Can domestic institutions affect exports and innovation?

Mediation effects of institutional quality on manufacturing sector exports and innovation in developing countries

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Abstract: Studies show that when exports go up, innovation goes up as well. But what is the mediating effect of domestic institutions in the association between exports and innovation? If any, which institutions are more likely to improve exports and innovation in developing countries, and how? To address this lacuna, this study employs estimations of industry fixed effects for 22 two-digit manufacturing industries in the period from 1996 to 2018. The first estimation includes 57 developing countries, and the second estimation excludes extreme outliers or unusual countries from the sample. The study finds that poor-quality institutions cause negative effects in the relationship between manufacturing sector exports and innovation in developing countries. Among the five institutional quality groups considered, the strongest negative effects can be observed for legal institutions (legal environment) in developing countries.

Key words: innovation, mediating effect, domestic institutions, industry fixed effects, manufacturing industries, poor-quality institutions, legal institutions

JEL classification: F14, E02, O32

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1   Introduction

In the early 1990s most countries implemented huge tariff cuts on their imported goods. This led exporters in developing countries to make advances such as having better participation in international markets and greater opportunities for international collaboration and innovation. In turn it is interesting to note how inconsistently some developing regions perform relative to the others[1]. Exporters in Africa, Latin America, and South Asia, in particular, have suffered from corrupt and abusive practices of politically connected firms, while the authoritarian governments for example in East Asia provide their exporters with more opportunities to accumulate industry know-how and rapid business upgrading. However, developed countries still have far better innovation outcomes associated with creative destruction, democracy, and economic growth.

On that front a large and growing body of literature has revealed critical factors that determine sound export performance, innovation, and better growth intentions regardless of a country's development status. Most of the factors identified, however, are necessary although there are not sufficient conditions for innovation and export performance in developing countries. What is missing is the quality of institutions. Such institutions can be defined as the rules, boundaries, and policies that are used for the purpose of coordinating the legal, political, economic, and social behaviour of people towards specific goals.

These institutions vary greatly depending on a country's attitude towards development. There has been some discussion about the relationship between the quality of institutions and its impact on exports, but most of the discussion does not investigate its link to innovation, which can drive better outcomes in developing countries. Although there are empirical studies on the institution–exports–growth nexus, most are limited in how they measure and model institutional impacts on exports and innovation related variables. On that front this paper presents an updated and more methodical way to assess which domestic institutions mediate the relationship between exports and innovation in developing countries, and how.

Looking at this issue more closely and using a panel data model of industry fixed effects, this paper offers an empirical approach to investigate thoroughly the potential mediating effects of five different groups of institutions[2] in the relationship between exports and innovation. My sample includes 57 export-generating developing countries for the period 1996–2018. I consider 22 manufacturing industries as the manufacturing sector is still considered to be the engine of economic growth which is important for countries at early stages of their development. A Hausman test is used to verify the suitability of fixed effects or random effects in the empirical specification. The results may reflect endogeneity due to reverse causality.[3] To respond to the potential problem of reverse causality, I use industry's dependence on institutions[4] as the weighting

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[1] See Figures 3 to 10 in Appendix E.

[2] See Appendix C.

[3] Frankel and Romer (1999) provide a better way to treat reverse causality by constructing an instrument for trade based on an argument that closer countries trade more. The same strategy is employed in this paper by extending Frankel and Romer (1999) by adding institution (interaction) into the model and estimating the model using country–industry–year data instead of country–year data.

[4] See Appendix D.

variable, based on the average score of the top five developing countries in the property rights index.

However, I observe some outlier countries, which mostly occur when developing economies behave differently in terms of socio-political and demographic circumstances. Figure 2 shows the upper and lower extremes of the dataset. Based on that, I consider China, Singapore, and Zimbabwe as outliers and they therefore had to be excluded from the second empirical estimation.[5]

I find that not having high-quality legal institutions (legal environment and property rights), a good network of political institutions (political stability), and better-quality economic institutions (investment and production facilitation) limit the ability of developing countries to be more connected to competitive global markets and have truly innovative exports.

The results indicate that total manufacturing sector exports have positive effects on innovation in developing countries. However, manufacturing sector goods exports (merchandise exports) have weakly negative or insignificant effects on innovation. Imports of services and the human capital index show positive and significant signs on innovation. The Hausman test statistics are significant at the 1 per cent level for both cases, which suggests using fixed effects models.

The rest of the paper is set out as follows. Section 2 presents the conceptual framework. Section 3 describes the specification of the empirical model, estimation methods, and data used in the study. Section 4 presents the main results. Section 5 concludes. Finally, Section 6 discusses the main results, policy recommendations, and some avenues for future research.

2   Conceptual framework

As can be seen from Figure 1, this study defines four main types of institutions: legal, political, economic, and social institutions. These four types of institutions relate to each other in different ways: (i) the legal framework leads to changes in political stability, which leads to (ii) changes in the process of governing and its effects on economic institutions, and, in turn (iii) political, legal, and economic institutions influence and are affected by socio-cultural outcomes. All these institutions can have profound effects on exports and innovation.

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[5] Table 3 presents the results excluding outliers.

