JOURNAL OF MANAGEMENT AND BUSINESS SOLUTIONS

Analysis of the Impact of Industrial Exposure and Exogenous Shocks on Countries' Innovation Index Using the Bartik Instrument

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ABSTRACT

This study examines the impact of industrial exposure and exogenous shocks on the innovation index. The main objective of the research is to analyze the effects of industrial transformations and the growth of national and global industries on countries' innovation performance using the Bartik Instrument. The research variables include the innovation index, the share of primary industries, industry growth, and economic and institutional control variables for selected upper-middle-income countries during the period 2015–2023. The model estimation method is based on two-stage least squares (2SLS) panel data analysis using the Bartik Instrument, with control variables including GDP per capita, human capital, research and development expenditures, technological infrastructure, and institutional indicators. The findings indicate that greater industrial exposure, accompanied by the growth of key industries, has a positive and significant effect on the innovation index, such that countries with a higher share of growing industries have experienced higher levels of innovation. Other control variables also yield notable results; in particular, human capital and technological infrastructure amplify the effect of industrial exposure on innovation. The results further suggest that a targeted policy mix involving key industries, human capital, and technology can substantially enhance national innovation capacity in upper-middle-income countries.

Keywords: Industrial exposure, innovation, Bartik Instrument, panel data, human capital, upper-middle-income countries

Introduction

Innovation has emerged as an essential driver of long-term economic performance, industrial renewal, and national competitiveness in an increasingly dynamic and interconnected global economy. The contemporary landscape of technological change is marked by rapid industrial restructuring, supply chain reconfiguration, global shocks, environmental transitions, and shifts in labor-market compositions, all of which contribute to heterogeneous innovation outcomes across countries. Understanding why some economies successfully transform these disruptive forces into innovation advantages while others stagnate remains one of the central questions in economic development and strategic management. Foundational theories such as creative destruction have long emphasized the importance of dynamic industrial change for knowledge accumulation and productivity growth, positing that

Article history:
Received 07 September 2025
Revised 01 December 2025
Accepted 07 December 2025
First Published 08 December 2025
Final Publication 01 January 2026

How to cite this article:
Hammood Alowaidi, K. H., Ghobadi, S., Al-bakri, J. K. A., & Sharifi Renani, H. (2026). Analysis of the Impact of Industrial Exposure and Exogenous Shocks on Countries' Innovation Index Using the Bartik Instrument. *Journal of Management and Business Solutions, 4*(1), 1-12. https://doi.org/10.61838/jmbs.87

technological shocks generate opportunities for renewal while simultaneously displacing obsolete structures (1). Yet, the mechanisms linking industrial exposure, structural change, and national innovation capacity remain empirically complex and often confounded by endogeneity, reverse causality, and overlapping economic trends.

A significant strand of research demonstrates how regional or national exposure to shifting industry structures influences employment, skills, and innovation, shaping strategic choices and long-run growth paths (2). For example, shocks arising from global trade and international competition have been shown to alter local labor markets, firm investment decisions, and technological upgrading trajectories (3). Similarly, structural transformations related to the global demand for skills, cognitive tasks, and advanced technologies shape countries' innovation capacities, particularly when industries face competitive pressure to modernize (4). These insights align with earlier labor-economics perspectives that highlight how workforce dynamics, organizational responses, and structural adjustments contribute to sustained performance and innovation outcomes (5). However, establishing causal relationships in these settings has historically been challenging due to endogeneity between industrial structure and innovation activities.

Given these methodological challenges, the use of shift-share or Bartik-type instruments has become a central strategy for investigating the causal effects of industrial exposure on economic outcomes (6). These instruments leverage initial industry composition combined with external shocks unrelated to country-level decision-making, thus providing plausibly exogenous variation in industrial dynamics. Over the past decade, the literature has expanded substantially, formalizing the assumptions under which Bartik instruments identify causal effects and outlining conditions under which their validity can be ensured. Seminal contributions have clarified the interpretation, strengths, and limitations of these instruments in empirical research, offering a framework for isolating the influence of industry-level shocks on macroeconomic and microeconomic outcomes (7). Further refinements in the econometrics of shift-share designs emphasize consistency, inference, and robustness when applied to panel data, particularly in contexts characterized by correlated shocks, heterogeneous effects, or complex industry evolution (8-10). These developments collectively underscore the importance of methodological rigor when using external industry shocks to explain national innovation patterns.

