Bulletin of Business and Economics, 13(1), 8-21
https://bbejournal.com
https://doi.org/10.61506/01.00164

From Theory to Practice: Examining the True Impact of Institutional Quality on Innovation Commercialization

Syed Waqar Akbar[1], Ajid Ur Rehman[2], Imran Arshad[3], Waseem Abbas Shaheen[4]

Abstract

Does better corruption controls as institutional quality measure affect commercialization of innovation? Institutional quality from corruption control perspective is very important to be considered for making strong strategic policies favorable for innovation commercialization. Using panel data consists of 15-year time span (2001-2015) covering 143 countries, initial regression estimates with robust check along with fixed effects presents that better corruption controls are *positively* effective in promoting innovation commercialization in the country which is further verified by using GMM estimates. Our preferred specifications imply that corruption effects on innovation commercialization is worse in Middle East and North American (MENA) regions which is around negative 65% especially in upper middle income and Catholic countries. Apart from the exports of high-tech products, other demand and supply side contributors of innovation commercialization are also important to account for. While improving the research and development aspects, the policy makers must also have to plan strategically for improving these channels which may help in improving the institutional quality in the country including investment in improving the grass root literacy levels, flexible facilities for entrepreneurial incubators, and optimal utilization of population growth with urbanization measures in the country.

Keywords: Innovation Commercialization, Institutional Quality, Corruption Level, Regional Geographies, Income Disparities, Religions

1. Introduction

Is institutional quality with respect to better corruption controls matter for promoting innovation commercialization? By looking at recent technological innovation trend globally happened with the advent of the "Third Industrial Revolution", technological innovation has reached a high-water mark globally. Leading countries including U.S. China, Germany, Japan, France, Singapore and U.K etc. are putting forward to capture their international market share by dragging down via more and more technological innovation commercialization. Some of the prominent examples are "Made in China 2025" by China, Technological Innovation Plan (TIP) and "the American Innovation Strategy" by U.S., "Create Tomorrow's Products" by France, "2020-Innovation Partnership and Standard Innovation Plan" by both Singapore and the U.K., and "Digital Japanese Innovation Plan" by Japan. These examples clearly show a trend of technological development and commercialization competitions have now entered in maturity stage globally. By looking at the trend of the patents registered, trademarks registered and the scientific publications during 2001 to 2015, we can observe a clear increasing trend of these parameters (see figure 1.1). Also in frequency trend time based comparison between no of R&D technicians and scientists, we can see an increasing trend in these parameters too (see figure 1.2). As these parameters are also indicators for measuring innovation commercialization, so we can say that the commercialization of innovation activities has also been increased over the past years of given time spam. The statistics also show that the research and development expenditures during past 15 years (2001-2015) have been increased by 7% while exports of high-tech products show an increasing trend which is about 105% higher during that time spam. However, GDP growth shows an overall increase of 41%.

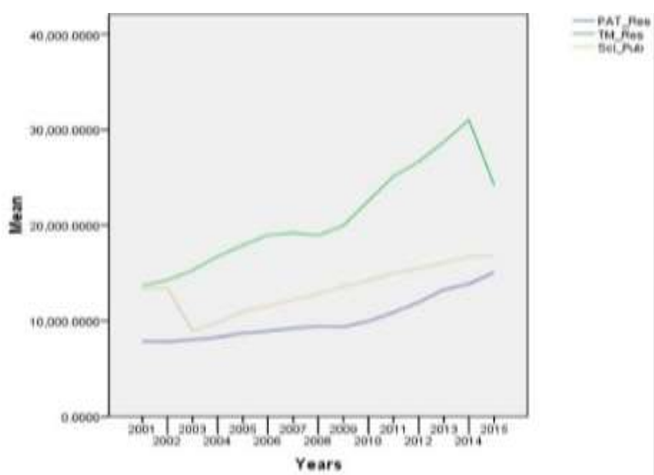

Figure 1.1: Frequencies of Patents Registered, Trade Mark Registered and Scientific Publications (2001-2015)

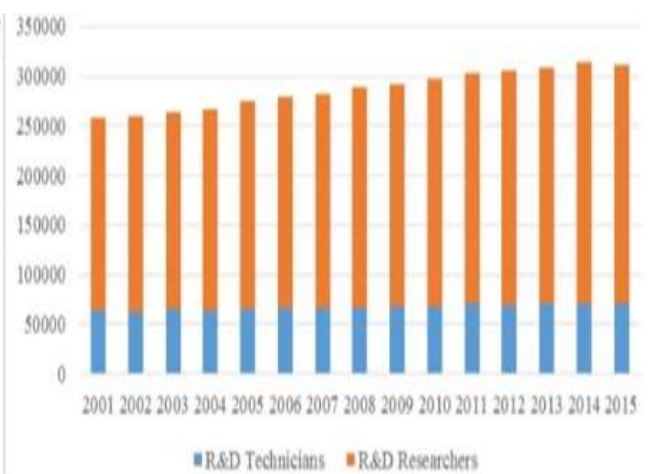

Figure 1.2: Frequencies Trend of R&D Technicians and R&D Researchers (2001-2015)

The important point here is the scientists' attitudes towards innovation commercialization which may be shaped by the institutional quality of the country. The level of accountability (corruption level) of the country is one of the main measures of institutional quality. In industrialized countries such as the U.K., U.S., Germany and France, where policy networking approaches are developed,

[1] Riphah International University, Islamabad, Pakistan, amayazakbar@gmail.com
[2] Riphah International University, Islamabad, Pakistan, ajid.rehman@gmail.com
[3] Riphah International University, Islamabad, Pakistan, imran.arshad@riphah.edu.pk
[4] Quaid – e – Azam University, Islamabad, Pakistan, wasimabbas54@yahoo.com

government agencies organize themselves around policy issues, including those related to innovation and its commercialization, which are at the heart of policy network governance (Berardo and Scholz, 2010; Audi et al., 2021; Imran et al., 2021). The governments' institutions are expected to fund generously and transparently with minimal level of corruption, scientific research and regulate science to ensure its openness. We believe that strict financial controls over corruption associated with innovation commercialization are very important to study as innovation commercialization activities which are important for any country's economic development.

1.1. Institutional Quality and Innovation Commercialization

Is corruption harmful for commercialization of innovation activities in the world or not? The is the question which seek attention despite of many studies have been done showing that corruption control has consistent positive relationship between various important economic welfare indicators including foreign direct investment, productivity and revenue growth etc. Corruption also causes suppression of investment in innovation because their returns are uncertain and therefore increases transaction costs and further limits the scope of their activities. For example, in promoting the high-tech economy, the government provided research and development funds and promotes public research facilities. International experience has shown that structural relationships between government agencies, public and private organizations and other stakeholders are essential for the development of innovative policies. We have argued that institutional quality particularly corruption level is very important for making strong strategic policies favorable for making and commercializing innovations. However in this whole discussion of innovation commercialization and institutional quality, the role of financial disparities, geographical dynamics and religious affiliations of the country are also important which cannot be ignored. Previously this matter as a whole has been not discussed at all. We have therefore investigated these aspects in detail. Overall, our study is quite unique in nature and opens new avenues for multi-disciplinary research pertaining to innovation commercialization and institutional quality.

