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Financing and the Challenges of Developing the Innovation Capacity of Enterprises in Developing Countries: The Case of the MENA Region and Africa

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Abstract: Innovation currently represents a significant source of added value and competitiveness for companies on the international scale. However, financing innovation activities is a real challenge to overcome in order to successfully achieve the goals in emerging countries. The main objective of this paper is to conduct an empirical analysis on the identification of different sources of financing for firm innovation in the MENA region and Africa. To do this, we have constructed a battery of measures of the innovation capacity of firms: product, process, invention and innovation intensity of firms. In addition, the sources of financing were assessed by financing investments and working capital through bank debt, non-bank financial institutions, capital increase, equity, commercial debt and other sources of financing. The empirical study is based on the World Bank survey of more than 34,000 firms in the MENA region and Africa over the period 2011 and 2020. Through the use of several econometric modeling, the estimation results indicate the importance of bank financing, non-bank financial institutions, and trade credit in financing innovation of MENA and African firms.

Keywords: innovation; invention; R&D; access to finance; MENA; Africa.

JEL classification: O16; O31; G21; G23; C5.

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1. INTRODUCTION

Theories of industrial evolution (Lambson, 1991; Hopenhayn, 1992; Audretsch, 1995; Ericson and Pakes, 1995; Klepper, 1996) view innovation as the key to market entry, firm growth and survival, and how entire industries evolve over time. Sometimes, innovation is the source of the creation of entirely new industries. In today's environment, for companies of all sizes, innovation has become a kind of grail to be sought and encouraged, and the same is true for countries striving to see their economies grow. However, innovation is not limited to economic and/or monetary benefits for the organization that undertakes it. Innovation can also contribute to social and environmental well-being and to building a prosperous world.

Moreover, innovation is not an activity that is undertaken solely by private sector firms. In fact, large-scale, long-term public investment is behind the emergence of general-purpose technologies over the past two decades (e.g., nuclear power, space, the internet, vaccines, ...). Mazzucato (2018) argued that it is the state that funds, or even undertakes, much of the early-stage innovation (57% of R&D funding by the US government is for basic research in 2008). According to Janeway (2018), since the first industrial revolution, the state has served as a catalyst by subsidizing and taking responsibility for funding scientific and engineering advances, from which meaningful economic innovation flows. The private sector is seen as best able to commercialize opportunities.

The literature on innovation is vast. This article focuses specifically on innovation in its later stages, when it is exploitable and marketable, but also on the firm's decision to innovate through investment in research and development (R&D). Probably the simplest definition of innovation is "new ways of doing something." (Paul, 2020). Kanter (1983) defined innovation as "the generation, acceptance, and implementation of new ideas, processes, products, and services ... [that] involves creative use as well as original invention. Schumpeter (1996) described five types of innovation, with an emphasis on "*novelty*:" The introduction of a new or improved good or service; The introduction of a new process; The opening of a new market; The identification of new sources of raw material supply; and the creation of new types of industrial organization. More recently, Sugarhood *et al.* (2014), defined innovation more narrowly as "the practical application of new inventions into marketable products and services." A definition that excludes the last three categories of innovation above from Schumpeter (1996). In reality, there are dozens of definitions of innovation.

However, if innovation is risky, in a highly competitive environment, not innovating is riskier. Indeed, when innovations begin to push an organization into new and unfamiliar markets, the risks increase. Understanding an organization's core competencies is the basis for managing innovation risk. The further the organization moves away from its core competencies, the greater the risk. An organization faces both business risk - arising from the nature of the innovation project and its business environment - and funding risk - arising from the way the innovation activity is funded. Indeed, the use of external funds, whatever their nature, entails new risks and new constraints. Because of the inability to borrow or cede control, companies tend to limit the use of external funds, whether loans or equity. They may modify their business model to minimize the need for external financing and keep capital investment and fixed costs as low as possible. However, if the opportunity proves commercially viable, then companies may need to find external funding to finance the innovation project.

Financing any project with external loans involves paying fixed costs, which are due whether or not the project generates profits. The orthodoxy of prudent financing is to match

the nature and duration of the loan to the duration of its use. However, lenders are generally unwilling to finance the development of innovative projects over the long term. This is because the return is uncertain and will only materialize in the distant future. For these reasons, they consider such projects too risky and prefer to finance a well-established company that has a proven track record and assets that can be used as collateral for the loan. Indeed, the financing needs of different types of innovation, in volume and in kind (internal or external financing, equity or loans), can be very different.

It is generally accepted that longer-term and riskier projects require equity financing. For a well-established company, this type of financing can come from venture capitalists, and if the company is publicly traded, it is possible to raise money to finance an innovative project by issuing additional shares. Stock market investors are more sympathetic to the long periods of low or no cash flow for innovative companies. They believe that these companies could develop new industries or dominate huge new markets and generate profits in the future. On the other hand, investors may have a short-term orientation and demand dividends or share buybacks, which affects priorities in the optimal allocation of resources and hinders innovation. Similarly, a company with a diversified and balanced product/market portfolio can also generate the cash needed to finance innovation. All forms of external financing come with a new set of risks that cannot be ignored. These can be directly linked to the company's projects or to its portfolio of activities. Indeed, the financing needs of different types of innovation, in volume and in kind (internal or external financing, equity or loans), can be very different.

The contribution of this article to the literature review, is to answer the problem of what are the sources of financing for innovation, internal sources, external sources or both? To do this, we will exploit the World Bank's survey of firms in Africa and MENA between 2011 and 2020 on a sample of 35,763 firms. To our knowledge, this is the first empirical study on this topic that analyzes the effect of financing sources on innovation in the two regions.

The choice of the MENA region and Africa is justified by several reasons. These two regional blocs encompass diverse economies, ranging from resource-rich countries (such as the Gulf states) to emerging and developing economies. This diversity provides an opportunity to examine how different economic structures influence the financing mechanisms for innovation. Businesses in the MENA region and Africa often face difficulties in accessing external financing due to the underdevelopment of their financial markets, limited access to bank credit, and an understructured venture capital ecosystem. Although several countries have invested in research and development, the overall level of innovation remains relatively low compared to other regions of the world. Finally, juxtaposing the MENA region with Africa allows for insightful comparisons, particularly regarding similarities and differences in access to financing and their respective effects on innovation.

The contribution of this article is multifaceted. First, the study seeks to examine how the diversity of economic structures influences the financing modalities of innovation. In this context, analyzing both internal and external financing sources provides a significant contribution to the literature on innovation financing in developing and emerging economies. This, in turn, helps to better understand the obstacles and potential levers for strengthening the competitiveness of businesses in developing countries.

After presenting the introduction in this first point, we will present the literature review in Section 2. Section 3 will be devoted to the presentation of the data and the methodology. Section 4 is devoted to the presentation of the results. Finally, in the last Section, we will present the main conclusions of the work and their implications.

2. LITERATURE REVIEW

Investment in soft or hard innovation activities has unique characteristics compared to ordinary physical investment. These unique characteristics are the intangibility of assets (human capital, scientists, ...), uncertain and long-term returns, moral hazard, and asymmetric information (Ayalew *et al.*, 2019). Thus, it is difficult to assess with certainty which innovative projects at any given time require funding (Kerr and Nanda, 2015). This points to the conclusion that innovative firms face difficulties in raising the funds needed to finance their innovation activities.

