Banks and Innovation
A Case Study of the Arab World

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Abstract

This study investigates the relationship between banks development and innovation at macroeconomic levels, using a sample of 19 Arab countries during the period from 1963 to 2012 and applying Ordinary Least Square (OLS) estimation. Innovation was measured by patent per capita per 1,000,000 person, while banks development was measured by domestic credit to private sectors by banks as proportion of GDP. Other control variables reflecting the education level, economic growth and openness to international trade were added.

The study found evidence that innovation is influenced by an increase in the level of education and a low level by the development of banks in the Arab World, suggesting the need for enhancing the education level in the Arab world and more partnerships between public and private sectors to finance innovation. However, the study found no evidence of economic growth and openness on the innovation level in the Arab World. Future research is recommended in this area including other variables.

Keywords, *Arab World, Innovation, Banks Development, and Time Series.*

Introduction

A growing set of studies indicated the importance of a well-developed financial system in promoting economic growth, such as King and Levine (1993), Levine (1996), Levine and Zervos (1998),and Levine et. al. (2000).

In the context of the complex and dynamic economy, innovation plays an importance role, where Schumpeter was the first to introduce the concept of innovation in his extended works: Schumpeter (1912), Schumpeter (1934), Schumpeter (1939), Schumpeter (1942).

The complicated modern economy increases the need for higher economic interaction, which means that the development of innovation needs more parts and it no longer depends on an individual attitude (Sl'edzik 2013).

The governments in the Arab world, like other developing countries, have played a critical role in stimulating the development of innovation. Even though innovation in the Arab world is still low, the residence patent per capita per 1,000,000 person was almost 3 in 2012.

On the other hand, innovation in the Arab world countries is weak because their is no financing, therefore banks can play a crucial role in financing innovation as indicated by Benfrattello et. al. (2008), Ayyagrati et.al. (2011).

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The objective of this study is to highlight if bank development in the Arab world stimulates the development of innovation at a macroeconomic point of view (macro-level) during the period from 1963 to 2012, using Ordinary Least Square estimation (OLS).

The study consists of five sections, beside this introduction. Section Two, provides a documentary of the innovation in the Arab world. Section Three, reviews empirical literature and determinants of the development of innovation. Section Four; discusses the data and methodology used in the study, followed up by the analysis in section five. Conclusions and Recommendations are stated in section six.

Innovation in the Arab World

As indicated in Table (1), the three Gulf Council Countries (GCC) ranked the first of all the Arab world countries (United Arab Emirates, Saudi Arabia and Qatar, respectively). Jordan ranked the fifth, where it scores 61 out of 142 countries.

The last three countries were Algeria, Sudan and Yemen. Unfortunately, Yemen ranked the last in all countries under study by the global innovation index report.

It is also indicated that Tunisia ranked the first according to the number of researcher per 1,000,000 person (3,239.9), followed by Jordan (1,933.7) and Egypt (1,017.5).

It is also indicated that the gross expenditure on R&D as a proportion of GDP is very low, were it did not exceed 1.1 percent of GDP for Tunisia. According to the UNESCO Science Report 2010, Arab World contributes less than 0.4 percent of the world gross expenditure on R&D.

All of the above indicates a significant and further development potential of innovation in the Arab world if it faces a number of challenges that affected its development, which promotes us to explore the macroeconomic (macro) determinant of the development of innovation in the Arab world.

Table 1: Ranking of the Arab World in 2013.

Country	Global Innovation Index		Research and Development	
	Score(0-100)	rank (out of 142)	Researcher, headcounts/ million population	Gross Expenditure on GDP%R&D,
United Arab Emirates	41.9	38	Na	Na
Saudi Arabia	41.2	42	47.4	0.1
Qatar	41	43	Na	na
Kuwait	40	50	151.9	0.1
Jordan	37.3	61	1,933.7	0.4
Bahrain	36.1	67	Na	Na
Tunisia	35.8	70	3,239.8	1.1
Lebanon	35.5	75	Na	Na
Oman	33.3	80	Na	Na
Morocco	30.9	92	934.7	0.6
Egypt	28.5	108	1,017.5	0.2
Syria	23.7	134	Na	Na
Algeria	23.1	138	419.8	0.1
Sudan	19.8	141	Na	Na
Yemen	19.3	142	Na	Na

Sources: Dutta and Lanvin (2013), Global Innovation Index Report, 2013.