1.2. Initial Findings

To estimate the theoretical model empirically we linked the country's institutional quality and innovation commercialization by using different instrumental variables. In addition, we have integrated country and year fixed effects; and a set of time and country-varying control variables, such as literacy level, employment level, population density and growth etc. Our empirical analysis leads to several conclusions. We found that when a country has a sufficiently high level of institutional quality via better corruption controls, it can enhance innovative productivity more effectively. We have also found consistent results by having regional geographies, financial disparities and religious affiliations of the countries. Our results are strong and consistent enough with the alternative commercialization innovation measures too. Our research extends the growing literature on the relationship between institutional quality and innovation commercialization across-countries. The layout of the paper is: Section 1 provides the introduction followed by a brief literature review in section 2. Section 3 is the research methodology part which provides detailed explanation of the variables, data collection, data processing and measurements, empirical model and the descriptive statistics; Section 4 provides initial regression analysis, findings and discussions for the impact of institutional quality on innovation commercialization; detailed empirical specifications analysis are provided in section 5; and finally section 6 conclude the whole discussion and provide important policy suggestions and future directions.

2. Literature Review

2.1. Innovation and Commercialization of Innovation

Innovation and economic growth go side by side, and for a modern day economy, innovation is very critical factor (Hausman and Johnston, 2014). For example, Fan (2011) argued on China and India's innovative capabilities and found that it contribute significantly to economic growth. He identified that the innovation capability of China and India is mainly due to the increase in investment in research and development sector which is resulted in an increase in research and development personnel. Santacreu (2015) studied the basis of economic growth and domestic as well as foreign innovation obtained through trade, and found that technology accumulation via high-tech products' exports is the "engine of growth" for a country. In post-socialist economic context, Marozau and Guerrero (2016) believed that commercialization of innovation faces different kinds of hurdles in the way of its success including a high level of bureaucracy, lack of economic motivation to commercialize the inventions, lack of financial resources for independent market technology, lack of free decision-making to obtain patents, and lack of industry participation networks. In transition economies, universities receive government subsidies to provide new technologies for large publicly owned enterprises, regardless of the economic interests of scientists, inventions are wholly owned by universities or national governments. The commercialization of innovations is the phenomenon which can't be measured directly. That is why researchers used numerous proxies to approximate the commercialization of innovation phenomenon in an economy. The following table summarizes the details of different measures of innovation commercialization used in different studies.

2.2. Institutional Quality

With the rapid rise of emerging market economies into the global markets competitions, scholars are increasingly interested in exploring the role of home country's institutional systems and their quality for internationalization (Meyer and Peng, 2016; Imran et al., 2023). In order to fill that literature gap, we form the institutional quality literature as our theoretical base given by Kaufmann et al., (2010). Our study highlights the role of a country's institutions in influencing strategic decision-making and behavior in innovation commercialization. Based on prominent institutional studies (Scott, 1995) and World Governance Indicators (Kaufmann et al., 2010; Imran et al., 2022), we define the quality of the system as limited by government intervention, a fair justice system, stable political environment, strong financial markets and a lack of cumbersome regulations. It actually determines the ways through which the enterprises can obtain valuable but scarce resources and knowledge in order to develop its competitive advantage. Going abroad is one of the responses that enterprises have taken to reduce domestic institutional constraints (Stoian and Mohr, 2016; Imran et al., 2024). A well-functioning and developed host country system environment in terms of institutional quality helps to ensure transparency, reduce transaction costs for foreign entry of companies, reduce information asymmetries and promote foreign access (Uhlenbruck et al., 2006; Audi et al., 2022). Institutions always play an equally important role in technological progress and for the commercialization of innovative process. In a corrupt country, the lack of a system for the protection of property rights makes productive and innovation activities vulnerable to plunder. Corruption can affect the return of innovative activities and reduce the likelihood that entrepreneurs will receive their share. The debate over the negative impact of corruption on innovation commercialization is quite compelling and is neglected in past by economists. The better the institutions, the lower the corruption, so as better the patent is protected and commercialized.

Table 1

Authors	Measures	Contribution to Commercialization of innovation/patents Understandings
Wagner, Wakeman (2016)	Patent-based	Insecurity regarding patent protection minimizes the speed of commercialization
Cavdar, Aydin (2015)		Indicator that can assist future generation of economic benefits
Aarikka-Stenroos et al., (2014)	Actions of network stakeholders (distributors, users, customers, suppliers, investors, associations, public organizations, regulators and policy makers)	* Network actors facilitate adoption/diffusion & create markets * Network of organizations are vital for commercialization activity
Walsh (2012), Corkindale (2010)	* Demand and sophistication of the market * The quality of commercialization environment (Innovation Wasteland, Innovation Push, Innovation Pull and Innovation Nirvana)	* Commercialization of patents depends on demand and eco-sophistication of the market * Commercialization strategies are being affected by commercialization environments
Arora et al. (2016)	Origin of invention: internal/external	Origin of invention can be linked to commercialization
Lin et al. (2016)	Cross-functional collaboration and organizational knowledge activities	It facilitates knowledge creation and commercializing technologies
Khademi et al. (2015)	Licensee availability	Availability of licensee facilitates commercialization
Wu et al. (2015)		If commercialization of inventions is perceived positively by the inventor, invention of university is licensed.
Cavdar, Aydin (2015), Lipkova, Braga (2016)	Exports of high-tech products	Indicator of economic effectiveness of commercialization process
Do et al. (2012)	R&D	R&D is a part of commercialization process

2.3. Innovation Commercialization and Corruption Level in the Country

The positive relationship between corruption control and various economic welfare indicators is available is literature which includes per capita GDP growth (Kaufmann and Kraay, 2003), income inequality (Carmignani, 2005) and total factor productivity (Lambsdorff, 2003). Corruption often involves violations of the trust of public officials, and undermines the foundation on which broad interpersonal trust based. It inevitably increases the level of uncertainty and transaction costs associated with detention and expropriation because innovators' value chains must involve relevant officials and authorities at some stage of their innovation process. The technology commercialization policies are formulated by the central government which are then transformed to the lower levels hierarchically. The society in which key voters and stakeholders feel insecurity regarding their investments and increasing level of corruption in the country, effect the economic growth inversely. Therefore, based upon the above literature it can be believed that there exists some connection between innovation commercialization and the institutional quality (corruption level) which has not been explored yet.