The Pecking Order Theory (POT) suggests that firms prefer to finance new investment projects first from retained earnings (reserves), then, if necessary, resort to external financing through debt, and finally resort to external equity (capital increase) (Myers, 1984; Myers and Majluf, 1984). This hierarchy depends on the degree of asymmetry of the firm's information. Indeed, the informational opacity of innovative firms means that lenders are unable to assess the quality of financing requests and consequently assign an unrealistic risk rating to these firms. As a result, financial institutions fail to produce equilibrium prices and efficient transactions in the debt market (Stiglitz, 2000). Indeed, opacity emerges when innovative firms intentionally avoid revealing information about innovation projects to their lenders or competitors. These asymmetries are sources of agency costs and produce constraints in the credit market, which are manifested in the partial or total rationing of a financing request. In the case of the MENA region and Africa, where financial markets are underdeveloped or developing, these difficulties are necessarily more severe.

Sources of funding for innovation investment can be classified into internal and external sources. According to Modigliani and Miller (1958) In perfect capital markets, external financing is a substitute for internal financing. In reality, markets are characterized by informational asymmetries that are accentuated in innovative companies. It is in this sense that the financing strategy of firms has a direct influence on the intensity and direction of innovation. Internal financing, more precisely retained earnings and new equity from existing shareholders, is the main source of financing for most innovation projects (Czarnitzki and Hottenrott, 2011; Mare *et al.*, 2021). According to Brown *et al.* (2009) publicly traded start-ups, investing in cutting-edge technology, finance their R&D activities entirely from internal cash flow. Cash flow is a volatile source (Brown *et al.*, 2009). Raising new capital can be costly and, at times, unwarranted. As a result, innovative projects with high upfront costs may be delayed, deferred, or even abandoned due to a lack of external funding. This problem is likely to be more significant for smaller and younger firms that have more difficulty accessing external financing (Oudgou, 2021).

Recent literature shows the importance of the impact of different sources of finance (mainly debt and equity) on innovation intensity (Ullah, 2019; Wellalage and Fernandez, 2019; Wellalage and Locke, 2020). Early empirical studies focused on the bank financing-innovation relationship, and found that banks are not a prime source of financing for innovative firms. Indeed, banks require higher costs (interest and guarantees) than in the case of investments in physical assets (Hall and Lerner, 2010; Agénor and Canuto, 2017) knowing that the majority of innovative companies' assets are intangible and their profit is uncertain, which makes their projects too risky for bank financing (Mare *et al.*, 2021). Mann (2018) and Nanda and Nicholas (2014) provide empirical evidence on the importance of bank financing for innovative firms. Ayyagari *et al.* (2011) find that access to external finance (primarily

bank finance) is associated with higher innovation intensity among firms in 47 developing economies. Cornaggia *et al.* (2015) find that small innovative firms rely primarily on bank financing more than large and publicly traded firms.

External financing can also be provided in the form of equity. Public equity (stock market) is an important source for financing innovation projects and R&D investments (Brown *et al.*, 2009; Acharya and Xu, 2017; Ayalew *et al.*, 2019). They can have positive effects on the rate and quality of innovation, especially in sectors that are more dependent on external financing (Acharya and Xu, 2017; Mare *et al.*, 2021). Hsu *et al.* (2014) suggest that the development of the equity market promotes technological innovation while the credit market discourages it. Schäfer *et al.* (2004) found that firms use more equity financing to show better innovation performance. However, new equity financing may entail agency costs. Due to the lack of adequate oversight, managers may engage in long-term underinvestment against shareholders' pursuit of short-term goals. According to Bernstein (2015), going public is associated with less innovation because it is perceived as riskier by managers.

A compromise between equity financing and debt financing is always sought with respect to the issues of ownership control and the extension of strategic projects to competitors. Indeed, equity financing is generally more appropriate for investment projects characterized by a high level of risk and long term (Giudici and Paleari, 2000). Young and small companies bear high financial distress costs (Zizi *et al.*, 2020; Zizi *et al.*, 2021). This indicates that equity financing is more appropriate than bank debt. In this framework, venture capitalists engage in active monitoring of the innovative firm's activities (Hall and Lerner, 2010) as well as in providing experience and network resources (Denis, 2004; Wellalage and Locke, 2020).

The use of trade credit is more motivated than bank financing when firms suffer from negative cash flows or a temporary liquidity shock and a transactional banking relationship (Lin and Chou, 2015; Oudgou, 2021). Moreover, empirical studies show that trade credit is used more in contexts of underdeveloped financial markets and when the bank-firm relationship is purely transactional (Petersen and Rajan, 1997; Garmaise and Moskowitz, 2004; Lin and Chou, 2015; Oudgou, 2021). Innovation can also be financed by using credit from relatives, family, friends and intra-group financing. Other sets of empirical studies show that firms with government financial support grow faster and invest more in the most radical innovation activities (Garcia and Mohnen, 2010; Paul, 2020).

Recent studies continue to debate the costs and benefits and importance of informal versus formal financing (Ayyagari *et al.*, 2011; Ullah, 2019; Wellalage and Fernandez, 2019). Both financing modalities have advantages and disadvantages, and innovative firms can benefit from having both coexist in their financial structure (Degryse *et al.*, 2016). One perspective supports informal financing given that it reduces moral hazard and adverse selection problems through the personal relationship between lender and borrower (Allen *et al.*, 2019). However, this advantage may expose innovators to conflicts of interest over short-term maturity and high compensation. On the contrary, formal financing allows firms to benefit from longer repayment terms and long-term innovation outcomes (Armendáriz and Morduch, 2007; Wu *et al.*, 2016). Thus, firms benefit from a fair assessment of the degree of risk of their innovation project. The development of the formal financial sector has a positive effect on firm-level innovation (Cornaggia *et al.*, 2015).

In light of the challenges associated with innovation financing, theory and empirical evidence (Ayyagari *et al.*, 2011; Gorodnichenko and Schnitzer, 2013; Mare *et al.*, 2021)

support the idea that the type of financing affects firms' decision to innovate as well as the extent of their innovation.

There are two broad categories of empirical studies on innovation financing. The first, examines publicly traded firms in developed economies and is limited to examining debt and/or equity financing separately. The second, considers two categories of innovation financing sources, formal and informal (Ayyagari *et al.*, 2008; Ullah, 2019; Wellalage and Locke, 2020). In this study, we consider a broad spectrum of financing sources to be analyzed separately: banks, internal funds, supplier credits and customer advances, non-banking financial institutions, own funds, others such as family and friends. We will examine the association of these different sources of finance with innovation in MENA and African firms. In other words, the contribution of this paper is to show how heterogeneity of financing sources is associated with greater innovation stimulation of firms in MENA and Africa.