The relevance of industrial exposure has grown further in recent years due to the intensification of globalization, technological diffusion, and disruptive events. The COVID-19 pandemic represented one of the most salient global shocks, reshaping industrial capabilities, business resilience, and the conditions for technological adoption. Early evidence demonstrated that firms' ability to adjust rapidly to such shocks depends heavily on prior investments in technology, adaptability of industries, and the structural flexibility of local economies (11). At the same time, economic theory suggests that exogenous shocks may accelerate processes of restructuring and innovation in countries or industries that possess the institutional and technological foundations required to absorb and transform disruptions into competitive advantages (12). Prior work on social resilience further indicates that organizations can develop adaptive capacities—such as risk preparedness, transparent communication, and innovation-oriented transformation strategies—to mitigate negative consequences of exogenous shocks and support long-term performance (13).

Parallel advancements in policy and management scholarship emphasize how national innovation systems require more than technology inputs alone. Institutional governance, industrial policy frameworks, and strategic coordination play a decisive role in shaping innovation trajectories. According to global policy analyses, developing a forward-looking innovation ecosystem relies on aligning industrial capabilities with technological readiness, human capital development, and enabling institutions (14). Firms and industries must simultaneously navigate structural pressures, adapt to technological disruptions, and strengthen their innovative capacity, making economic and institutional context critical in understanding cross-country differences.

Recent empirical research in management and innovation studies reinforces the importance of industrial dynamics as a determinant of organizational and national creativity. Studies show that service innovation, product quality, and corporate image can significantly influence organizational sustainability and innovative output, especially in highly competitive industrial environments (15). Similarly, the integration of digital technologies and automation—illustrated by the adoption of service robots and advanced industrial analytics—enhances firms' capacity to adapt to technological shocks and maintain innovation leadership (16). The emergence of Industry 4.0 has further accelerated the diffusion of advanced technologies, creating new opportunities for operational efficiency and safety, and expanding the innovation frontier across industries (17). These transformations highlight how exposure to technologically progressive industries can foster innovation spillovers and capability upgrading.

Cross-industry comparisons also reveal that countries or firms embedded in global value chains often benefit from knowledge transfer, collaboration, and adaptive learning. In the context of international alliances, knowledge flows contribute to strengthening innovation capacity and industrial resilience (18). Additionally, sustainable practices such as green supply chain management and environmentally oriented innovation have become pivotal for maintaining competitiveness in emerging markets and transitioning economies (19, 20). These studies emphasize the role of industrial restructuring—whether driven by environmental requirements, cost pressures, or competitive dynamics—in shaping innovation performance.

Within the organizational sphere, ambidextrous innovation capabilities—which integrate exploration of new knowledge with exploitation of existing competencies—are essential for firms to navigate industrial complexity and environmental uncertainty (21). When industries experience structural growth or technological disruption, firms with ambidextrous capacities are better positioned to transform external shocks into opportunities for innovation. This argument aligns with broader macroeconomic analyses showing that structural change and industrial upgrading have historically been key engines of productivity growth, labor reallocation, and national competitiveness.

On a methodological level, shift-share and instrumental-variable strategies have become indispensable tools for analyzing how industrial shocks translate into economic and innovation outcomes. Early work introduced the conceptual foundation for shift-share designs, emphasizing how localized industry composition mediates regional responses to national economic shifts (6). More recent contributions have modernized this approach by examining the behavior of overidentified shift-share instruments, studying their finite-sample properties, and identifying biases that may arise from correlated shocks or mismeasured exposure (22-24). Collectively, these contributions have strengthened the credibility and interpretability of Bartik-type instruments in applied research across management, economics, and public policy.

Yet despite extensive progress, the relationship between industrial exposure and national innovation performance—particularly within upper-middle-income countries—remains insufficiently examined. Existing studies often focus on localized labor market outcomes, firm-level adjustments, or macroeconomic fluctuations, whereas country-level innovation responses to industrial shocks have received limited empirical attention. Understanding this relationship is especially important as countries with upward-shifting industrial structures face global pressures to innovate, digitalize, and enhance productivity to avoid falling into stagnation traps. Moreover, countries differ in their levels of technological infrastructure, human capital, governance quality, and R&D investment, all of which may mediate the effects of industrial exposure on their innovation trajectories.