Figure 1: The channels through which institutions mediate the effects on exports and innovation
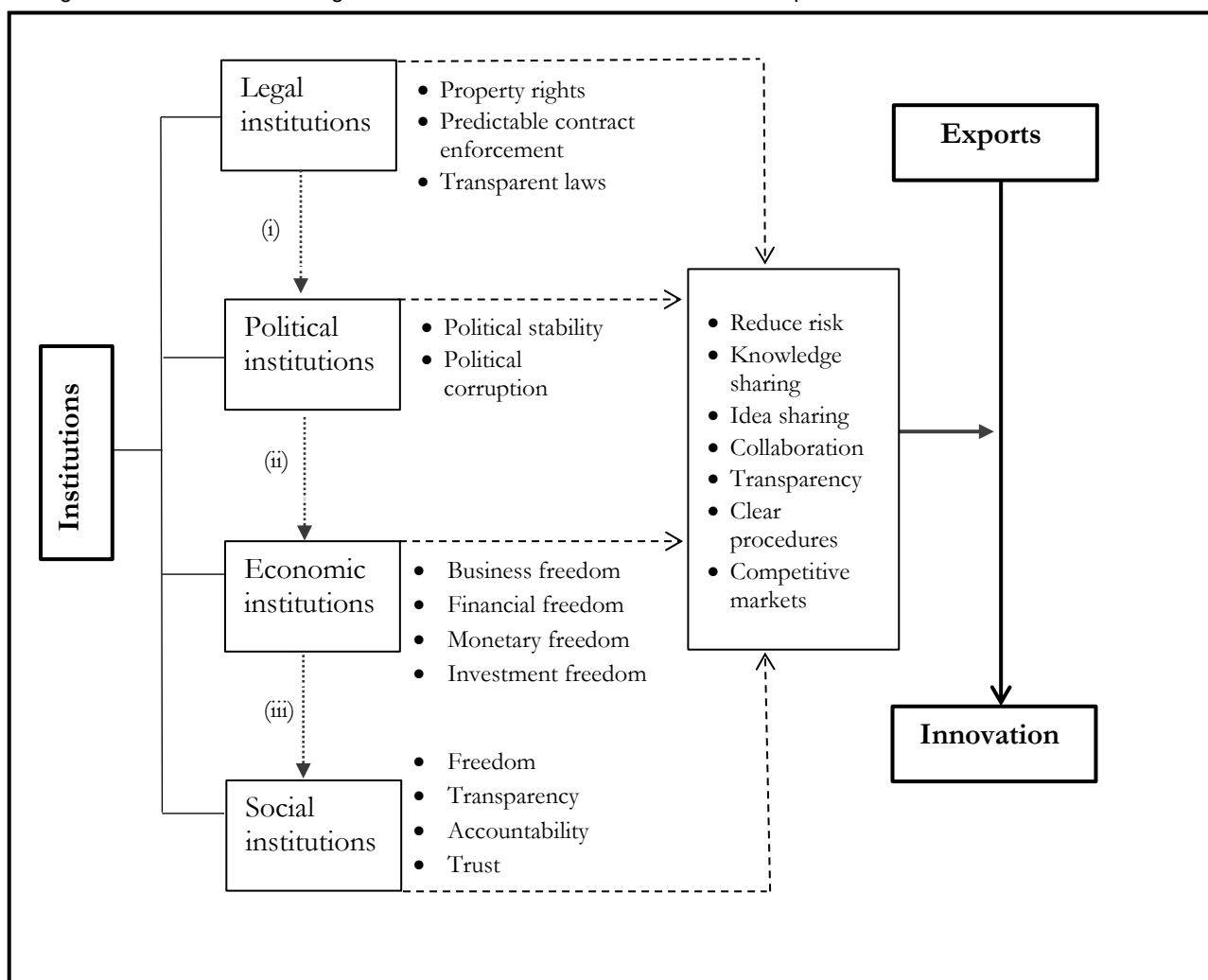
Legal institutions can have different effects on political institutions, as in link (i), depending on the nature and quality of the judicial and legislative entitlements, transparency of the electoral outcomes, and good governance measures. According to North (1990) the level of enforcement will vary enormously according to the efficiency and transparency of political institutions.

However, when considering developing countries, the normal rules, laws, and judiciary are unproductive in the absence of enforcement mechanisms. Consequently, developing-country exporters face difficulties associated with the inefficient separation of legal institutions from political context factors. In most developed countries strong and formal sanctions for breaking rules are common, but it is not yet clear whether these sanctions exist for all types of export-related institutions in most of the developing countries. In this context it is essential for developing countries to develop tight and credible sanctions for any kind of rule breaking. Rodrik (1999) argues:

> This possibility [groups are less likely to cooperate when it is difficult to coordinate on a 'fair' distribution of resources] is most salient when the society's institutions of conflict management are weak – when the rule of law does not prevent an opportunistic grab for resources, for example, or when civil and political liberties

are too fragile to protect the interests of minorities, the disenfranchised, and those without political connections. Rodrik (1999: 393)

In this context, legal institutions determine the nature and distribution of power in politics and impact governmental innovation, networks, conflict resolution, and economic growth (Acemoglu et al. 2005; Alexander et al. 2011). However, in most developing countries, politically connected firms are likely to break rules, which has a negative impact on a country's export competitiveness and innovation outcomes.

Link (ii) considers the reciprocal role of political and legal institutions influencing and being affected by economic institutions. The case of Italy's dual economy—wealthy north and poor south—demonstrates how different informal institutions regarding corruption and the cultural acceptance of democracy affect regional economic growth (Putnam 1993). Similarly, the classic example is post-1950s Korea where separation made South Korea rich and North Korea poor. In a similar vein Acemoglu and Robinson (2008, 2012), using various country case studies, introduced two interrelated concepts—economic institutions and political institutions—into the mainstream of economic policy debate. To illustrate the importance of institutions, they compare the growth rates between countries that are similar in many respects including their institutions. Correspondingly, to win elections, some political parties take decisions to secure future victories at the expense of long-term economic growth. This is exactly why political leadership and economic growth are directly linked. Flachaire et al. (2014) argue, however, that politically led institutions are the crucial factor for economic growth. This is elaborated by Acemoglu and Robinson (2012):

> ...the rapid industrialization of South Korea under General Park is an example. Park came to power via a military coup in 1961, but he did so in a society heavily supported by the United States and with an economy where economic institutions were essentially inclusive. Though Park's regime was authoritarian, it felt secure enough to promote economic growth. Acemoglu and Robinson (2012: 93)

China's export-led innovation is described as being the result of its governmental influences towards liberalizing ownership structures, contract enforcement, and improved legal framework (Sheng and Yang 2016).

In Figure 1, point (iii) shows how informal and social institutions are influenced by legal, political, and economic institutions. Unlike formal rules, social institutions are mainly associated with informal institutions. Informal institutions are usually associated with unwritten laws which represent the generally accepted ways of doing things and include the ethics, norms, culture, and traditions which shape the behaviour of individuals (Berman 2013). These include maintaining confidence, acceptance, allowing leeway in certain circumstances, recognizing non-contractual efforts, honesty, and reputation. All these institutions help developing countries to facilitate informal procedures related to innovative export markets in many ways. For example, reduced risks associated with export processing, knowledge, and idea sharing improve collaboration; transparency and clear procedures establish trust; and better-quality legal, political, economic, and social institutions create competitive export markets, which lead to innovation and contribute to faster growth rates.