2.4. Regional Geographies, Income Inequalities and Religious Affiliations' Role

Socio-economic research is basically analyzing the specific drivers of economic development including culture (Maridal, 2013), economic governance (Dixit, 2009), government, religion and other factors (Spolaore and Wacziarg, 2013). In this context, Diamond (1997) is considered as the leading advocate of international inequality geography theory. This theory based on the fact that the endowments of natural resources, climate, disease ecology, transport costs and the ease of dissemination of technology from more advanced regions depend mainly on geographical location. Testing the relative role of geography and institutions in determining global income levels, Levchenko (2013) used cross-sectional trade data for an average of 141 countries over a period of 1970-1999 years to identify countries with export intensive products showing better rule of law. However, Lin et al. (2016) worked on firm level data and provide evidence at the corporate level that US multinationals corporations (MNCs) are more likely to operate in countries with better state governance, such as corruption and property rights. There are a number of reasons why commercialization of innovation is related not only to the institutional quality of countries but to the average income level inequalities among countries.

Income inequality depends on a variety of factors, from factor endowments in the economy, geography, institutions and social capital, to its historical trajectory, technological change and return on capital (Autor, 2014). Therefore, we have argued that countries having better institutional quality based upon better corruption controls have more positive impacts on the commercialization of innovation. Some countries may be able to achieve comparable results too because of extensive natural resources and regional geographical benefits. On the other hand, religious culture can influence social norms and the system which in turn plays a major role in supporting long-term technological innovation and patterns of growth (Coccia, 2009). Socio-economic studies have shown interesting results on the relationship between religion, culture and economic growth. For example, Guiso et al. (2003) analyzed the interaction between the intensity of religious beliefs and its impact on the institutional quality and economic growth such as cooperation, trust, transparency, government systems, legal rules and market fairness, and found that on average religious beliefs are conducive to increasing per capita income and growth. Bettendorf and Dijkgraaf (2010) on the other hand argued and support the assumption that the impact of religion on income is more favorable in high-income countries as compared to low income countries and found that religion in low-income countries has a negative impact. Therefore, it can be assumed that although religious affiliations may affect directly or indirectly the nexus of innovation commercialization and institutional quality which is not yet explored theoretically or empirically. To conclude the discussion, it is observed that since technological innovation and its commercialization is the main determinant of economic growth, and R&D is the engine of technological innovation, thus an interesting socio-economic issue is the analysis of how dominant religious affiliations, income inequalities and geographical locations of the countries can be linked to the nexus between institutional quality and innovation commercialization and this is one of the potential research gap of our study too.

3. Research Methodology

3.1. Research Questions

Many game-changing innovations from academic institutions struggled in the Death Valley of technology and failed to commercialize. The quality of institutions provided by the government and the quality of technology required by the market often translates into unforeseen costs and risks. Anokhin and Schulze (2009) found that doing business in a competitive market is critical to innovation and its commercialization benefits. They also argue about the importance of government trust. Corruption reduces trust in the government because government is the main source of research and development funding. Untrustworthy practices on behalf of government which may occur due to corruption factors increases the uncertainty of how quickly companies get the permits and licenses they need. The debate over the negative impact of corruption on commercialization of innovation is quite compelling. We believe that the better control of corruption in a country boosts the innovation commercialization activities as companies and innovators can see the institutions more trustworthy. Based upon this the main research question for our study is:

Question 1: Is institutional quality particularly the accountability (level of corruption) effect the innovation commercialization as accountability is reflected in building the trust worthiness in the country and countries having strict control over corruption have more tendencies over commercialization of innovation process and grow fast to compete in global markets via availability of up to date innovative products?

Going further, we also believe that countries regional geographies also affect the relationship between commercialization of innovation and the institutional quality. Following Diamond's (1997) theory about international inequality geography and findings of Peng and Lebedev (2017) that regional capacity enhances the risk taking capacities for emerging-market companies as they expand overseas. Since economic growth in emerging countries has been highlighted domestically and internationally, the markets in the under developed and less developed global regions having lack of resources have become the focus of attention for many developed countries. In subsequent research questions, we study the quality of institutions in relation to the regional geographies for measuring its impact on innovation commercialization:

Question 2: Are regional geographies of the countries effect the nexus between institutional quality and innovation commercialization as geographical dynamics boost a hidden regional competition in innovation activities among the neighboring countries?

Innovations at death valley in the literature presents a number of assumptions that can be analyzed on the basis of low-income level and lack of commercialization opportunities because of the financial constraints (Nogami et al., 2018). Policymakers are often more interested in the risks and opportunities presented by growth turning points than in long-term growth drivers. As Aiyar et al. (2018) considered and found that anxiety about slowing growth is particularly acute in middle-income countries. There is growing concern about the risk to the income trap of the policy debate, which may simply be defined as the stagnation and failure of fast-growing economies in middle-income levels to be included into the ranks of high-income countries. However, a theoretical basis for the existence of income trap has not been explored empirically in institutional quality and innovation commercialization context yet. This forms our next subsequent research question:

Question 3: Is income level of the countries assumed to be a pre-requisite for the enhancing the innovation commercialization opportunities via improvement in the institutional quality because better the country is financially strong the better will be their technology commercialization strategies to grow well globally as innovations laying in the death-valley are due to the lack of financial resources?

Lastly, most of the literature highlights the importance of home country institutional systems specifically for emerging market economies; very few studies examine the religious affiliations of the country which can also be a factor in the context of forming the institutional policies. In fact, taking into account the given literature on interdisciplinary perspective, socio-economic research is actually analyzing the specific drivers of economic development including culture, economic governance, and religion. Auriol and Platteau (2017) analyzed the comparative effect of dispersion and contrast concentration of religions for cooperation between dictators and religious clergy in political stability context. In other words, religious culture as suggested by McCleary (2008) plays a major role in supporting long-term technological innovation and patterns of economic growth. This has raised our next research question given below:

Question 4: Does religions play any role in countries to maintain the optimal institutional quality which affect the tendency of innovation commercialization, as religious clergy shapes the social ethics in the society which may enhance the innovation culture via transparent implementation of strategic policies?

3.2. Data and Variables

We used panel data of 143 countries from 2001 to 2015 for our study and variables details are given below:

3.2.1. Explanatory Variables

There are many dimensions available in the literature to measure the institutional quality including voice and accountability, political stability and absence of violence, government effectiveness and regulatory quality, rule of law, control of corruption and ease of doing business (Bruinshoofd, 2016; Kaufmann et al., 2010). We have taken the corruption level in the country to measure the institutional quality in a country. The reason is that innovation commercialization involves huge R&D funding from the government which needs to be allocated and monitored transparently. The data for the level of corruption is collected from the World Governance Indicators (WGI) available on World Bank Group, CPIA database. A total of 188 countries and territories have been included in the CPI and WGI database. But because innovation commercialization data is limited to 143 countries, we have therefore used 143 out of 188 countries in our final dataset. The corruption level of the countries index ranks countries ranges from 0 to 10; where 10 represents an entirely clean country while zero indicates a country with extremely high corruption level.

