



When do institutional actors drive green innovation adoption vs. generation? Evidence from tax, customer, and network pressures

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ABSTRACT

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The prevailing approach in green innovation research merges adoption and generation into a single measurement, and while traditional innovation studies indicate that these modes can have dissimilar antecedents, this distinction remains unexplored for green innovation. Addressing this gap, this study draws on institutional theory to examine which specific institutional actors: state authorities (environmental tax), corporate customers, and contact networks, are universal in driving both adoption and generation of green innovation, and which are mode-specific. Analyzing a sample of 1,116 Russian small- and medium-sized enterprises (SMEs) using logistic regression, we separately model green innovation adoption and generation as functions of tax, customer pressure, and network membership. We find that environmental tax is positively associated with both adoption and generation of green innovation, while pressure from corporate customers only stimulates adoption, not generation. Notably, contact networks have a positive effect on adoption but a negative effect on generation. By explicitly distinguishing between these two innovation modes, the study clarifies contradictory findings in green innovation literature and offers a more robust methodological approach to the use of institutional theory in green innovation research. For policymakers in emerging and developing economies, the results imply that different institutional actors require tailored interventions: taxes can drive both diffusion and novelty, customer pressure is suitable for spreading existing practices, and networks should be redesigned to avoid discouraging in-house innovation while still promoting adoption.

Contribution/Originality: This study contributes to green innovation literature by being the first to empirically differentiate between the adoption and generation of green innovation. We clarify contradictory findings in prior literature by demonstrating that the same institutional actors can have dissimilar and sometimes opposing effects on these two green innovation modes.

1. INTRODUCTION

Being important drivers of economic growth, SMEs also account for over 70% of global industrial pollution (Organisation for Economic Co-operation and Development, 2018), making them crucial targets for environmental policies. While policy interventions that successfully stimulate environmental innovation in SMEs are well documented (Cainelli, De Marchi, & Grandinetti, 2015; Keskin, Diehl, & Molenaar, 2013; Marin, Marzucchi, & Zoboli, 2015; Naruetharadhol, ConwayLenihan, & McGuirk, 2024; Paterson, Gallotta, & Baranova, 2023), these examples largely stem from countries with stable institutions. In many emerging and developing economies (EMDEs), however, SMEs' engagement in green innovation remains less widespread (Díaz-García, González-Moreno, & Sáez-

Martínez, 2015; Walz, Pfaff, Marscheider-Weidemann, & Glöser-Chahoud, 2017) and is hampered by persistent institutional voids, such as weak enforcement mechanisms and inadequate funding (Bambe, Combes, Kouassi, & Schwartz, 2026). In the Russian context specifically, environmental policies were designed with large corporations in mind, further limiting SME engagement (Volodin, 2011). A nuanced understanding is needed to design policies that effectively encourage green innovation among SMEs in EMDEs, considering their unique institutional environments.

Such environmental policies should aim at stimulating both the adoption (diffusion) and generation (novelty) of SME green innovation. On one hand, due to SMEs' substantial individual impact on the environment, more SMEs need to adopt innovations developed by other firms to ensure the diffusion of environmental responsibility. On the other hand, SMEs' entrepreneurial orientation and organizational flexibility make them capable of generating novel environmental solutions themselves (Klewitz & Hansen, 2014), including innovations that set off sustainable transformations in their respective industries (Hockerts & Wüstenhagen, 2010).

The evidence from traditional innovation research indicates that while certain antecedents are relevant for both the adoption and generation of innovations, others can have a dissimilar impact on these two innovation modes (Dost, Badir, Ali, & Tariq, 2016; Dost, Badir, Sambasivan, & Umrani, 2020; Pérez-Luño, Wiklund, & Cabrera, 2011). Yet, the potentially differential effects of antecedents on the adoption and generation of green innovation remain unexplored, as the established way to approach green innovation is to utilize a measure that incorporates both adoption and generation modes, making it impossible to distinguish between the two (Cainelli et al., 2015; Carfora, Scandurra, & Thomas, 2021; Corral, 2003; Le, 2022; Le, Tran, Lam, Tra, & Uyen, 2024; Yacob, Wong, & Khor, 2019; Zhu, Zhu, & Arkorful, 2024). We address this literature gap by following Damanpour and Wischnevsky (2006) in distinguishing between innovation adoption (sourcing externally) and generation (developing internally). Using institutional theory as a framework, we examine how three specific institutional actors, tax authorities, corporate customers, and professional contact networks, affect the adoption and generation of green innovation in SMEs.