Viewed in this light, legal, political, economic, and social institutions are extremely important in expanding a country's horizon towards export diversification, innovation, and product expertise. In the view of the empirical growth literature, countries with higher growth rates have a long history of being governed with strong institutional structures to facilitate significant knowledge

creation and innovations. Therefore, creating a sound institutional environment would be an important step forward in reducing obstacles to any developing country's economic development (Yildirim and Gökalp 2016). Innovation is essential for achieving better, faster, and sustainable growth rates and is an important criterion for a country's export competitiveness. Webster (1999) explains the different channels for innovation sources such as education, training, ideas, expertise, and research and development. From this perspective developing-country governments can facilitate export competitiveness and innovation through increased investment in education, human capital formation, and improved global knowledge and idea sharing by making people more open to new experiences and opportunities outside the boundaries of their countries. A good example of this is how Bangladesh learned about the garment industry from South Korea. When countries are more open to international trade, they learn from competitive international markets and are more likely to be innovative (Palangkaraya et al. 2017). Diversity is important for enhancing export competitiveness and innovation in developing countries because export volumes depend on how institutions affect specific production and distribution processes, while primary product exporters in developing countries may be subject to declining terms of trade in the long run if supply outstrips demand (Donaldson 2015; Singer 1950). Giving consideration to improving institutional quality is an important crucial step for competitive exports, increased innovation, and the resilience of economies that currently rely on primary product exports.

3   Empirical framework and data

3.1   Specification of empirical model

The econometric specification of this paper differs from the previous empirical models in three major aspects. First, I attempt to expand the depth of data coverage by integrating data from multiple sources and types. For example some previous studies on innovation specifically dealt only with patent data from the United States Patent and Trademark Office (USPTO). Unlike those studies this paper sources total patent application data from both the USPTO and the European Patent Office (EPO) as a way to increase country coverage. Also, most of the previous research on institutional quality has been conducted using data only from Worldwide Governance Indicators. However, I employ institutional quality data from three main sources: the Worldwide Governance Indicators, Heritage Foundation Freedom House Indicators, and Variables of Democracy data. Second, most of the previous research has limitations such as only including country-level panel data or cross-sectional data (see De Groot et al. 2004). This paper employs 22 two-digit manufacturing sector data over 22 years of observations for 57 developing countries.

The panel data model is specified as:

$$\ln (inov_{ijt)} = \beta_0 + \mu_t + \alpha_j + \delta_{it}$$
$$+ \beta_1 \ln (totx_{ijt}) \times \ln (inst_{it}) \times weight_j + \beta_2 \ln (totx_{ijt})$$
$$+ \beta_3 \ln (inst_{it}) + \beta_4 \ln (xgoods_{ijt}) + \beta_5 \ln (mservices_{it})$$
$$+ \beta_6 \ln (hc_{it}) + \varepsilon_{ijt}$$

where i is 57 developing countries, j is industry,[6] t denotes time, μ_t denotes time-specific fixed effects, α_j denotes industry fixed effects, and cross-country year variation is controlled by the fixed

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[6] The list of 22 two-digit manufacturing industries is provided in Appendix B.

effects δ_{it}. inov_{ijt} is total patent applications of country i of industry j at time t. totx_{ijt} is total exports from country i to country j for industry j at time t. inst_{it} is institutional quality of country i at time t. $weight_j$ is the weighted percentage of industry's dependence on institutions. xgoods_{ijt} is exports of goods by country i of industry j of time t. mservices_{it} is imports of services into country i at time t. hc_{it} is the human capital index in country i.

3.2 Estimation methods

The most typical problem with the ordinary least squares method involves finding adequate ways to address the heterogeneous issue of time and space involved in the panel data analysis. Hence, I develop several techniques to deal with this problem. These include capturing time-specific variations, industry-specific variations, and cross-country year variations in the econometric model to control for potential unobservable effects. Further, to recognize the differences between fixed effects and random effects models, I employ Hausmann test (HT) statistics.

3.3 Data

Dependent variable

The dependent variable total number of patent applications (inov_{ijt}) of country i of industry j at time t is sourced from PATSTAT Global via OECD data. PATSTAT Global is a rich source of data for gaining up-to-date empirical insights about a country's innovation. I use patents from PATSTAT Global to measure the innovation level of manufacturing industries.[7] However, in OECD data, indicators of patent families are presented according to the classes of the International Patent Classification (IPC class up to four characters) and for selected technology domains. Thus the IPC is not compatible with the International Standard of Industry Classification (ISIC). To accurately match as many classes as possible, this paper employs the IPC four-digit to ISIC Rev.3 two-digit concordance of UC Davis Patent & Trademark Concordance.[8] This concordance helps to convert IPCs into ISICs based on probabilistic counts. As one IPC may belong to different ISICs, I multiply the total patent applications of each IPC by probability weights. The multiplied values are then totalled by each of the 22 two-digit manufacturing industries by country and over year.

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[7] In this paper PATSTAT Global, Spring 2021 total patent applications data has been sourced from the OECD patent data from the OECD's Directorate for Science, Technology and Industry. I use the total of patent applications to the EPO and applications to the USPTO.

[8] UC Davis concordance uses a text-mining approach called algorithmic links with probabilities (ALP) to construct probabilistic concordances between patents, trade, and industrial classification systems (see Lybbert and Zolas 2014).

Interaction variable

For the empirical model the mediating effect of institutional quality is estimated in the following form:

$$\beta_1 \ln(totx_{ijt}) \times \ln(inst_{it}) \times weight_j$$

where $totx_{ijt}$ denotes the total of exports of country i for industry j during time t. $inst_{it}$ denotes institutional quality of country i at time t. $weight_j$ is the industry's dependence on institutions weighted to the top five developing countries in the property rights index.[9] $totx_{ijt}$ is sourced from UN Comtrade data via World Integrated Trade Solutions (WITS). $inst_{it}$ denotes 12 different institutional quality indicators sourced from World Bank Worldwide Governance Indicators, Heritage Foundation Freedom House Indicators, and Variables of Democracy (V-Dem) data. These indicators are then sub-grouped into five main groups of institutions.[10] The complete list of institutional quality indicators is given in Appendix C. $weight_j$ is sourced from the World Bank Enterprise Survey data.

