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Environmental Tax, SME Financing Constraint and Innovation. Evidence from OECD Countries

By

Ishmael Tingbani¹, Samuel Salia², Javed G. Hussain³ and Yahaya Alhassan⁴

1 University of Southampton, UK. Email: I.S.Tingbani@southampton.ac.uk

2 De Montfort University, Leicester, UK. Email: samuel.saliam@dmu.ac.uk

3 Birmingham City University, Birmingham, UK. Email: Javed.Hussain@bcu.ac.uk

4 University of Sunderland, London Campus, UK. Email: yahaya.alhassan@sunderland.ac.uk

Abstract:

This paper examines the impact of environmental tax on SME innovation and how SME financing constraint moderates this relationship. Given the paucity of research on the implications of financing constraints on SMEs' green innovative activities, the study adopts cross-country panel data to investigate the impact of environmental tax on SME's innovative activities across 24 OECD countries for the period 2000-2019. Results from our study indicate that an increase in environmental tax leads to a decrease in SME innovation. Further, we also find that financing constraint positively moderates the relationship between environmental tax and SME innovation. Our findings shed new light on the theoretical and practical implications of financing constraints on SMEs' green innovative activities.

Managerial Relevance Statement

This paper aims to create awareness amongst managers of the implication of environmental tax on SMEs financing constraints, thereby requiring managerial decisions and strategies to avoid attracting environmental taxes to help them innovate. Thus, the results of this papers will assist SMEs managers in responding to the impact of environmental taxes by pursuing policies that mitigate the impact of environmental taxes. Besides, evidence of how SMEs' financing constraint moderates the relationship between environmental tax and SMEs' innovation has been provided in this paper to guide managers.

Keywords: Green-Innovation, Environmental Tax, SME Financial Constraints, Governance

JEL classifications: G38, M48, Q58, Q55

I. INTRODUCTION

As environmental concerns have increased, this has given rise to greater awareness and urgency to place environmental policies that can arrest the rapid increase in greenhouse emissions. Therefore, the main focus of research has been to pursue practices and policies that promote innovative approaches that mitigate the negative impact of past and present practices that lead to climate degradation (Afrifa et al., 2020). Governments have acknowledged that poor corporate governance and regulatory framework have led to environmental degradation (Elmaggrhi et al., 2019 and He et al., 2021). To address the economic malaise and reduce unemployment, OECD countries have promoted market-based environmental policies to enhance competitiveness through innovative green projects (McLaughlin et al., 2019). However, whether there is a relationship between environmental policies and innovation remains under-explored (Chen et al., 2018; Shao et al., 2020).

It is suggested (Lundgren and Zhou, 2017) that firms being responsible citizens should proactively pursue environmentally friendly policies as a strategic tool to align with societal expectations as part of a corporate social responsibility agenda. However, the evidence on the relationship between innovation, environmental regulations and firms' competitiveness is sparse. This suggests that there is a gap and that there is a need to examine the interconnectedness between firms' green investment and environmental management.

SMEs are major users of energy that contribute towards gas emissions, which are responsible for environmental degradation. In equal measure, SMEs are major contributors to a country's economic growth (Naucler et al., 2012). Given the importance of SMEs for the economy's wellbeing and the environment, there is an expectation that enterprises, being socially responsible, would pursue environmentally friendly practices to reduce the negative impact of their operations on the environment (Chege and Wang, 2020; Lundgren and Zhou, 2017). There has been a realisation amongst OECD countries that they need to adopt innovative practices through technological development to reduce pollution, which has been since the 1960s (Bergek and Berggren, 2014). However, the rapid acceleration of greenhouse emissions has heightened the need for incentives and regulations to innovate and adapt clean technology. To persuade the industry to transition from polluting technologies towards clean practices, there has been a policy shift where economic instruments, such as CO₂ taxes and trading emission approaches, address environmental concerns (Bergek and Berggren, 2014; Song, Wang, & Zhang, 2020). The goal of environmental taxes is to promote innovation in industry to reduce greenhouse emissions. It is suggested that tax instruments are an efficient means to

encourage SMEs to adopt emission reduction technologies instead of regulatory persuasions (Bergquist *et al.*, 2013; Bergek and Berggren, 2014). This suggestion is plausible because firms will innovate and adopt technology to maintain economic efficiency, especially fiscal incentives (i.e. pull factors such as subsidies) and CO₂ taxation (push factors) (Yu & Cheng, 2021). Persuasive regulations alone are insufficient to induce a behaviour change in SMEs' innovation and adaptation of green technologies. As rational actors, economic choices are dictated by profit motives which persuasive regulations alone cannot circumvent.

The economic paradigm of environmental regulation suggests that taxes add to costs. Porter and van der Linde (1995) argue that environmental regulation instruments, such as taxes, can persuade firms to innovate, offset the cost of complying with environmental regulations. However, not all regulations are conducive to innovation. It is suggested that purposefully designed regulations effectively achieve the desired objective and target polluters such as small and medium-sized enterprises (SMEs). SMEs are a significant contributor to GDP and employment (Arshad *et al.*, 2020; Woźniak *et al.*, 2019) and occupy a significant portion of the economy, impacting the environment.

The environmental tax aims to discourage SMEs from polluting the environment and push them towards innovation and the adoption of clean technology. However, there are side-effects of environmental taxes that inadvertently impact negatively on innovation and diffusion amongst SMEs. Such negative effects have not received sufficient attention in the literature, and discussions on the impact of an environmental tax on financing constraints are inconclusive. Requate (2005: 193) suggests that "instruments which provide incentive through the price mechanism, by and large, perform better than command and control policies". This is due to a firm's unwillingness to be more efficient than expected.

Additionally, environmental taxes seek cooperation from SMEs willing to reduce pollution beyond their expected level. For there to be an effective pollution reduction, this requires financial investment. However, SMEs, especially smaller enterprises, tend to have financial constraints (Bodlaj, et al., 2020; Gupta and Barua 2018), which limit their ability to innovate and adopt clean technology. Tax instruments are used to discourage SMEs from pursuing polluting technologies and persuade SMEs, instead, to move to a non-emission infrastructure.

Existing studies on the policies that address environmental concerns tend to focus on infrastructure and technological issues (Pan et al., 2021; Chatzimentor et al., 2020) whilst

omitting the impact of taxation and finance-related concerns. Clean technology infrastructure is capital intensive. Therefore, policy formulation needs to integrate the financial instruments that enable SMEs to engage with environmentally friendly operations. This implies that an analysis that examines environmental regulatory instruments, and its impact on SMEs' innovation, needs to consider financial constraints. This suggests the need for a more informed insight into the linkages between development, clean technology, and taxation.

The purpose of this study is to investigate the impact of an environmental tax on SMEs' innovation and how SMEs' financing constraint moderates this relationship. Hence, this research will prove the effect of tightening environmental policies on financing and innovation in OECD countries. To achieve this objective, the study adopts cross-country panel data to investigate the impact of environmental tax on SMEs' innovative activities. The data set covers 24 OECD countries for the period 2000-2019. The results of this study suggest that environmental taxes have a negative impact on SMEs' innovation. Furthermore, the findings show that financing constraints moderate the relationship between environmental tax and SMEs' innovation.

This paper contributes both to the literature on the use and impact of environmental taxes on SMEs' innovation and finance constraints. This cutting-edge research, to our knowledge is the first study to examine the relationship between environmental, finance constraint, and SMEs' innovation. These empirical findings demonstrate the negative relationship between environmental tax and innovation. Developing policies to mitigate the negative impact of environmental taxes will ensure the desired outcomes of the policy are achieved; this will promote innovation agenda and provide an impetus for sustainable economic development. Our findings are consistent with prior research (Cai *et al.*, 2018; Shao and Xiao, 2019; Damihamedani *et al.*, 2018), indicating that tax impacts firm innovation negatively, which suggests a negative effect tax on financing constraints. Furthermore, this empirical study builds on the findings of existing studies and extends knowledge in that it investigates the impact of an environmental tax on SME innovation and how SME financing constraints moderates this relationship. This understanding will enable practitioners and policy makers to be mindful of the relationship when developing interventions.

We conduct a series of tests to reduce the fear that other economic factors do not confound our results. First, we perform a 2-stage instrumental variable baseline analysis as an identification strategy to tackle endogeneity issues. Second, we adopt propensity score

matching in order to reduce any potential selection and omitted variable biases. Third, we also incorporated a country-level alternative measure of innovation to provide a broader scope of its impact on environmental tax -innovation sensitivity. Lastly, we explore our analysis' sensitivity to financial crises. Overall, we find our baseline results remain robust to all the above robustness checks.

The rest of this paper is structured as follows. A brief review of the pertinent literature is provided in section 2. Methodological considerations are considered and discussed in section 3. In section 4, we report and discuss the empirical results. Finally, in section 5, we provide the conclusions and make recommendations.

II. LITERATURE REVIEW

A. Theoretical Framework

Environmental concerns and implications have gained traction within developed and emerging economies (Hopkinson et al., 2018). Emerging literature explores green innovation, sustainable development, and circular economy (Jiang et al., 2020). The values of assets are informed by managers choice of clean technology utilised to produce innovative goods and services. Thus, there is a causal link between clean technology and the environment; this is further interconnected with the financing decisions of SMEs and government taxation policies. The separation between owners and managers complicates decisions relating to the adoption of clean technology; managers' choices of clean technology may differ from shareholders preferences. Essentially, finance mediates the theoretical linkage between shareholders (Hoskisson et al., 2018; Le et al., 2020) and resource-based view theories (RBV). Therefore, whilst considering stakeholder theory, this research employs the resource-based view to examine the impact of an environmental tax on SMEs financing and innovation to mitigate the adverse impact of environmental hazards. Thus, we use the RBV to explain the relationships between environmental tax, financing constraint and SMEs' innovation in OECD countries. The RBV theory is based on the premise that resources are a significant contributor to the SMEs' ability to innovate and adopt clean technologies, but resources (financial and others) are scarce (Barney, 1991; Kraaijenbrink et al., 2010;) and this involves choices, and when the cost is in the form of environmental taxes, this further complicates the price signalling mechanisms in a competitive market. Thus, the environmental taxes that are used to reduce pollution give rise to a cost that affects resource allocation; hence, environmental taxes have the capacity to impact a SMEs' competitive advantage in the marketplace (Jun et al., 2019;

Yacob et al., 2019; Yang, 2019). There is a strong relationship between SMEs' access to finance, innovation and competitiveness within the marketplace (Adegboye and Iweriebor, 2018).

