American Journal of Economics and Business Innovation (AJEBI)

ISSN: 2831-5588 (ONLINE), 2832-4862 (PRINT)

VOLUME 5 ISSUE 2 (2026)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

American Journal of Economics and Business Innovation (AJEBI)

Volume 5 Issue 2, Year 2026
ISSN: 2831-5588 (Online), 2832-4862 (Print)
DOI: https://doi.org/10.54536/ajebi.v5i2.7949
https://journals.e-palli.com/home/index.php/ajebi

Governance Quality and Technology Innovation in Selected North American Countries

Chimezie Ebere Onyewuchi[1*], Sonny Nwonodi Amadi[1]

Article Information

Received: April 02, 2026

Accepted: June 07, 2026

Published: August 27, 2026

Keywords

Corruption Control North America, Governance Quality, Government Effectiveness, Patent Applications, Technology Innovation

ABSTRACT

This study examines the effect of governance quality on technological innovation, focusing on annual patent applications in North America (the United States, Canada, and Mexico). The governance quality was patterned after the World Bank World Governance Indicators (WGI), comprising the rule of law, government effectiveness, control of corruption and regulatory quality. Annual time-series data for each variable were obtained from the World Intellectual Property Organisation (WIPO) and the World Bank. The within-regression estimator and quasi-demeaning generalised least squares (GLS) were used to estimate the fixed- and random-effects models, respectively, while the Hausman test was used to select the appropriate model. The findings showed that the rule of law and government effectiveness significantly increased annual patent applications during the study period, indicating that stronger legislation and government commitment to technological innovation are critical for the growth of patent applications in Canada, Mexico, and the USA. At the same time, regulatory quality is significant in increasing technological innovation. This highlights the effectiveness of quality regulation in promoting patent applications. Additionally, the results show that controlling corruption significantly reduced annual patent applications in North American countries, implying that anti-corruption efforts might lower innovation spending and patent applications. Given the findings, this study recommends that governments should strengthen patent enforcement, ensure a transparent judicial process, and improve dispute-resolution mechanisms to boost innovators' confidence and encourage greater patent applications.

INTRODUCTION

North America, comprising the United States, Canada, and Mexico, is one of the world's advanced economies, with increasing technological innovation. Wang *et al.* (2021) argue that the region has undergone rapid technological transformation across information and communication technology (ICT), artificial intelligence, biotechnology, renewable energy, and digital finance. This has continued to shape the region's economic prosperity, consistent with Romer (1990), and Lucas (1988), who assert that technological innovation is an important enabler of economic growth and development. It is also widely acknowledged that firms' innovativeness in these economies is key to their competitiveness and sustainability in the global market. In particular, Al-Emran & Griffy-Brown (2023) and Al-Ramahi & Odeh (2020) contend that the broad adoption of technological innovations across various sectors and regions enhances productivity, strengthens industry competitiveness, and improves quality of life.

Technological innovation and dissemination are key drivers among the Sustainable Development Goals (SDGs) for promoting sustainable development worldwide (Al-Emran & Griffy-Brown, 2023). Incorporating technological goals within the SDGs highlights the crucial role of technology in addressing various developmental issues, linking technological diffusion directly to global sustainability initiatives (Elfaki & Ahmed, 2024). However, one critical factor shaping innovation in these economies is the quality of institutions. Odei (2026) defines formal governance quality as encompassing legal and regulatory frameworks, protection of property rights, the rule of law, and the effectiveness of government institutions. A robust formal institutional environment offers businesses stability and confidence, encouraging investment in innovation and related activities, protecting intellectual property rights, and managing the complexities of the business landscape (Wang *et al.*, 2019).

Furthermore, Barasa *et al.* (2017) state that institutions are the boundaries created by society's members that regulate political, economic, and social interactions. These institutions are mainly guided by formal and informal rules that govern the participation of various actors and economic agents, enabling them to achieve their goals (Carney, Dieleman & Taussig, 2016). The governance quality encompasses a range of factors, including legislation, individual rights, and the efficiency of government regulations and services. Additionally, the quality of governance influences how effectively governments can develop and execute policies that foster research and development, attract investments, and drive technological innovation. In economies with high governance quality, businesses and individuals are more inclined to participate in innovative efforts due to lower uncertainty, stronger legal frameworks, and easier access to public infrastructure and services.