3.2.2. Dependent Variables

Different proxies has been used to measure the commercialization of innovation in our study as suggested by Cavdar and Aydin (2015); and Lipkova and Braga (2016) including log of exports of high-tech products (HT_Exp) for our main analysis and for alternative analysis we have used proportionate high-tech products exports to manufacturing products (HT_Exp_M), no of trademarks registered by residents (TM), research and development expenditures (RD); research and development technicians (RD_T); and scientific publications by residents (Sci_Pub). To deal with the possible endogeneity problem, we have used primary enrollment rate, secondary enrollment rate and child mortality rate as our instrumental variables too suggested by Acemoglu et al. (2014, 2019). Apart from that different control variables has also been used including cost of intellectual property use (IP use payments and receipts), cost of business startups (CBS), urbanization (measured by the urban population as a share of the total population); population growth (PG), population density (PD) as suggested by Andersson et al. (2009); job creation (JC) suggested by Hooghe et al. (2010) which is measured through the level of unemployment in a country i.e higher the level of unemployment rate will be the lower will be the job creation and vice versa; economic openness (EO) as suggested by Cheung and Ping (2004) measured by exports-imports as a share of the GDP.

3.3. Sample Selection and Data Collection

Initially, 210 countries were there in the data collection stage. But for some countries including North Korea, Afghanistan and others, data were not available at all and some countries data had too much missing values. In order to maintain the proper accuracy level, we make a cut on the data and countries having more than 30% missing values has been exclude from the dataset for the purpose of our study. Remaining we have 143 countries in our dataset. In our final dataset, we have imputed missing values by mean value method for some countries. The dataset is further classified into 7 regional, 4 income level and 8 religious classifications for comprehensive analysis.

3.4. Empirical Model of the Study

Scientists' attitudes towards innovation commercialization may be shaped by the institutional quality (corruption level). On the basis of above mentioned studies done on different contexts separately, we have developed a new model by combining the models of Gao et al. (2017), Luo (2005) and Prud'hommeab (2018) and argued that innovation commercialization is dependent upon institutional quality. The base model for our regression analysis is

$$CI_{it} = \beta_0 + \beta_1 IQ + \varepsilon_{it} \qquad (1)$$

Where CI_{it} shows the innovation commercialization for the country i in a given year t, while IQ_{it} is the institutional quality for the country i in a given year t.

We have also argued that cost of intellectual property, cost of business startups, population growth, population density, urbanization, job creation and economic openness are also the factors that can't be ignored and must be controlled while measuring the impact of institutional quality on commercialization of innovation. We have also used a set of regional, income level and religious dummies to control the effect of other factors. Thus the extended model for our base regression model is as follow:

$$CI_{it} = \beta_0 + \beta_1 IQ_{it} + \sum_{i=1}^{t} \lambda \text{ Control}_{it} + \alpha_i + \delta_t + \sum_{i=1}^{t} \boldsymbol{\Omega}_{it} \textit{ (Regional/Income level/Religious Dummies)} + \varepsilon_{it} \qquad (2)$$

Here, CI_{it} shows the commercialization of innovation for the country i in a given year t, while IQ_{it} is the institutional quality for the country i in a given year t. The λ denotes the coefficients of all control variables used in our study for the country i in a given year t. The α_i denotes a full set of country fixed effects to absorb any time-invariant country characteristics effects, and the δ_t denotes a full set of year effects. The $\boldsymbol{\Omega}_{it}$ denotes the coefficients of regional, income level and religious dummies. The error term ε_{it} includes all other time varying unobservable shocks to innovation commercialization.

3.5. Descriptive Statistics and Multicollinearity

A table 2 provides the summary statistics for the main variables used including mean, standard deviations and percentiles. The patterns of the basic descriptive statistics show that average corruption level in the countries in our sample is 2.931 with a 31.7% variation. While our explained variable has more fluctuations among different countries with a 185.1% variation. Table 3.2 explains the pairwise correlation and variance inflation factor (VIF) to check multicollinearity among the variables used in our study. The correlation parts of the table shows that there is negative significant correlation exists between exports of high-tech products and corruption. Furthermore, the values of VIF indicates that our data has no issue of multicollinearity at all because the VIF values ranges from 1.045 for population density to 1.702 for urbanization. A rule of thumb suggested by Sheather and Simon (2009), the cut-off point for measuring the magnitude of multicollinearity through VIF is 5 i.e if VIF (β_i) > 5, then the multicollinearity is high. So based upon this threshold standard, we can conclude there is no issue of multicollinearity in our data.

Table 2: Summary Statistics for the Main Variables Used In Our Study

Variables	N	Mean	St. Dev.	p25	Median	p75
High-Tech Exports	2145	8.010	1.851	6.760	7.950	9.470
Corruption	2145	2.931	0.317	2.931	2.931	2.931
Cost of Intellectual Property	2145	2.826	0.253	2.670	2.870	3.060
Cost of Business Startups	2145	37.991	62.818	4.900	13.900	38.900
Population Growth	2145	1.389	1.659	0.390	1.180	2.170
Population Density	2145	4.285	1.506	3.510	4.410	5.180
Urbanization	2145	3.995	0.468	3.750	4.120	4.350
Job Creation	2145	8.998	6.200	4.820	7.600	11.220
Economic Openness	2145	-4.584	14.207	-12.520	-3.740	2.690
IP Use Payments	2145	18.472	3.166	16.050	18.740	21.390
IP Use Receipts	2145	17.400	3.954	14.460	17.610	21.380
Primary Enrollment rate	2145	2.788	0.087	2.779	2.815	2.839
Secondary Enrollment rate	2145	2.551	0.323	2.371	2.699	2.784
Child Mortality rate	2145	1.668	0.651	1.103	1.678	2.207

Note: This table presents the summary statistics for the main variables used in our study. Mean, median, standard deviations, 25th and 75th percentiles statistics have been provided in this table.

Table 3: Variance Inflation Factor (VIF) and Pairwise Correlation to check Multicollinearity

		VIF and Pairwise Correlation								
Variables	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) LnHT_Exp	-	1.000								
(2) Corp	1.121	-0.015*	1.000							
(3) CIP	1.352	0.407*	0.109*	1.000						
(4) CBS	1.573	-0.469*	-0.296*	-0.319*	1.000					
(5) PG	1.159	-0.352*	-0.081*	-0.072*	0.269*	1.000				
(6) lnPD	1.045	0.114*	-0.004	0.072*	-0.075*	0.024	1.000			
(7) LnUrb	1.702	0.455*	0.086*	0.457*	-0.482*	-0.138*	-0.060*	1.000		
(8) JC	1.162	-0.200*	-0.012	-0.039	-0.046*	-0.169*	-0.120*	0.056*	1.000	
(9) EO	1.517	0.406*	-0.020	0.354*	-0.265*	0.139*	0.017	0.425*	-0.281*	1.000

Note: This table presents the pairwise correlation and variance inflation factor (VIF) to check Multicollinearity among the variables. Variance Inflation Factor (VIF) statistics has been given in VIF column. Remaining columns 1 to 9 presents the results of pairwise correlation statistics of the variables. Here, * shows significance at the .05 level.