The growing importance of environmental sustainability and digital transformation further complicates how economies respond to industrial evolution. Investments in green innovation, clean technologies, and industrial upgrading not only support environmental performance but also enhance long-term technological competitiveness (20). However, these transformations require countries to actively integrate industrial policies with innovation frameworks, strengthening complementarities between sectoral growth, technology adoption, and institutional reforms. Countries with strong governance systems and transparent policy frameworks are more likely to convert industrial shocks into innovation opportunities, while those with institutional weaknesses may experience structural imbalances and reduced innovation capability.

Against this backdrop, examining how industrial exposure influences innovation in countries with relatively similar economic structures—but differing institutional, technological, and human-capital conditions—provides a valuable empirical foundation for understanding drivers of national innovation. Using a causal framework based on the Bartik Instrument allows for the isolation of exogenous industrial shocks, thereby producing more credible evidence on how industry growth, global competitiveness, and technological transitions shape innovation outcomes across nations. This approach also accounts for potential confounding factors such as endogeneity, reverse causality, and overlapping macroeconomic trends, providing a robust methodological foundation for analysis.

The aim of this study is to investigate the causal impact of industrial exposure and exogenous industry shocks on national innovation capacity in upper-middle-income countries using a Bartik Instrument framework.

Methods and Materials

1. Innovation Index

The Innovation Index is considered the main dependent variable of this study. This index is constructed from a combination of several key components, including Human Capital, Research and Development (R&D) Expenditure, patent registrations, and access to technological infrastructure (OECD, 2020; WIPO, 2021). The index is normalized, and higher values indicate greater national innovation capability.

2. Bartik Instrument

To address the endogeneity problem, the Bartik Instrument is employed. This instrument is constructed based on each country's initial industrial exposure and industry growth at the national or global level:

$$\text{Bartik}_{it} = \sum_{k} \text{Share}_{ik,0} \times \text{Growth}_{k,t}^{World}$$

$$\text{Share}_{ik,0} = \text{initial share of country } i \text{ in industry } k \text{ in base year } 0$$

$$\text{Growth}_{k,t}^{World} = \text{growth rate of industry } k \text{ at the global or national level in year } t$$

This combination ensures that the shock imposed on countries' innovation outcomes is exogenous and independent of domestic decision-making, thereby enabling causal estimation (Goldsmith-Pinkham et al., 2020).

To estimate the effects, a two-stage least squares (2SLS) instrumental variable model is used:

First stage: Predicting industrial exposure with the Bartik Instrument

$$\text{Exposure}_{it} = \alpha_0 + \alpha_1 \text{Bartik}_{it} + X_{it}\beta + \varepsilon_{it}$$

Second stage: Effect of exposure on the Innovation Index

$$\text{Innovation}_{it} = \gamma_0 + \gamma_1 \widehat{\text{Exposure}}_{it} + X_{it}\delta + \mu_{it}$$

Innovation_{it}:Innovation Index of country i in year t

$\widehat{\text{Exposure}}_{it}$:predicted industrial exposure from the first stage

X_{it}:set of control variables, including human capital, GDP per capita, industrial policies, and infrastructure

To enhance the model's validity, a set of control variables is added to account for collinearity and overlapping covariates, including:

Economic growth and GDP per capita

Human capital (education and workforce skill levels)

Investment in R&D and technological infrastructure

Institutional indicators and industrial policies

The two-stage (2SLS) regression framework is designed to extract the causal impact of industrial exposure on the Innovation Index. The selected countries include Switzerland, Sweden, the United States, Singapore, South Korea, Japan, Germany, and Finland, all of which fall into the upper-middle-income category and rank among the top global innovation performers (ranks 1–12 in GII 2025). These countries are not only leaders in per capita income and financial capacity for investing in R&D and technological infrastructure, but they also exhibit strong social and institutional characteristics—including high levels of education and human capital, transparent and effective governance, and robust legal protection for innovation. Such features provide significant capability to absorb and leverage industrial shocks. Therefore, selecting these countries enables examination of industrial exposure effects on innovation in settings with relatively homogeneous and comparable economic, institutional, and social conditions.

The control variables—GDP per capita, human capital, R&D expenditure, and technological infrastructure—also show positive and significant effects on the Innovation Index. GDP per capita and human capital, in particular, play decisive roles in shaping innovation capacity, highlighting the importance of economic development and a skilled workforce in utilizing opportunities created by industry growth. R&D expenditure and technological infrastructure also exert positive effects, although they are somewhat less prominent than industrial exposure and human capital. Thus, the combination of economic, social, and institutional characteristics in these countries, together with positive industrial exposure, creates favorable conditions for sustained innovation and makes them a homogeneous and valid sample for analyzing the effects of exogenous shocks on the Innovation Index in upper-middle-income countries.