***Hypothesis**: Firms that have the ability to access external financing (such as bank financing, financing from non-bank financial institutions, trade credit, and other sources) are more likely to innovate.*

3. DATA, VARIABLES AND DESCRIPTIVE STATISTICS

3.1 Data

Our main source of data for this study is the World Bank's Enterprise Survey (available at: www.entreprisesurveys.org), using a standard, global methodology. This ensures that comparisons can be made across firms in more than 152 countries surveyed since 2006. Surveys conducted on African countries and some MENA countries before 2011 do not include questions on innovation. Because of this inconsistency, we drop the data for MENA countries conducted before 2011 and retain only the surveys conducted after 2011. This study will finally cover a sample of 45 countries and 35,763 firms between 2011 and 2020. Thus, the sample is composed of 15,662 firms from the MENA region and 20,101 from Africa. In the different models to be estimated, firms with missing information on some variables will be excluded.

The Table no. 1 indicates that the majority of the companies in the sample are industrial companies (49%), while companies in the trade and service sector represent 15.28% and 35.75% respectively. In terms of size, small companies (less than 20 permanent employees) represent 35.87%, medium and large companies represent 31% and 15.15% respectively.

Table no. 1 – Characteristics of the sample

Region	Sectors of activity			Size			Number	
	Industry	Trade	Service	Small (<20)	Average (20-99)	Great (100+)	Companies	Country
AFRICA	8,633	3,815	7,653	11,711	5,900	2,490	20,101	34
MENA	8,883	1,648	5,131	7,556	5,177	2,929	15,662	11
Total	**17,516**	**5,463**	**12,784**	**19,267**	**11,077**	**5,419**	**35,763**	**45**
%	***48.98***	***15.28***	***35.75***	***35.87***	***30.97***	***15.15***	**-**	**-**

Source: www.entreprisesurveys.org, created by the author using STATA 18

3.2 The variables

3.2.1 Measuring business innovation

Following the example of Ayalew *et al.* (2019), Okumu *et al.* (2019), and Oudgou (2021) we will adopt direct measures of the outcome of the innovation. Specifically, these are product/service innovation and process innovation. For product/service innovation (Product), firms were asked if: "*during the last three years, has this establishment introduced new or significantly improved products or services*? If the answer is "yes", the company is considered innovative in terms of products or services. For process innovation (*Process*), firms were asked if: "*during the last three years, has this establishment introduced any new or significantly improved process? (Including: methods of manufacturing products or offering services, logistics, delivery, or distribution methods for inputs, products, or services, or supporting activities for processes*". If the answer is "yes," this indicates that the firm has introduced a process innovation in the last three years as of the WBES survey date. We also construct a variable to measure the firm's decision to invest in innovation via the engagement of research and development (invention) activities. In other words, the firm's ability to invent (Mare *et al.*, 2021). This variable takes the value 1 if the firm has invested in research and development (R&D), otherwise, the variable takes the value 0.

In addition, a company can introduce one type of innovation, two at a time, or invest in research and development. Therefore, the fourth measure of innovation is developed and measures the innovation score (*inovsc*). The innovation score will take four values (from 0 to 3), 0 if the firm is not innovative and the value 3 if the firm is innovative and has introduced both product and process innovation and has invested in research and development. For the robustness tests, the innovation index is constructed by principal component analysis from the three innovation categories (*inovdx*).

3.2.2 Financing sources

The independent variable studied in this paper is the financial structure of firms, measured by the proportion of fixed assets and working capital financed by different sources of finance. Following the example of previous empirical studies, notably those of Ayalew *et al.* (2019), Mare *et al.* (2021) and Wellalage and Locke (2020). In this paper, we choose six sources of financing: internal funds or retained earnings; owner's equity contribution or equity financing; bank financing; financing by non-bank financial institutions (microfinance, finance companies, etc.); trade credit (credit due on purchases from suppliers) and customer advances; other sources of financing (lenders, friends, relatives, etc.). The detailed description of these variables is presented in the Table no. 2.

3.2.3 Control variables

Consistent with the existing literature (Wellalage and Fernandez, 2019; Wellalage and Locke, 2020; Mare *et al.*, 2021; Oudgou, 2021) we consider different independent control variables, including firm-specific characteristics and ownership structure. Firm-specific characteristics include age (age) measured by the number of years between the start of operations and the survey date; firm size (sizewk) measured by the natural logarithm of the

number of permanent employees; manager's years of experience in the industry (experience) and export activity (Export). We consider the financial transparency of the firms by the certification of their financial statements by an external auditor (audit) and the technological capacity of the firm (ICT) as follows Asiedu *et al.* (2013). The ownership structure is taken into account by three variables: the percentage of the firm's capital held by foreign owners (Forgien), by the government (Government) and the participation of women in the firm's capital (gend1) as follows Asiedu *et al.* (2013), Aterido *et al.* (2011), Aterido *et al.* (2013), Cole *et al.* (2019). Table no. 2 shows the measures of the dependent and independent variables used in this study.

Table no. 2 – Variables: definitions and measures

Variables	Definitions and measurements
	Innovation
Product	Takes value 1 if the firm introduced new or significantly improved products or services during the last three years of the survey, 0 otherwise
Process	Takes value 1 if the firm introduced new or significantly improved methods of manufacturing products or offering service during the last three years of the survey, 0 otherwise
R&D	Innovation inputs take 1 if the firm has invested in R&D activities during the last fiscal year, 0 otherwise
INOVDX	Principal Component Analysis (PCA) of Product, Process and spend on R&D
INOVSC	The sum of Product, Process and spend on R&D
Inovscd	Variable dummy takes 1 if the firm introduced at least one type of innovation, 0 otherwise
	Characteristics of the companies
sizewk	Natural logarithm of the number of permanent full-time workers.
Age	The number of years in which the firm began operations to date of the survey
Audit	Percentage of firms with their annual financial statement reviewed by an external auditor
Export	Percent of firms exporting directly or indirectly (at least 10% of sales)
Exper	Years of the top manager's experience working in the firm's sector
ICT	take 1 if the firm license from foreign companies, website and e-mail, 0 otherwise (sum t4a, t5, t6)
	Ownership structure
Forgien	Percentage (%) of the firm's capital held by foreign private owners
Govern-ment	Percentage (%) of the firm owned by the government or state.
Gend-owner	Takes 1 if at least one female among the owners in the firm, 0 otherwise
	Sources of funding
Internal	Proportion of investments and working capital financed by internal funds (%)
Banks	Proportion of investments and working capital financed by banks (%)
Supplier	Proportion of investments and working capital financed by supplier credit (%)
Equity	Proportion of investments financed by equity or stock sales (%)
Nbfi	Proportion of investments and working capital financed by non-bank financial institutions (%)
Others	Proportion of investments and working capital financed by other financing sources (%)

Sources: conducted by authors

3.3 Descriptive statistics

The descriptive statistics for the overall sample studied are shown in Table no. 3. The results indicate that 32% of the enterprises introduced a product or process innovation during the last three years preceding the date of the survey, while 15% of the enterprises surveyed had committed to Research and Development (R&D). Overall, 43% of enterprises are innovative enterprises, having introduced at least one type of innovation (inovcsd). Table no. 3 also shows that MENA and African firms are financed mainly by retained earnings (76.80%)

and 10% of the financing comes from private or public banks. As indicated in the literature review, firms that do not have easy access to external financing resort to internal financing.