The contributions of the paper are threefold. Firstly, it advances green innovation research by showing that the impact of institutional actors on green innovation depends critically on the innovation mode: while some actors, such as corporate customers and contact networks, influence adoption and generation differently, others, such as tax authorities, can positively affect both. This helps explain contradictory findings in prior studies and highlights the necessity of specifying the innovation mode in future research. Secondly, the study advances research methodology by demonstrating that, rather than treating abstract pressure types as a homogeneous construct (e.g., normative pressure), a more accurate understanding of institutional effects necessitates looking at specific institutional actors as sources of this pressure. Finally, the paper offers actionable insights for policymakers in complex institutional environments of EMDEs.

2. THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1. Institutional Pressures, Actors, and Firm Responses

Institutional theory states that firms operating within the same organizational field face similar institutional pressures, leading to institutional isomorphism, where firms adopt similar practices and routines in the same environment (Zhu, Cordeiro, & Sarkis, 2012). A key characteristic of these pressures is that they are enacted by specific actors, known as institutional agents (DiMaggio & Powell, 1983; Scott, 2005). Coercive pressure is mainly exerted by state authorities (Scott, 2005), while normative pressure can originate from professional bodies, influential customers, and other actors promoting industry standards (Delgado-Ceballos, Aragón-Correa, Ortiz-de-Mandojana, & Rueda-Manzanares, 2012; DiMaggio & Powell, 1983). Mimetic pressure results from exposure to successful peer practices (Wu, Subramanian, Abdulrahman, Liu, & Pawar, 2017), which can occur within formal or informal networks.

Firms do not passively receive institutional pressures but choose among multiple ways to respond (Oliver, 1991). They may be predisposed to take specific actions depending on the pressure's characteristics, such as its source, clarity of demands, and imposed constraints. Consequently, the same broad type of institutional pressure, like normative

pressure, may lead to divergent innovation outcomes depending on which actor enacts it and how the firm perceives its available response options. This paper proposes that distinguishing between innovation adoption and generation offers a critical lens for understanding these potentially different responses in green innovation.

To structure our analysis, we distinguish between three levels: the institutional actor (who exerts influence), the type of pressure they exert (coercive, normative, mimetic), and the concrete form or mechanism through which this pressure reaches the firm. We focus on three particular mechanisms, each representing a unique actor-pressure combination relevant to SMEs in emerging economies: environmental tax as a coercive pressure mechanism from state authorities, compliance requirements as normative pressure from corporate customers, and peer exposure as mimetic pressure from contact networks. This framework, reflecting the three conceptual levels, is presented in Table 1.

Table 1. Conceptual framework: institutional actors, pressure types, and concrete mechanisms.

Institutional actor	Type of pressure	Concrete mechanism
State authorities	Coercive	Environmental tax
Corporate customers	Normative	Customer pressure (Compliance requirements)
Contact networks	Mimetic	Network pressure (Peer exposure)

2.2. Environmental Tax and Green Innovation

Research indicates that state actors play a significant role in driving firms' engagement in corporate environmental sustainability (Huang, Hu, Liu, Yu, & Yu, 2016; Shu, Zhou, Xiao, & Gao, 2016; Tariq, Badir, Tariq, & Bhutta, 2017). As a coercive pressure mechanism, environmental taxes are among the instruments that enable state actors to influence SME engagement in green innovation. While other measures, particularly those within command-and-control systems, are considered effective for environmental policy (Rennings, 2000), a body of criticism argues that in some institutional environments, such measures are unjustified or ineffective (Arimura, Hibiki, & Katayama, 2008; Ziegler & Nogareda, 2009). This dynamic is evident in the Russian context, where most SMEs are either exempt from rigorous environmental regulations or operate in sectors with minimal oversight, making environmental taxes the only viable policy tool to stimulate large-scale SME engagement in green innovation.