Despite their geographical proximity and economic integration, countries in the North American region

[1] Department Of Economics, Rivers State University, Port Harcourt, Nigeria
[*] Corresponding author's e-mail: Christoezekwe@gmail.com

exhibit heterogeneous governance quality, institutional effectiveness, and innovation performance. While the United States and Canada consistently rank highly in global innovation and governance indicators, Mexico continues to face institutional and governance challenges that may influence the pace and effectiveness of technological development. This heterogeneity in governance quality and innovation has continued to attract the attention of policymakers and researchers. In this context, this study examines how governance quality contributes to technological innovation across selected North American countries, with a focus on the United States, Canada, and Mexico. The study is organised into five sections. Section 1 provides the introduction, while Section 2 embodies the literature review, including theoretical and empirical literature. Section 3 focuses on the methodology, while Sections 4 and 5 present the findings and discussion, respectively, and conclude the paper.

LITERATURE RIREVIEW

Theoretical Literature

Institutional theory highlights the importance of institutions such as property rights, the rule of law, and anti-corruption measures in shaping economic outcomes. North (1990) describes formal institutions as the political, economic, and legal rules that restrict individual and firm behaviour and promote effective social cooperation. Seyoum (2009) extend this postulation, stating that formal institutions include laws, regulations, and rules that underpin production, exchange, and distribution, as well as those governing property rights, competition, and contracts. The strength of these institutions significantly influences the overall business climate. Robust formal institutions create a conducive environment for firms to operate, invest, endure, and innovate successfully.

The quality of institutions can greatly influence product innovation and ripple through a country's economic growth and development. The ease of doing business and the regulatory framework in emerging markets affect innovation costs and obstacles (Rodríguez-Pose & Zhang, 2020). Similarly, Barasa *et al.* (2017) contend that simplifying regulatory procedures can reduce bureaucratic barriers and encourage companies to invest more in R&D and innovation. Thus, protecting property rights is crucial to fostering product innovation in emerging-market firms. When firms and individuals believe their intellectual property and investments are legally safeguarded, they are more likely to engage in R&D and pursue innovative projects (Dunyo & Odei, 2023). Therefore, institutional quality identifies good governance as integral to technological innovation, including patent applications.

Empirical Literature

There is extensive research on how quality governance influences innovation across both developing and developed economies and across economic blocs. Ibanez *et al.* (2024) used Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine how good governance affected innovation in the European Union (EU). The findings indicate that good governance, education, and indicators of gross domestic product have a positive effect on innovation across EU countries and supranational government-controlled institutions. The results further indicated that gross domestic product mediates the relationship between good governance and innovation, as well as between education and innovation. Naimoğlu, Şahin & Özbek (2025) analysed the factors influencing green growth in Türkiye between 1995 and 2022, focusing on institutional quality, corruption, trade openness, and innovation. The study employed the ARDL method using annual data. The findings suggest that good governance improves green growth, and effective governance structures support sustainable development. Conversely, corruption undermines green growth, underscoring the importance of anti-corruption efforts. Additionally, the study found that greater trade openness harms green growth, likely because increased trade drives higher production and fossil fuel use, which hampers sustainable development.

Odei (2026) explores how formal institutional quality affects product innovation, considering how policy instability and technological infrastructure can influence this relationship. The research examines 44 emerging markets in sub-Saharan Africa (SSA) from 2006 to 2022, using a two-way fixed-effects probit model. Findings show that strong institutional quality boosts product innovation; technological infrastructure can weaken this effect overall; both policy instability and technological infrastructure can strengthen the link between institutional quality and innovation; and policy instability enhances this relationship further, especially when technological infrastructure is in place. This study offers meaningful insights for policymakers and business leaders seeking to foster innovation in emerging markets.

Using data from 2010 to 2024 for all South Asian countries except Afghanistan, Chowdhury, Abdullah, and Quader (2025) examine the impact of institutional quality and technological innovation on entrepreneurship development in the South Asian region. Applying the two-step system generalised method of moments, the study finds that technological innovation, institutional quality, and economic growth have a positive and significant impact on entrepreneurship development, whereas foreign direct investment and financial development have a positive but insignificant impact. The study further finds that the interaction between institutional quality and technological innovation significantly influences entrepreneurship development. The study provides appropriate policy recommendations for the government, regulatory authorities, institutions, and other relevant stakeholders to strengthen the entrepreneurship ecosystem in South Asia in the future.