MENA and African companies are relatively young with an average age of 18 years and 75% are less than 25 years old. 58% of companies have summary statements certified by an external auditor and 19% are exporting companies. Regarding the ownership structure, on average 8.5% of the companies' capital is foreign owned and 0.65% on average is government owned, knowing that there are companies that are totally foreign or totally government owned (100%); and among the owners for 25% of the companies there is at least one woman. Finally, 93% of the companies use a technological tool (website or e-mail) in their daily business activities and have a foreign license (ICT).

Table no. 3 – Descriptive statistics for the total sample

Variable	N	Mean	SD	Min	P25	Median	P75	Max
Product	34241	32.38	46.79	0.00	0.00	0.00	1.00	1.00
Process	33965	32.19	46.72	0.00	0.00	0.00	1.00	1.00
R&D	34112	15.07	35.78	0.00	0.00	0.00	0.00	1.00
inovsc	35763	75.95	99.48	0.00	0.00	0.00	1.00	3.00
Inovscd	35763	43.00	50.00	0.00	0.00	0.00	1.00	1.00
inovdx	33686	0.00	1.34	-1.05	-1.05	-1.05	1.60	2.95
sizewk	34967	2.99	1.28	0.00	1.95	2.71	3.69	8.29
Age	34728	18.99	15.75	0.00	8.00	15.00	25.00	162.00
Audit	35037	58.70	49.24	0.00	0.00	1.00	1.00	1.00
Export	34582	19.37	39.52	0.00	0.00	0.00	0.00	1.00
Exper	34748	17.79	11.27	0.00	9.00	15.00	25.00	60.00
Foreign	34885	8.55	25.43	0.00	0.00	0.00	0.00	100.00
Government	34908	0.65	5.78	0.00	0.00	0.00	0.00	100.00
Gend-owner	35194	25.49	43.58	0.00	0.00	0.00	1.00	1.00
ICT	35763	93.18	89.02	0.00	0.00	1.00	2.00	3.00
Internal	33857	76.80	31.40	0.00	56.25	100.00	100.00	100.00
Banks	34459	10.63	20.49	0.00	0.00	0.00	12.50	100.00
Supplier	33976	6.86	16.10	0.00	0.00	0.00	0.00	100.00
Equity	11076	4.91	16.69	0.00	0.00	0.00	0.00	100.00
NBFI	33748	1.38	7.29	0.00	0.00	0.00	0.00	100.00
Others	33418	5.08	17.22	0.00	0.00	0.00	0.00	100.00

Source: www.entreprisesurveys.org, created by the author using STATA 18

Table no. 4 shows the different indicators for measuring innovation (see Table no. 2) by country and by region (Africa and MENA). The individual indicators indicate that the most introduced innovations are at the process level, easy to introduce at low cost and low risk to be easily financed. In this sense, the most innovative countries in Africa, where more than 50 percent of firms introduced a product and process innovation, are Ghana, Malawi, Mauritania, Namibia, Tanzania, and Uganda. In the MENA region, innovative firms are located in Djibouti, Malta, and Yemen. On the other hand, fewer firms in both regions are engaged in research and development. The Republic of Central Africa (43.9%), Namibia (46%), and Zimbabwe (30%) have the most R&D-intensive firm samples. Therefore, at the level of the aggregate variables (inovsc and inovdx), a high value of these scores indicates that firms in these countries are more innovative (Central African Republic, Burundi, Ghana, Namibia). The countries least engaged in innovation are Benin, Eswatini, Lesotho, South Africa and Egypt.

Table no. 4 – Innovation Indicators for African and MENA Countries

Country	N	Product	Process	R&D	inovsc	inovscd	inovdx
				Africa			
Benin	150	0.262	0.141	0.128	0.527	0.340	-0.344
Burundi	157	0.465	0.675	0.223	1.363	0.745	0.761
Cameron	361	0.407	0.149	0.105	0.651	0.485	-0.204
Central African republic	150	0.480	0.633	0.439	1.547	0.807	1.001
Chad	153	0.366	0.158	0.118	0.641	0.458	-0.198
Ivory Coast	361	0.365	0.177	0.102	0.634	0.457	-0.206
Congo, Dem. Rep.	529	0.418	0.439	0.235	1.085	0.550	0.400
Eswatini	150	0.277	0.071	0.219	0.553	0.413	-0.368
Ethiopia	1,492	0.395	0.456	0.136	0.983	0.558	0.261
Gambia	151	0.477	0.207	0.099	0.781	0.510	-0.028
Ghana	720	0.515	0.670	0.222	1.396	0.728	0.813
Guinea	150	0.306	0.140	0.099	0.527	0.360	-0.341
Kenya	1,782	0.560	0.488	0.244	1.283	0.699	0.661
Lesotho	150	0.054	0.061	0.041	0.153	0.120	-0.841
Liberia	151	0.450	0.245	0.107	0.801	0.497	0.017
Malawi	523	0.539	0.661	0.221	1.392	0.740	0.849
Mali	185	0.359	0.326	0.144	0.822	0.503	0.031
Mauritania	150	0.553	0.691	0.223	1.460	0.760	0.893
Mozambique	601	0.334	0.173	0.093	0.601	0.408	-0.254
Namibia	580	0.639	0.796	0.465	1.848	0.864	1.482
Niger	151	0.336	0.180	0.106	0.616	0.411	-0.225
Nigeria	2,676	0.498	0.629	0.174	1.263	0.670	0.680
Rwanda	601	0.332	0.376	0.155	0.862	0.491	0.095
Senegal	601	0.476	0.572	0.072	1.110	0.661	0.426
Sierra Leone	152	0.342	0.191	0.112	0.645	0.408	-0.198
South Africa	1,097	0.049	0.025	0.239	0.312	0.271	-0.634
South Sudan	738	0.492	0.416	0.168	1.061	0.686	0.374
Sudan	662	0.554	0.446	0.253	1.230	0.606	0.590
Tanzania	813	0.520	0.598	0.167	1.260	0.683	0.656
Togo	150	0.367	0.153	0.173	0.693	0.453	-0.132
Uganda	762	0.645	0.729	0.279	1.633	0.768	1.153
Zambia	1,321	0.442	0.418	0.200	1.051	0.613	0.351
Zimbabwe	1,199	0.429	0.414	0.296	1.137	0.560	0.465
				MENA			
Djibouti	266	0.351	0.473	0.180	0.970	0.534	0.257
Egypt	7,786	0.115	0.098	0.049	0.261	0.179	-0.707
Israel	483	0.243	0.172	0.170	0.584	0.335	-0.277
Jordan	1,174	0.182	0.155	0.127	0.450	0.300	-0.475
Lebanon	1,093	0.282	0.249	0.122	0.652	0.399	-0.186
Malta	242	0.469	0.203	0.203	0.872	0.612	0.108
Morocco	1,503	0.121	0.149	0.115	0.373	0.243	-0.551
Tunisia	1,207	0.193	0.210	0.132	0.533	0.322	-0.347
West Bank and Gaza	799	0.199	0.202	0.097	0.494	0.309	-0.401
Yemen	353	0.408	0.438	0.137	0.980	0.530	0.242

Source: www.entreprisesurveys.org, created by the author using STATA 18

The Figure no. 1 repeats the results of the Table no. 4 to clearly show the innovation capacity of African firms compared to MENA firms. It is clear that for countries in both regions, investment in research and development is very low and product and process innovation indicators are the most important. On the other hand, firms in Africa have a higher innovation score than firms in the MENA region (inovsc).