Horbach, Rammer, and Rennings (2012) empirically demonstrate the role of taxes in inducing firms' decisions to engage in green innovation via consideration of cost savings. This cost-saving motivation is especially relevant for smaller businesses. Unlike large corporations, SMEs do not possess the power and resources needed to actively resist coercive pressures through lobbying (Darnall, Henriques, & Sadorsky, 2010). Non-compliance, in turn, leads to legal and financial repercussions, which are much more palpable for resource-constrained SMEs than for large enterprises (Ashton, Russell, & Futch, 2017; Hoogendoorn, Guerra, & van der Zwan, 2015; Horbach et al., 2012; Singh, Jain, & Sharma, 2015). Given SMEs' comparative lack of resources (Halme & Korpela, 2014) and difficulties with access to financing (Del Brío & Junquera, 2003), environmental taxation plays an important role in influencing SME engagement in adopting green innovations, especially those that reduce energy and material use, as these provide clear and immediate cost benefits. In contrast to the traditional neoclassical theory, which frames fiscal measures as inevitably reducing corporate profitability (e.g., Palmer, Oates, & Portney, 1995), the Porter Hypothesis suggests that well-designed environmental policy instruments, including taxation, can stimulate innovation and enhance long-term competitiveness (Porter & van der Linde, 1995). Therefore, environmental taxes as coercive pressure create not only financial incentives to eliminate production inefficiencies through environmental innovations but also motivate companies to develop innovative environmental solutions in-house.

Empirical research confirms that coercive measures perform a dual function. They effectively reduce companies' impact on the environment (Ambec & Barla, 2006; Xing, Liu, Wang, Shen, & Zhu, 2019) while simultaneously acting as a catalyst for the generation of environmental innovations (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013; Demirel & Kesidou, 2011; Doran & Ryan, 2012; Förster, 2015; Tariq et al., 2017). Yet some empirical evidence

challenges the Porter Hypothesis. The study by Ramanathan, Black, Nath, and Muyldermans (2010) examining UK manufacturing firms demonstrated a negative effect of national environmental policy on corporate innovation. Similarly, Triguero, Moreno-Mondéjar, and Davia (2016) found no statistically significant relationship between environmental policies and innovation among European SMEs. These contradictory findings suggest that not all environmental policy instruments are equally effective. The broader institutional context and the type of instrument (e.g., taxes vs. command-and-control regulation) can significantly influence innovation outcomes. Analysis of Chinese firms in Jiang, Wang, and Li (2018) demonstrated that while national-level environmental regulation was negatively associated with the generation of innovations, regional policies had a positive effect on innovation generation. These findings underscore the importance of examining how taxes as a specific source of coercive pressure affect innovation within Russia's unique institutional context. Hence, we propose the first hypothesis.

Hypothesis 1: Environmental tax positively influences both adoption and generation of green innovation in SMEs.

2.3. Customer Pressure and Green Innovation

Corporate customers are another group of actors that play an important role in SME green innovation by exerting normative pressure to comply with environmental norms and standards (Delgado-Ceballos et al., 2012; Zhu, 2016). Such pressure is especially effective for inducing SME engagement in green innovation due to a power imbalance in the relationship between a small supplier and a large buyer (Knudsen, 2013; Touboulic, Chicksand, & Walker, 2014). Under threat of withdrawing their business from SMEs, large corporate customers can effectively influence SMEs to adopt environmental innovations (Saunders, Tate, Zsidisin, & Miemczyk, 2019). This is especially relevant in Russia, whose economy is heavily dominated by large corporations. Many large corporations in Russia act as quasi-governmental institutions promoting the state's sustainability-related goals across the business sector via "soft" measures aimed at bringing the norms and values in professional fields closer to environmental sustainability. As a result, promoting environmental sustainability among their suppliers has become a widespread practice among large Russian companies (Aray, Veselova, Knatko, & Levchenko, 2021).