Mac and Bhaird (2010) postulate that, for a firm to have a sustainable competitive advantage and innovate within the market, it ought to have effective and efficient financial (tangible and intangible) resources. Financial resources are the prerequisite to innovation. Thus, these are critical to enabling SMEs to implement change to mitigate the impact of environmental taxes, thereby sustaining competitive prices to ensure that product demand is not adversely affected (Bergner *et al.*, 2017; Nozawa and Managi, 2019). Hence, SMEs with access to financial resources can reduce gas emissions, invest in clean technology, maintain market share, build an eco-friendly brand, and reduce gas emissions to safeguard the environment.

B. Environmental Tax, Financing Constraint and SMEs Innovation

Environmental policy instruments that aim to foster sustainability tend to be non-prescriptive, such as taxes and cap-and-trade systems (Liao, 2018; Bergek and Berggren, 2014). However, carbon taxes are targeted to replace polluting technologies with efficient and environmentally friendly economic activities. In theory, SMEs should benefit from clean technology. They may receive economic compensation for not incurring social costs by polluting the environment (Lv et al., 2021). Environmental regulatory instruments (financial and technical) control firms' actions by setting acceptable standards that cause a behaviour change. Some of these regulatory instruments are prescribed whilst others are optional, which firms may choose to comply with to enhance their social credentials (Bergek and Berggren, 2014) and brand competitiveness.

Taxation policies through price mechanisms incentivise firms to use or innovate clean technologies to reduce pollution. Some SMEs will merely comply with the mandatory requirements whilst others exceed their mandatory standards (Bergquist et al., 2013). Taxation policies are politically sensitive as they are not well received due to their impact on consumer prices and SMEs' profit. Taxation unequally affects different stakeholders: the larger population bears the penalty for polluting the environment (Noailly, 2012). Thus, affecting behaviour change through carbon taxes and promoting innovation poses economic, social, and political challenges (Zhang and Zhang, 2018; Barrage, 2020). Therefore, the challenge for

researchers is to disaggregate the impact of an environmental tax on SMEs innovation due to scarcity of energy that leaves limited choices for firms.

Fiscal instruments are used for a range of objectives; however, environmental taxes are specific to lowering polluting activities through incentives that enable firms to adopt clean technology. Firms that invest in sustainable technologies are compensated with lower carbon taxes, and SMEs polluting the environment are penalised through higher taxes. Environmental tax policies drive SMEs to use clean technologies to avoid tax costs (Lv et al., 2021). Fiscal policy is distinct from regulatory instruments, prescribed regulations that ensure that SMEs comply with specific requirements to avoid penalties (Bergek and Berggren, 2014). However, the carbon tax impact on product prices motivates SMEs to innovate and develop clean technologies. Such fiscal policies have political and economic implications for inducing SMEs to innovate (Zhang et al., 2020; Caldera et al., 2019; Barrage, 2020). Raising taxes makes the political establishment unpopular, as this leads to higher prices.

In contrast, the regulatory policies are more directed at SMEs to employ clean technologies; thus, the cost is borne by SMEs (Marin *et al.*, 2015). However, the adoption of clean technologies burdens SMEs with a higher cost that negatively impacts them because they lack the resources for innovation (Bakar *et al.*, 2020). Also, there exists a risk of market failures, including information asymmetry and competitive advantages for SMEs. To address the market anomaly, SMEs may reduce innovation costs and allocate resources in financing innovation projects. As a result, product value can be increased to achieve green productivity.

Shareholder theory (Le et al., 2020) links environmental concerns that SMEs have to respond to mitigate the adverse impact of gas emissions. According to Chithambo et al. (2021), stakeholders have a crucial role in adverting the adverse impact of gas emissions. In responding to these stakeholder pressures, SMEs are now adopting innovative, cutting-edge technologies to mitigate their environmental pollution activities to enhance their performance (See Boakye et al., 2021; 2020). Governments have attempted to use environmental regulatory tools to effect behaviour change; one such policy is environmental tax (Elmagrhi et al., 2019; Doan et al., 2021). Figure 1, the conceptual framework, illustrates the causal relationship between environmental tax and SMEs innovation to mitigate environmental degradation. This gives rise to whether environmental tax policy discourages environmental pollutions, as observed in He et al. (2021). Financial theory suggests that environmental tax is a cost element that reduces the finance level available for SMEs to innovate, as illustrated in figure 1 below. This,

therefore, raises important questions. Firstly, will environmental tax increase the cost of SMEs or not. Secondly, does financing constraint play a role in this relationship to determine whether or not environmental tax burdens SMEs innovation?

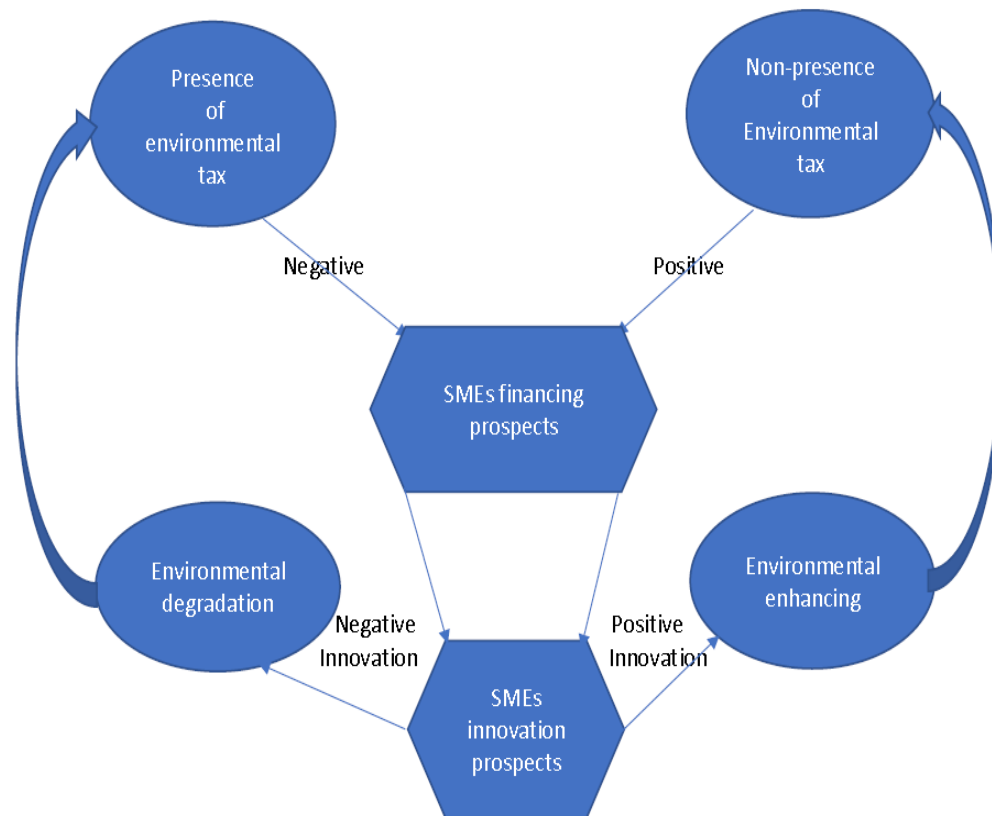


Figure 1: Conceptual framework-Relationships between Environmental tax, SMEs financing and innovation prospects

Source: Authors 2021

Environmental tax leads to finance constraints for SMEs that negatively impact a firm's innovation and adoption of clean technologies (Aghion et al., 2012; Brancati, 2015; Hall and Sena, 2017). Financially constrained SMEs are less likely to invest in green technologies or innovation due to the risk of failure (Madrid-Guijarro *et al.*, 2016). This is further corroborated by Silva and Carreira (2012), who report a negative relationship between SMEs' financial constraints and innovation. These findings are also supported by Loof and Nabavi (2016). Adopting technology and innovation is negatively associated with capital constraints. The introduction of carbon taxes exacerbates the SMEs' ability to finance constraining technology. Innovation is negatively associated with capital constraints, and the introduction of carbon taxes exacerbates SMEs' financing constraints. The literature on finance constraint focuses on information asymmetry, financial constraint, collateral, and financial institutions' rigidities in

their lending policies towards high-risk technology to reduce gas emissions (Harvie, *et al.*, 2013; Xiang et al., 2019). The tax literature is focused on the administration of corporate tax regimes and the effect on innovation (Cai et al., 2018; Shao and Xiao, 2019; Damihamedani et al., 2018). For example, Cai et al. (2018) examined the impact of a switch in corporate tax collection from local to state tax bureau on firm innovation.

Similarly, Shao and Xiao (2019) explored the causality of corporate tax on firm innovation in developing countries whilst, Damihamedani et al. (2018) evaluate the relationship between corporate tax and innovative entrepreneurship. However, extant empirical findings examine the relationship between environmental tax and its impact on SMEs' financing constraints and innovation. Thus, this study attempts to fill in an important gap in the literature that examines the impact of environmental taxes and their unintended consequences for SMEs innovation.

This empirical research examines how financial constraints and environmental taxes affect SMEs' innovation amongst OECD countries. Therefore, this study using OECD countries data firstly examines the impact of an environmental tax on SMEs innovation capabilities and consequences for achieving gas emission reduction. We propose our first hypothesis:

H1: Environmental tax has a negative impact on SMEs' innovation

The second hypothesis explores the causes and consequences of an environmental tax on SMEs financing prospects and how this impacts SME innovation capabilities. Based on this, we propose our following hypothesis:

H2: The relationship between environmental tax and SMEs' innovation is positively moderated by finance constraints.

III. RESEARCH METHODOLOGY

A. Data and Sample

The study adopts cross-country panel data to investigate the impact of environmental tax on SMEs' innovative activities. Our data set covers 24 OECD countries for the period 2000-2019. We collected data on the environmental tax from the OECD and Innovation and SME financing constraints from the Global Entrepreneurship monitor. We also use the World Bank Development Indicators (WBDI) data to capture the individual governance indicators, GDP, interest rates and inflation. In contrast, data was captured from the World Bank Development

Indicators (WBDI). The countries included are as follows: Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, U.K., Slovenia, Latvia, Canada, and the USA. The sample of countries employed in the data is shown in Table 1.