For each of the five institutional quality groups, I identify specific variables to represent an industry's dependence on institutions. The list of industry dependences on institution variables is given in Appendix D. I derive the interaction variable based on the weighted average of industry's dependence on institutions ($weight_k$ as the measure of proximity in the model) following a similar method to that in Frankel and Romer (1999)[11] and Rajan and Zingales(1998).[12] The estimation approach is based on countries' institutional characteristics along with their export levels. Thus institutions and exports are potentially correlated with other determinants of innovation, such as modification of export structures or changes in the domestic and international context. As the vast literature on exports shows, there are many channels through which exports can affect innovation. These are, notably, specialization, exploitation of increasing returns from larger markets, exchange of ideas through communication and travel, and spread of technology through investment and exposure to new goods. On the other hand, exporting firms are influenced by within-country characteristics. For example countries with good transport systems, or with government policies that promote competition and reliance on markets to allocate resources, are likely to have more competitive exporting firms given their institutional characteristics and a high level of innovation given their exports.

Control variables[13]

The control variable $xgoods_{ijt}$ is exports of goods by country i of industry j of time t. I include exports of goods to understand the effects of merchandise exports such as raw materials and manufactured goods on innovation in developing countries. The data was sourced from the UN Comtrade database and the dataset was according to industries of HS 2002 classification. I employ

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[9] The top five countries in the property rights index are Chile, Israel, Jordan, Malaysia, and Uruguay.

[10] See Appendix C.

[11] Frankel and Romer (1999) construct an interaction variable for the argument that closer countries trade more as their geographical position is exogenously given.

[12] Rajan and Zingales (1998) use a measure of dependence on external finance using an industry's dependence on external funds proxying to large firms in the United States.

[13] See Figures 11 to 13 in Appendix E.

the WITS HS 2002 to ISIC Rev.3 two-digit concordance. mservices_{it} is imports of services in country i at time t, which is also sourced from UN Comtrade, and the aggregate values of the extended balance of payments (EBOPS) are used. hci_{it} is the human capital index and is sourced from Penn World Tables.

4   Results

First, Table 1 reports the summary statistics which provide a preliminary overview of the key variables.

Table 1: Summary statistics

Variable (1)	Observations (2)	Minimum (3)	Maximum (4)
Dependent variable			
Total patent applications (innov_{ijt})	47,550	0	28926.72
Institutional quality variables[14] (**insti_{it}**)			
Legal environment	34,684	5.91	44.78
Property rights	22,977	0.61	50.40
Corruption control	19,750	19.45	96.51
Political stability	18,538	-36.11	22.4211
Investment and production	23,437	10.00	90.275
Voice, freedom, and accountability	19,044	7.53	73.5106
Other variables			
Total exports of manufacturing industries (totx_{ijt})	13,792	0.00	5E+08
Exports of goods of manufacturing industries (xgoods_{ijt})	18,806	56.00	1.20e+10
Imports of services—total of EBOPS (mservices_{it})	18,354	1.60E+07	5.20E+11
Human capital index (hc_{it})	18,653	1.35963	4.15445

Note: this table presents summary statistics of the main variables used in the empirical estimation. The variables are listed in column (1), number of observations in column (2), minimum values in column (3), and maximum values in column (4). Total patent applications are in numbers. Institutional quality variables and human capital index are in percentage values. Total exports of manufacturing industries, total exports of goods in manufacturing industries, and imports of services data are in US$ millions. Sources of variables are explained in Section 3.

Source: author's calculations.

Second, the modelling and empirical estimation are presented in Table 2 to support the arguments defined by theory and the empirical literature.

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[14] The list of institutional quality variables and sub indicators is given in Appendix C.

Table 2: Results: all countries between 1996 and 2018[15] (industry fixed effects)

Dependent variable: $innov_{ijt}$	Institutional quality indicator[16]					
	Legal institutions	Property rights	Control of corruption	Political stability	Investment and production	Voice, freedom, accountability
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(totx_{ijt}) \times \ln(inst_{it}) \times weight_j$	-0.004***	-0.002***	-0.000001	-0.002***	-0.004***	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$inst_{it}$	3.62***	2.96***	0.49***	1.52***	6.69***	2.52***
	(0.56)	(0.41)	(0.16)	(0.37)	(0.88)	(0.34)
$totx_{ijt}$	1.13***	1.02***	0.37***	0.62***	2.62***	0.93***
	(0.13)	(0.08)	(0.02)	(0.08)	(0.25)	(0.08)
$xgoods_{ijt}$	-0.15***	-0.14	-0.12	-0.14	-0.16	-0.09
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
$mservices_{it}$	0.81***	0.80***	0.82***	0.83***	0.77***	0.87***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
hc_{it}	0.31**	0.32**	0.44***	-0.04	0.39***	0.28*
	(0.15)	(0.14)	(0.15)	(0.15)	(0.14)	(0.14)
R squared	0.57	0.58	0.57	0.57	0.58	0.57
Hausman test	55.56***	64.77***	78.26***	36.60***	167.98***	74.35***
No. of observations	4,487	4,487	4,487	4,470	4,698	4,487