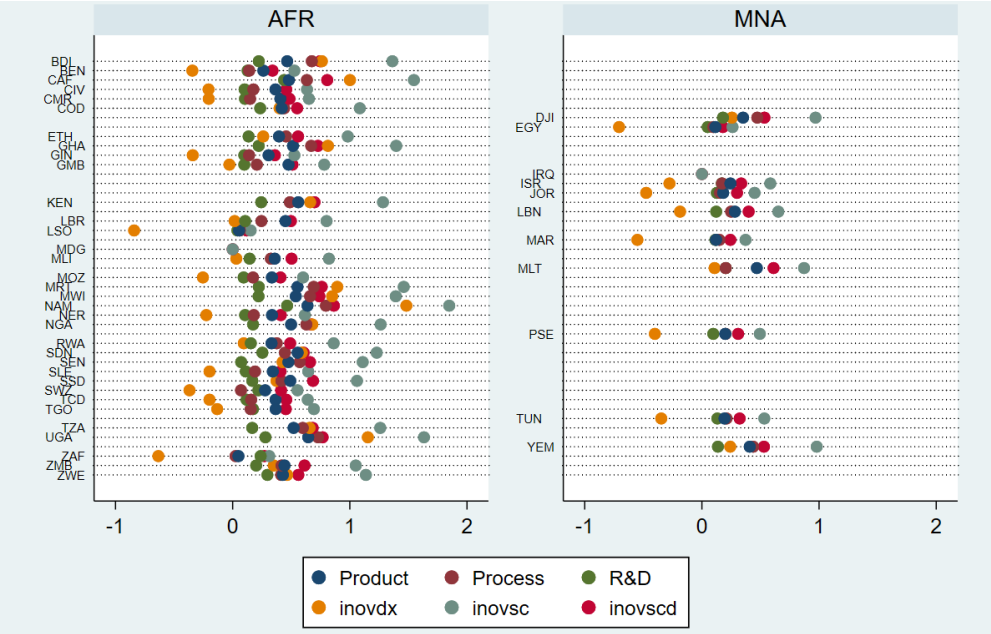

Figure no. 1 – Innovation Indicators for African and MENA Countries
Source: www.entreprisesurveys.org, created by the author using STATA 18

The Table no. 5 shows that the main sources of financing for MENA and African firms are internal funds and retained earnings. For some countries, firms finance more than 90 percent of their needs from retained earnings, most notably the Republic of Congo, Guinea, South Africa, and South Sudan, which are characterized by an underdeveloped financial system. External financing is largely dominated by banks, and a high rate of external financing is synonymous with low recourse to internal funds in several countries: Burundi, Lesotho, Namibia, Togo, Malta, Lebanon, Morocco and Tunisia. Overall, bank financing accounts for less than 26 percent of the financing needs of MENA and African firms. Trade credit is also an attractive source of financing for firms in several countries: Côte d'Ivoire (11.3%), Ghana (10.14%), Kenya (11.09%), Sudan (17.58%), and Tunisia (12%). Lesotho and Jordan make massive recourse to the issuance of shares, while other means of financing (friends and family, ...) are widely used among companies in Lesotho (14.6%), Liberia (10.76%) and Nigeria (16.9%).

Table no. 5 – Financing Modalities in African and MENA Countries

Country	N	Internal	Banks	Supplier	Equity	NBFI	Others
Africa							
Benin	150	71.527	17.457	7.605	4.559	3.588	3.095
Burundi	157	67.753	22.070	7.828	4.597	1.510	1.898
Cameroon	361	72.265	11.341	6.572	5.342	4.162	6.909
Central African	150	75.631	8.833	8.674	7.215	1.661	6.919
Chad	153	81.772	6.675	7.347	4.899	1.083	5.773
Ivory Coast	361	76.785	10.578	11.290	3.074	0.528	1.351
Congo, Dem. Rep.	529	90.145	4.526	4.013	2.353	1.226	2.451
Eswatini	150	69.807	9.928	5.198	7.170	3.686	9.000
Ethiopia	1,492	85.719	8.594	1.599	3.838	0.846	1.145
Gambia	151	85.420	9.354	6.523	5.045	1.262	1.469
Ghana	720	75.028	11.217	10.140	4.538	1.677	1.927
Guinea	150	90.011	7.735	2.381	2.690	0.187	2.188
Kenya	1,782	65.389	17.071	11.095	6.575	1.579	2.758
Lesotho	150	53.443	20.825	5.355	16.190	1.547	14.594
Liberia	151	72.943	10.457	4.555	7.233	2.144	10.765
Madagascar	532	79.311	9.843	7.761	5.055	1.551	4.073
Malawi	523	69.617	14.204	9.459	8.620	2.312	4.775
Mali	185	81.879	12.237	4.243	2.665	0.312	1.285
Mauritania	150	77.250	15.639	3.764	4.495	1.324	2.730
Mozambique	601	83.943	5.605	5.868	3.770	0.741	5.172
Namibia	580	62.814	26.364	2.818	1.667	0.390	3.275
Niger	151	74.243	15.430	7.950	1.181	0.175	4.684
Nigeria	2,676	54.337	8.795	7.330	7.779	3.563	16.900
Rwanda	601	74.440	17.667	4.047	6.956	1.918	2.010
Senegal	601	82.516	8.528	8.184	3.252	1.445	2.592
Sierra Leone	152	87.295	8.461	4.596	3.383	0.846	1.535
South Africa	1,097	93.113	8.278	1.497	5.625	0.353	0.276
South Sudan	738	90.147	5.777	2.968	2.746	0.741	3.694
Sudan	662	78.482	4.908	17.580	2.061	0.719	2.278
Tanzania	813	72.877	11.939	6.285	5.354	2.340	6.650
Togo	150	67.289	20.101	5.463	8.194	3.605	2.946
Uganda	762	76.526	12.322	5.346	7.831	3.698	3.089
Zambia	1,321	81.768	8.863	5.324	3.567	1.409	4.481
Zimbabwe	1,199	79.106	9.221	7.890	4.036	0.770	5.966
MENA							
Djibouti	266	82.664	14.339	2.895	2.143	0.344	1.660
Egypt	7,786	83.892	6.426	6.869	2.217	0.315	6.326
Iraq	756	84.882	4.821	6.766	1.496	0.875	5.605
Israel	483	75.795	19.508	3.063	3.278	0.490	0.875
Jordan	1,174	76.307	12.585	9.548	10.666	0.699	2.392
Lebanon	1,093	75.063	19.252	2.172	2.656	0.264	1.065
Malta	242	61.574	26.848	8.579	2.384	0.757	0.921
Morocco	1,503	65.242	16.861	7.429	7.777	2.435	7.110
Tunisia	1,207	59.707	17.120	11.970	6.663	5.822	4.094
West Bank And Gaza	799	77.712	8.333	9.936	4.577	0.688	5.356
Yemen	353	85.691	6.075	7.846	1.810	0.100	2.863

Source: www.entreprisesurveys.org, created by the author using STATA 18

Figure no. 2 shows the average proportion of financing, excluding equity financing, used in each country of the two regions. Financing through the banking system remains the most widely adopted means of financing and differs significantly from other sources of financing. On the other hand, the use of non-bank financial institutions is lowest in both regions.