B. Variable Definitions

This paper's primary dependent variable is innovation, proxied by the percentage of R&D to GDP. Several studies have used R&D expenditure to measure innovation (Afrifa et al., 2020; Cirera et al., 2016). For instance, Afrifa et al. (2020) adopted R&D in their study to measure innovation efforts. According to Afrifa et al. (2020), R&D expenditure provides much robust evidence of firms and countries' scientific and technological efforts compared to other types of innovative measurements. The advantage of using R&D expenditure as a measure of innovation is that it is easily quantifiable. It demonstrates the extent to which national research and development lead to the new commercial opportunities available to firms (Cirera et al., 2016). This paper's main independent variable is environmental tax, measured as a tax whose tax base is a physical unit (or a proxy of it) that has a proven specific negative impact on the environment. Several prior studies have similarly used this measure to capture environmental tax policies among several countries (Lu et al., 2019; Wang and Yu, 2021). In the study, we also adopt the availability of financial resources—equity and debt—for small and medium enterprises (SMEs) to capture the SME financing constraint.

To control factors that may impact the relationship between environmental tax and SME's innovative activities, we controlled specific country-level characteristics, including inflation, GDP, and interest rate. The inflation rate is determined by constant changes in the general prices of goods and services produced within a country. Prior studies, including Funk and Kromen (2010), demonstrate that inflation negatively impacts firms' innovation. The level of economic growth impacts the level of innovation made by firms. Firms operating in high growth countries tend to be more innovative than their peers in low growth countries (Demirel and Danisman, 2019; Lee, 2018). In view of this, GDP is measured in terms of real GDP growth rate to capture the country's overall economic activities. Following the World Economic Outlook 2020 report, we measure GDP as the total value at constant prices of goods and services produced within a country in a year. Interest rate is captured using long-term interest rates charged by government bonds maturing in ten years. Long-term rates impact the firm's investment and innovative activities. Given the impact of governance on innovative and

economic activities within a country, we further examine the moderating influence of country-level governance factors, including political stability, government effectiveness, regulatory quality, and control of corruption, on the impact of an environmental tax on SME's innovative activities.

C. Econometric Model

To examine the relationship between environmental tax, the SME financing constraint and SME's innovative activities, the following regression equation was estimated:

$$\begin{aligned} \text{Innovation}_{it} = & \alpha_i + \beta_1 \text{Environmental tax}_{it} + \beta_2 \text{SME Finance}_{it} + \beta_3 \text{GDP}_{it} + \\ & \beta_4 \text{Inflation}_{it} + \beta_5 \text{Interest rate}_{it} + \beta_6 \text{Environmental tax} * \\ & \text{SME Finance}_{it} + \text{Year effects}_i + \text{Country effects}_{it} + \\ & \varepsilon_{it} \end{aligned} \quad (1)$$

To examine the interaction influences of political stability, government effectiveness, regulatory quality and control of corruption on the relationship between environmental tax and SME's innovative activities, we estimated the following econometric Equation:

$$\begin{aligned} \text{Innovation}_{it} = & \alpha_i + \beta_1 \text{Environmental tax}_{it} + \beta_2 \text{SME Finance}_{it} + \beta_3 \text{GDP}_{it} + \\ & \beta_4 \text{Inflation}_{it} + \beta_5 \text{Interest rate}_{it} + \beta_6 \text{Environmental tax} * \text{SME Finance}_{it} + \\ & \beta_7 \text{Environmental tax} * \text{Governance}_{it} + \beta_8 \text{Governance}_{it} + \text{Year effects}_i + \\ & \text{Country effects}_{it} + \\ & \varepsilon_{it} \end{aligned} \quad (2)$$

This is where the variable, governance, denotes governance indicators, including political stability, government effectiveness, regulatory quality and control of corruption. ε_{it} represents the disturbance term. β is the vectors of coefficient estimates. Table 1 below defines all the variables used in this study.

[INSERT TABLE 1]

IV. EMPIRICAL ANALYSES

A. Descriptive Statistics

Table 2 presents the study's descriptive statistics. All the continuous variables were winsorised at 1% to reduce the problem of outliers. Evidence from Table 2 suggests that as a

percentage of GDP, OECD countries generate, on average, 7% tax revenue from environmental tax with a median and standard deviation of 7% and 2%, respectively. The standard deviation figure demonstrates a substantial variation in the different environmental tax revenues across the sample. Similarly, we also find mean innovation across the sample to be 3%, with standard deviation and median values of 0.42% and 2.7%, respectively. In terms of the SME financing constraint, we find that, on average, SMEs get access to about 3% of financial resources to enhance their growth opportunities. With respect to the control variables, we find the average GDP to be approximately £38 billion. The mean interest rate and inflation is 3.8% and 0.2 %, respectively. For the governance indicator variables, we find the mean governance effectiveness, political stability, regulatory quality, and control of corruption to be 1.4, 0.87, 1.3 and 1.4, respectively. Appendix 1 also presents a country-wide mean distribution of Innovation, Environmental Tax, and Financial Constraints for the sample. In Column (1), we observe Latvia and Slovenia have the highest share of Environmental Taxes 10.08% and 9.95%, respectively and Canada with the lowest of 3.72%. Column (4) displays mean wide cross-country variation in SME's innovative activities ratio. Switzerland and Luxembourg have the highest innovation ratios of 3.33% and 3.07%, respectively, whilst the Slovak Republic has the lowest ratio of 2.05%. In terms of SME financing constraints, we observed that SMEs in Netherlands and Latvia have the highest access of about 30% and 26% to financial resources to enhance their growth opportunities, whilst Canada has the lowest access of about 12%.

[INSERT TABLE 2]

B. Pearson Correlation Matrix

Table 3 presents the Pearson correlation matrix for the study. The findings presented in the table suggest a significantly negative correlation between environmental tax and SME innovation. We find the correlations between all the control variables below 50%, and, therefore, they indicate no multicollinearity concerns.

[INSERT TABLE 3]

C. Baseline Regression: Environmental Tax, SME Financing Constraint, and Innovation

The theoretical justification for environmental taxes is that it discourages polluting energy, which will increase the use of green energy and give rise to the use of innovative approaches. The hypotheses

are motivated based on this relationship contextualising economic (fiscal policy) and SMEs clean technology adoption to innovate. Table 4 presents the baseline regression results on the relationship between environmental tax, financing constraint, and SME innovation to test the proposition. Column (1) provides the results of the moderating impact of the SME financing constraint on the relationship between environmental tax and SME innovation without control variables, country, and year effects. Column (2) reports the moderating impact of the SME financing constraint on the relationship between environmental tax and SME innovation without country and year effects. Column (3) presents the relationship between SME financing's moderating impact on environmental tax and SME innovation with the relevant control variables and controls for variables' year and country effects.

Results from Column (1) of Table 4 reveal that the environmental tax's coefficient is negative and statistically significant at the 1% level ($\beta = -0.0446$, t -statistic = -3.05). This suggests that an increase in environmental tax costs (Marin *et al.*, 2015) constrains SMEs' innovation. This is consistent with earlier studies that suggest firms are less likely to adopt technologies or innovation due to the risk of failure (Madrid-Guijarro *et al.*, 2016). This is more pronounced in the face of financing constraints. In line with this, we found the interaction term coefficient of Environmental Tax X SME financing constraints to be positive and statistically significant. Given the influence of the country's macroeconomic factors on country-level data, we suspect that the evidence presented in Column (1) might be driven by the country's macroeconomic climate and not only by the environmental tax. In view of this, we control for, in Column (2) of Table 4, the possibility of macroeconomic factors impacting a firm's innovation.

[INSERT TABLE 4]

Interestingly, we find that each of the coefficients has increased in magnitude. We further controlled for the country and individual year effects in Column (3). Like Column (2),

we find that all signs and significance are maintained with a relatively increased coefficient magnitude. In particular, we find the interactive term's coefficient (Environmental Tax X SME financing constraints) to be positive and statistically significant at the 1% level ($\beta = 0.120$, t -statistic = 2.94), and that high environmental tax significantly constrains the innovative efforts of financially constrained SMEs. This supports our hypothesis that finance constraints positively moderate the relationship between environmental tax and SMEs' innovation. The literature corroborates the results (Aghion et al., 2012; Brancati, 2015; Hall and Sena, 2017). The higher green tax has a negative impact on SMEs innovation, similar to the “Schmookler hypothesis” (Jiang et al., 2020). The overall evidence from Columns (1), (2) & (4) suggests that although environmental tax negatively impacts SMEs' innovation efforts, its impact tends to be more severe among financially constrained SMEs. The study finds their estimated coefficients broadly consistent with prior studies (Chu et al., 2015). For instance, we find a significantly positive relation between GDP and innovation in all columns, indicating that high economic growth countries innovate more. However, interest rates and inflation are insignificant in all columns (see columns 1, 2 & 3).

D. Further Analysis: Governance, Environmental Tax, and Innovation

We extend our analysis by exploring the impact of governance on the relationship between environmental tax and innovation. Several prior literature works have argued that countries with good governance invest and pursue innovative initiatives to support businesses' growth. Given this, the study adopts several governance indicators relevant to estimating the impact of an environmental tax on SME innovation, especially among OECD countries. The first governance indicator adopted for this study is political stability. Existing evidence suggests that political instability generates vulnerability that distorts institutional and government efforts to develop innovative policies to support businesses' growth and survival (Barro, 1991; Alesina and Perotti, 1996; Cummings et al., 2016). According to Barro (1991) and Alesina and Perotti (1996), government instability, unrest and political violence are significantly associated with

cross-country differences in investment and growth. We argue that the relationship between environmental tax and innovation is most likely influenced by political stability.

Table 5 reports the findings on the relationship between political, environmental tax and innovation. The overall evidence suggests that political stability significantly moderates the relationship between environmental tax and innovation throughout Columns (1) – (3). Specifically, we find the coefficient of the interaction term (Environmental Tax X Political stability) is positive and statistically significant at the 1% level ($\beta = 0.149$, t-statistics = 3.33) for Column (3). The evidence suggests that governments become more effective in managing environmental tax revenues within a stable political system to support firms' innovation, especially SMEs. Our findings suggest that a 10% increase in political stability accounts for a 15% drop in the firm's innovation's environmental tax impact. The findings suggest that the impact of an environmental tax on innovation becomes less severe within a politically stable environment. This is consistent with current studies (Alesina and Perotti, 1996; Cumminngs, 2016) that political stability impacts innovation. Interestingly, we find the interactive term's coefficient (Environmental Tax X SME financing constraints) positive and statistically significant throughout all the columns (see columns 1-3). This evidence supports our initial findings in Column (3) of Table 4 that SME financing constraints positively moderate the relationship between environmental tax and SME innovation. We find the results of the control variables to be similar to the previous results of Table 4.