4. Empirical Analysis

Here, we have estimated the proposed relationship by using different regression techniques.

4.1. Effect of Corruption on Commercialization of Innovation (log High-Tech Exports)

In table 4, we have used pooled OLS regression, fixed effect regression and regression by using Probit, Logit and Tobit for measuring the impact of corruption on commercialization of innovation. The negative significant impact of corruption is found across all estimates with -185.7% coefficient in logit estimates being the highest. The results are similar to the directions that we have found in the literature.

4.2. Regression Estimates across Regions, Income Disparities and Religions

In table 5, the estimates for the impact of corruption on exports of high-tech products (HT_Exp) across geographical regions has been observed and we have found that corruption effect negatively and significantly the exports of high-tech products across all regions of the world. However in Middle East and North American (MENA) region corruption effect the most at -65.8%.

In table 6, the impact of corruption on commercialization of innovation across income level classifications of the countries has been analyzed. We have found that the impact of corruption on exports of high-tech products (HT_Exp) across income level classifications of the countries is negative significant. Specifically, the effect is most in high income countries at -65.8%.

In table 7, the impact of corruption on innovation commercialization across religious affiliation classifications of the countries has been measured and negative significant impact of corruption on innovation commercialization irrespective of the religious affiliations has been found with a -65.1% being the most in Catholic countries.

Table 4: Effect of Corruption on Commercialization of Innovation (log High-Tech Exports)

	(1)	(2)	(3)	(4)	(5)
	Pooled_OLS	Fixed	Probit	Tobit	Logit
VARIABLES	LnHT_Exp	LnHT_Exp	PHTExp	LnHT_Exp	PHTExp
Corp	-0.647***	-0.649***	-1.082***	-0.690***	-1.857***
	(0.115)	(0.096)	(0.157)	(0.112)	(0.296)
CIP	1.178***	1.163***	1.364***	1.839***	2.442***
	(0.138)	(0.131)	(0.178)	(0.153)	(0.323)
CBS	-0.007***	-0.007***	-0.014***	-0.008***	-0.025***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)
PG	-0.366***	-0.368***	-0.389***	-0.375***	-0.751***
	(0.024)	(0.019)	(0.027)	(0.021)	(0.057)
lnPD	0.092***	0.090***	0.104***	0.096***	0.206***
	(0.021)	(0.019)	(0.025)	(0.021)	(0.045)
LnUrb	0.647***	0.629***	0.909***	0.697***	1.595***
	(0.073)	(0.080)	(0.116)	(0.090)	(0.212)
JC	-0.061***	-0.060***	-0.037***	-0.045***	-0.068***
	(0.005)	(0.005)	(0.006)	(0.005)	(0.011)
EO	0.026***	0.027***	0.024***	0.027***	0.047***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.006)
Constant	5.042***	5.162***	-3.564***	3.004***	-6.509***
Constant	5.042***	5.162***	-3.564***	1.289***	(1.348)
	(0.615)	(0.516)	(0.726)	(0.587)	
	(0.615)	(0.516)	(0.726)	(0.031)	
Observations	2,145	2,145	2,145	2,145	2,145
R-squared	0.495	0.494			
Number of Years		15			

Notes: This table presents estimates for the impact of corruption on commercialization of innovation. Columns 1 represents Pooled_OLS estimates, followed by fixed effects estimates, probit estimates, tobit estimates and logit estimates in columns 2 – 5. In columns 1, 2 and 4, logarithms have been taken for exports of high-tech products, while in column 3 and 5, high-tech exports in binary values have been used. A number of control variables have also been used in the models. R-squared values has been reported. Further, robust standard errors values have been reported in parentheses. Here, *, ** and *** represent that the results are statistically significant at the 10%, 5% and 1%.

Table 5: Regression Analysis for the Impact of Corruption on Commercialization of Innovation (Exports of High-Tech Products) across Regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	EAP	ECA	LAC	MENA	NorthA	SA	SSA
VARIABLES	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp
Corp	-0.657***	-0.579***	-0.488***	-0.658***	-0.620***	-0.644***	-0.647***
	(0.118)	(0.112)	(0.110)	(0.116)	(0.115)	(0.114)	(0.115)
CIP	1.230***	1.099***	1.021***	1.168***	1.037***	1.158***	1.178***
	(0.139)	(0.140)	(0.136)	(0.138)	(0.137)	(0.137)	(0.138)
CBS	-0.007***	-0.006***	-0.006***	-0.007***	-0.007***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PG	-0.353***	-0.318***	-0.372***	-0.319***	-0.366***	-0.365***	-0.366***
	(0.023)	(0.026)	(0.023)	(0.026)	(0.024)	(0.024)	(0.025)
lnPD	0.073***	0.098***	0.070***	0.104***	0.116***	0.085***	0.091***
	(0.022)	(0.021)	(0.022)	(0.021)	(0.021)	(0.022)	(0.021)
LnUrb	0.670***	0.596***	0.813***	0.742***	0.633***	0.698***	0.642***
	(0.073)	(0.073)	(0.071)	(0.077)	(0.073)	(0.078)	(0.080)
JC	-0.056***	-0.062***	-0.065***	-0.058***	-0.058***	-0.061***	-0.061***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
EO	0.024***	0.027***	0.024***	0.026***	0.028***	0.026***	0.026***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	4.746***	5.029***	4.623***	4.633***	5.260***	4.886***	5.061***
	(0.609)	(0.610)	(0.581)	(0.634)	(0.616)	(0.623)	(0.637)
Observations	2,145	2,145	2,145	2,145	2,145	2,145	2,145
R-squared	0.507	0.502	0.525	0.500	0.508	0.496	0.495

Notes: This table presents pooled regression estimates for the impact of corruption on commercialization of innovation across geographical regions of the world presented in columns 1 – 7. A number of control variables have been used in the analysis. R-squared values has been reported. Further, robust standard errors values have been reported in parentheses. Here, *, ** and *** represent that the results are statistically significant at the 10%, 5% and 1%.