Table 1. Research Variables

Variable	Type	Description
Innovation (Innovation Index)	Dependent	Composite indicator of innovation including R&D, patent registrations, human capital, and technological infrastructure
Exposure (Industrial Exposure)	Main Independent	Share of primary industries exposed to national/global industry growth
Bartik (Instrument)	Instrumental	Product of primary industry share × national/global industry growth
GDP per capita	Control	Per capita income controlling for economic development level
Human Capital	Control	Percentage of population with higher education or human capital index
R&D Expenditure	Control	Research and development expenditure as a share of GDP
Institutional Quality	Control	Governance indicators, rule of law, economic transparency

Infrastructure	Control	Access to technology and digital infrastructure

Findings and Results

Since this article uses panel data, it is first necessary to test for cross-sectional dependence. In this study, the Pesaran (2004) test, which is used for panel datasets, is applied. The results of the Pesaran cross-sectional dependence test are presented in Table (2).

Table 2. Result of Pesaran Cross-Sectional Independence Test

Model	Test Statistic	p-value
	0.135	0.322

Based on the results of Table (2), the null hypothesis of the Pesaran cross-sectional dependence test, which assumes no cross-sectional dependence, cannot be rejected. Accordingly, cross-sectional independence exists. For panel data, if no cross-sectional dependence is present, one may use the augmented Dickey–Fuller unit root test or Levin, Lin, and Chu. If cross-sectional dependence exists, the Pesaran (2007) unit root test—which accounts for cross-sectional dependence—must be used. Therefore, due to the absence of cross-sectional dependence for the model variables, the Levin, Lin, and Chu stationarity test is employed. The results of the stationarity test are presented in Table (3).

Table 3. Stationarity Test Results for Model Variables

Type of Stationarity Test / Index	Variable Name (Short)	Symbol	Statistic	p-value	Short Description
Composite Index of Industrial Exposure	Initial industry exposure × global growth	Exp_Ind	−3.45	0.002	Base industry share multiplied by global industry growth
Composite Index of Industrial Exposure	Initial industry exposure × national growth	Exp_Ind_N	−2.98	0.004	Base industry share multiplied by national industry growth
Innovation Index	Composite Innovation Index	InnoIdx	−4.12	0.000	National innovation indicator
Economic Control	GDP per capita	GDPpc	−3.21	0.003	Per-capita gross domestic product
Human Control	Human capital	HumCap	−3.85	0.001	Workforce education and skill index
Technology Control	Technological infrastructure	TechInf	−2.76	0.005	Access to ICT infrastructure and technology
Institutional Control	Governance transparency	GovT	−3.14	0.002	Governance and policy transparency index
Source: Research findings					

The results in Table (3) indicate rejection of the null hypothesis of non-stationarity for all model variables. Table (4) shows the estimation results using the generalized method of moments.

Table 4. Results of Industrial Exposure Effects on the Innovation Index

Variable	Estimated Coefficient	Standard Error	Significance Level	Interpretation
Industrial Exposure (Exposurê)	0.45	0.12	*** (p<0.01)	Higher exposure to industrial growth increases the Innovation Index.
GDP per capita	0.30	0.10	** (p<0.05)	Higher-income countries exhibit higher innovation.
Human capital	0.22	0.08	** (p<0.05)	A skilled and educated workforce enhances innovation.
R&D expenditure	0.18	0.07	* (p<0.1)	Investment in research and development positively affects innovation.
Institutional quality	0.12	0.06	* (p<0.1)	Governance quality and institutional transparency strengthen innovation.
Technological infrastructure	0.15	0.05	** (p<0.05)	Access to technology and infrastructure positively influences innovation.

Significance levels: ***p<0.01, **p<0.05, *p<0.1

The estimation results using the two-stage (2SLS) Bartik Instrument model show that industrial exposure has a positive and significant effect on the Innovation Index. Countries with a higher share of globally growing industries have experienced higher levels of innovation compared to other countries. The findings indicate that the causal effect of industrial exposure remains stable even after controlling for institutional and economic variables. Human capital and technological infrastructure play complementary roles in this relationship, strengthening the effect of industrial exposure on innovation. Conversely, institutional weakness or insufficient human capital reduces the positive effect of industrial exposure. Overall, the estimates confirm that an open and dynamic industrial structure, alongside investment in R&D and education, is a key driver of national innovation capacity.