Na: not available from source.

Literature Review

Almost all previous studies took Schumpters as a starting point, where he was the first to introduce the concept of innovation in his extended works Schumpeter 1912, Schumpeter 1934, Schumpeter 1939, and Schumpeter 1942. He divided the innovation process into four dimensions: Invention, Innovation, Diffusion and Imitation (Sl'edzik 2013).

Then the researcher attention has moved on to the determinant of the development of innovation either at micro or macro level.

At micro level, Choen and Soto (2007) used data for 95 countries (8 MENA, 26 Sub-Saharan Africa, 23 Latin America and Caribbean , 8 East Asia and Pacific, 3 South Asia, 4 Eastern Europe and Central Asia and 23 High Income Countries) over the period from 1960 to 2000, where they found a positive effect of the level of education on the development of innovation.

Almedia and Fernandess (2008) examined the international technology transfers for 17,667 manufacturing firms from 43 countries (11.5% Africa, 42% East Asia, 20.1% Eastern Europe and Central Asia and 26.3% Latin America) during the period from 2002 to 2005, where they found that the level of openness enhanced the development of innovation.

At macro level, Porter and Stern (2000) used date for 10 developed countries from 1973-1993. Ulku (2004) examined data from 20 OECD and 10 non-OECD countries during 1981 to 1997. Similarly, Falk (2005) examined the determinants of European Patent Office per capita using a data from 22 OECD countries over the period from 1980 to 1999. Khan and Roy (2011) used data from 10 countries (5 OECD and 5 BRICS Countries) during the period from 1997-2010. They concluded that the level of economic, education and the level of openness stimulated the development of innovation.

Recently, researchers examine the relationship between access to finance and innovation at micro level (firm-level), where the bulk of work focuses on developed countries.

At a cross-country level, Tadess (2005) used data from 10 manufacturing countries during the period from 1980 to 1995, where he found a positive effect of bank development on the development of innovation. Similarly, Sharma (2007) examined the affect of financial development on innovation for 21,000 small manufacturing firms across 57 countries (28 Eastern and Europe, 9 Africa, 5 South East Asia and 15 Latin America) during the period from 2003-2006 and found a positive effect of the development of innovation. Xiao and Zhao (2011) used data from 28,000 firms from 46 countries over the period from 2002 to 2005, where they found positive effect of bank development on the development of innovation.

On the other hand, Ayyagri *et.al.*(2007) conducted an extended survey for 1900 manufacturing firms from 47 developing countries.

For Italy, Angelini and Certroelli (2003) and Benfrattello *et.al.* (2008) examined the effect of bank development of Italian manufacturing firms, where they found that bank development stimulated the development of innovation, were Benfrattello *et.al.* (2008), use a large number of manufacturing firms during the 1990s.

For USA, Amore *et.al.* (2012) examined data for 1980s and 1990s. Chava and Oettle (2012) used data from 51 states during 1975 to 2005 and Cornaggia et. al. (2013) examined data for US listed corporations and private firms during 1976 to 2006.

Bircan and De Hass (2013) conducted a survey for 4,200 Russian firms and 45,000 bank branches for the year 2011 and 2012. They all found that bank deregulation has a positive effect on the development of innovation.

On the other hand, few works focus on macroeconomic point of view (macro-level), such as Mehmood (2013) where he examined data from 75 countries during the period from 1988 to 2010, and found that the level of education and bank development positively effect the development of innovation.

This study contributes to the previous literature and focuses on macroeconomic point of view.

Macro Input determining the development of Innovation

Based on the previous studies, we can group the inputs stimulating the development of innovation into micro and macro inputs (this study focuses on macro inputs):

Bank Development:

The degree of bank development is one of the important factors affecting the development of innovation.