Note: this table presents the empirical results of the industry fixed effects model discussed in Section 3.1. The equation in Section 3.1 is in log-linear form to transform the variables into the same unit and base. The variables of interest in this paper are described in Section 3. Robust standard errors are in parentheses. Significance levels: *10 per cent; ** 5 per cent; *** 1 per cent.
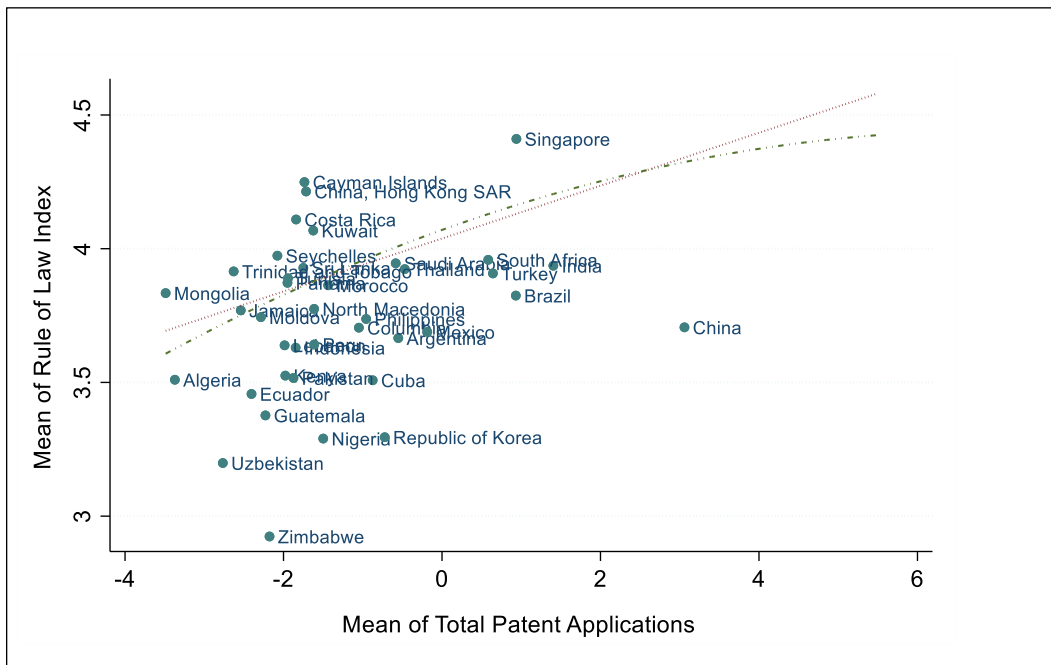
Source: author's calculations.

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[15] The list of countries included in the estimation can be found in Appendix A and the list of industries in the sample estimation is presented in Appendix B.

[16] See Appendix C for the list of institutional quality indicators belonging to each group of main institutions. Columns (1) to (6) show the results for the main institutional quality groups: column (1) legal environment, column (2) property rights, column (3) corruption control, column (4) political stability, column (5) investment and production, and column (6) voice, freedom, and transparency related institutions.

From Table 2 it is evident that the mediating effects of five institutional quality groups on the relationship between manufacturing sector exports and innovation $(\ln(totx_{ijt}) \times \ln(inst_{it}) \times weight_j)$ have negative effects in developing countries. It is notable that all the effects are significant at the 1 per cent level except for control of corruption (column 3). On the whole, the coefficients for legal environment, investment and production related institutions, political stability, and property rights are higher compared to corruption control and voice, freedom, and accountability related institutions. However, all institutional quality variables alone show positive effects on innovation. The model's findings indicate that manufacturing sector exports, imports of services, and the human capital index have positive significant effects on innovation, while exports of manufacturing goods do not have positive effects on innovation in developing countries. The HT results provide convincing evidence of the appropriateness of the fixed effect estimators.

Among the fast-growing developing countries and fragile state economies, different attitudes to production facilitation may generate outlier countries as innovation activities vary across regions. These outlier countries can be seen in Figure 2.

Figure 2: Outlier countries: rule of law index and total patent applications

Note: among the East Asian countries, China and Singapore are outlier nations, while Zimbabwe is characterized by low rule of law, high dispersion and low skewness of innovation. See Appendix A for the list of all countries.

Source: author's calculations.

In the next step I address the effects when outlier countries are excluded (see Table 3).

Table 3: Results: all countries except outliers[17] between 1996 and 2018[18] (industry fixed effects)

Dependent variable: $innov_{ijt}$	Institutional quality indicator[19]					
	Legal institutions	Property rights	Control of corruption	Political stability	Investment and production	Voice, freedom, accountability
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(totx_{ijt}) \times \ln(inst_{it}) \times weight_j$	-0.002***	-0.0001	-0.001***	-0.003***	-0.005***	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$inst_{it}$	3.45***	0.97*	0.25	1.81***	9.74***	-0.51
	(0.75)	(0.58)	(0.19)	(0.41)	(0.86)	(0.40)
$totx_{ijt}$	0.93***	0.38***	0.34***	0.69***	3.48***	-0.11
	(0.19)	(0.14)	(0.03)	(0.09)	(0.26)	(0.10)
$xgoods_{ijt}$	-0.21***	-0.18***	-0.17***	-0.20***	-0.23***	-0.12***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
$mservices_{it}$	0.76***	0.80***	0.79***	0.77***	0.76***	0.85***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
hc_{it}	0.58**	0.73***	0.64***	0.03	0.35**	0.70***
	(0.16)	(0.16)	(0.15)	(0.15)	(0.14)	(0.14)
R squared	0.50	0.50	0.50	0.50	0.51	0.51
Hausman test	91.22***	60.31***	41.02***	28.57***	44.59***	3.82***
No. of observations	4,015	4,015	4,015	3,998	4,226	4,015

Note: this table presents the empirical results of the industry fixed effects model discussed in Section 3.1. The equation in Section 3.1 is in log-linear form to transform the variables into the same unit and base. The variables of interest in this paper are described in Section 3. Robust standard errors are in parentheses. Significance levels: *10 per cent; ** 5 per cent; *** 1 per cent.

Source: author's calculations.

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[17] The list of countries included in the estimation can be found in Appendix A. Note that Table 3 excludes outlier countries: China, Singapore, and Zimbabwe.

[18] The list of industries in the sample estimation is presented in Appendix B.

[19] See Appendix C for the list of institutional quality indicators belonging to each group of main institutions. Columns (1) to (6) shows the results for main institutional quality groups: column (1) legal environment, column (2) property rights, column (3) corruption control, column (4) political stability, column (5) investment and production, and column (6) voice, freedom, and transparency related institutions.

This study tests the effects on exports and innovation of each institutional quality variable alone and as an interaction variable. The effects of five institutional quality groups on manufacturing sector exports and innovation for all countries except outliers are presented in Table 3. Thus the mediating effects of the interaction variable show strong negative and significant effects compared to the all-country sample (presented in Table 2) except for property rights institutions. Initially, institutional quality variables alone create positive significant effects on innovation in developing countries except outliers. Similarly, manufacturing sector exports, imports of services, and human capital index have positive significant effects on innovation, while exports of manufacturing goods do not have positive effects on innovation in developing countries. Table 3 further indicates the HT results of both estimations. The HT results favour the fixed effects specification.