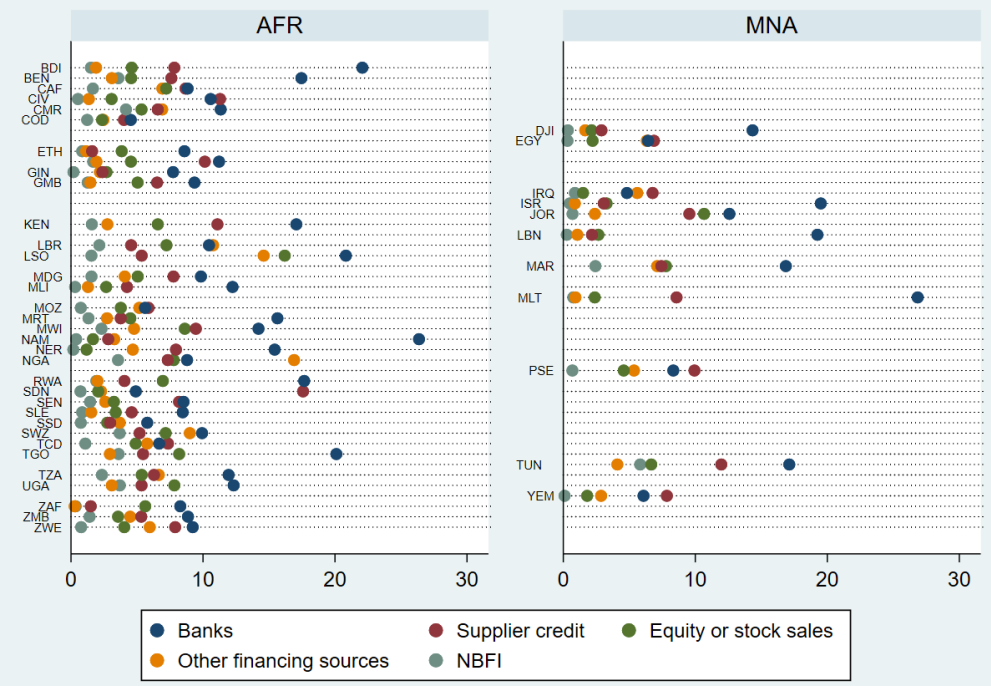

Figure no. 2 – Financing Modalities in African and MENA Countries
Source: www.entreprisesurveys.org, created by the author using STATA 18

3.4 Modeling and analysis strategy

Our empirical strategy is unpacked in three main points. We begin our analysis of the relationship between sources of finance and the innovation behavior of firms in MENA and Africa using a Probit model. The basic model is presented as follows:

$$\Pr(inov_{i,j,t} = 1/0) = \Phi(\alpha_{i,j,t} + \beta.\,Fin_{i,j,t} + \beta X_{i,j,t} + \varepsilon_{i,j,t}) \quad (1)$$

where $inov_{i,j,t}$ is a binary variable that takes 1 if the firm introduced an innovation (product or process), an invention (R&D) or if the firm introduced at least one type of innovation (inovscd), otherwise it takes 0. The subscripts i,j and t denote the firm, country and time respectively. Φ the cumulative standard normal distribution. $Fin_{i,j,t}$ denotes the variables of the funding sources. $X_{i,j,t}$ the vector of control variables shown above (Table no. 2).

In order to estimate the relationship between the sources of financing and the innovation score (inovsc), an ordinal Probit model (oprobit) is used where the dependent variable Y_i will

take 4 modalities from 0 (non-innovative firm) to 3 (firm has introduced three categories of innovation). Y_i This model can naturally be written with a latent variable as a generalization of the simple Probit model:

$$Y_i = \begin{cases} 0 & \text{si } Y_i^* \leq c_1 \\ 1 & \text{si } c_1 < Y_i^* \leq c_2 \\ \dots & \dots \\ m & \text{si } c_m < Y_i^*. \end{cases}$$

where the c_j are in ascending order and where the latent variable Y_i^* follows a linear model:

$$Y_i^* = x_i\beta + \varepsilon_i \quad (2)$$

Thus, we can calculate for all $= 0$ à 3 :

$$Pr(Y_i = j) = Pr(c_j < Y_i^* \leq c_{j+1} = F(c_{j+1} - x_i\beta) - F(c_j - x_i\beta) \quad (3)$$

Finally, the OLS regression is used to estimate the association between a firm's sources of finance and its innovation intensity as measured by its innovation index (inovdx) (see equation 4 below).

$$inovdx_{i,j,t} = \alpha_{i,j,t} + \beta.\,\mathrm{Fin}_{i,j,t} + \beta X_{i,j,t} + \varepsilon_{i,j,t} \quad (4)$$

For all the modeling, we will first deal with the overall sample of the study and secondly, for the robustness of the results, we will divide the sample into two subgroups: firms from Africa and firms from the MENA region. Finally, in all specifications we will include the date of the survey and the sector of activity according to the international industry coding (isic) as dummy variables in order to take into account their fixed effect. Countries are also retained in each estimation to control for possible heterogeneity between MENA and African countries (Coad *et al.*, 2016; Ullah, 2019; Mare *et al.*, 2021). To account for possible correlation of error terms across firms interviewed in each survey, we pool standard errors at the country level.

Before proceeding with the various estimations, we conducted an analysis to detect potential collinearity issues. Table no. 9 in the appendix shows that the correlation coefficients between the different independent variables are very low. Consequently, multicollinearity is not a concern in the context of our estimations.

4. RESULTS AND DISCUSSION

Table no. 6 traces the results of the estimations of the relationship between the different measures of innovation and the sources of financing of the firms in the overall sample. Models M1-M3 show individual innovation indicators (product, process and R&D) while models M4-M6 show aggregate indicators.

Across all models (M1 to M6), the results of Table no. 6 indicate the existence of a positive and significant relationship between bank financing, non-bank financial institution (NBFI) financing and the different innovation indicators. Moreover, commercial credit has a positive effect on product innovation (M1) and if the firm is innovative (M4). These initial results confirm our stated hypothesis: firms that have access to finance are the most likely to

innovate. These results are also consistent with the results of other studies conducted in similar contexts (Ayalew *et al.*, 2019; Bakhouche, 2021; Mare *et al.*, 2021).