Table 6: Regression Analysis for the Impact of Corruption on Commercialization of Innovation (Exports of High-Tech Products) across Income Level Classifications

	(1)	(2)	(3)	(4)
	Hi	Li	Lmi	Umi
VARIABLES	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp
Corp	-0.658***	-0.633***	-0.665***	-0.641***
	(0.116)	(0.114)	(0.116)	(0.113)
CIP	1.196***	1.190***	1.155***	1.135***
	(0.139)	(0.139)	(0.138)	(0.140)
CBS	-0.007***	-0.007***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)
PG	-0.367***	-0.375***	-0.368***	-0.371***
	(0.024)	(0.025)	(0.024)	(0.024)
lnPD	0.093***	0.093***	0.088***	0.086***
	(0.021)	(0.021)	(0.021)	(0.022)
LnUrb	0.678***	0.705***	0.667***	0.649***
	(0.076)	(0.078)	(0.074)	(0.074)
JC	-0.062***	-0.061***	-0.061***	-0.060***
	(0.005)	(0.005)	(0.005)	(0.005)
EO	0.027***	0.027***	0.027***	0.027***
	(0.003)	(0.003)	(0.003)	(0.003)
Constant	4.936***	4.728***	5.070***	5.193***
	(0.625)	(0.624)	(0.616)	(0.625)
Observations	2,145	2,145	2,145	2,145
R-squared	0.495	0.496	0.496	0.496

Notes: This table presents pooled regression estimates for the impact of corruption on commercialization of innovation across income level classifications of the countries presented in columns 1 – 4. A number of control variables have also been used in the analysis. R-squared values has been reported. Further, robust standard errors values have been reported in parentheses. Here, *, ** and *** represent that the results are statistically significant at the 10%, 5% and 1%.

Table 7: Regression Analysis for the Impact of Corruption on Commercialization of Innovation (Exports of High-Tech Products) across Religions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Muslims	Christian	Catholic	Orthodox	Jewish	Hinduism	Buddhist	Others
VARIABLES	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp	LnHT_Exp
Corp	-0.642***	-0.629***	-0.651***	-0.649***	-0.645***	-0.630***	-0.611***	-0.578***
	(0.115)	(0.115)	(0.115)	(0.115)	(0.115)	(0.116)	(0.115)	(0.110)
CIP	1.204***	1.179***	1.191***	1.173***	1.171***	1.167***	1.046***	1.309***
	(0.137)	(0.138)	(0.137)	(0.138)	(0.138)	(0.138)	(0.137)	(0.131)
CBS	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
PG	-0.379***	-0.368***	-0.360***	-0.370***	-0.368***	-0.370***	-0.350***	-0.379***
	(0.026)	(0.024)	(0.024)	(0.025)	(0.024)	(0.024)	(0.023)	(0.024)
lnPD	0.090***	0.095***	0.090***	0.091***	0.087***	0.088***	0.064***	0.071***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.022)	(0.021)	(0.022)	(0.020)
LnUrb	0.644***	0.674***	0.611***	0.647***	0.628***	0.626***	0.735***	0.628***
	(0.073)	(0.075)	(0.075)	(0.073)	(0.074)	(0.072)	(0.074)	(0.073)
JC	-0.062***	-0.062***	-0.061***	-0.061***	-0.061***	-0.062***	-0.056***	-0.060***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
EO	0.026***	0.027***	0.026***	0.026***	0.026***	0.026***	0.025***	0.025***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	4.967***	4.847***	5.101***	5.078***	5.149***	5.142***	4.957***	4.762***
	(0.613)	(0.615)	(0.621)	(0.618)	(0.617)	(0.617)	(0.607)	(0.591)
Observations	2,145	2,145	2,145	2,145	2,145	2,145	2,145	2,145
R-squared	0.495	0.497	0.496	0.495	0.497	0.497	0.505	0.513

Notes: This table presents pooled regression estimates for the impact of corruption on innovation commercialization across religious affiliation classifications of the countries presented in columns 1 – 8. A number of control variables have also been used in the analysis. R-squared values has been reported. Further, robust standard errors values have been reported in parentheses. Here, *, ** and *** represent that the results are statistically significant at the 10%, 5% and 1%.

Table 8: Effects of level of corruption on log of exports of high-tech products (LnHT_Exp)

		Panel A: Within Estimates		
VARIABLES	(1)	(2)	(3)	(4)
Corp	-0.234***	-0.237***	-0.228***	-0.213***
	(0.060)	(0.060)	(0.060)	(0.060)
LnHT_ExpL1	0.775***	0.717***	0.718***	0.717***
	(0.012)	(0.022)	(0.022)	(0.022)
LnHT_ExpL2		0.067***	0.080***	0.077***
		(0.021)	(0.027)	(0.027)
LnHT_ExpL3			0.026	0.029
			(0.027)	(0.027)
LnHT_ExpL4			-0.045**	-0.047*
			(0.021)	(0.027)
Long term effect of Corp	0.047	0.053	0.048	0.053
	(0.070)	(0.070)	(0.070)	(0.069)
Effect of Corp after 15 years	-0.138**	-0.139**	-0.136**	-0.145**
	(0.069)	(0.069)	(0.069)	(0.069)
Constant	1.377***	1.301***	1.326***	1.395***
	(0.340)	(0.340)	(0.341)	(0.341)
Observations	2,130	2,130	2,130	2,130
R-squared	0.831	0.832	0.832	0.833
No of Countries	142	142	142	142
		Panel B: Arellano and Bond Estimates		
VARIABLES	(1)	(2)	(3)	(4)
Corp	-0.169***	-0.164**	-0.155***	-0.141***
	(0.103)	(0.101)	(0.098)	(0.091)
LnHT_ExpL1	0.787***	0.727***	0.728***	0.725***
	(0.026)	(0.031)	(0.031)	(0.029)
LnHT_ExpL2		0.067***	0.083***	0.082***
		(0.024)	(0.029)	(0.028)
LnHT_ExpL3			0.016	0.019
			(0.029)	(0.029)
LnHT_ExpL4			-0.034*	-0.042
			(0.019)	(0.032)
Long term effect of Corp	0.059	0.057	0.054	0.051
	(0.066)	(0.067)	(0.063)	(0.057)
Effect of Corp after 15 years	-0.120	-0.129*	-0.121	-0.122
	(0.076)	(0.076)	(0.075)	(0.077)
Constant	0.944*	0.931*	0.890*	0.993*
	(0.513)	(0.522)	(0.514)	(0.508)
Observations	2,130	2,130	2,130	2,130
No of Countries	142	142	142	142
		Panel C: 2SLS Estimates		
VARIABLES	(1)	(2)	(3)	(4)
Corp	-2.613***	-2.648***	-2.742***	-2.946***
	(0.918)	(0.921)	(0.953)	(0.987)
LnHT_ExpL1	0.721***	0.663***	0.659***	0.659***
	(0.025)	(0.036)	(0.037)	(0.037)
LnHT_ExpL2		0.067**	0.050	0.045
		(0.028)	(0.037)	(0.038)
LnHT_ExpL3			0.013	0.007
			(0.036)	(0.038)
LnHT_ExpL4			0.009	-0.038
			(0.034)	(0.037)
Long term effect of Corp	1.052***	1.071***	1.112***	1.189***
	(0.401)	(0.403)	(0.417)	(0.425)
Effect of Corp after 15 years	-0.631***	-0.639***	-0.658***	-0.688***
	(0.212)	(0.213)	(0.220)	(0.220)
Constant	7.043***	7.038***	7.239***	7.617***
	(2.250)	(2.255)	(2.306)	(2.320)
Observations	2,130	2,130	2,130	2,130
R-squared		0.695	0.685	0.662
No of Countries	142			

Note: This table presents the estimates for the effect of corruption on log of exports of high-tech products. The table is divided into 3 sections. Section A presents the results by using within estimator, followed by Arellano and Bond's GMM estimator in section B and 2SLS estimator in section C. In all specifications we control for a full set of country and year fixed effects. R squared values has been reported at the bottom of each part and the models include a full set of control variables. Standard error robust against heteroskesdasticity and serial correlation at the country level are in parenthesis. Here, *, ** and *** represent that the results are statistically significant at the 10%, 5% and 1%.