Zhang & Rodríguez-Pose (2024) examined how government reform, treated as an exogenous shock to regional institutions, affected the innovation performance of city-regions in China between 2009 and 2016. The study finds a positive and significant relationship between

enhanced institutional quality and innovation performance in Chinese city-regions, especially in those with medium- to high-level innovation.

This emphasises the important role of government institutions in fostering innovation throughout China and underscores regional differences in how government agency reforms are adopted, shaping the country's innovation landscape. Hussen & Çokgezen (2021) utilised data from the World Bank Enterprise Survey (WBES) involving firms from 19 African countries to investigate how regional institutional quality influences innovation. They compared three institutional factors: regulatory quality, rule of law, and corruption, to assess their impact on firm innovation. The findings indicate that institutional quality at the regional level significantly influences firms' innovation performance. In contrast, firm-specific factors such as age, ownership, and exporting activity showed no significant correlation with innovation. However, factors such as firm size, R&D spending, on-the-job training (OJT), and owners' ability to adopt new technologies were significantly associated with a firm's propensity to innovate. Using a Tobit panel-data regression model, Dal-Molin & Leggerini (2026) examined the role of institutional quality in fostering the twin transition across European regions. Twin transition innovation is measured by the share of patents that simultaneously address environmental sustainability and digital transformation. The findings indicate that higher institutional quality significantly increases the likelihood and intensity of twin transition patenting. In a related study, Koçak (2017) employed annual data from 1997-2014 to investigate the influence of institutional quality on innovation performance in developing countries. The results show that bureaucratic quality, government stability, democratic accountability, and law and order positively affect innovation performance. The study concludes that strengthening institutional structures in developing countries could significantly boost innovation and economic development.

Stylised Facts on annual patent applications per million people in North America

The stylised facts for annual patent applications are presented as a time series trend as:

The time-series trend in annual patent applications per million people across North American countries reveals notable differences in the levels and trajectories of technological innovation in Canada, the United States, and Mexico over the study period. The United States consistently had the highest number of annual patent applications, rising from around 640 per million in the early 2000s to about 800 by 2007. After a marginal decline in 2008–2009, patent applications continued to grow, reaching an all-time record high level of over 900 per million between 2013 and 2017. It gradually declined to about 800 in the early 2020s. Despite this fluctuation, the U.S. maintained a much higher level of innovation than Canada and Mexico, reflecting its strong technological capacity and extensive R&D investment. Canada is next to the U.S patent application rate, beginning at approximately 120 per million and gradually rising to 160–170 by 2005–2006. From the late 2000s, applications gradually declined to about 100–110 around 2016–2018. A slight recovery after 2019 stabilised just above 110 applications per million, suggesting a steady but lower innovation environment compared to the U.S. On the other hand, Mexico had the lowest patent application rate over the period, with applications increasing gradually from 2016 to 2018. Applications in Mexico were significantly lower than in Canada and the U.S. and declined slightly over time. This reflects lower levels of innovation, research, and patent activity. The trend clearly indicates an innovation gap among countries in the North American region, with the U.S. leading in patent applications, Canada remaining moderate, and Mexico's rates remaining low.

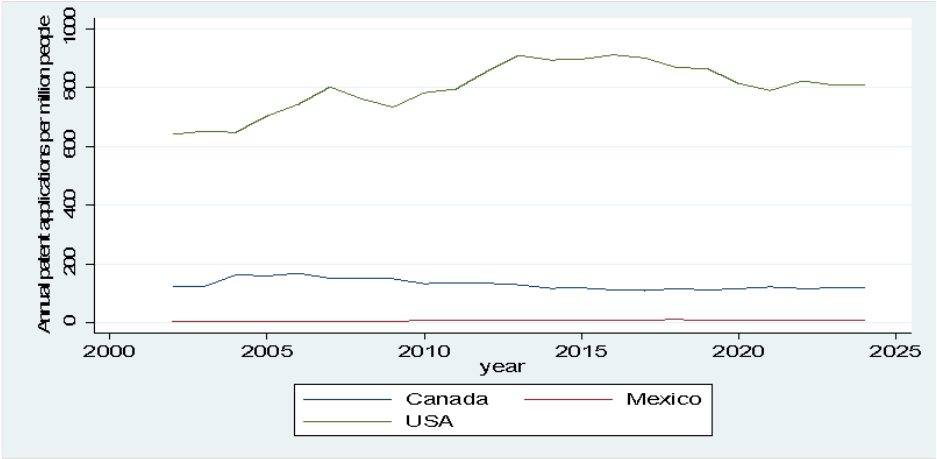

Figure 1: Annual patent applications per million people in North America

MATERIALS AND METHODS

Data and Variable Description/Measurement

Annual time-series data were used in this study from the World Intellectual Property Organisation (WIPO, 2026) and the World Bank World Governance Indicators (WGI). The level of technological innovation was measured by the number of annual patent applications per million people.