[INSERT TABLE 5]

The second governance indicator that the study further explored is governance effectiveness. Prior literature reveals that government effectiveness in creating and enabling a business environment significantly impacts investment decisions (Giroud and Mueller, 2010; Billett et al., 2011). According to Billett et al. (2011), firms with good governance experience attract and effectively manage significant investments. This is evident from Giroud and Mueller's 2010 findings that poor governance contributes to the underinvestment of firms. Several prior shreds of evidence suggest that government effectiveness matters in countries' innovative efforts (Becker-Blease, 2011 Sapra et al., 2015). The overall evidence suggests that countries that maintain effective governments become more successful in pursuing effective, innovative policies towards supporting firms' growth and survival. Building on these findings, we argue that government effectiveness most likely influences the relationship between environmental tax and innovation.

Table 6 reports the findings on the relationship between government effectiveness, environmental tax and innovation. Evidence from Table 6 reveals that government effectiveness positively moderates the relationship between environmental tax and innovation in Columns (1), (2) & (3). This is consistent with previous estimations. Consistent with our expectations, we also find the coefficient of the interaction term (Environmental Tax X SME financing constraints) is positive and statistically significant at the 1% level ($\beta = 0.432$, t-statistics = 2.92) for Column (3). This confirms our previous findings that SME financing constraints positively moderate the relationship between environmental tax and innovation.

[INSERT TABLE 6]

The third most crucial governance indicator, which significantly impacts the relationship between environmental tax and innovation, is regulatory quality. For the extent that the prior evidence shows that regulatory quality significantly impacts governments' innovation outcomes see Zhuge et al. (2020). Against this backdrop, we expect the regulatory quality to significantly moderate the relationship between environmental tax and innovation. Table 7 presents the empirical results on a regulatory quality's role in the relationship between environmental tax and innovation. The evidence from Table 7 suggests that regulatory quality has an insignificant relationship between environmental tax, regulatory quality and innovation throughout all the columns of Table 7. On the other hand, we find the coefficient of the interaction term (Environmental Tax X SME financing constraints) to be positive and statistically significant at the 1% level ($\beta = 0.368$, t-statistics = 2.70) for Column (3), thus confirming our previous findings that are presented in Table 4.

[INSERT TABLE 7]

Finally, we explore the implication of corruption on the relationship between environmental tax and innovation. We build our argument on the premise that the pace and extent of innovative activities tend to be affected by corruption (Wellalage et al., 2020). For example, corrupt governments may distort innovative policies because corrupt politicians (or corrupt public officers) may be expected to use their authority on those activities. It is easier to collect bribes (see Hwang, 2002). In view of this, we investigate the empirical link between control of corruption, environmental tax and innovation. Evidence of this relationship is presented in Table 8. Evidence from Table 8 shows an insignificant relationship between control of corruption, environmental tax and innovation throughout all the columns of Table 8. Similar to the rest of the estimation presented, we find that the coefficient of the interaction

term (Environmental Tax X SME financing constraints) is positive and statistically significant at the 1% level ($\beta = 0.113$, t -statistics = 2.60) for Column (3). This confirms our previous findings that SME financing constraints positively moderate the relationship between environmental tax and innovation.

[INSERT TABLE 8]

V. ADDITIONAL RESULTS AND ROBUSTNESS CHECKS

This section conducts a series of tests to determine our analysis's sensitivity after controlling for endogeneity and alternative measures of the relevant variables, subsamples, and periods.

A. *Endogeneity Concerns*

We predict a fundamental problem on the relationship between environmental tax, financing constraint, and SMEs innovation is endogeneity. This could be explained by the fact that the amount and type of environmental tax and financial constraints in the sample countries are not exogenous and thus a key potential source of endogeneity. For instance, the level of both green and non-green product innovation may very well determine environmental tax, implying that causality might occur in the reverse direction. Given this, the study adopts several steps in addressing the above issues of causality and endogeneity associated with the study.

B. *Dynamic Activity of Innovation and Its Non-linearity*

Existing evidence suggests that innovation is a dynamic activity, given that knowledge acquired from previous SME innovation is used in the current innovation procedure (Dziallas and Blind, 2019; Kneller and Manderson, 2012). Moreover, R&D spending in the current year cannot reflect the innovation (process and product) of the same year. Against this backdrop, the study adopts a dynamic panel regression to mitigate further endogeneity issues. In order to achieve this, we adopt lag values of all the variables used for the study, including the dependent variable (innovation) and the independent variable (Environmental Tax). Evidence from dynamic panel regression is presented in Panel B of Table 9. The econometric regressions and control variables are the same as in Table 4. The results are consistent with the baseline results presented in Table 4 and show a statistically significant relationship between innovation and environmental tax. Consistent with our predictions, we find that the lag value of SME innovation (dependent variable) significantly impacts the current year's innovation. Therefore, the evidence suggests that knowledge acquired from previous innovation is significantly

relevant for a country's current year's innovation strategy of SMEs (Dziallas and Blind, 2019; Azar and Ciabuschi, 2017).

To further strengthen the results, we also captured the non-linear relationship between SME innovation and environmental tax. This is because R&D expenditure normalised by GDP may vary from country to country depending on unobserved country-level factors, which may cause the relationship between SME innovation and an environmental tax to be non-linear. Because of this, we adopt a squared term of environmental tax in the regression model to capture the non-linear relationship between SME innovation and environmental tax. Panel A of Table 9 presents the key findings of the non-linear relationship between SME innovation and environmental tax. Evidence from Table 9 finds the significant negative relationship between the squared term of environmental tax and SME innovation. We also find a significantly positive relationship between environmental tax and SME innovation. The overall evidence clarifies that the negative impact of an environmental tax on innovation has a short-term effect on a country's innovation. In the long term, the impact of an environmental tax on SME innovation tends to be beneficial to countries. This is consistent with the evidence presented by (Bitencourt et al., 2020). According to Bitencourt et al. (2020), regulatory instruments have significant antecedents to green innovation, further underscoring the importance of understanding the relationship between green tax regulations and innovation, as argued in this paper.

[INSERT TABLE 9]

C. Two-Stage Least Square

Even though the extensive use of sets of control variables and the use of lagged independent variables may reduce reverse causality issues, the study believes issues of reverse causality and endogeneity may not be fully resolved. Therefore, to further address the endogeneity concerns, we conduct an instrumental variable analysis as an identification strategy to tackle the fear that environmental tax and innovation could be exogenous in establishing the quality and type of innovation. Following Lei et al. (2018), we employed a two-stage least square procedure using three country-level instruments to encapsulate the different country-level aspects of the amount and type of environmental tax. These instruments include Information Sharing, Legal Origin and Creditors Rights. In the study, we examine closely the validity of the IVs used for the study's IV estimations. For the variables to be classified as a valid instrument, they ought to have been both exogenous (uncorrelated with the

regression residuals) and relevant (highly correlated with the endogenous explanatory variable) for the study. Instrument relevance is confirmed by first-stage regressions (untabulated for brevity). Instrument relevance is further established by Angrist-Pischke's weak identification test and Cragg-Doland statistics. Hansen's overidentification test has a joint null hypothesis of proper IVs (relevance and exogeneity). The validity of IVs is substantiated by the fact that we cannot reject the null hypothesis at a conventional level of significance. We also found both the Durbin (score) Chi-Square and Wu-Hausman F statistic test for endogeneity, suggesting the 2SLS approach is appropriate with the relevant instruments given the endogeneity problem.

Aside from these tests of the validity of the instruments, the study also suggests that these three instrumental variables are exogenous (uncorrelated with the regression residuals) and relevant (highly correlated with the endogenous explanatory variable) to country-level other variables in the models. For instance, Legal Origin, Creditor Rights, and Information Sharing are significantly related to SME finance and credit. Several prior studies (Bhattacharya and Daouk, 2002; Qian and Strahan, 2007) have suggested that countries with strong creditor rights protect lenders from agency costs and facilitate repossession of collateral in default. According to Mann (2015), elevated creditor rights promote the use of patents, an essential intangible asset used as collateral to lessen covenants on loans and borrowings. We expect the overall benefit of more substantial creditor rights to be disproportionately higher among innovative firms at the country level.

Similarly, legal origin impacts the level of investment. La Porta et al. (1998) also argues that laws vary a lot across countries because of differences in legal origin, which affects the level of protection on the investments for both shareholders and creditors. According to the authors, common law countries give both creditors and shareholders better protection and legal rights compared to civil law countries. This form of protection is relevant in securing and protecting the firm's investment in innovation, especially patent and R&D investment. Information sharing has been argued to significantly affect access to and the cost of credit (See Behr and Sonnekalb 2012). Similarly, Kamaşak and Bulutlar (2010) demonstrate the effects of information sharing on innovation. Evidence from the study suggests that knowledge collecting had a significant effect on all types of innovation and ambidexterity.

The findings of our first stage regression are presented in Panel A of Table 10. In each of the results presented in Table 10, we regressed environmental tax on our instrumental variables: Information Sharing, Legal Origin and Creditors Rights and all the control variables

used in Equation (2). In the second stage, we used the predicted probability from the first stage regression to represent the environmental tax variable as the primary independent variable in Equation (2). Results of the second stage estimations are presented in Panel B of Table 10. The results confirm our previous evidence that financial constraint moderates the relationship between environmental tax and SME innovation. The result, however, implies that financial constraint remains relevant for a country's environmental tax policy for SME innovation after controlling for endogeneity.

[INSERT TABLE 10]

D. The Sensitivity of Crisis Period

We further explored our analysis' sensitivity to the financial crisis. Our premise is influenced by Duchin et al. (2010), suggesting that during the 2008 financial crisis, firms relied heavily on excess cash to finance their investment, including innovation. As a result, the effect of environmental tax and financial constraints on SME innovation may be unique to the crisis periods. To investigate this possibility, we divide our sample into crisis and non-crisis periods. We identified 2007, 2008, and 2009 as crisis years and presented the results in Table 11. A dummy variable is a proxy for crisis 1 for the crisis periods (2007, 2008, and 2009) and 0 for any other years.