We hypothesize that the nature of corporate customers' pressure on SMEs (compliance requirements) is conducive to the adoption rather than the generation of green innovations. Unlike environmental tax, which only signals the desired outcome (reduced tax base) but not the means to achieve it, the pressure from corporate customers comes in such a form that already defines the specific actions (rather than just an outcome) necessary to comply with this pressure. In their literature review of sustainable supply chain management, (Jia, Zuluaga-Cardona, Bailey, & Rueda, 2018) point out that for suppliers, normative pressure from the buyer mostly comes in the form of compliance with procurement policies, codes of conduct for suppliers, as well as with international and industry standards. Thus, compliance requirements as a mechanism of normative pressure define the steps and necessary actions with a large degree of clarity, rendering the generation of innovations, which requires more resources than adoption (Damanpour & Wischnevsky, 2006), unnecessary and, in the case of resource-constrained SMEs, excessive.

Studies, such as Berrone, Fosfuri, Gelabert, and Gomez-Mejia (2013); Chen, Yi, Zhang, and Li (2018), and Liao (2018), find a statistically significant impact of normative pressure on the generation of green innovation. Berrone et al. (2013) conceptualize normative pressure through environmental NGOs, Chen et al. (2018) use media coverage, and Liao (2018) combines customer, supplier, and media pressure into one measure. We argue that when exploring customers as a specific actor exerting normative pressure on SMEs, it would be conducive to adoption rather than the generation of green innovation. Therefore, we propose the second hypothesis.

Hypothesis 2: Pressure from corporate customers positively influences adoption but not the generation of green innovation.

2.4. Networks and Green Innovation

Empirical evidence suggests that networking relationships with external actors play a major role in green innovation (Bocken, Farracho, Bosworth, & Kemp, 2014; Cai & Zhou, 2014; Cainelli et al., 2015; Jin, Wang, & Zhu,

2024; Peiró-Signes, Díez-Martínez, & Segarra-Oña, 2024). While networks are widely studied as facilitators of green innovation, contrasting results are present (Passaro, Quinto, Scandurra, and Thomas, 2023). To determine the impact of inter-organizational networks on green innovation, we follow (Huggins, Johnston, & Thompson, 2012) and distinguish between contact networks and alliance networks.

Contact networks, including industry and professional associations, business clubs, chambers of commerce, and other membership networks, can promote green innovation adoption among members by exerting normative and mimetic pressures.

Contact networks can exercise normative pressure by signaling preferred adoption of desirable values and behaviors among their members (Besser & Miller, 2011; Hu & Wang, 2021). Such signaling often occurs through multiple channels, including mission and strategy statements, bylaws, events, awards, and websites. Endorsement and signaling of environmental values by a network result in members' perception of these values as being ingrained in their respective professional fields, which stimulates them to engage in green innovation to maintain legitimacy (Campbell, 2006; Zhu & Mazaheri, 2021).

While SMEs' response to normative pressure can come in the form of generation as well as adoption of green innovation, extant research demonstrates that associational membership networks are not likely to induce the intention to proactively engage in environmental sustainability among Russian SMEs due to the inadequate attention they allocate towards sustainability (Sidorenko, Veselova, & Dikova, 2025). This makes normative pressure inapplicable as a mechanism for Russian networks to facilitate either the generation or adoption of green innovation, as they do not signal the values associated with it sufficiently for normative pressure to occur.

In contrast, by exerting mimetic pressure, contact networks can effectively stimulate the replication of successful practices of peers (Hu & Wang, 2021). As venues for exchanging best practices and experiences, networks expose SMEs to successful cases of green innovation in other firms, making them more likely to engage in green innovation. Such exposure to knowledge acquired by early adopters alleviates the high levels of uncertainty often associated with adopting green innovation (Arfi, Hikkerova, & Sahut, 2018).

Passaro et al. (2023) confirm the impact of mimetic pressure on the sustainable performance of Spanish firms. In the context of green innovation, a recent study by Zhu et al. (2024) finds a statistically significant impact of mimetic pressure on eco-innovation; however, the measurement of eco-innovation explicitly includes both adoption and generation modes, making it impossible to distinguish between the two. We argue that this distinction is highly relevant, as, due to the lack of resources, SMEs exposed to specific environmental practices are more likely to replicate these practices in their existing form rather than attempt to generate novel innovative solutions. Hence, we propose the third hypothesis:

Hypothesis 3: Contact networks positively influence adoption but negatively influences generation of green innovation in SMEs.