The WGI was employed to measure governance quality, with a focus on the rule of law, government effectiveness, control of corruption and regulatory quality.

In particular, the rule of law was measured using the rule of law index, a composite indicator expressed as a standard normal distribution, ranging from approximately -2.5 to 2.5. A priori, improvements in the rule of law are expected to boost technological innovation. The estimates for government effectiveness and control of corruption are in units of a standard normal distribution, ranging from approximately -2.5 to 2.5. Similarly, the estimate for regulatory quality is measured as an aggregate indicator, in units of a standard normal distribution, ranging from approximately -2.5 to 2.5.

Model Specification

This study is anchored in institutional theory and closely follows the work of Odei (2026) and Ibanez *et al.* (2024), with improvements in technology innovation enabled by the use of annual patent applications and the focus on the WGI governance quality indicators. The fixed-effects model representation is as follows:

$$APAT_{it} = \beta_0 + \beta_1 RULE_{it} + \beta_2 GOVE_{it} + \beta_3 CORC_{it} + \beta_4 REQT_{it} + U_i + \varepsilon_{It} \ldots\ldots\ldots (1)$$

Where: APAT = annual patent applications, proxy for technology innovation, RULE = rule of law index, GOVE = government effectiveness index, CORC = corruption control index, REQT = regulatory quality index, β_0 = intercept, $\beta_1 - \beta_4$ = slope parameters, U_i = fixed effects (individual effects), and ϵ_{it} = error term.

The random effects model is specified as follows:

$$APAT_{it} = \beta_0 + \beta_1 RULE_{it} + \beta_2 GOVE_{it} + \beta_3 CORC_{it} + \beta_4 REQT_{it} + U_i + v_{it} \ldots\ldots (1)$$

vi = Remainder disturbance term

Estimation Strategy

The within regression estimators were used to the fixed effects model. This is considered ideal given the one-way error component model, which captures the individual effects. However, the random effects model was estimated using quasi-demeaned generalised least squares (GLS), consistent with Balestra & Nerlove's (1966) proposition. Consequently, the individual effect is treated as random. The choice of the appropriate estimator between the fixed and random effects was based on Hausman's (1978) test results. Additionally, descriptive statistics were used to analyse the distribution of each variable over the study period.

RESULTS AND DISCUSSION

Descriptive Statistics

The summary statistics for each variable are presented in Table 1.

The results showed that the annual patent applications across the sampled North American countries (Canada, Mexico, and the USA) averaged 313.25 per million people, ranging from 4.545 to 910.51 per million during the study period. The rule of law index and government effectiveness index averaged 0.784 and 0.8365, respectively.

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min.	Max
APAT	69	313.25	353.51	4.545	910.51
RULE	69	0.784	1.039	-1.15	1.8
GOVE	69	1.115	0.8365	-0.32	1.98
CORC	69	0.828	1.078	-0.95	1.98
REQT	69	1.102	0.689	-0.2	1.84

Source: STATA 15 output

The minimum and maximum values for the rule of law index ranged from -1.15 to 1.8. The standard deviations for annual patent applications and the rule of law exceed their respective means, indicating that the observations for each do not cluster around their respective means. However, the standard deviation for government effectiveness is less than the corresponding mean, indicating that the observations are clustered around the mean. The results further showed that the control of corruption index and regulatory quality index averaged 0.828 and 1.102, respectively. While the observations for the control of corruption index do not cluster around the mean, those for the regulatory quality index do. This suggests that the countries in the sample tend to experience similar regulatory quality during the study period.

Model Estimation

The model estimation followed a static panel approach, with emphasis on fixed- and random-effects models. The results are summarised in Table 4.2.