Table no. 6 – Relationship between innovation and sources of funding (global sample)

Variables	Product (M1)	Process (M2)	R&D (M3)	Inovscd (M4)	Inovsc (M5)	Inovdx (M6)
sizewk	0.058	0.049	0.111	0.064	0.076	0.064
	(0.010)***	(0.012)***	(0.019)***	(0.011)***	(0.009)***	(0.014)***
Age	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Audit	0.001	0.002	0.003	0.002	0.002	0.002
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Export	0.002	0.001	0.003	0.002	0.002	0.002
	(0.000)***	(0.000)***	(0.001)***	(0.000)***	(0.000)***	(0.000)***
Exper	0.001	0.001	-0.002	0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Forien	0.000	0.000	-0.001	0.000	-0.000	-0.000
	(0.000)	(0.001)	(0.000)***	(0.001)	(0.000)	(0.001)
Gover	0.001	0.003	0.003	0.003	0.002	0.003
	(0.001)	(0.002)	(0.002)	(0.002)*	(0.001)*	(0.001)**
Gend	0.170	0.129	0.160	0.174	0.170	0.168
	(0.025)***	(0.026)***	(0.026)***	(0.031)***	(0.022)***	(0.023)***
ICT	0.241	0.239	0.293	0.278	0.280	0.283
	(0.024)***	(0.028)***	(0.028)***	(0.029)***	(0.026)***	(0.037)***
Banks	0.003	0.003	0.003	0.003	0.003	0.003
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Supplier	0.003	0.001	0.001	0.003	0.002	0.002
	(0.001)**	(0.001)	(0.001)	(0.001)*	(0.001)	(0.001)
Equity	0.000	0.000	0.001	0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
NBFI	0.003	0.007	0.005	0.005	0.005	0.006
	(0.001)**	(0.002)***	(0.001)***	(0.002)***	(0.001)***	(0.002)***
Others	-0.001	-0.000	0.000	-0.000	-0.000	0.000
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
cut1					-0.346	
					(0.059)***	
cut2					0.369	
					(0.055)***	
cut3					1.343	
					(0.052)***	
_cons	-0.361	-0.048	-1.021	0.206		0.541
	(0.063)***	(0.072)	(0.073)***	(0.117)*		(0.080)***
N	23,148	23,009	23,091	23,216	24,104	22,898
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
ISIC FE	YES	YES	YES	YES	YES	YES

Note: * p<0.1; ** p<0.05; *** p<0.01

Table no. 6 also indicates firm characteristics that are associated with firm innovation behavior in MENA and Africa. Indeed, large firms are more innovative than small firms (at the 1% threshold). Exporting firms and firms with certified statements of accounts are more engaged in innovation activities (at the 1% threshold). As regards ownership structure, firms with female owners are more innovative (Oudgou, 2021). In terms of ownership structure, government involvement has a positive effect on aggregate innovation indicators. The use of technology (foreign license, e-mail, web-site, ...) has a positive effect on innovation. In this sense, the results associated with technology use (ict), certification (audit) and export orientation (export) can collectively reflect a quality of the firm's human capital (Bakhouche, 2021; Cirera *et al.*, 2021). The adoption of these managerial characteristics requires a skilled, competent and more experienced workforce. The increase in foreign ownership (Forgien) reduces the probability of investing in R&D (Oudgou, 2021). This result is comparable to those of Wellalage and Locke (2020) which supports the hypothesis that foreign participation supports hard innovation more than soft innovation.

In order to take into account, the specificities of each region and for the purpose of validating the above results (Table no. 6), the overall sample is divided into two subsamples representing firms from African countries on the one hand and firms from MENA countries on the other. Within this framework, the same estimates were rerun on each region and the results by region are reported at the Table no. 7.

The estimation results indicate that bank financing and non-bank financial institution (NBFI) financing positively impact the innovation activities of firms in Africa and the MENA region. However, in the MENA region, trade credit appears to be a primary source of financing for innovation activities. On the other hand, equity financing and other means of financing are important for product innovation only in the MENA region. It can be concluded that MENA firms benefit from a diversified financing offer compared to African countries. These results suggest that the diversity of financing sources could be a key factor in the intensity of a firm's pursuit of innovation (Allen *et al.*, 2019; Mare *et al.*, 2021). These findings are similar to those of Ayalew *et al.* (2019) in a study of firm innovation in Africa where he found that sources of finance have a positive and significant effect on the probability of innovating. The results of these estimates also support our hypothesis. The coefficients of the other variables (not reported in the table) remain unchanged.

One of the major theoretical controversies concerning the study of the sources of financing for innovation is related to the size of the firms. Table no. 8 presents the different econometric estimates of the sources of innovation finance in MENA and Africa by firm size. Overall, the three categories of firms (small, medium, and large) finance their various innovation activities mainly through banks in the MENA region and Africa. Unlike large firms, non-bank financial institutions (NBFIs) are an extremely important source of financing for small and medium-sized firms. This is because small firms face difficulties in accessing finance due to high informational opacity. Large companies use NBFIs to finance R&D activities whose outcome is uncertain and spread over several years. It is possible that this financing constitutes a kind of hedge against the risks of failure of R&D investments for large firms. This type of investment with uncertain results is a source of information asymmetry for banks and they generally refuse to grant financing.

Table no. 6 – Relationship between innovation and sources of finance: Africa Vs MENA

Variables	Product (M1)	Process (M2)	R&D (M3)	Inovscd (M4)	Inovsc (M5)	Inovdx (M6)
			AFRICA			
Banks	0.003	0.002	0.003	0.003	0.003	0.003
	(0.001)**	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Supplier	0.003	0.001	0.000	0.002	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Equity	-0.000	0.001	-0.000	0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
NBFI	0.004	0.006	0.005	0.005	0.005	0.006
	(0.002)**	(0.002)***	(0.001)***	(0.002)**	(0.002)***	(0.002)***
Others	-0.002	-0.000	0.001	-0.001	-0.001	-0.001
	(0.001)**	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
_cons	-0.376	-0.101	-0.998	0.095		0.434
	(0.058)***	(0.057)*	(0.080)***	(0.059)		(0.060)***
N	14,209	14,114	14,164	14,251	14,520	14,039
			MENA			
Banks	0.003	0.004	0.003	0.004	0.004	0.004
	(0.001)***	(0.001)***	(0.001)**	(0.001)***	(0.001)***	(0.001)***
Supplier	0.005	0.003	0.002	0.004	0.004	0.003
	(0.001)***	(0.002)	(0.001)**	(0.002)**	(0.001)***	(0.001)*
Equity	0.002	-0.001	0.004	0.003	0.002	0.001
	(0.001)*	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)
NBFI	0.004	0.008	0.006	0.007	0.007	0.006
	(0.001)***	(0.002)***	(0.003)**	(0.002)***	(0.002)***	(0.002)**
Others	0.003	-0.001	-0.002	0.001	0.001	0.001
	(0.001)***	(0.001)	(0.003)	(0.001)	(0.001)	(0.000)
_cons	-0.912	-0.484	-1.906	-1.408		-0.225
	(0.112)***	(0.118)***	(0.110)***	(0.160)***		(0.105)*
N	8,939	8,895	8,927	8,965	9,584	8,859
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
ISIC FE	YES	YES	YES	YES	YES	YES