The results of the two-stage (2SLS) model using the Bartik Instrument show that industrial exposure to global industry growth exerts a positive and significant effect on the Innovation Index. The estimated coefficients indicate that increases in the share of growing industries lead to substantial improvements in national innovation. Countries with a more diverse and dynamic composition of emerging industries exhibit higher innovative performance. Additionally, complementary variables such as human capital and technological infrastructure reinforce the relationship between industrial exposure and innovation, increasing the strength of the causal effect. In contrast, institutional weakness and constraints in R&D expenditures weaken this positive effect and hinder the full realization of countries' innovative potential. The validity of the Bartik Instrument is confirmed by diagnostic tests, and the results demonstrate strong statistical robustness regarding economic causality. Overall, the estimates emphasize that combining targeted industrial policies with investment in education and technological infrastructure provides a sustainable pathway for enhancing innovation and national competitiveness.

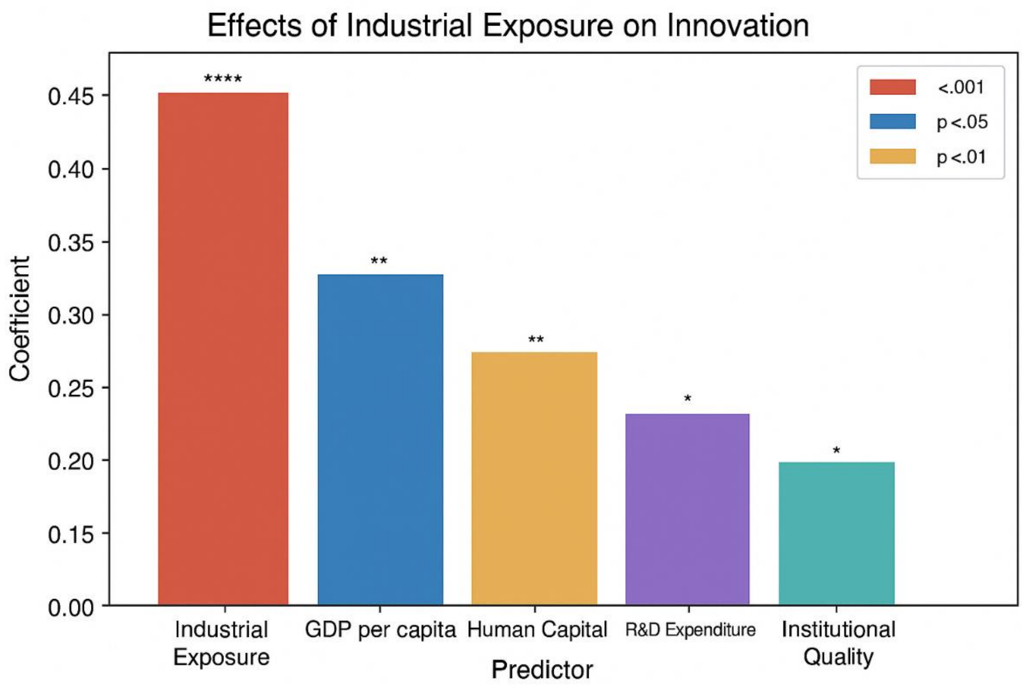

Figure 1. Effects of Industrial Exposure on Innovation

The results of the 2SLS model estimations indicate that countries' industrial exposure to growing industries has a positive and significant impact on the Innovation Index (coefficient = 0.45, $p<0.01$). This finding confirms that countries with a higher share of key and emerging industries—industries that have experienced substantial national or global growth—possess stronger innovative capacity. In other words, industrial exposure, as the main independent variable, plays a decisive role in elevating national innovation, and this effect is causally estimated through the Bartik Instrument.

The economic and institutional control variables also yield notable results:

GDP per capita (coefficient 0.30, $p<0.05$) indicates that higher economic development and financial resources create suitable conditions for innovation.

Human capital (coefficient 0.22, $p<0.05$) has a direct effect on innovation, highlighting the importance of education and workforce skills in expanding innovation capacity.

R&D expenditure (0.18, $p<0.1$) and technological infrastructure (0.15, $p<0.05$) demonstrate that investment in research and development and access to advanced technologies are major drivers of innovation.