5. Specification Tests

In this section, we provide specification estimates of our dynamic panel model. We have imposed the following assumption here:

Assumption 1 (sequential exogeneity): For Level of Corruption

The first assumption for our dynamic panel regression model is sequential exogeneity. Empirically we can say that:

$E(\varepsilon_{it} \mid \ln(HT\_Exp)_{it-1}, \ldots\ldots, Corp_{it}, \ldots\ldots, Corp_{it0}, \alpha_i, \delta_t) = 0$

This is the standard assumption in order to deal with dynamic panel models. It implies that level of corruption (Corp) and the past exports of high-tech products are orthogonal to contemporaneous and future error term, and that the error term ε_{it} is serially uncorrelated. This assumption effectively requires sufficiently many lags of exports of high-tech products to be included in equation (2) both to eliminate residual serial correlation in the error term of this equation and to remove the level of corruption (Corp) dip in the exports of high-tech products.

5.1. Effects of level of corruption on log of exports of high-tech products (LnHT_Exp)

Under assumption 1, we have estimated equation (2) in table 5.1. The table is divided into three parts. Part A explains the results of this estimation controlling for different number of lags on our base sample. The first column of part A controls for a single lag of exports of high-tech products (HT_Exp) on the right hand side. The pattern found common with all the results presented in the analysis. There is a sizeable amount of persistence in exports of high-tech exports, with a coefficients on lagged ln (HT_exp) of 0.775 with a standard error of 0.012. The corruption variable is estimated significant and negative with a coefficient of -0.234 with a standard error of 0.060. These parameters estimates show that in a year the exports of high-tech products decrease by 23.4% due to increase in level of corruption. The level of corruption has same effects in the long run too. Column 2 and 3 of part A explains the estimates by adding second lag and all four lags of exports of high-tech products respectively which is our preferred specification in the model given in column 1. In column 4 of part A, we adds 4 more lags with a total of 8 lags of exports of high-tech products. Overall similar pattern in the effect of dynamic first and second lags of exports of high-tech products consistent of the column 2 is found. However, the impact of corruption on exports of high-tech products is slightly improved by 9% but highly significant.

Part B explains GMM estimates developed by Arellano and Bond (1991) which deals with the possible Nickell bias proposed by Nickell (1981) and produce consistent estimates for the finite *T*. The moment conditions for the sequential exogeneity implies as follows:

$E[(\varepsilon_{it} - \varepsilon_{it-1})(\ln(HT\_Exp)_{is}, Corp_{is+1})`] = 0$ for all $s \leq t - 2$

The GMM estimates are almost similar to our within estimates in part A of the table with a slight improvement as compared to within estimates. The dynamics of exports of high-tech products in the first lag has been strengthened in all models. The number of moment conditions is the order of T^2 is one potential shortcoming of using Arellano and Bond's GMM estimator. It tells us that by increasing in T, we have a problem of having "too many instruments" in our model, which leads to an asymptotic bias of order 1/N as explained by Alvarez and Arellano (2003). For that we have used two stage least square (2SLS) estimator as proposed by Angrist and Krueger (2001) reported in part C. We have more declined and significant results here as compared to within estimates and Arellano and Bond's estimates. However, these results are consistent in direction with the previous model results that we found in part A and part B. In the rest of the specification results we focus by having four lags of exports of high-tech products to be our benchmark. As we have noted and found that by having four lags and consistent with assumption 1, there is no further serial correlation found in the residuals.

Table 9: Further lags of exports of high-tech products uncorrelated with Corruption

Dependent Variable:	Contemporary Corruption Level				
HT_Exp lags included:	3 lags	6 lags	9 lags	12 lags	15 lags
	(1)	(2)	(3)	(4)	(5)
LnHT_ExpL1	0.000	0.000	0.000	0.000	0.000
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
LnHT_ExpL2	0.000	0.000	0.000	0.000	0.000
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
LnHT_ExpL3	-0.004	-0.003	-0.003	-0.003	-0.003
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
LnHT_ExpL4		-0.001	-0.001	-0.001	-0.001
		(0.004)	(0.004)	(0.004)	(0.004)
Constant	3.774***	3.772***	3.770***	3.786***	3.794***
	(0.239)	(0.240)	(0.240)	(0.241)	(0.241)
Observations	2,142	2,139	2,136	2,133	2,130
R-squared	0.009	0.009	0.009	0.011	0.013
Number of Countries	143	143	143	143	142

Notes: This table presents the estimates of a model with level of corruption as a dependent variables and lags of exports of high-tech products (HT_Exp) as explanatory variables. The no. of lags included are indicated in the top rows. All the models include a full set of country and year fixed effects. Standard error robust against heteroskesdasticity and serial correlation at the country level are in parenthesis. Here, *, ** and *** represent that the results are statistically significant at the 10%, 5% and 1%.

5.2. Causality Checks

For reverse causality issue in our model, we have checked it with two ways. Firstly, we used a model by having corruption level as dependent variables and in explanatory variable we have taken lags of exports of high-tech products (HT_Exp). Table 9 explains that further lags of HT_Exp do not have any significant explanatory power to effect the corruption level in the country at all. Secondly, for predicted residuals that we got from equation (2) estimation are given in table 5.2.2. We have found that the estimated ε_{it} values are uncorrelated with lags of corruption level in the country. These results are actually required by assumption 1 we have for our model. These results bolster our confidence that our dynamic panel model for measuring the impact of level of corruption on exports of high-tech products with four lags adequately captures exports of high-tech products dynamics.

Table 10: Corruption Uncorrelated with future Commercialization of Innovation (HT_Exp) Shocks

Dependent Variable:	Estimated Shock to High-Tech Exports at *t*				
	(1)	(2)	(3)	(4)	(5)
CorpL1	-0.107				0.146
	(0.112)				(0.237)
CorpL2		-0.157			-0.042
		(0.108)			(0.275)
CorpL3			-0.192		0.000
			(0.104)		(0.245)
CorpL4				-0.237	-0.305
				(0.103)	(0.185)
Constant	0.334	0.493	0.595	0.736	0.620
	(0.605)	(0.595)	(0.591)	(0.592)	(0.620)
Observations	2,144	2,143	2,142	2,141	2,141
R-squared	0.001	0.001	0.002	0.003	0.003

Notes: This table presents the estimates of lagged of level of corruption on the estimated residual. The model includes a full set of control variables. Standard error robust against heteroskesdasticity and serial correlation at the country level are in parenthesis. Here, *, ** and *** represent that the results are statistically significant at the 10%, 5% and 1%.