Most previous studies found a positive and significant effect on the development of innovation. For instance, Angelini and Certroelli (2003) found that bank development (measured by banking deregulation) increases the development of innovation through increasing the supply of loanable funds and decreasing the charge up by banks.

Similarly, Amore et. al. (2012), Chava and Oettl (2012) and Cornaggia et. al. (2013) found that bank deregulation also has a positive effect.

Benfrattello et.al. (2008) and Bircan and De Hass (2013) indicated that bank development (measured by branch density) stimulate the development of innovation because it decreases monitoring cost and increase competition and supply of credit.

On the other hand, Tadess (2005), Xiao and Zhao(2011) and Mehmood (2013), measured bank development as domestic credit to private sectors by banks as proportion of GDP, where they all found positive effect on development of innovation.

Sharma (2007) studied the impact of bank development measured in different measures: domestic credit to private sectors by banks as proportion of GDP, deposit accounts and interest rate spread. He found that high levered firms by banks are more innovative. Therefore, the following alternative hypothesis is proposed,

H1: There is a statistically significant relationship between the level of bank development and the development of innovation in the Arab world.

Level of Economic Growth

A sustainable economic growth promotes the development of innovation (Ulku 2004)

Previous studies investigated the effect of economic growth on the development of innovation, such as Porter and Stern (2000), which was measured by GDP. On the other hand, Ulku (2004) and Falk (2005) measured it by GDP per capita to reflect the market size. They all found a positive and significant effect.

On the other hand, Tadess (2005) found significant and negative effect. Therefore, the following alternative hypothesis is proposed,

H2: There is a statistically significant relationship between the level of economic growth and the development of innovation in the Arab world.

Human Capital

Human capital is the major player in innovation, where it promotes the development and growth through increasing the capacity and productivity of labor (Schneider et.al., 2010)

Choen and Soto (2007) indicated that there is no clear measure of human capital, even though most previous studies used education as a measure of human capital.

Most previous studies argued that when the level of education in a country increases, it leads to development of innovation; Falk (2005) he measured education as the average years of education among working age population (from 25 to 64 years of age).

Khan and Roy (2011) measured education as enrollment in post-secondary education as a percent of all enrollments. Ulku (2004), measured education as secondary school enrollment.

Similarly, Mehmood (2013) found the same result where he measured education as tertiary enrollment.

The study of Ayyagri et.al. (2007) measured human capital as the education and the workforce of management, and they found that firms with higher education and medium expertise are more innovative. Therefore, the following alternative hypothesis is proposed.

H3: There is a statistically significant relationship between the level of education and the development of innovation in the Arab world.

Level of Openness

This reflects the openness to international trade. The more the openness, the greater the global integration and facilitating of knowledge (Hoekman and Javorcik 2006).

Almeida and Fernandess (2008) suggest that as the export increases, the development of innovation increases from two points of view; first, because of the interaction with foreign buyers and because of the pressure of competiveness in the foreign market.

Most studies suggest that openness are linked to innovation, such as Ulku (2004), Almeida and Fernandess (2008), Khan and Ray (2011) and Mehmood (2013), where they measured openness as total trade as a proportion of GDP.

On the other hand, Falk (2005), found no significant effect on innovation. Therefore, the following alternative hypothesis is proposed,

H4: There is a statistically significant relationship between the level of openness and the development of innovation in the Arab world.

Variables and Measurements

We conducted an empirical analysis to explore the relationship between banks development and innovation in the Arab world, where innovation is measured by patent per capita per 1,000,000 person. The independent variables are the bank development measured by domestic credit to private sectors by banks as proportion of GDP. Control variables include economic growth measured by GDP per capita, education measured by secondary school enrollment, and openness measured by total trade as proportion of GDP.

Using a regression model with time series data for the Arab World countries (except Palestine, Comoros, Mauretania) between 1963 and 2012, all variables were obtained from the World Development Indicators (World Bank). Table 2 shows the summary of variables {definition, sources and, expected relation with development of innovation}

Table 2: Summary of the study Variables.