5   Conclusion

Recent empirical studies on institutions have tried to explore the institutional effects on exports using different types of institutional quality variables. However, it is worth mentioning that studies on institutions and their effects on both exports and innovation still remain inadequately studied. For this increasingly prevalent but inadequately studied scenario, the current paper empirically measures the mediating effects of five different institutional quality groups[20] on the relationship between exports and innovation using two main empirical estimations. The first estimation includes all the countries in the sample[21] and the second estimation excludes the three outlier countries of China, Singapore, and Zimbabwe. I employ a HT to choose between random effects and fixed effects estimations. In this paper I report only the fixed effects model preferred by the HT. The results of the first model (Table 2) suggest that the mediating effects of the interaction variable have negative and significant effects. Specifically, legal environment, political stability, investment and production related institutions, and property rights matter the most. The second estimation results (see Table 3) indicate much stronger effects on exports and innovation compared to the all-country sample. In both estimations manufacturing sector total exports, imports of services, and human capital index can improve export flows and innovation in developing countries. But manufacturing sector export goods have negative or insignificant effects on exports and innovation. Consistent with the first estimation, HTs for the second estimations are significant at the 1 per cent level.

6   Discussion and policy recommendations

I conclude with three recommendations for establishing more effective institutions to address the challenges which exporting firms face in investing in innovation.

In many developing countries, the legal systems are generally inconsistent and politically influenced. If this continues, fragile economies in developing countries will suffer and start to collapse in the very near future. My first recommendation is therefore to establish the credibility of the legal enforcement in developing countries. Clearly, in this context, enforceable contracts, secured property rights, and judicial independence will be needed to end rampant (political) corruption and to establish the rule of law. Developing-country governments can achieve

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[20] See Appendix C.

[21] See Appendix A for the list of countries in estimation 1.

credibility and transparency by continuously and publicly providing accurate information about their activities, initiatives, and money in politics.

The second recommendation is therefore to underpin democracy and good governance practices. In other words, broken democracies and corrupt governments will not mature until they embrace very principled practices. However, developing countries still seek to promote democracy and their exporting firms continue to interfere with politics.

Perhaps developing countries need highly trained, globally competent new leaders. How interesting it would be if developing countries placed greater emphasis on allowing a proper internationally supervised transition to facilitate the rise of new political leaders. If they did so, such leaders would lead their countries towards structural changes to succeed in the competitive global economy.

Finally, due to inadequate capacity, ineffective mechanisms and weak monitoring systems, many developing countries do not have reliable official data sources. Official statistics in developing countries do not always show what is really happening. This establishes a foundation for future research on this topic both by involving more countries and by digging deeper into the causes of differences.

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Appendix A: List of countries

The list of countries includes Algeria, Argentina, Brazil, Cayman Islands, Chile, China, Hong Kong SAR, Chinese Taipei, Costa Rica, Cuba, Democratic People's Republic of Korea, Ecuador, Egypt, Guatemala, India, Indonesia, Iran, Israel, Jamaica, Jordan, Kenya, Kuwait, Lebanon, Malaysia, Mexico, Moldova, Mongolia, Morocco, Nigeria, North Macedonia, Pakistan, Panama, Peru, Philippines, Republic of Korea, Saudi Arabia, Seychelles, Singapore, South Africa, Sri Lanka, Thailand, Trinidad and Tobago, Tunisia, Turkey, United Arab Emirates, Uruguay, Uzbekistan, Venezuela, Zimbabwe, Columbia, Armenia, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Russia, and Ukraine.

Appendix B: List of manufacturing industries (as categorized in ISIC Rev.3)

The list of manufacturing industries includes food and beverages, tobacco products, textiles, wearing apparel, leather, leather products and footwear, wood products (excl. furniture), paper and paper products, printing and publishing, coke, refined petroleum products, nuclear fuel, chemicals and chemical products, rubber and plastics products, non-metallic mineral products, basic metals, fabricated metal products, machinery and equipment n.e.c., office, accounting and computing machinery, electrical machinery and apparatus, radio, television and communication equipment, medical, precision and optical instruments, motor vehicles, trailers, semi-trailers, other transport equipment, furniture, manufacturing n.e.c., and recycling.

Appendix C: Institutional quality indicators

Legal institutions include laws with predictable enforcement from Variables of Democracy data and rule of law index of the Worldwide Governance Indicators. Political corruption is sourced from Variables of Democracy data. Property rights indicators are derived from property rights index of Heritage Foundation Freedom House Indicators and property rights of men and property rights of women indicators of Variables of Democracy data. Indicators for control of corruption are derived from Worldwide Governance Indicators. Political stability variable includes institutionalized autocracy, institutionalized democracy, domestic autonomy, and political stability from Worldwide Governance Indicators and Variables of Democracy data. Investment and production variable includes business freedom, monetary freedom, financial freedom, and investment freedom sourced from Heritage Foundation Freedom House Indicators. Voice, freedom, and accountability variable includes voice and accountability and freedom of expression data from Worldwide Governance Indicators and Variables of Democracy data.

Appendix D: Industry dependence on institution variables

Legal environment:

Percentage of firms choosing crime, theft, and disorder as their biggest obstacle

Percentage of firms choosing courts as their biggest obstacle

Political stability:

Percentage of firms choosing political instability as their biggest obstacle

Control of corruption:

Percentage of firms choosing corruption as their biggest obstacle

Investment and production:

Percentage of firms expected to give gifts to get a construction permit

Percentage of firms choosing business licensing and permits as their biggest obstacle

Voice, freedom, and accountability:

Percentage of firms choosing informal sector practices as their biggest obstacle

Appendix E: Additional tables and descriptive figures

Figure 3: South Asia
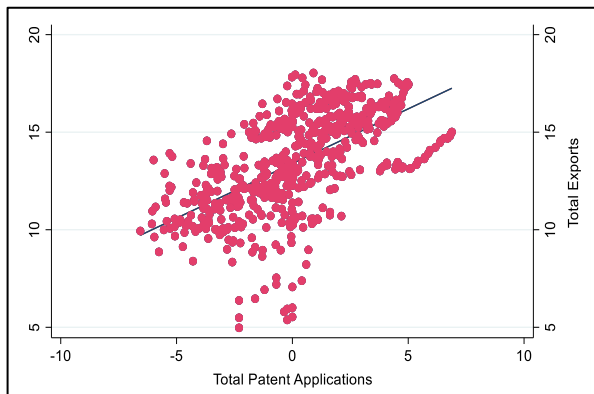
Note: total exports and total patent applications are in logarithms. This graph shows the correlation between total exports and total patent applications in South Asia.