Note: * p<0.1; ** p<0.05; *** p<0.01

Table no. 7 – Financing of innovation by company size

Variable	Product (M1)	Process (M2)	R&D (M3)	Inovscd (M4)	Inovsc (M5)	Inovdx (M6)
			Small businesses			
Banks	0.003	0.003	0.003	0.003	0.003	0.003
	(0.001)**	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Supplier	0.003	0.001	0.002	0.003	0.002	0.002
	(0.001)***	(0.002)	(0.001)	(0.001)**	(0.001)*	(0.001)
Equity	-0.001	0.000	0.000	0.000	-0.000	-0.000
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
NBFI	0.004	0.006	0.005	0.005	0.005	0.006
	(0.002)**	(0.003)**	(0.002)**	(0.002)**	(0.002)***	(0.002)**
Others	-0.001	-0.001	0.001	-0.001	-0.000	-0.000
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
_cons	-0.183	-0.131	-0.942	0.239		0.526
	(0.115)	(0.106)	(0.110)***	(0.186)		(0.120)***
N	12,742	12,663	12,719	12,782	13,431	12609

Variable	Product (M1)	Process (M2)	R&D (M3)	Inovscd (M4)	Inovsc (M5)	Inovdx (M6)
Medium-sized companies						
Banks	0.002	0.003	0.002	0.003	0.003	0.003
	(0.001)**	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Supplier	0.004	0.000	0.000	0.002	0.002	0.001
	(0.002)**	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Equity	0.000	0.001	0.002	0.003	0.001	0.001
	(0.001)	(0.001)	(0.001)*	(0.001)**	(0.001)*	(0.001)
NBFI	0.003	0.009	0.004	0.007	0.005	0.006
	(0.002)	(0.002)***	(0.002)	(0.002)***	(0.002)***	(0.002)***
Others	-0.001	0.000	0.000	0.001	-0.000	0.000
	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
_cons	-0.271	0.074	-0.459	0.488		0.794
	(0.116)**	(0.163)	(0.218)**	(0.154)***		(0.127)***
N	7,162	7,150	7,140	7,214	7,395	
Large companies						
Banks	0.004	0.005	0.003	0.005	0.004	0.005
	(0.001)***	(0.001)***	(0.001)**	(0.002)***	(0.001)***	(0.001)***
Supplier	0.002	0.004	-0.001	0.001	0.002	0.003
	(0.002)	(0.002)*	(0.001)	(0.002)	(0.002)	(0.002)
Equity	0.002	-0.000	0.000	0.001	0.001	0.001
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
NBFI	-0.002	0.004	0.010	0.001	0.004	0.004
	(0.003)	(0.004)	(0.003)***	(0.003)	(0.003)	(0.003)
Others	0.001	-0.002	-0.004	-0.003	-0.002	-0.001
	(0.001)	(0.002)	(0.003)	(0.001)**	(0.001)	(0.001)
_cons	-0.816	-0.492	-1.430	-0.273		0.014
	(0.134)***	(0.229)**	(0.291)***	(0.250)		(0.163)
N	3,207	3,145	3,185	3,201	3,278	3172
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
ISIC FE	YES	YES	YES	YES	YES	YES

Note: * p<0.1; ** p<0.05; *** p<0.01

Innovation firms and projects have unique characteristics: intangibility, random returns, moral hazard, and high information asymmetry, which directly affect the choice of a source of financing and access to external sources of finance (Lengnick-Hall, 1992; Hall and Lerner, 2010; Kerr and Nanda, 2015; Ayalew *et al.*, 2019).This is one reason why innovative firms in MENA and Africa show a low proportion of equity financing usage. In this context, banks would normally be the primary source of external financing since they dominate the financial systems. In this respect, the results of the different estimates confirm the fact that bank financing is the most important external source for financing innovation. About 10.63% of the total financing of innovative firms comes mainly from banks (Table no. 3), a contribution that remains quite low compared to the contribution of the sector to the financing of the economies of Africa and the MENA region. Furthermore, the results show the importance of non-bank financial institutions (NBFIs) in financing innovation, despite a very low recourse,

on average 4.9%, of firms to these organizations (Table no. 3). This is due to the fact that these institutions (microfinance, credit unions, finance companies, etc.) represent a small part of the financial systems and generally only finance projects for individuals or the creation of very small inclusive enterprises. However, over the past decade, non-bank financial institutions (NBFIs) have oriented their activities towards financing innovative entrepreneurship projects. The development of this sector could bring greater benefits to innovation than other sources of financing.

5. CONCLUSION

Innovation is a key factor for the growth and competitiveness of companies and for the development of economies. The financial literature on innovation has shown the importance of financing in the promotion, intensity and quality of innovation in various contexts. In this work, we tried to test the hypothesis of the importance of heterogeneity of financing sources on innovation, invention, and innovation intensity of firms in the MENA region and Africa. In this framework, a sample of over 35,000 firms from the World Bank Enterprise Survey covering the period 2011-2020 was used.

The main results of the various econometric estimations indicate that bank financing and funding from non-bank financial institutions (NBFIs) have a positive impact on the innovation behavior of firms in the MENA region and Africa. This suggests that access to these financing modalities increases the likelihood of firms in these regions engaging in innovation.

Furthermore, trade credit or inter-company credit also represents a significant source of innovation financing for firms in the MENA region. It is common in the region for businesses to engage in credit-based transactions. However, extending supplier payment periods may have negative effects on innovation and disrupt firms' procurement strategies.

In terms of magnitude, financing through NBFIs has the most significant impact on innovation compared to other financing modalities. Regular access to this form of financing could provide a competitive advantage for firms. Based on this finding, we strongly recommend that governments promote the development of non-bank financial intermediaries, as this could further enhance innovation efforts among businesses in the MENA region and Africa.

The study has certain limitations. In fact, we included all countries in the MENA region and Africa in the econometric estimations, either together or separately, without considering the economic development level of each country within the panel. It would therefore be valuable to incorporate additional macroeconomic indicators, as they may influence the innovation efforts of the firms analyzed.

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ANNEX

Table no. 9 – Correlation matrix of independent variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	1												
(2)	0.256	1											
(3)	0.273	0.138	1										
(4)	0.287	0.0885	0.0924	1									
(5)	0.187	0.447	0.169	0.0722	1								
(6)	0.164	-0.0257	0.0757	0.152	-0.0289	1							
(7)	0.0961	0.0759	0.0211	0.0737	0.00131	0.0115	1						
(8)	0.0698	0.0588	0.0853	0.0672	0.0306	0.0245	0.0129	1					
(9)	0.399	0.137	0.318	0.219	0.102	0.149	0.0387	0.143	1				
(10)	0.0933	0.0481	0.0868	0.0837	0.0376	0.00826	0.0172	0.0705	0.103	1			
(11)	0.0046	0.0132	0.00578	0.0287	0.0321	-0.00283	0.00639	0.0204	0.00523	-0.0134	1		
(12)	-0.0129	-0.0180	-0.00820	0.0597	-0.0471	0.0208	0.0362	0.0277	0.0151	0.0419	0.00772	1	
(13)	-0.0221	-0.0234	-0.0475	0.0607	-0.0213	-0.00503	0.0316	0.0517	-0.0140	0.0300	0.0268	0.0302	1
(14)	-0.0546	-0.0177	-0.0617	0.0514	-0.0395	-0.00918	0.0414	-0.0172	-0.102	-0.0543	-0.0237	0.0261	0.00951

Note: Sizewk (1); Age (2); Audit (3); Export (4); Exper (5); Forgien (6); Government (7); Gend-owner (8); ICT (9); Banks (10); Supplier (11); Equity (12); NBFI (13); Others (14).