5.3. Robustness

As robustness checks in our model, we have used different methods. First of all we have add different covariates composed of regional, income level and religious dummies in our base model. Secondly we use dynamics of level of corruption, and lastly we have removed the effect of outliers to estimate the model for the effect of corruption on exports of high-tech products. Following is the detailed explanation of each method we have used:

5.3.1. Adding Covariates

Table 11 presents the estimates for the effect of level of corruption on log of exports of high-tech products by adding covariates. To save the space, we have only reported coefficient estimates of corruption, lag of high-tech exports and cost intellectual property use in the table. Columns 1 presents our baseline estimates to be used as benchmark for our comparisons later by adding different covariates. The covariates control for the geographical regional effects for the possible external shocks that drive the exports of high-tech products and the corruption have been reported in column 2. There are two reasons for using this specification. Firstly, the geographical classifications control for potentially country-varying effects of baseline differences across different regions of the countries. Secondly, it is used to exploit only the within groups differences of those countries initially having similar exports of high-tech products in our sample. These regional controls have relatively a little effect on our baseline estimates like in case of within estimates the coefficient of corruption are -0.151 with standard errors 0.055. The coefficient for regional geographies has been improved a bit -0.124 with a consistent standard error. The covariates control for the differential financial effects for the possible external shocks that drive the exports of high-tech products and corruption are reported in column 3. The reason for using this specification is that it is used to control the within groups financial differences of those countries having different income levels in our sample. These financial controls have relatively a little effect on our baseline estimates. For example in case of Arellano and Bond's GMM estimates the coefficient of corruption -0.080 with standard errors 0.103 respectively which is a bit lower as compared to our baseline estimates. The covariates control for the differential religious affiliation effects for the possible external shocks has been reported in column 4. The reason for using this specification is that it is used to control the within groups religious and spiritual affiliations of those countries having different religions in our sample. These religious controls have relatively a little effect as compared to our baseline estimates. For example in case of 2SLS estimates the coefficients of corruption have been improved to -1.891 from -1.607 with standard errors 0.630 and 0.558 respectively as compared to our baseline estimates. In case of within estimates and Arellano and Bond's GMM estimates we can observe the similar kinds of trend.

6. Conclusion and Policy Recommendations

This is an inter-disciplinary study with primary focus on how institutional quality (corruption level) affects the commercialization of innovation measured via exports of high-tech products. Using panel data from 143 countries around the world from 2001 to 2015, divided into 7 regional, 4 income level and 8 religious classifications, it has been observed that there is necessary causal relationship exists between institutional quality and commercialization of innovation. However, in detailed regression analysis using GMM and 2SLS estimates and by having dynamics of innovation commercialization and corruption with fixed effects, it has been further clarified that corruption do effect commercialization of innovation. However, in Middle East and North American (MENA) region corruption effect most at -65.8%, while it is least effective in upper middle income countries. While having religious affiliations shocks, we have also found that the impact has been most in Catholic countries which is -65.1%. This study contributed in forming the inter-regional trade policies among countries as it provides reasonably strong empirical as well as theoretical evidences for the policy makers while making and reshaping their inter-regional economic policies. This study opens up new debates for policy makers about how the countries trade globally by keeping in mind about the regional, income disparities, and the religious aspects to upgrade their short term and long term innovation commercialization strategies. Apart from the exports of high-tech products, other demand and supply side contributors of innovation commercialization are also important to account for. While improving the research and development aspects, the policy makers must also have to plan strategically for improving these channels, which may help in improving the institutional quality in the country, including investment in improving the grass root literacy levels, flexible facilities for entrepreneurial incubators, and optimal utilization of population growth with urbanization measures in the country.

Table 11: Effects of Corruption on log of exports of high-tech products (LnHT_Exp) adding Covariates

		Panel A: Within Estimates		
VARIABLES		Regional dummies	Financial dummies	Religious dummies
	(1)	(2)	(3)	(4)
Corp	-0.151***	-0.124**	-0.163***	-0.115**
	(0.055)	(0.055)	(0.055)	(0.055)
HT Exports lag	0.743***	0.720***	0.741***	0.725***
	(0.012)	(0.013)	(0.012)	(0.013)
Cost of intellectual property use	0.076***	0.067***	0.078***	0.078***
	(0.008)	(0.008)	(0.009)	(0.008)
Constant	1.296***	1.193***	1.242***	1.114***
	(0.300)	(0.306)	(0.320)	(0.306)
Observations	2,141	2,141	2,141	2,141
R-squared	0.838	0.842	0.838	0.842
No of Countries	143	143	143	143
		Panel B: Arellano and Bond's Estimates		
VARIABLES		Regional dummies	Financial dummies	Religious dummies
	(1)	(2)	(3)	(4)
Corp	-0.073**	-0.027*	-0.080*	-0.046*
	(0.098)	(0.117)	(0.103)	(0.103)
HT Exports lag	0.759***	0.733***	0.758***	0.743***
	(0.031)	(0.032)	(0.032)	(0.033)
Cost of intellectual property use	0.082***	0.070***	0.081***	0.084***
	(0.023)	(0.025)	(0.022)	(0.024)
Constant	1.011**	0.995*	0.836*	1.068*
	(0.509)	(0.591)	(0.557)	(0.550)
Observations	2,141	2,141	2,141	2,141
No of Countries	143	143	143	143
		Panel C: 2SLS Estimates		
VARIABLES		Regional dummies	Financial dummies	Religious dummies
	(1)	(2)	(3)	(4)
Corp	-1.891***	-0.804*	-0.541	-1.607***
	(0.630)	(0.484)	(0.603)	(0.558)
HT Exports lag	0.710***	0.707***	0.728***	0.704***
	(0.018)	(0.014)	(0.016)	(0.016)
Cost of intellectual property use	0.042**	0.057***	0.075***	0.048***
	(0.017)	(0.013)	(0.014)	(0.016)
Constant	6.284***	3.036**	2.294	5.436***
	(1.849)	(1.378)	(1.738)	(1.665)
Observations	2,141	2,141	2,141	2,141
No of Countries	143	143	143	143

Note: This table is divided into 3 sections. Section A presents the results by using within estimator, followed by Arellano and Bond's GMM estimator in section B and 2SLS estimator in section C. In all models, we control for a full set of country and year fixed effects. Additionally we control for the covariates specified in each column label and describe in the text. R squared values has been reported at the bottom of each part and the models include a full set of control variables. Standard error robust against heteroskesdasticity and serial correlation at the country level are in parenthesis. Here, *, ** and *** represent that the results are statistically significant at the 10%, 5% and 1%.

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