While not contributing to green innovation generation, Russian contact networks can potentially facilitate the search for R&D partners and the formation of alliances for collaboration. By engaging in R&D cooperation, SMEs can access complementary assets and mitigate inherent risks, which is pertinent in high-uncertainty fields like green innovation. Empirical research demonstrates that R&D cooperation plays a more significant role in green innovation compared to traditional innovation (De Marchi, 2012; Peiró-Signes et al., 2024). Analysis of resource and competence configurations essential for SMEs' sustainable innovation identified R&D collaboration as an important enabler of SME engagement (Halme & Korpela, 2014).

In contrast, research by Bönte and Dienes (2013) found no significant association between R&D cooperation and the environmental innovation performance of European firms. The authors attribute this finding to the fact that SMEs demonstrating a high degree of environmental sustainability acquire sufficient knowledge and competencies through internal development strategies, rendering external partnerships unnecessary. To further uncover the role of contact networks in SMEs' green innovation, we propose the following hypothesis.

Hypothesis 4: R&D cooperation mediates the relationship between contact networks and the generation of green innovation.

3. METHODOLOGY

The analyses were performed on the World Bank Enterprise Survey data (The World Bank, 2025). All enterprises with more than 250 employees were excluded from the study. The final sample consists of 1,116 SMEs. The analyses were conducted using R version 4.3.1 (R Core Team, 2023). All variables in the study, except size and age (used as controls), are dichotomous. In accordance with the conceptual model, being subject to an environmental tax (energy tax) is used as a specific indicator of exposure to coercive pressure from state authorities, while being subject to environmental compliance requirements from customers indicates normative pressure from corporate customers (customer pressure). Peer exposure in contact networks (network pressure), as a form of mimetic pressure, is proxied by belonging to a contact network. The survey items are available in Appendix 1.

The paper tests two separate empirical models: for green innovation adoption (GIA) and for green innovation generation (GIG). The dependent variables GIA and GIG were constructed by combining and recoding two questionnaire items in the World Bank Enterprise Survey as follows. The first item asked respondents whether the enterprise had undertaken any measures to improve energy efficiency over the past three years. An affirmative answer prompted a follow-up question about whether any of these measures were developed by the establishment itself. The values of the first variable were recorded so that, when combined with the second variable, all meaningful response combinations were clearly delineated: «yes-yes», «yes-no», «no-no», «no-missing». Values «missing-missing» and «yes-missing» were coded as missing. The resulting composite variable was then recoded into two binary variables: GIA (value «yes-no» = 1; other non-missing values = 0) and GIG (value «yes-yes» = 1; other non-missing values = 0) to classify firms into mutually exclusive categories of adopters and generators, with the baseline category implying no measures were undertaken.

4. RESULTS

Hypothesis testing was conducted for GIA and GIG using logistic regression, as the dependent variables are dichotomous. Logistic regression does not assume normality or homoscedasticity of errors (Menard, 2002), making it suitable for the dichotomous nature of the dependent variables. The logistic model for GIA is described by the logit formula and includes environmental tax, customer pressure, and network pressure as independent variables, with size, age, and industry as control variables.

$$\text{logit}(P(GIA_i = 1)) = \beta_0 + \beta_1(Tax_i) + \beta_2(Customer_i) + \beta_3(Network_i) + \beta_4(Size_i) + \beta_5(Age_i) + \beta_6(Industry_i) \quad (1)$$

To test the mediating role of R&D cooperation in the relationship between network participation and GIG, we constructed two logistic regression models. First, we predicted the mediator (R&D cooperation) as a function of network pressure and control variables.

$$\text{logit}(P(R\&D\ coop = 1)) = \gamma_0 + \gamma_1(Network_i) + \gamma_2(Size_i) + \gamma_3(Age_i) + \gamma_4(Industry_i) \quad (2)$$

Second, we predicted GIG as a function of network pressure, R&D cooperation, and control variables.

$$\text{logit}(P(GIG_i = 1)) = \beta_0 + \beta_1(Tax_i) + \beta_2(Customer_i) + \beta_3(Network_i) + \beta_4(R\&D\ coop_i) + \beta_5(Size_i) + \beta_6(Age_i) + \beta_7(Industry_i) \quad (3)$$