Variable	Proxies	Definition	Expected relation with development of innovation	Sources of Data
Dependent Variable				
Innovation	Innovation	Residence patent per capita per 1,000,000 person.	-	World Bank, World Development Indicators(WDI)
Independent Variables				
Banks Development	Bank	Domestic Credit to Private sectors by banks(% of GDP)	+ve	WDI
Control Variables				
Economic Growth	GDP	GDP per capita (current US $)	+ve	WDI
Education Level	EDU	Secondary school enrollment (%)	+ve	WDI
Openness	Opnn	Total Trade(exports plus imports)(% of GDP).	+ve	WDI

Research Methods

To explore the relationship between these variables and Innovation Ordinary Least Square estimation (OLS) is applied , which is expressed in logarithmic value {(Porter and Stern (2000), Ulku (2004),Falk (2005) and Mehmood (2013)}, where logarithmic linear equation is mostly applied for demand model, and estimated coefficient are descried as elasticities.

In order to check whether the time series are stationery or non-stationary (having unit root), the unit root test for all time series are applied. The Dickey-Fuller test shows that for all the variables, except the dependent variables and education level , the existence of unit root cannot be rejected at 5% level of significance. Therefore, all the explanatory variables are non-stationary and have unit root. However, the unit roots test and visual inspection (graph) show that the first differences are stationary. It is clear that if each variable has unit root, then the regression analysis based on the non-stationary variables can be spurious regression. Thus, we need to check if there is a co-integration relation among variables. If they are co-integrated, then the regression analysis makes sense. If there is no co-integrating relation, then the regression result does not make sense. However, the result of the Engle-Granger (tau) co-integration tests show that the time series are co-integrated.

A Variance Inflation Factor (VIF) test was applied to test for Multicollinearity; the mean VIF for the three models was under 10 meaning that the estimation of Multicollenerarity is not violated. The heteroscedasticity test (Brusch-Pagan test) associated with estimation of the models present can accept the null hypothesis of homoscedasticity and can use the OLS estimation.

To test our hypothesis, the following model is applied;

$$LInnoviation_t \equiv \beta_0 + \beta_1 \Delta LBank_t + \beta_2 \Delta LGDP_t + \beta_3 LEDU_t + \beta_4 \Delta LOpnn_t + \Sigma_t \quad t=1963,....,2012$$

Where: Innovation represent patent per capita per 1,000,000 person; Bank represents bank development; GDP represents GDP per capita; EDU represents education level; Opnn represents openness level; and t represents the year. The parameter $\beta 0$ is an intercept. The coefficient $\beta 1, \beta 2, \beta 3, \beta 4$, are unknown parameters. L represents logarithms; Δ represents first differnce; and Σ represnt random error term.

Empirical Results

Summary statistics on the explanatory variables are reported in Table (3); the patent per capita for the Arab world has increased from 0.821 per 1,000,000 person in 1963 to 2.99 per 1,000,000 person in 2012, where the number of patent for residents were 83 in 1963 for the Arab world and increased to reach 1083 in 2012.

The largest number of patents was held by Egypt (683), Morocco (197), and Algeria (119) in 2012.

The average patent per capita per 1,000,000 person for the Arab world was 2.15 during the period from 1963 to 2012, the minimum amount was 0.7310 in the year 1977 and the maximum amount was 4.05 which was achieved in the year 2000.

Using independent variables, the average bank development is around 26.38 percent during the period from 1963 and 2012, which is a high ratio, indicating the importance role that banks play in financing in the Arab world, where the max ratio was 47.11 percent in 2009 and the minimum ratio was 10.81 percent in 1964. The countries with the highest ratio are Morocco (73.3%), Jordan (72.8%) and Tunisia (72.1%).

The economic level measured by GDP per capita shows an increasing trend between 1963 and 2012, with an average of $ 2606.014 indicating that Arab countries are lower middle-income countries. The average openness is around 75.52 percent during the period from 1968 to 2012, this high ratio indicates the openness of the Arab world to the international trade. The maximum ratio was 100.56 percent in 2008 and the minimum ratio was 58.78 percent in 1968.