Source: author's compilation based on UN Comtrade data via WITS data and OECD patent data (total patent applications to the United States Patent and Trademark Office and total patent applications to European Patent Office).
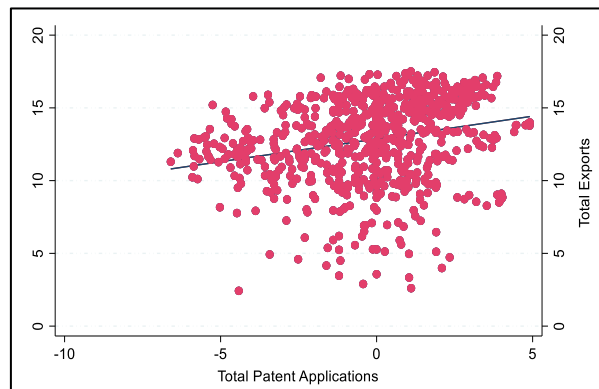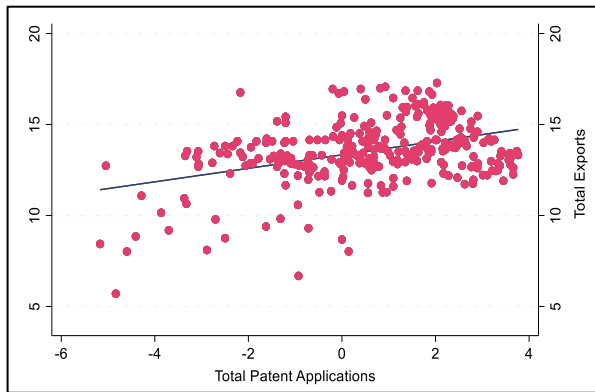
Figure 4: East Asia
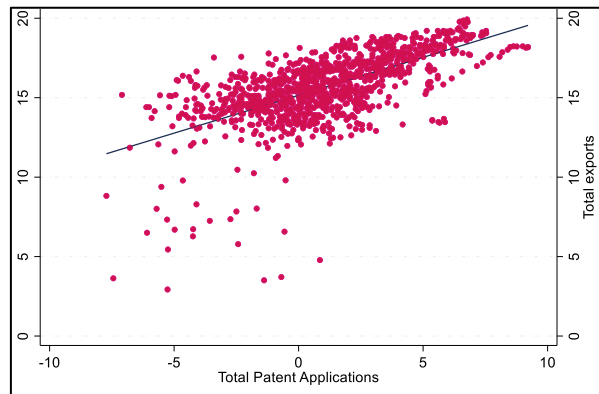
Note: total exports and total patent applications are in logarithms. This graph shows the correlation between total exports and total patent applications in East Asia.

Source: author's compilation based on UN Comtrade data via WITS data and OECD patent data (total patent applications to the United States Patent and Trademark Office and total patent applications to European Patent Office).

Figure 5: Mexico and Central America
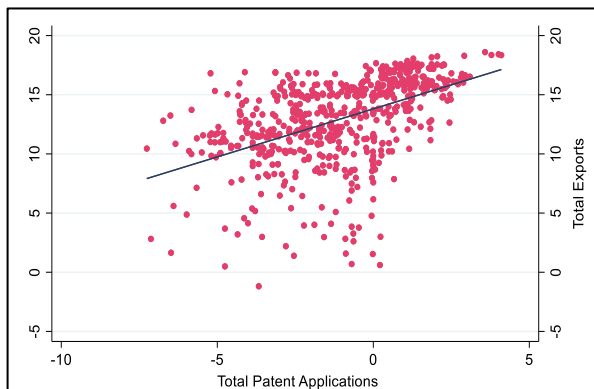
Note: total exports and total patent applications are in logarithms. This graph shows the correlation between total exports and total patent applications in Mexico and Central America.

Source: author's compilation based on UN Comtrade data via WITS data and OECD patent data (total patent applications to the United States Patent and Trademark Office and total patent applications to European Patent Office).

Figure 6: Western Asia

Note: total exports and total patent applications are in logarithms. This graph shows the correlation between total exports and total patent applications in Western Asia.

Source: author's compilation based on UN Comtrade data via WITS data and OECD patent data (total patent applications to the United States Patent and Trademark Office and total patent applications to European Patent Office).
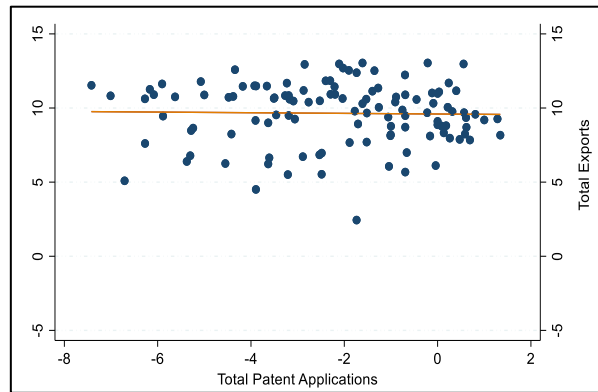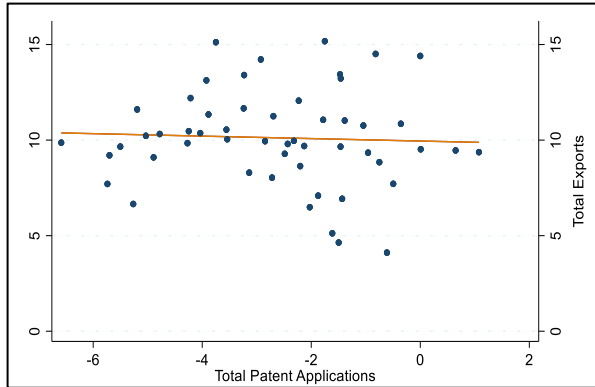
19

Figure 7: Southern Africa

Note: total exports and total patent applications are in logarithms. This graph shows the correlation between total exports and total patent applications in Southern Africa.