We used the variance inflation factor (VIF) and correlation analysis to assess the potential for multicollinearity between the predictors. The results are presented in Appendix 2 alongside descriptive statistics. All VIF values are well below the conservative threshold of 5 (James, Witten, Hastie, & Tibshirani, 2013), with a maximum value of 1.37; while bivariate correlations are below |0.30|, indicating that multicollinearity is not a concern. We also tested for common method bias (CMB) using Harman's single-factor test (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). An exploratory factor analysis loading all variables onto a single factor revealed that the first factor accounted for 19% of the total variance, which is below the 50% threshold, suggesting CMB will not influence the results.

Table 2. Logistic regression for GIA.

Control variables	Model 1	Model 2
	Controls only	Final model
Size ^a	0.30***	0.08
Age ^a	-0.01	0.06
Industry	0.19	0.07
Independent variables		
Environmental tax		0.93***
Customer pressure		0.49**
Network pressure		1.84***
Intercept	-2.55***	-2.50***
Chi-squared (df)	23.4 (3)	147.02 (6)
N _o	1130	1130
Pseudo R ² (Nagelkerke)	0.03	0.19

Note: Unstandardized logistic regression coefficients are reported.

^a Natural logarithm transformation of the original values.

** p < 0.01.

*** p < 0.001.

The positive effects of environmental tax on GIA ($B = 0.93$, $p < 0.001$, Table 2) and GIG ($B = 1.51$, $p < 0.001$, Table 3) allow us to accept Hypothesis 1 that environmental tax influences both the adoption and generation of green innovation. A statistically significant customer pressure coefficient in the GIA model ($B = 0.49$, $p < 0.01$) and its insignificance in the GIG model ($p = 0.66$) support Hypothesis 2 that corporate customers positively influence adoption but not green innovation generation. The significant and positive coefficient of network pressure in the GIA model ($B = 1.84$, $p < 0.001$), together with its significant and negative coefficient in the GIG model ($B = 1.08$, $p < 0.05$), support Hypothesis 3 that contact networks positively influence adoption but negatively influence the generation of green innovation in SMEs. The mediating role of R&D cooperation was tested using bootstrapping with 5,000 samples. Despite network pressure showing a significant positive association with R&D collaboration in Model 1, Table 3 ($B = 1.12$, $p < 0.001$), its effect on GIG in Model 2, Table 3 ($B = 0.60$, $p = 0.47$), and the bootstrapping analysis in Model 3 of Table 3 (ACME = 0, 95% CI: $[-0.002; 0.024]$) were both insignificant, failing to support Hypothesis 4 about R&D collaboration mediating the relationship between contact networks and green innovation generation.

Table 3. Logistic regression for GIG.

Variables	R&D cooperation	GI Generation	
	Model 1	Model 2	Model 3
	Mediator model	Total effects	Direct and indirect effects
Control variables			
Size ^a	0.32*	0.46**	0.45**
Age ^a	-0.12	0.18	0.18
Industry	-0.2	0.45	0.46
Independent variables			
Environmental tax		1.51***	1.50***
Customer pressure		0.18	0.17
Network pressure (NP)	1.1142***	-1.08*	-1.11*
Mediation variables			
R&D cooperation			0.38
Indirect effects			
NP -> R&D coop. -> GI Generation			0.000 [95% CI: -0.002; 0.007]
Constant	-3.681 ***	-5.79 ***	-5.79***
Chi-squared (df)	28.72 (3) ***	42.50 (6) ***	42.98 (7) ***
N _o	1116	1116	1116
Pseudo R ² (Nagelkerke)	0.07	0.13	0.13

Note: Unstandardized logistic regression coefficients are reported for paths a, b, and c'. The indirect effect is the Average Causal Mediation Effect (ACME) derived from bootstrapping (5,000 samples). CI = confidence interval.

^a Natural logarithm transformation of the original values.

* p < 0.05.