Panel A presents the interactive effects of financial constraint and environmental tax on countries' innovation during financial crisis periods. The evidence throughout the Panel A of Table 11 supports our previous evidence that financial constraint and environmental tax positively affect SME innovation during the financial crisis. Therefore, it can be deduced that environmental tax negatively impacts SME innovation during the financial crisis due to the financial constraint countries tend to face during such periods. Consistent with Autry et al. (2010), investments in innovation and related technologies may not be advisable in such a turbulent environment.

E. Propensity Score Matching

Countries are intrinsically different in many aspects, which, in addition to financial constraint, may also influence the relationship between environmental tax and SME innovation. For instance, the sample's amount and type of environmental tax and financial constraints are not likely to be exogenous. Potentially, the evidence could be embedded in the quality and type of innovation. The results so far do not tell us whether the impact of an environmental tax on

SME innovation is likely to vary based on the level of SME innovation (high versus low innovation countries). Thus, are countries with high-level SME innovation demonstrate slightly less environmental tax SME innovation outcomes on average? However, given that our data is observational, countries are not randomly assigned to be high or low innovation countries. We split our sample into two high and low innovations for a better comparison based on the corresponding annual median following Lei et al. (2018). We created a dummy level of innovation, 1 for high innovation countries, i.e. countries with annual R&D per GDP values higher than the corresponding annual median and low countries for those below the corresponding annual median. We considered high innovation countries as our treatment group and low innovation countries as the control group.

In order to enhance covariate balance between the two groups, we need to ascertain the overlap assumption is satisfied, i.e. whether there is a chance of seeing observations in both the control and treatment groups. To achieve this, Maffioli et al. (2009) suggest the need to run t-tests of equality of means before and after the matching to evaluate if the PSM succeeds in balancing the characteristics between treated and untreated groups. In view of this, the study adopts a calliper of 0.1 to estimate the absolute difference in propensity scores between treated and untreated groups. A calliper of 0.1 denotes a match for each pair of observations with an absolute difference in propensity scores less than 0.1. The overlap balance graphical plots in Fig 2 demonstrate evidence of overlap of propensity scores between the treated and the control group of the sample with a high level of common support, demonstrating that the overlap assumption is satisfied.

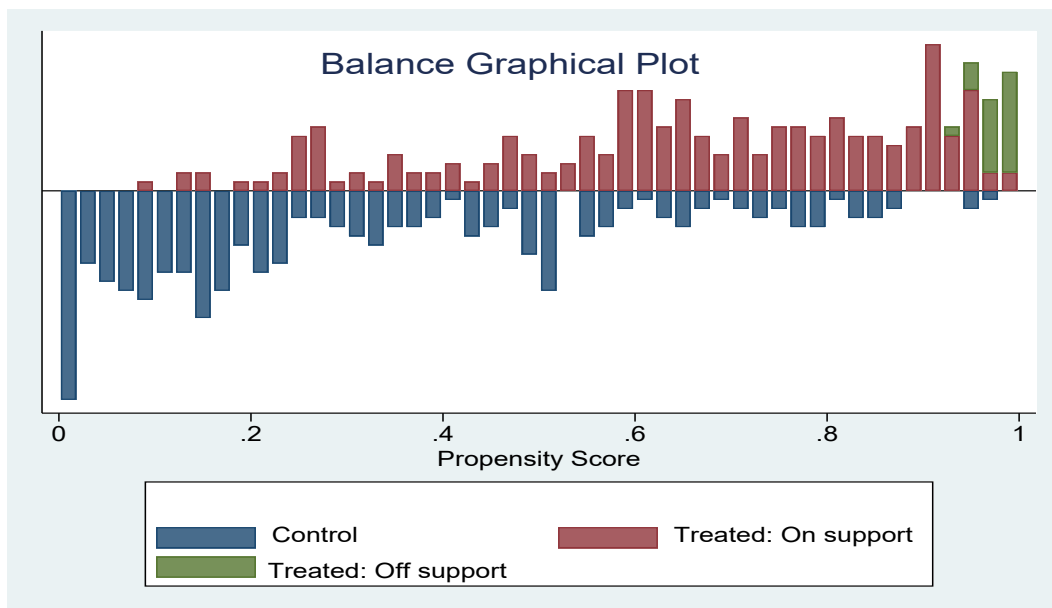


Fig 2: Graphical Balance Plot

In order to further determine the covariate balance of the sample, we conducted a formal balancing test, with the evidence presented in Table 11A. Evidence from the Table suggests a substantial reduction of the absolute values of standardised percentage biases for all the covariates. All the absolute standardised percentage biases after matching are reduced to less than 10. Before matching, we find the mean and median absolute standardised percentage biases for all the covariates to be 15.9 and 2.2, respectively. However, after the matching, both the mean and median absolute standardised percentage biases drop dramatically to 1 and 1.2. We also find the likelihood ratio (LR) tests for all the covariates to be jointly significant both before and after matching. Further, we matched one-to-one all the selected variables to the nearest neighbourhood (NNM) without replacement and match firms with similar scores in the study.

Using the level of innovation dummy as the dependent variable, we deploy a probit model for estimating the propensity scores, including all the control variables used in our previous estimations. The test shows that the propensity score-matched samples of high innovation countries (treated) firms are broadly similar to low innovation countries (control) firms. The results from the propensity score matching are presented in Panel B of Table 11B. The econometric regressions and control variables are the same as in Table 4. The results are consistent with the baseline results presented in Table 4 and show statistically significant differences in the level of SME innovation between propensity score-matched (comparable) High and Low innovation countries. In all estimations, common probability support of the treated and control units is enforced to ensure better comparability of matched units. The overall evidence suggests a complete fulfilment of the overall balancing condition for each outcome. Overall, the propensity score process appears to remove obvious sample selection biases and strengthen our results' robustness

[INSERT TABLE 11A &B]

F. Alternative Measure of Innovation

We adopt the country innovation rate as an alternative measure of our dependent variable to further enhance our results' robustness. Following (Kelley et al., 2012), our measure of innovation was replaced with the innovation rate. Innovation rate measures the percentage of firms involved in total early-stage entrepreneurial activity, which indicate that their product or service is new to at least some customers and that few/no businesses offer the same product (Kelley et al., 2012; Rusu and Dornean, 2019). A high innovation rate score reflects a high rate

of innovation for a country. In light of this, we further rerun our estimation using innovation rate as an alternative measure of innovation to determine our analysis's sensitivity to an alternative measure of innovation. However, we align the empirical analysis with the model by repeating the model's predictions of the impact of an environmental tax on our new measurement of innovation (innovation rate) to avoid any disconnections between the theoretical definition of normalised innovation its accepted empirical counterpart.

The results are presented in Table 12. Column (1) shows the relationship between environmental tax, SME financing constraints and innovation rate. Columns (2) - (4) report on the implications of the various governance indicators (political stability, government effectiveness, regulatory quality and control of corruption) on the relationship between environmental tax and innovation rate, respectively. The results throughout the columns remain substantial and statistically significant, as previously established. In particular, we find the coefficient of the interaction term (Environmental Tax X SME financing constraints) positive and statistically significant as previously established. Overall, the evidence presented in Table 12 suggests that all our new innovation measures positively and significantly moderate the relation between environmental tax and innovation rate.

[INSERT TABLE 12]

VI. SUMMARY AND CONCLUSION

Environmental taxes, theoretically, are imposed to influence behaviour change in firms to mitigate adverse environmental outcomes. Thus, encouraging green innovation. Within this context, SMEs' innovation is critical for all economies to develop a technology that will help reduce carbon emission to better the environment. The paper contributes to the literature. It empirically demonstrates the extent to which taxes are used to discourage firms from polluting the environment. To measure the effectiveness of environmental taxes, the paper uses data from OECD countries and tests the effect of green tax on SMEs' capability to innovate and discontinue polluting technologies. Summary of the key findings shows that (a) environmental taxes negatively impact SMEs ability to innovate, (b) financing constraint moderates the relationship between environmental tax and SMEs innovation, (c) financial constraint and environmental tax positively affect SME innovation during the financial crisis due to the financial constraint countries tend to face in such periods.

SMEs encounter a finance constraint that tends to affect their investment strategy at large and, most specifically, their ability to innovate and use environmentally friendly

technologies. Internally generated working capital is insufficient to invest in clean technologies (Kenney et al., 2020; da Silva et al., 2017). Thus, to encourage investment in clean technologies, SMEs rely on external finance. However, external finance for innovation and the adoption of clean technology are not easily accessible due to its high risk, limiting SMEs' ability to innovate. The analysis suggests that SMEs have a financial gap that limits their ability to innovate technologies that reduce carbon emission, and environmental taxes exacerbate these outcomes. Due to the existence of a finance gap, instead of innovating and embedding technologies, SMEs merely comply with environmental regulations to avoid paying environmental taxes. These findings suggest that a financing constraint will positively affect the relationship between environmental tax and SMEs' innovation to reduce carbon emission.

Finance is a resource required for innovation, and environmental taxes are a cost that increases the cost of innovation; this generates a vicious cycle that negates the purpose of using environmental taxes to encourage SMEs to replace polluting technologies. This suggests that fiscal policies, such as green taxes, are insufficient to persuade SMEs to bring about a change to their behaviour. There is, therefore, a case for government intervention to finance SMEs' innovation through a financial stimulus to promote eco-innovation (Cecere et al., 2020).

Results reported in Table 4 question the environmental tax policy used to encourage SMEs to innovate and adopt green technologies. The results indicate that the environmental tax's coefficient is negative and statistically significant at the 1% level. This suggests that an increase in environmental tax constrains SMEs' innovation. The findings also reveal that the interaction term coefficient of environmental tax and SME financing constraints is positive and statistically significant. Given the influence of the country's macroeconomic factors on the country-level data, we suspect that the evidence presented in Column (1) might be driven by the countries' macroeconomic climate and not only by the environmental tax. Therefore, we controlled for macroeconomic factors such as interest rate, GDP and inflation. However, the results remained unchanged (i.e. the impact of an environmental tax on SMEs' financing constraint). The results further showed that governance factors (i.e. political instability, corruption, regulatory quality and government effectiveness) significantly moderate the relationship between environmental tax and SMEs' Innovation.