Source: author's compilation based on UN Comtrade data via WITS data and OECD patent data (total patent applications to the United States Patent and Trademark Office and total patent applications to European Patent Office).

Figure 8:North Africa

Note: total exports and total patent applications are in logarithms. This graph shows the correlation between total exports and total patent applications in North Africa.

Source: author's compilation based on UN Comtrade data via WITS data and OECD patent data (total patent applications to the United States Patent and Trademark Office and total patent applications to European Patent Office).
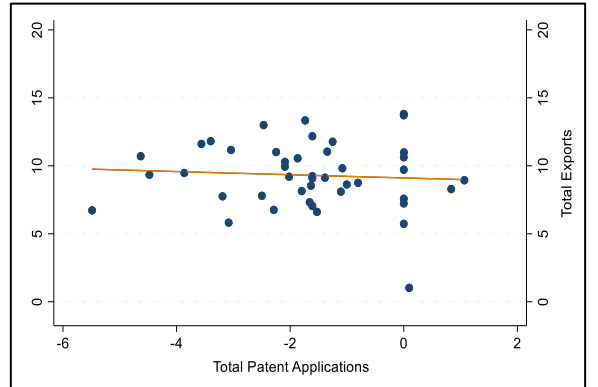
Figure 9: Latin America

Note: total exports and total patent applications are in logarithms. This graph shows the correlation between total exports and total patent applications in Latin America.

Source: author's compilation based on UN Comtrade data via WITS data and OECD patent data (total patent applications to the United States Patent and Trademark Office and total patent applications to European Patent Office).

Figure 10: Western Africa

Note: total exports and total patent applications are in logarithms. This graph shows the correlation between total exports and total patent applications in Western Africa.

Source: author's compilation based on UN Comtrade data via WITS data and OECD patent data (total patent applications to the United States Patent and Trademark Office and total patent applications to European Patent Office).
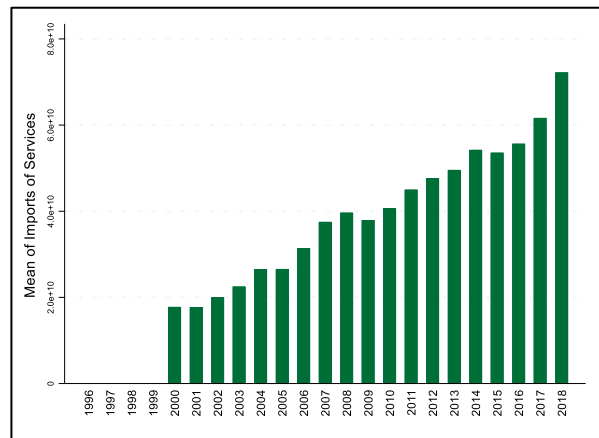
Control variables

Figure 11: Exports of goods
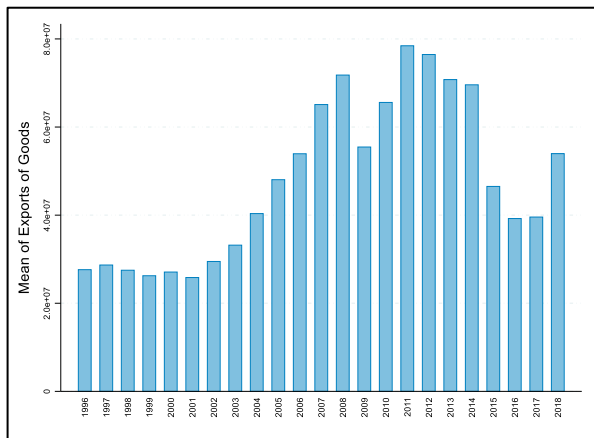
Note: This graph shows the mean of manufacturing sector exports by developing countries (listed in Appendix A). Values are in USD millions.

Source: author's compilation based on UN Comtrade data via WITS data.
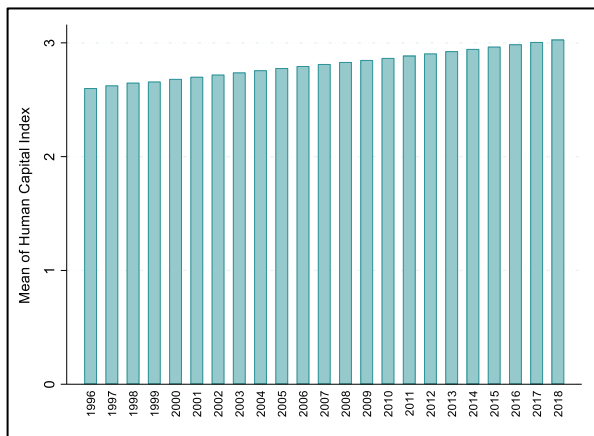
Figure 12: Imports of services

Note: The graph shows imports of services in developing countries (listed in Appendix A) for the period 1996–2018. Units are in total of extended balance of payments (EBOPS). Values are in USD millions.

Source: author's compilation based on UN Comtrade data.
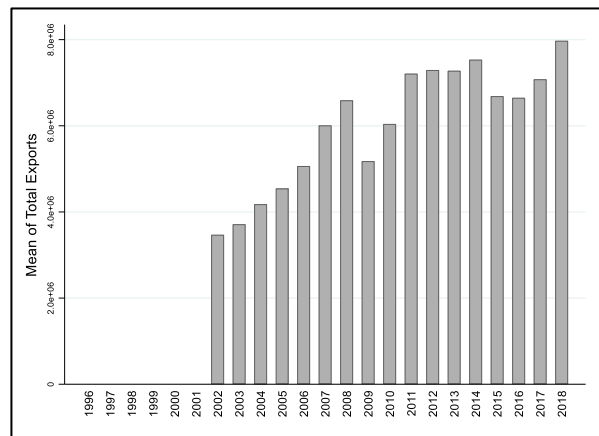
Figure 13: Human capital index

Note: This graph shows the human capital index for the countries listed in Appendix A for the period 1996–2018.

Source: author's compilation based on Human Capital Index of the World Bank via Penn World Tables

Figure 14: Total exports of manufacturing industries

Note: total exports and total patent applications are in logarithms. The graph shows manufacturing sector exports for the period 1996–2018. Values are in USD millions.

Source: author's compilation based on UN Comtrade data via WITS data.

21