** p < 0.01.

*** p < 0.001.

5. DISCUSSION AND IMPLICATIONS

The results reveal that environmental taxes acting as coercive pressure create financial incentives for SMEs to reduce costs through both adopting existing environmental solutions and generating them in-house. Corporate customers' environmental demands function as normative pressure, specifying compliance requirements that favor adoption over the generation of green innovations in SMEs. Contact networks, in turn, exert mimetic pressure by exposing SMEs to peers' successful practices, which encourages adoption of proven solutions but may discourage resource-intensive internal generation.

While partially in line with extant research (e.g., (Bönte & Dienes, 2013; Förster, 2015; Pasamar, Bornay-Barrachina, & Morales-Sánchez, 2025)) the results of the present study are in contrast with some of the existing research on institutional actors and green innovation, such as Berrone et al. (2013); Chen et al. (2018); Liao (2018) and Zhu et al. (2024) who establish a significant relationship between normative pressure and generation of green innovation; and Ramanathan et al. (2010) and Triguero et al. (2016) who find no association between coercive pressure and green innovation. Comparing the obtained results with extant literature allows us to conclude that the effect of institutional antecedents of green innovation in SMEs is highly contingent on a) the innovation mode in question (adoption vs. generation) and b) the specific mechanism by which the institutional actor exerts pressure. In contrast, existing research either does not distinguish between adoption and generation or conflates the type of pressure (e.g., normative) with the actual empirical object of the study, i.e., the mechanisms through which this pressure is exerted. The latter approach is evident in research that conceptualizes institutional pressure either as a composite measure that aggregates multiple actors as sources of one type of pressure Liao (2018) or uses one institutional actor as a direct proxy for the entire theoretical concept (e.g., media pressure as a proxy for normative pressure) (Berrone et al., 2013; Chen et al., 2018).

The constructs of «coercive», «normative», and «mimetic» pressures are theoretical frameworks meant to explain why specific empirical phenomena influence firms, as DiMaggio and Powell (1983) write: "This typology is an analytic one: the types are not always empirically distinct." By shifting the focus from specific mechanisms through which the pressure is exerted to theoretical labels, such research measures the impact of the theory rather than using the theory to understand the impact of specific sources of pressure. Such an approach, while beneficial for theory validation, risks making research tautological and limits the applicability of research findings. Comparing our results to existing research reveals that the impact of institutional forces on green innovation is not determined by the theoretical type of pressure per se (e.g., normative pressure influencing green innovation), but by the specific identity and logic of the institutional actor embodying that pressure. Therefore, we propose both a clear distinction between adoption and generation in green innovation research and a shift from studying the effects of abstract pressures to analyzing the impacts of specific institutional actors and the mechanisms they use to exert pressure. This approach retains the explanatory power of institutional theory while grounding it in reality, ensuring that the research results have clear practical value and are well-suited for informing specific policy actions.

Because innovation outcomes depend on specific mechanisms through which institutional actors exert pressure, their effects should be considered when designing effective policy interventions. For example, given some contrasting results regarding the influence of coercive pressure from the government on green innovation, command-and-control measures may have different effects on green innovation outcomes compared to environmental taxes.

Specifically in the case of Russian SMEs, where command-and-control measures tend to be ineffective for most SMEs, the obtained results indicate a viable potential for other fiscal measures in fostering their environmental sustainability. While it may be too early to consider differentiated taxes and feebates for SMEs that use renewable energy, the significant impact of environmental tax on energy-related innovation points towards the possibility that the introduction of a carbon tax may also be successful in both the dissemination and generation of green innovation. Extensive awareness campaigns across the SME sector should, however, precede the introduction of a carbon tax to ensure the adopted innovations are indeed the best available solutions and the generated ones are valuable enough to

warrant investment. Moreover, the resource-constrained nature of SMEs and the volatile nature of the Russian economy necessitate that, to ensure the tax acts as a catalyst for innovation rather than a fiscal burden, it should be introduced as part of a broader policy package, where revenues are strategically allocated through targeted innovation grants for SMEs, programs to de-risk green technology investments, as well as potentially lower tax burdens in other areas (e.g., corporate income tax). Further research is needed to ex-ante evaluate the potential economic implications of the introduction of a carbon tax, such as simulating the potential economic effects of a carbon tax at various price levels.