Our results suggest that environmental taxes impact SMEs' innovation, but finance constraint negatively impacts innovation. These findings support the resource-based view theory in that finance is a significant motivator for SMEs' innovation. It encourages them to respond to the impact of environmental taxes by pursuing policies that mitigate the impact of

environmental taxes. These findings suggest that environmental taxes (push factors) need to be accompanied by additional stimulus (pull factors) to encourage SMEs to shift towards innovation and the adoption of clean technologies.

Empirical findings of the study have implications for governments, policymakers and practitioners in OECD countries to encourage green innovation. There is the need to re-examine the mechanism to encourage green innovation without negatively impacting SMEs access to finance. Firstly, policymakers should ensure that environmental taxes complement the public sector initiatives that enable SMEs to innovate. Secondly, policy measures should consider the macroeconomic and governance environment to further the agenda for environmental management. Thirdly, more attention should be paid to the potential negative impact of environmental taxes on SMEs financing as a means to encourage green innovation.

The limitations of this study are: First, not all economies in the sample have well developed financial environment and taxation systems; thus, we ought to be mindful that environmental taxes will affect countries in the sample differently. Secondly, given that we focused on the OECD countries; the findings might not be generalised to other countries where the effect of environmental taxes on SMEs' innovation may differ depending on the social-economic factors. Thus, the result might not be replicable in different countries. Another limitation worth acknowledging is that our study covered a limited period from 2000 to 2019. thus, our results may suffer from an in-depth chronology.

Future studies should focus on cross-country data to examine the impact of environmental tax to optimise the tax policies targeting behaviour change. In addition, subject to data availability, future studies should segregate the different types of firms, sectors, intensity of carbon emission and their respective response to the environmental tax.

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Appendix 1: A Country-Wide Mean Distribution

This table presents results of a country-wide mean distribution of Innovation, Environmental Tax, and Financial Constraints.

| List of countries | Environmental Tax | Innovation | SME financing constraint |
|--------------------------|--------------------------|-------------------|---------------------------------|
| Belgium | 5.112 | 2.925 | 16.064 |
| Canada | 3.723 | 2.861 | 11.527 |
| Denmark | 9.418 | 2.614 | 25.692 |
| Denmark | 9.418 | 2.614 | 25.692 |
| Finland | 6.907 | 2.801 | 20.457 |
| France | 5.184 | 2.846 | 14.415 |
| Germany | 6.028 | 2.747 | 17.706 |
| Greece | 7.859 | 2.364 | 17.934 |
| Hungary | 7.221 | 2.228 | 17.784 |
| Iceland | 6.230 | 2.716 | 14.590 |
| Ireland | 8.012 | 2.837 | 23.334 |
| Italy | 7.469 | 2.353 | 18.279 |
| Luxembourg | 6.329 | 3.073 | 15.996 |
| Netherlands | 9.513 | 2.652 | 30.422 |
| Norway | 6.005 | 2.722 | 16.498 |
| Poland | 7.334 | 2.180 | 19.562 |
| Portugal | 8.088 | 2.672 | 22.286 |
| Slovak Republic | 6.901 | 2.049 | 18.039 |
| Spain | 5.704 | 2.539 | 13.773 |
| Sweden | 5.070 | 2.554 | 13.926 |
| Switzerland | 6.389 | 3.331 | 19.826 |
| UK | 7.375 | 2.537 | 21.367 |
| USA | 3.172 | 2.821 | 10.609 |
| Slovenia | 9.950 | 2.302 | 24.301 |
| Latvia | 10.081 | 2.281 | 26.086 |

Table 1: Variables' Definition

| Name | Definition | Data source |
|------------------------------------|---|---|
| Innovation | The extent to which national research and development will lead to new commercial opportunities is available to SMEs. | Global Entrepreneurship Monitor (https://www.gemconsortium.org/data) |
| SME financing constraint | The availability of financial resources—equity and debt—for small and medium enterprises (SMEs) (including grants and subsidies). | Global Entrepreneurship Monitor (https://www.gemconsortium.org/data) |
| Innovation Rate | Percentage of those involved in Total early-stage entrepreneurial activity indicates that their product or service is new to at least some customers AND that few/no businesses offer the same product. | Global Entrepreneurship Monitor (https://www.gemconsortium.org/data) |
| Environmental Tax | A tax whose tax base is a physical unit (or a proxy of it) has a proven specific negative impact on the environment. | https://data.oecd.org/envpolicy/environmental-tax.htm |
| GDP | Represents the total value of constant prices of final goods and services produced within a country in a year. | https://www.imf.org/external/datamapper/NGDP_RPCH@WEA/OEMDC/ADVEC/WEOWORLD |
| Long Term Interest Rate (interest) | Refer to government bonds maturing in ten years. Rates are mainly determined by the price charged by the lender, the risk from the borrower and the fall in the capital value | https://data.oecd.org/interest/long-term-interest-rates.htm |
| Inflation | Inflation, GDP deflator (annual %) | https://info.worldbank.org/governance/wgi/ |
| Political Stability | Estimate of governance (ranges from approximately –2.5 (weak) to 2.5 (strong) governance performance) | https://info.worldbank.org/governance/wgi/ |
| Government Effectiveness | Estimate of governance (ranges from approximately –2.5 (weak) to 2.5 (strong) governance performance) | https://info.worldbank.org/governance/wgi/ |
| Regulatory Quality | Estimate of governance (ranges from approximately –2.5 (weak) to 2.5 (strong) governance performance) | https://info.worldbank.org/governance/wgi/ |
| Control of Corruption | Estimate of governance (ranges from approximately –2.5 (weak) to 2.5 (strong) governance performance) | https://info.worldbank.org/governance/wgi/ |
| Information Sharing | A time-varying indicator variable equals one if either a public registry or a private bureau operates in the country, zero otherwise. Information sharing among creditors about clients' past (and possibly subsequent) indebtedness helps alleviate the costs of information asymmetries, and therefore facilitate lending decisions and promote more lending. | Data source: Djankov et al. (2007). |
| Creditor rights | An index aggregating four powers of secured lenders in bankruptcy. A score of one is added to the index when a country's laws and regulations provide each of these powers to secured creditors to arrive at the | Data source: La Porta et al. (1998) |

aggregate creditor rights index: (1) whether there are restrictions imposed, such as creditors' consent, when a debtor files for reorganization (restrictions on reorganization); (2) whether secured creditors have the ability to seize collateral after the petition for reorganization is approved (no automatic stay or asset freeze); (3) whether secured creditors are ranked first in the distribution of proceeds of liquidating a bankrupt firm as opposed to other creditors such as employees or government (secured creditor paid first); and (4) whether an administrator, rather than the incumbent management, is in control of a property pending and responsible for running the business during the reorganization (no management stay). The aggregate creditor rights index ranges from zero to four, with higher values indicating stronger creditor rights.

Legal origin

We categorised countries due to differences in legal origin. Common-law countries give both shareholders and creditors more substantial legal rights compared to civil law countries. Against this backdrop, we constructed a dummy legal origin 1 for common law and any other zero.

Data source: La Porta et al. (1998)

Table 2: Descriptive Statistics:

This table reports the descriptive statistics of the variables under consideration. All variable definitions are contained in Table 1. * indicates statistical significance at 5%.

| | Obs | Mean | Std. Dev. | perc 10 | Median | perc 90 |
|--------------------------|-----|--------|-----------|---------|--------|---------|
| Environmental Tax | 480 | 6.878 | 1.998 | 4.391 | 6.913 | 9.527 |
| SME financing constraint | 480 | 2.757 | 0.417 | 2.265 | 2.73 | 3.300 |
| Innovation Rate | 480 | 30.621 | 8.46 | 21.52 | 28.74 | 44.41 |
| Innovation | 480 | 2.757 | 0.417 | 2.265 | 2.73 | 3.300 |
| GDP | 480 | 38,797 | 16,851 | 20,897 | 36,316 | 58,070 |
| Interest Rate | 480 | 3.875 | 2.504 | 0.7296 | 3.895 | 6.429 |
| Inflation | 480 | 0.161 | 0.638 | 0.010 | 0.048 | 0.195 |
| Political Stability | 480 | 0.87 | 0.84 | 0.31 | 0.130 | 0.93 |
| Government Effectiveness | 480 | 1.40 | 0.53 | 0.595 | 1.56 | 1.150 |
| Regulatory Quality | 480 | 1.34 | 0.406 | 0.59 | 0.250 | 1.82 |
| Control of Corruption | 480 | 1.395 | 0.75 | 0.26 | 1.565 | 1.310 |

Table 3: Correlation Matrix

This table reports the correlation matrix of the variables under consideration. All variable definitions are contained in Table 1. * indicates statistical significance at the 5%

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|----------------------------|----------|----------|----------|----------|----------|----------|---------|---------|---------|----|
| 1 Innovation | 1 | | | | | | | | | |
| 2 Environmental Tax | -0.2945* | 1 | | | | | | | | |
| 3 SME financing constraint | 0.5204* | -0.2402* | 1 | | | | | | | |
| 4 GDP | 0.4747* | -0.3453* | 0.1641* | 1 | | | | | | |
| 5 Interest Rate | -0.2543* | 0.2364* | -0.3268* | -0.5450* | 1 | | | | | |
| 6 Inflation | -0.2152* | 0.0458 | -0.1669* | -0.3086* | 0.4789* | 1 | | | | |
| 7 Political Stability | 0.3216* | 0.0382 | 0.1752* | 0.2855* | -0.0524 | 0.0455 | 1 | | | |
| 8 Government Effectiveness | 0.5609* | -0.2355* | 0.4265* | 0.4776* | -0.2988* | -0.1783* | 0.5480* | 1 | | |
| 9 Regulatory Quality | 0.4696* | -0.2098* | 0.4395* | 0.5436* | -0.3797* | -0.1483* | 0.4642* | 0.8541* | 1 | |
| 10 Control of Corruption | 0.5394* | -0.2380* | 0.3742* | 0.5438* | -0.2919* | -0.1520* | 0.5594* | 0.9463* | 0.8666* | 1 |

Table 4: Baseline Regression: SME Financing Constraint, Environmental Tax, and SME Innovation