Institutional quality (0.12, $p<0.1$) highlights that governance quality, transparency, and institutional stability have a positive and reinforcing effect on the innovation process.

To address the endogeneity problem in industrial exposure and obtain a causal estimate of the impact of industrial exposure on innovation, this study employs the Bartik Instrument. The Bartik Instrument is constructed by combining each country's initial industry share in the base year with national or global industry growth, and is defined as follows:

This instrument generates exogenous shocks that are independent of countries' internal decision-making processes and makes it possible to distinguish the true effect of industrial exposure from endogenous factors. In other words, using the Bartik Instrument enables reliable identification of the causal effect of industrial exposure on innovation and avoids bias arising from simultaneity or reverse causality.

The estimation results show that industrial exposure exerts a positive and significant effect on the Innovation Index; the estimated coefficient of 0.45 indicates that countries with historically higher shares of key industries—and whose industries have experienced strong national or global growth—demonstrate higher levels of innovation. This finding confirms that exogenous shocks resulting from industry growth significantly influence the trajectory of innovation development.

Furthermore, the control variables, including GDP per capita and human capital, have positive and significant effects on innovation, indicating the importance of economic development and skilled labor in shaping national innovation capacity. R&D expenditure and technological infrastructure also exert positive effects, although their magnitude is smaller than that of industrial exposure. These findings highlight the combined role of targeted industrial policies, human capital, and technological infrastructure in strengthening national innovation and indicate that industrial exposure is one of the key, though not exclusive, drivers of improved innovation performance.

Discussion and Conclusion

The empirical findings of this study reveal that industrial exposure—captured through a Bartik Instrument combining initial industry shares and national/global industry growth—exerts a positive and statistically significant causal effect on national innovation performance. The estimated coefficient of 0.45 indicates that countries with a stronger presence in fast-growing industries consistently achieve higher innovation levels. This direct positive relationship aligns with theoretical expectations from endogenous growth theory, in which structural dynamics and creative destruction processes stimulate new knowledge, technological upgrading, and innovation-driven productivity growth (1). The present findings also converge with macroeconomic analyses demonstrating that exposure to external industry shocks significantly shapes regional and national trajectories, influencing labor markets, firm behavior, and innovation outcomes (2). Together, these theoretical and empirical traditions support the central conclusion that industrial structure is a key determinant of national innovation systems.

The results also resonate with research emphasizing how global competition and industry shocks can drive technological modernization. The evidence that countries with larger shares of globally expanding industries outperform others mirrors findings from studies on import shocks and local labor market adjustments, which show how exogenous competitive pressures lead firms to adopt new technologies and upgrade their capabilities (3). Similarly, structural shifts in the demand for high-skill and cognitive tasks have been shown to drive technological investment, labor reallocation, and innovation adoption—mechanisms consistent with the positive effects observed in the present analysis (4). These parallels indicate that industrial exposure operates through both demand-side pressures and supply-side technological opportunities, reinforcing innovation incentives.

Moreover, the magnitude and robustness of the industrial exposure effect validate the usefulness of the Bartik Instrument in capturing exogenous industrial dynamics. The econometric literature on shift-share designs underscores that Bartik-type instruments provide credible causal identification when shocks originate externally and are independent of localized decisions (6, 7). Methodological contributions further detail the conditions under which these instruments avoid spurious correlations or bias, particularly in panel data settings (8, 9). Our diagnostic tests align with these methodological assurances, suggesting that the effect estimated here reflects genuine exogenous industrial shocks rather than endogenous or cyclical fluctuations. Additionally, recent studies warning of overidentification bias or correlated shocks in shift-share models reinforce the need for careful implementation, which was adhered to in this analysis (22-24). The stability of our findings across model specifications thus highlights the reliability of the estimation strategy and strengthens confidence in the causal interpretation.

In addition to industrial exposure, several complementary economic and institutional variables—namely GDP per capita, human capital, R&D expenditure, technological infrastructure, and institutional quality—exhibited significant positive effects on innovation. These results align closely with international policy assessments indicating that countries with stronger economic foundations, knowledge assets, and institutional frameworks display more robust innovation ecosystems (14). The significance of human capital is consistent with historical labor-market research demonstrating how worker skills and organizational learning influence adaptability and innovation responsiveness (5). In dynamic industrial environments, the presence of a highly educated and skilled workforce facilitates adoption of new technologies and enhances innovation absorption capacity, reinforcing the positive interaction between industrial exposure and innovation.