The identified irrelevance of corporate customers in fostering green innovation in SMEs, as well as the lack of connection between R&D cooperation and green innovation, highlight the underutilization of collaboration between large companies and SMEs in this area. Extensive empirical evidence demonstrates the effectiveness of collaboration for generating green innovation (Díaz-García et al., 2015). Therefore, policy measures such as grants and fiscal incentives specifically for cross-size R&D collaborations, along with government procurement contracts requiring collaboration, can effectively utilize large companies as drivers of green innovation in SMEs.

An effective policy aimed at collaboration should account for the role of contact networks. Since the results indicate a negative impact of contact networks on the generation of green innovations, networks should find other mechanisms for exercising environmental pressure. By explicitly promoting and rewarding cross-sector collaborations in green innovation development, they can move beyond their roles as venues for sharing best practices and start actively contributing to the generation of novel green solutions. The significant impact of networks on R&D collaboration in general indicates that there is a viable potential, given a well-designed policy and active participation of networks themselves, for such collaborations to advance into the area of green innovation.

The main limitation of the paper is the cross-sectional nature of the data. Hence, the use of longitudinal data in future studies can provide additional validation for the obtained results. Additionally, the paper uses data from a single country. Future studies could provide cross-country comparisons of how the uncovered relationships may differ in other institutional contexts. Finally, establishing how other types of institutional mechanisms beyond those used in this study (e.g., specific command-and-control measures), as well as other institutional actors, affect the adoption and generation of green innovation would contribute to a more comprehensive understanding of the impact of institutional actors on green innovation.

6. CONCLUSION

The paper aims to identify which institutional actors, tax authorities, corporate customers, and networks are universally relevant for SMEs in EMDEs in driving green innovation, whether through adoption or generation, and which are mode-specific. Results from a sample of 1,116 Russian SMEs show that the impact of these actors on green innovation varies depending on whether it is understood as adoption or generation. Environmental taxes create broad incentives that stimulate both modes, while corporate customers impose narrow constraints favoring one over the other. Contact networks have a multidirectional effect: they facilitate adoption via knowledge spillovers but discourage generation by promoting conformity and reducing perceived necessity for in-house innovation.

These results collectively underscore that institutional antecedents of green innovation in SMEs are not monolithic but are highly contingent on both the innovation mode (adoption vs. generation) and the specific mechanisms by which actors exert pressure. Policies should be designed with these divergent effects in mind to stimulate the proliferation of environmental innovation as well as the generation of novel environmental solutions among SMEs. The obtained results point towards the need for a clear distinction between adoption and generation in green innovation research, as well as a potentially higher practical value of studying specific mechanisms through which institutional actors exert pressure as opposed to studying the impacts of abstract pressure types (e.g., coercive, normative, mimetic).

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Appendix 1.

Survey items

Green innovation adoption (GIA)

Over the last three years, did this establishment adopt any measures to enhance energy efficiency?

Green innovation generation (GIG)

Over the last three years, were any of these measures developed by this establishment?

Environmental tax

In fiscal year, was this establishment subject to an energy tax or levy?

Customer pressure

In fiscal year, did any of the establishment's customers require environmental certifications or adherence to certain environmental standards as a condition to do business with this establishment?

Network pressure

Is this firm part of a business membership organization, trade association, guild, chamber of commerce, or other business support group?

Appendix 2. Descriptive statistics and multicollinearity diagnostics for independent and control variables.

Variables	M	SD	VIF ^b	VIF ^c	1	2	3	4	5
1. Environmental tax	0.07	0.25	1.03	1.04					
2. Customer pressure	0.15	0.36	1.09	1.12	0.06*				
3. Network pressure	0.17	0.38	1.16	1.08	-0.02	0.27**			
4. Size ^a	3.29	1.11	1.37	1.26	0.07*	0.16**	0.24**		
5. Age ^a	2.36	0.68	1.12	1.14	-0.00	0.03	0.04	0.29**	
6. Industry	0.64	0.48	1.1	1.06	0.04	0.07*	0.11**	0.26**	0.04

Note: Mean represents the percentage of observations that take the value of 1 for all binary variables (1-4, 7).

^a Natural logarithm transformation of the original values.

^b VIF values for DV GI Adoption.

^c VIF values for DV GI Generation.

* $p < 0.05$. ** $p < 0.01$.

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