The level of education in the Arab world is high, where the average ratio is around 50.13 percent during the period between 1970 and 2012, suggesting increasing innovation capability.The countries with the highest ratio are Saudi Arabia (114%), Bahrain (96%) and Oman (96%).

Table(3): Descriptive Statistics.

Variable	Mean	SD	Minimum	Maximum	Observation
Innovation (per 1,000,000 person)	2.15	0.9198	0.7310	4.05	50
)%Bank Development (	26.38	10.21	10.81	47.11	50
Economic Growth(current US $)	2606.014	1880.129	293.621	7709.95	46
)%Openness (	75.52	11.61	58.78	100.57	45
)%Education (	50.13	15.00	25.10	72.00	43

The OLS estimation of the models give us the following results (Table 4); for bank development there is no statistically significant relation between bank development (measured by domestic credit to private sectors by banks as proportion of GDP) and innovation in the Arab world. Consequently, we reject hypothesis one. However the hypothesis can be accepted at 10 percent confidence, which means that banks in the Arab World facilitate innovation.

Our results are consistent with the results of most previous studies such as Mehmood (2013), where he found that bank development was significant at 10 percent level.

Since logarithm values are applied, the estimated coefficients are measures of elasticity, implying that an increase in 10 percent in bank financing increases innovation by 2.732 percent.

For education level, we found statistical positive relation at 1 percent confidence between education level (measured by secondary school enrollment) and innovation, consequently; we accept hypothesis three.

Our results is consistent with the results of most previous studies such as Falk (2005), Khan and Roy (2011), Mehmood (2013) and Ulku (2004), where he found a significant and positive relation for lower-income OECD countries.

Since logarithm values are applied, the estimated coefficients are measures of elasticity, implying that an increase in 10 percent in human capital increases innovation by 11.326 percent.

The importance of human capital was widely known since the work of Schumpeter (1934). As education level increases, the individual's ability to recognize business opportunities increase (Shan 2000) and raise the absorptive capacity of individuals (Grant 1996).

As indicated by Dutta and Lanvin (2013) in their report of Global Innovation Index, the level of education and research activity in any country is the main determinant of the development of innovation, where higher education is needed for any country to move from simple production process to innovative production process. Therefore the Arab World is recommended to focus more on education level and give priority to sectors that engage more with innovation as recommended by Dutta and Lanvin (2013).

For openness level and economic growth, we found positive but not significant relationship with innovation. Consequently, we reject hypothesis two and four and accept the null hypothesis. Our results are consistent with the results of Falk (2005), where he found insignificant relation with openness and also insignificant relation with economic growth when he used the dynamic panel data model.

Table(4): Determinants of Development of Innovation.

Variable	OLS-Results
Constant	0.6459 (0.000)*
Bank	0.2732 (0.073) ***
GDP	0.1791 (0.671)
UDU	1.1326 (0.000)*
Opnn	0.6122 (0.393)
Observation	43
Adjusted R-squared	%55.02

Note: p-values in parentheses.

***,**,* represent significance at 1%, 5% and 10% level, respectively.

Conclusion and Recommendation:

The patent per capita for the Arab world has increased from 0.821 per 1,000,000 person in 1963 to 2.99 per 1,000,000 person in 2012. Even though, innovation in the Arab world is still low.

The objective of this study is to highlight if bank development in the Arab world stimulates the development of innovation at a macroeconomic point of view (macro-level) during the period from 1963 to 2012, using Ordinary Least Square estimation (OLS).

The study found evidence that innovation is influenced by an increase in the level of education and a low level by the development of banks in the Arab World, suggesting the need to enhance more the education level in the Arab world and more partnerships between public and private sectors to finance innovation. However, the study found no evidence of economic growth and openness on the innovation level in the Arab World. Future research is recommended in this area including other variables, and this research can be replicated using panel data for the Arab world.

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