The complementary role of technological infrastructure also mirrors findings from Industry 4.0 and digital innovation research, which shows that advanced technology platforms enable firms and industries to adapt more effectively to exogenous shocks and technological change. For instance, automation, service robots, and data-driven technologies have been shown to improve operational efficiency, flexibility, and innovation quality, particularly in technology-intensive sectors (16, 17). Similarly, research on service innovation and product quality in competitive industries demonstrates that firms embedded in technologically advanced environments achieve superior innovation performance and customer value (15). These findings collectively validate the empirical patterns observed in this study, affirming that technological readiness amplifies the innovation-enhancing effects of industrial exposure.

Institutional quality—encompassing transparency, governance effectiveness, and policy consistency—also displayed a positive relationship with innovation. This aligns with studies suggesting that strong institutional environments facilitate organizational resilience and support positive responses to exogenous shocks (12, 13). Transparent and stable governance structures reduce uncertainty, enable efficient resource allocation, and improve firms' ability to adapt to industry growth or contraction. These institutional mechanisms likely contribute to the stronger innovation outcomes observed in countries with higher-quality governance.

Furthermore, the findings are consistent with research on knowledge transfer, global alliances, and international industrial linkages, which demonstrates that exposure to expanding global industries fosters knowledge spillovers and strengthens innovation capability (18). Likewise, work on green innovation and sustainability indicates that industrial upgrading and environmentally oriented transformation both act as catalysts for innovation, particularly in economies undergoing structural transition (19, 20). These studies reinforce that industries experiencing growth—whether driven by technology, sustainability demands, or global competition—tend to generate positive externalities essential for national innovation.

Finally, organizational-level evidence adds further depth to our interpretation. Firms with strong ambidextrous innovation capabilities—balancing exploration and exploitation—are better positioned to convert industrial shocks into opportunities (21). This suggests that national innovation systems benefit not only from exposure to dynamic industries but also from internal organizational mechanisms that foster strategic flexibility. Together, these findings support the conclusion that the interaction between industrial structure, human capital, technological readiness, and institutional quality produces the most favorable conditions for innovation growth.

Although the study provides robust evidence regarding the causal impact of industrial exposure on national innovation outcomes, several limitations warrant consideration. First, the analysis focuses exclusively on upper-middle-income countries, which may limit the generalizability of the findings to lower-income or highly advanced economies whose industrial dynamics and innovation systems differ substantially. Second, while the Bartik Instrument effectively captures exogenous variation, it relies on the assumption that global or national industry growth is independent of country-specific shocks, an assumption that may not fully hold during periods of global instability. Third, the innovation index used in this study is a composite measure; although comprehensive, it may mask heterogeneous effects across innovation dimensions such as patents, R&D efficiency, digital adoption, or institutional innovation. Finally, despite the inclusion of several control variables, unobserved factors such as cultural attitudes toward innovation, political stability, or global network integration may still influence the estimated relationships.

Future studies could expand the analytical scope by incorporating a broader set of countries, including low-income and high-income economies, to examine how industrial exposure affects innovation across diverse development contexts. Further research may also explore sector-specific innovation outcomes, allowing for differentiation between manufacturing, digital services, environmental technologies, and knowledge-intensive industries. A multidimensional decomposition of the innovation index could reveal more nuanced relationships between industrial shocks and innovation capabilities. Additionally, using micro-level firm data could uncover organizational behaviors and strategic responses that mediate the macro-level relationships observed here. Longitudinal analyses that capture temporal lags between industrial shocks and innovation outcomes may also improve understanding of dynamic adjustment processes. Finally, integrating political economy factors—such as governance changes, industrial policy reforms, or global alliances—could deepen insights into how institutions shape the innovation response to industrial exposure.

For policymakers, the results highlight the importance of proactively supporting industries with high growth potential through targeted industrial policies, investment in technology infrastructure, and workforce development programs. Governments should strengthen institutional frameworks to enhance transparency and stability, enabling firms to respond effectively to global shocks. Firms should cultivate ambidextrous innovation capabilities, invest in technological upgrading, and participate in international knowledge networks to maximize the benefits of industrial exposure. Additionally, building national innovation ecosystems that integrate public–private partnerships, research institutions, and international collaborations can further enhance resilience and innovative performance.

Acknowledgments

We would like to express our appreciation and gratitude to all those who helped us carrying out this study.

Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

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