Note: ***, ** and * denote statistically significant at 1%. 5% and 10% levels, respectively

Table 2: Summary of fixed and random effects results

Dependent variable: APAT	**(1)**	**(2)**
Variable	FE	RE
RULE	17.087	623.84***
	(0.713)	(0.007)
GOVE	-32.73	594.81***
	(0.521)	(0.001)
CORC	-39.975	-1322.23***
	(0.466)	(0.000)
REQT	-81.976	659.02**
	(0.224)	(0.050)
Constant	459.79***	-469.95**
	(0.000)	(0.031)
Observations	69	69
R-squared	0.214	0.519
F-test		
Prob.(F-stat.)		
Number of crossid	3	3
F-test(u_i=0)	881.93	
Prob.>F-(u_i=0)	0.0000	
Chi-square(var(u_i=0))		69.17
Prob.> chi2(var(u_i=0))		0.0000
Hausman test results		Prob>chi2 = 0.1382

Source: STATA 15 output

Figures denote the p-values of corresponding coefficients

The Hausman test result shown in the last row of Table 4.2 has a p-value of 0.1382, which is less than 0.05, indicating that the random effects model is preferred. Thus, the estimated random-effects model served as the basis for interpreting and discussing the findings. The results showed that the rule of law index has a significant positive effect on annual patent applications, with a unit increase in the rule of law index leading to a 623.84 unit increase in annual patent applications during the study period. This finding aligns with earlier results by Chen, Yao & Zhong (2022) and Zhang, Xie & Gao (2022), who found that adherence to environmental laws positively affected green invention patent applications. Similarly, the random-effects results showed a significant positive effect of the government effectiveness index on patent applications. A unit increase in the government effectiveness index is associated with a 594.81 unit increase in annual patent applications across the selected North American countries during the study period. This is consistent with the findings of Gao & Fan (2023), who established that institutional effectiveness is critical for technological innovation. This further attests to the government's effectiveness and responsiveness in promoting technological innovation in the region. The results further showed that the regulatory quality index has a positive effect on annual patent applications across the countries in the study sample. This corroborates the findings of Jiang & Sun (2025) and Agostino *et al.* (2020), who found that regulatory policies are integral for technological innovations. On the other hand, corruption control has a significant negative effect on annual patent applications across the North American countries. One possible explanation for this counterintuitive result is that governments prioritising anti-corruption efforts may reduce spending on research and development (R&D), innovation incentives, or technology commercialisation programs, thereby undermining patent applications. The R-squared of 0.519 indicates that about 51.9% of the total variation in annual patent applications is jointly explained by changes in the governance quality indicators. This finding attests to the statistical reliability of the estimated random effects model. It is further observed from the results that the p-value (0.0000) of the chi-square statistic (69.17) is less than 0.05, indicating that the governance quality indicators (rule of law, government effectiveness, control of corruption and regulatory quality) are jointly significant in explaining changes in patent applications during the study period. This further validated the statistical reliability of the estimated random effects model.

CONCLUSION

This study provides insights into the implications of governance quality on technology innovation, focusing on

annual patent applications in North America. In particular, the effects of the rule of law, government effectiveness, control of corruption and regulatory quality on annual patent applications were examined. The findings showed that the rule of law and government effectiveness significantly increased annual patent applications during the study period, indicating that stronger legislation and government commitment to technological innovation are critical for the growth of patent applications in Canada, Mexico, and the USA. At the same time, regulatory quality is significant in increasing technological innovation. This highlights the effectiveness of quality regulation in promoting patent applications. Additionally, the results showed that control of corruption significantly reduced annual patent applications in the selected North American countries. Given the findings, this study concludes that improved governance quality provides a pathway for technology innovations in North America. Therefore, governments should strengthen patent enforcement, ensure a transparent judicial process, and improve dispute-resolution mechanisms to boost innovators' confidence and encourage greater patent applications. Governments in North America should collaborate to ensure that anti-corruption measures do not create excessive bureaucracy that may undermine technological innovation.

REFERENCES

Agostino, M., Nifo, A., Trivieri, F., & Vecchione, G. (2020). Rule of law and regulatory quality as drivers of entrepreneurship. *Regional Studies, 54*(6), 814-826.

Al-Emran, M., & Griffy-Brown, C. (2023). The role of technology adoption in sustainable development: Overview, opportunities, challenges, and future research agendas. *Technology in Society, 73,* 102240.