This table presents the baseline cross-country panel data fixed effect regression results of model (1) on the moderating impact of SME financing constraint on the relationship between environmental tax and SME Innovation. Column (1) provides the results of the moderating impact of SME financing constraint on the relationship between environmental tax and SME innovation without control variables, country, and year effects. Column (2) reports the moderating impact of SME financing constraint on the relationship between environmental tax and SME innovation without country and year effects. Column (3) presents the relationship between the moderating impact of SME financing constraint on environmental tax and SME innovation with the relevant control variables and controls for variables' year and country effects. Time and country-level dummies are included in the estimations but not reported. A detailed definition of all the variables is in Table 1. T statistic is in brackets. Degrees of freedom are in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

| | (1) | (2) | (3) |
|--|-----------------------|----------------------|-----------------------|
| | Innovation | Innovation | Innovation |
| Environmental Tax | -0.0446*** (-3.05) | -0.0378** (-2.36) | -0.0442*** (-2.69) |
| SME financing constraint | 0.674*** (7.08) | 0.638*** (6.31) | 0.648*** (6.37) |
| GDP | | 0.157*** (3.04) | 0.314*** (4.55) |
| Interest Rate | | 0.0121 (1.74) | 0.00568 (0.90) |
| Inflation | | -0.00262 (-0.42) | -0.00522 (-0.81) |
| Environmental Tax X SME financing constraint | 0.093 *** (2.21) | 0.101** (2.53) | 0.120** (2.94) |
| Constant | 0.110 *** (2.80) | -0.767** (-0.90) | 18.44* (1.74) |
| Year dummy Included | No | No | Yes |
| Country dummy Included | No | No | Yes |
| N | 480 | 480 | 480 |
| R-Squared | 0.27 | 0.39 | 0.48 |

Table 5: Political Instability, Environmental Tax and SME Innovation

This table reports a cross-country panel data fixed effect regression results of model (2) on the impact of political instability on the relationship between SME financing constraint, environmental tax and SME Innovation. Column (1) provides the results of the impact of political instability on the relationship between SME financing constraint, environmental tax and SME Innovation without control variables, country, and year effects. Column (2) reports the relationship without for country and year effects. Column (3) presents the relationship with the relevant control variables and controls for variables' year and country effects. Time and country-level dummies are included in the estimations but not reported. A detailed definition of all the variables is in Table 1. T statistic is in brackets. Degrees of freedom are in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

| | (1) | (2) | (3) |
|--|-----------------------|-----------------------|-----------------------|
| | Innovation | Innovation | Innovation |
| Environmental Tax | -0.0983*** (-4.64) | -0.0469*** (-2.93) | -0.0475*** (-2.96) |
| Political Stability | -0.0513** (-2.39) | -0.0260 (-1.28) | -0.0362* (-1.69) |
| SME financing constraint | | 0.685*** (6.89) | 0.672*** (6.84) |
| GDP | | 0.154*** (2.92) | 0.277*** (3.79) |
| Interest Rate | | 0.00870 (1.33) | 0.00301 (0.45) |
| Inflation | | -0.00104 (-0.17) | -0.00275 (-0.43) |
| Environmental Tax X SME financing constraint | 0.392** (2.36) | 0.307** (2.12) | 0.334** (2.31) |
| Environmental Tax X Political stability | 0.0491*** (8.20) | 0.140*** (3.21) | 0.149*** (3.33) |
| Constant | 2.34 *** (15.62) | -1.10** (-1.33) | 15.84* (1.19) |
| Year dummy Included | No | No | Yes |
| Country dummy Included | No | No | Yes |
| N | 480 | 480 | 480 |
| R-Squared | 0.26 | 0.44 | 0.49 |

Table 6: Governance Effectiveness, Environmental Tax and SME Innovation

This table presents a cross-country panel data fixed effect regression results of model (2) on the implications of governance effectiveness on the relationship between SME financing constraint, environmental tax and SME Innovation. Column (1) presents the results without control variables, country, and year effects. Column (2) reports the relationship without for country and year effects. Column (3) presents the relationship with the relevant control variables and controls for variables' year and country effects. Time and country-level dummies are included in the estimations but not reported. A detailed definition of all the variables is in Table 1. T statistic is in brackets. Degrees of freedom are in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

| | (1) | (2) | (3) |
|--|-----------------------|----------------------|----------------------|
| | Innovation | Innovation | Innovation |
| Environmental Tax | -0.0831*** (-4.63) | -0.0370** (-1.98) | -0.0423** (-2.09) |
| Governance effectiveness | -0.0333 (-1.31) | -0.0307* (-1.76) | -0.0309* (-1.76) |
| SME financing constraint | | 0.560*** (5.19) | 0.554*** (5.10) |
| GDP | | 0.118** (2.32) | 0.215** (2.39) |
| Interest Rate | | 0.00822 (1.31) | 0.00521 (0.84) |
| Inflation | | -0.00219 (-0.36) | -0.00349 (-0.56) |
| Environmental Tax X SME financing constraint | 0.772*** (5.37) | 0.441*** (3.01) | 0.432*** (2.92) |
| Governance effectiveness X Environmental Tax | 0.0475*** (8.06) | 0.119*** (2.75) | 0.127*** (2.84) |
| Constant | 2.34 *** (15.62) | -1.10** (-1.33) | 15.84* (1.19) |
| Year dummy Included | No | No | Yes |
| Country dummy Included | No | No | Yes |
| N | 480 | 480 | 480 |
| R-Squared | 0.40 | 0.47 | 0.49 |

Table 7: Regulatory Quality, Environmental Tax and SME Innovation

This table reports the results of a cross-country panel data fixed effect regression results of model (2) on the effect of regulatory quality on the relationship between SME financing constraint, environmental tax and SME Innovation. Column (1) presents the results without control variables, country, and year effects. Column (2) reports the relationship without for country and year effects. Column (3) presents the relationship with the relevant control variables and controls for variables' year and country effects. Time and country-level dummies are included in the estimations but not reported. A detailed definition of all the variables is in Table 1. T statistic is in brackets. Degrees of freedom are in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

| | (1) | (2) | (3) |
|--|----------------------|----------------------|-----------------------|
| | Innovation | Innovation | Innovation |
| Environmental Tax | 0.113*** (2.60) | -0.0422** (-2.30) | -0.0786*** (-3.33) |
| Regulatory quality | -0.0423** (-2.31) | -0.0408 (-0.27) | -0.0106 (-0.07) |
| SME financing constraint | | 0.661*** (5.77) | 0.639*** (5.63) |
| GDP | | 0.146*** (2.70) | 0.333*** (3.80) |
| Interest Rate | | 0.0111 (1.60) | 0.00455 (0.71) |
| Inflation | | -0.00321 (-0.49) | -0.00443 (-0.68) |
| Environmental Tax X Regulatory quality | -0.00623 (-0.30) | 0.00902 (0.48) | -0.0515 (-3.07) |
| Environmental Tax X SME financing constraint | 0.0500*** (8.39) | 0.0941** (2.25) | 0.368*** (2.70) |
| Constant | 2.19*** (8.10) | -0.65** (-0.81) | 20.76* (1.52) |
| Year dummy Included | No | No | Yes |
| Country dummy Included | No | No | Yes |
| N | 480 | 480 | 480 |
| R-Squared | 0.26 | 0.40 | 0.47 |

Table 8: Control of Corruption, Environmental Tax, and SME Innovation

This table reports results of a cross-country panel data fixed effect regression results of model (2) on the effect of control of corruption on the relationship between SME financing constraint, environmental tax and SME Innovation. Column (1) presents the results without control variables, country, and year effects. Column (2) reports the relationship without for country and year effects. Column (3) presents the relationship with the relevant control variables and controls for variables' year and country effects. Time and country-level dummies are included in the estimations but not reported. A detailed definition of all the variables is in Table 1. T statistic is in brackets. Degrees of freedom are in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

| | (1) | (2) | (3) |
|--|-----------------------|---------------------|---------------------|
| | Innovation | Innovation | Innovation |
| Environmental Tax | -0.0788*** (-3.97) | -0.0334* (-1.91) | -0.0338* (-1.93) |
| Control of Corruption | 0.455*** (4.70) | 0.252** (2.38) | 0.239** (2.24) |
| SME financing constraint | | 0.590*** (5.43) | 0.579*** (5.33) |
| GDP | | 0.0959* (1.80) | 0.244*** (2.80) |
| Interest Rate | | 0.00852 (1.34) | 0.00468 (0.75) |
| Inflation | | -0.00449 (-0.74) | -0.00534 (-0.86) |
| Environmental Tax X Control of Corruption | -0.0474*** (-3.92) | -0.0190 (-1.44) | -0.0252 (-1.72) |
| Environmental Tax X SME financing constraint | 0.0478*** (8.06) | 0.104** (2.46) | 0.113*** (2.60) |
| Constant | 2.06*** (11.43) | -0.30** (-0.38) | 15.79* (1.10) |
| Year dummy Included | No | No | Yes |
| Country dummy Included | No | No | Yes |
| N | 480 | 480 | 480 |
| R-Squared | 0.39 | 0.46 | 0.49 |

Table 9: SME Financing Constraint, Environmental Tax, and SME Innovation using Non-linear relationship and Dynamic Model

This table presents a cross-country panel data fixed effect regression results of model (1) on the impact of SME financing constraint on the relationship between environmental tax and SME Innovation using a non-linear and dynamic model estimation. Panel A provides the results of a non-linear relationship of SME financing constraint on the relationship between environmental tax and SME innovation. We took the square of environmental tax to capture its non-linear term. Panel B reports the dynamic panel results of SME financing constraint on the relationship between environmental tax and SME innovation. We lagged of both the dependent and independent variables in the dynamic model of panel B. All control variables, time and country-level dummies are included in the estimations but not reported. A detailed definition of all the variables is in Table 1. T statistic is in brackets. Degrees of freedom are in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