Al-Ramahi, N., & Odeh, M. (2020). The impact of innovative technology on the quality assurance at higher education institutions in developing countries: a case study of Jordan. *International Journal of Information and Education Technology, 10*(11), 826-831.

Balestra, P., & Nerlove, M. (1966). Pooling cross-section and time series data in the estimation of a dynamic model: The demand for natural gas. *Econometrica: Journal of the Econometric Society,* 585-612.

Barasa, L., Knoben, J., Vermeulen, P., Kimuyu, P., & Kinyanjui, B. (2017). Institutions, resources and innovation in East Africa: A firm level approach. *Research Policy, 46*(1), 280-291.

Carney, M., Dieleman, M., & Taussig, M. (2016). How are institutional capabilities transferred across borders?. *Journal of World Business, 51*(6), 882-894.

Chen, Y., Yao, Z., & Zhong, K. (2022). Do environmental regulations of carbon emissions and air pollution foster green technology innovation: Evidence from China's prefecture-level cities. *Journal of Cleaner Production, 350,* 131537.

Chowdhury, E. K., Abdullah, M. N., & Quader, S. M. (2025). The impact of entrepreneurship on economic growth: Exploring the role of technological innovation and institutional quality in South Asia. *Journal of the Knowledge Economy, 16*(1), 3550-3573.

Dal Molin, M., & Leggerini, C. (2026). Strengthening Institutions for a Green and Digital Future: Regional Evidence from Europe's Twin Transition. *Journal of Regional Science.* e70062.

Dunyo, S. K., & Odei, S. A. (2023). Firm-level innovations in an emerging economy: do perceived policy instability and legal institutional conditions matter?. *Sustainability, 15*(2), 1570.

Elfaki, K. E., & Ahmed, E. M. (2024). Globalization and financial development contributions toward economic growth in Sudan. *Research in Globalization, 9,* 100246.

Gao, X., & Fan, M. (2023). The role of quality institutions and technological innovations in environmental sustainability: Panel data analysis of BRI countries. *Plos one, 18*(6), e0287543.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the Econometric Society,* 1251-1271.

Hussen, M. S., & Çokgezen, M. (2021). The impact of regional institutional quality on firm innovation: evidence from Africa. *Innovation and Development, 11*(1), 69-90.

Ibanez, A., AlRadaideh, A., Jimber del Rio, J. A., & Sisodia, G. S. (2024). Good governance and innovation: A renewed global framework for national and supranational policy advancement. *Journal of the Knowledge Economy, 15*(2), 5794-5816.

Jiang, J., & Sun, H. (2025). Marine environmental regulation and green technology innovation: evidence from enterprises in coastal areas of China. *Frontiers in Marine Science, 11,* 1509506.

Koçak, E. (2017). Does institutional quality drive innovation? Evidence from system-GMM estimates. *MPRA* Paper No. 90299. Retrieved from: https://mpra.ub.uni-muenchen.de/90299/

Lucas Jr, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics, 22*(1), 3-42.

Naimoğlu, M., Şahin, S., & Özbek, S. (2025). Governance, corruption, trade openness, and innovation: key drivers of green growth and sustainable development in Türkiye. *Sustainable Development, 33*(3), 4147-4162.

North, D. C. (1990). Institutions, institutional change and economic performance. *Cambridge University Press.*

Odei, S. A. (2026). Formal Institutional Quality and Product Innovation: Moderating Effects of Policy Instability and Technological Infrastructure. *Thunderbird international business review, 68*(2), 191-207.

Rodríguez-Pose, A., & Zhang, M. (2020). The cost of weak institutions for innovation in China. *Technological Forecasting and Social Change, 153,* 119937.

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5, Part 2), S71-S102.

Seyoum, B. (2011). Informal institutions and foreign direct investment. *Journal of Economic Issues, 45*(4),

917-940.

Wang, K. H., Umar, M., Akram, R., & Caglar, E. (2021). Is technological innovation making world" Greener"? An evidence from changing growth story of China. *Technological Forecasting and Social Change, 165,* 120516.

Zhang, M., & Rodríguez-Pose, A. (2024). Government reform and innovation performance in China. *Papers in Regional Science, 103*(3), 100023.

Zhang, M., Xie, W., & Gao, W. (2022). Have environmental regulations promoted green technological innovation in cities? Evidence from China's green patents. *Plos one, 17*(12), e0278902.