| | Panel A: Non-linear relationship | | | | | Panel B: Dynamic model | | | | |
|--|----------------------------------|----------------------|--------------------------|-----------------------|-----------------------|------------------------|----------------------|--------------------------|-----------------------|-----------------------|
| | Innovation | Political Stability | Government Effectiveness | Regulatory Quality | Control of Corruption | Innovation | Political Stability | Government Effectiveness | Regulatory Quality | Control of Corruption |
| Innovation _{t-1} | | | | | | 0.581*** (12.19) | 0.575*** (11.80) | 0.564*** (11.66) | 0.584*** (12.41) | 0.568*** (11.82) |
| Environmental Tax Squared | -0.006*** (-2.83) | -0.006*** (-2.89) | -0.00922*** (-4.02) | -0.0069*** (-2.85) | -0.009*** (-3.97) | | | | | |
| Environmental Tax | 0.181** (2.57) | 0.209*** (3.06) | 0.274*** (3.67) | 0.197*** (2.61) | 0.251*** (3.58) | -0.049*** (-3.27) | -0.017*** (-5.72) | -0.0161*** (-4.59) | -0.0119*** (-3.31) | -0.0186*** (-5.47) |
| SME financing constraint | -0.0379** (-2.14) | -0.0421** (-2.50) | -0.0228 (-1.32) | -0.0246 (-1.32) | -0.0262 (-1.58) | -0.0818** (-2.10) | -0.0282** (-2.39) | -0.0223* (-1.80) | -0.0286** (-2.09) | -0.0248** (-2.09) |
| Environmental Tax X SME financing constraint | 0.575*** (5.00) | 0.604*** (5.59) | 0.460*** (4.18) | 0.503*** (4.25) | 0.499*** (4.72) | 0.017*** | 0.213*** (5.20) | 0.176*** (3.85) | 0.189*** (4.17) | 0.174*** (3.76) |
| Governance Indicator | | 0.261** (2.46) | 0.550*** (4.05) | 0.164 (1.08) | 0.348*** (3.87) | | 0.0562 (0.62) | 0.176* (1.86) | 0.154* (1.70) | 0.103 (1.62) |
| Environmental Tax X Governance Indicator | | 0.0277* (1.74) | 0.0601*** (3.41) | 0.0274 (1.40) | 0.0403*** (3.44) | | 0.00338 (0.26) | 0.0146 (1.20) | 0.00105 (0.08) | 0.00811 (1.00) |
| Constant | 29.53*** (4.99) | 27.82*** (4.04) | 19.58*** (2.80) | 32.35*** (4.86) | 25.83*** (3.84) | 5.890 (1.18) | 7.506 (1.24) | 4.057 (0.67) | 5.760 (0.97) | 5.608 (0.94) |
| Control Variables Included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year dummy Included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country dummy Included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 480 | 480 | 480 | 480 | 480 | 456 | 456 | 456 | 456 | 456 |
| R-Squared | 0.51 | 0.52 | 0.54 | 0.52 | 0.54 | 0.63 | 0.64 | 0.63 | 0.64 | 0.63 |

Table 10: SME financing constraint, Environmental tax, and SME Innovation using two-stage least square estimation:

This table presents the relationship between SME financing constraint, Environmental tax, and SME Innovation using two-stage least square (2SLS) estimations. Panel A report the first-stage estimations on the effect of SME financing constraint, Environmental tax, and SME innovation. Panel B present the second-stage estimations. The study adopts Information Sharing, Legal Origin and Creditors Rights as key instruments for the instrumental variable regressions. A detailed definition of all the variables is in Table 1. A year and industry dummies are included in the estimations but not reported. T statistic is in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively. Instrument relevance is further established by Angrist-Pischke's weak identification test and Cragg-Doland statistics. Hansen's overidentification test, which has a joint null hypothesis of proper IVs (relevance and exogeneity), is also presented in the table.

| | Panel A: First-stage estimations | | | | | Panel: Second-stage estimations | | | | |
|---|----------------------------------|----------------------|--------------------------|----------------------|-----------------------|---------------------------------|-----------------------|--------------------------|----------------------|-----------------------|
| | Innovation | Political Stability | Government Effectiveness | Regulatory Quality | Control of Corruption | Innovation | Political Stability | Government Effectiveness | Regulatory Quality | Control of Corruption |
| Environmental Tax | -0.682 (-0.90) | -0.754 (-1.54) | -0.774* (-1.82) | -0.914* (-1.76) | -1.110 (-1.62) | -0.159*** (-6.66) | -0.155*** (-8.00) | -0.0881*** (-3.10) | -0.149*** (-5.69) | -0.110*** (-5.40) |
| Environmental Tax | 0.420*** (2.87) | 0.417*** (6.65) | 0.403*** (6.45) | 0.528*** (8.16) | 0.478*** (6.48) | 0.0499*** (5.67) | 0.0498*** (8.89) | 0.0470*** (8.30) | 0.0525*** (9.08) | 0.0491*** (8.69) |
| SME financing constraint | -1.137 (-0.69) | -1.229 (-1.21) | -1.443 (-1.56) | -1.701 (-1.44) | -2.224 (-1.43) | 0 . | 0 . | 0 . | 0 . | 0 . |
| GDP | 0.229 (0.89) | 0.241 (1.52) | 0.276* (1.90) | 0.324* (1.73) | 0.403* (1.65) | 0.487*** (5.43) | 0.458*** (10.75) | 0.431*** (9.10) | 0.541*** (11.51) | 0.455*** (9.62) |
| Interest Rate | 0.0501 (1.03) | 0.0565* (1.84) | 0.0552** (2.24) | 0.0567** (2.05) | 0.0702* (1.88) | 0.0206** (2.10) | 0.0205*** (3.60) | 0.0181*** (3.23) | 0.0176*** (3.07) | 0.0172*** (3.18) |
| Inflation | -0.0309 (-1.50) | -0.0342** (-2.23) | -0.0325** (-2.33) | -0.0334** (-2.27) | -0.0403** (-2.03) | -0.0171* (-1.96) | -0.0179*** (-2.64) | -0.0138** (-2.16) | -0.0155** (-2.30) | -0.0155** (-2.45) |
| Governance Indicator | | -0.295 (-0.85) | -0.0313 (-1.32) | -0.0306 (-0.92) | -0.0536** (-2.19) | | 0.107 (0.96) | -0.0417*** (-2.66) | -0.0113 (-0.73) | -0.0316*** (-3.25) |
| Environmental Tax X Governance Indicator | | 0.0423 (0.92) | 0.237 (1.29) | 0.0213 (0.10) | 0.318** (2.20) | | -0.00830 (-0.49) | 0.379*** (3.15) | 0.00575 (0.04) | 0.260*** (3.38) |
| Constant | 22.44 (1.38) | 18.21* (1.76) | 21.53** (2.52) | 32.93*** (3.76) | 31.25*** (3.34) | 29.67*** (2.96) | 27.16*** (4.00) | 25.07*** (3.69) | 35.01*** (5.38) | 30.34*** (4.58) |
| N | 480 | 480 | 480 | 480 | 480 | 480 | 480 | 480 | 480 | 480 |
| Year dummy Included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country dummy Included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Angrist-Pischke χ^2 -statistic p-value (underidentification) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | | |

| | | | | | | | | | | |
|---|-------|--------|--------|--------|--------|------|------|------|------|------|
| Angrist-Pischke F-statistic p-value (weak identification) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | | | | |
| Hansen J-statistic p-value (overidentification) | 0.202 | 0.146 | 0.133 | 0.158 | 0.187 | | | | | |
| Cragg-Doland Wald F Stat | 46.62 | 299.57 | 334.43 | 244.28 | 243.87 | | | | | |
| R-Squared | 0.16 | 0.10 | 0.07 | 0.12 | 0.11 | 0.50 | 0.52 | 0.53 | 0.51 | 0.53 |

Table 11A: Balancing Test:

This table presents the balancing test results for the propensity score matching for the study. $|\% \text{Bias}|$ denotes the absolute value of standardised percentage bias, which is the % difference of the sample means in the treated and non-treated (full or matched) sub-samples as a percentage of the square root of the average sample variances in the treated and non-treated groups. The last two rows report the likelihood ratio (LR) test for the joint insignificance of all the regressors, along with the p-values in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively, based on t-tests for means equality in the two samples (before and after matching).

| | Before Matching | | | After Matching | | |
|--|-----------------|---------|--------------------|----------------|---------|--------------------|
| | Treated | Control | $ \% \text{Bias} $ | Treated | Control | $ \% \text{Bias} $ |
| Environmental Tax | 6.4121 | 6.230 | 44.6*** | 6.4121 | 5.5641 | 0.49* |
| GDP | 10.647 | 10.308 | 2.1 | 10.647 | 10.639 | 1.20 |
| Interest Rate | 3.2271 | 4.30 | -0.6 | 3.2271 | 3.2405 | 1.25 |
| Inflation | 1.8764 | 2.151 | 1.5 | 1.8764 | 1.8451 | 1.23 |
| SME financing constraint | 2.8985 | 2.890 | 2.3 | 2.8985 | 2.8899 | 1.28 |
| Environmental Tax X SME financing constraint | 18.54 | 17.875 | 44.3*** | 18.54 | 16.023 | 0.53* |
| Mean $ \% \text{Bias} $ | | | 15.9 | | | 1.00 |
| Median $ \% \text{Bias} $ | | | 2.2 | | | 1.22 |
| LR Test | | | 215.35*** | | | 22.54*** |

Table 11B: SME Financing Constraint, Environmental Tax, and SME Innovation using Financial Crisis and Propensity Score Matching

This table presents the fixed effect regression and propensity score matching results of the financial crisis effect on the impact of SME financing constraint on the relationship between environmental tax and SME Innovation. Panel A provides the results of the financial crisis effect on the impact of SME financing constraint on the relationship between environmental tax and SME innovation. A dummy variable is a proxy for crisis 1 for the crisis periods (1991, 2001, 2007, 2008, and 2009) and 0 for any other years. Panel B reports the propensity score matching results of SME financing constraint on the relationship between environmental tax and SME innovation using a probit model. ATT is the Average Treatment effect on the Treated using the *Nearest neighbour* matching. Note that all standard errors refer to bootstrapped standard errors (the analytical ones do not differ much and are rather underestimated). # treated (# untreated) is the number of treated (control) units. All control variables, time and country-level dummies are included in the estimations but not reported. A detailed definition of all the variables is in Table 1. T statistic is in brackets. Degrees of freedom are in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

| | Panel A: Financial Crisis | | | | | Panel B: Propensity Score Matching | | | | |
|--|---------------------------|---------------------|--------------------------|----------------------|-----------------------|------------------------------------|--------------------------|--------------------------|----------------------|-----------------------|
| | Innovation | Political Stability | Government Effectiveness | Regulatory Quality | Control of Corruption | Innovation | Political Stability | Government Effectiveness | Regulatory Quality | Control of Corruption |
| Environmental Tax | -0.0986** (-2.09) | -0.0820* (-1.75) | -0.0920** (-1.99) | -0.0985** (-1.98) | -0.0902** (-2.01) | -0.0646** (-2.49) | - 0.038*** (-3.05) | -0.0328*** (-2.73) | -0.037*** (-3.06) | -0.00841** (-2.09) |
| Environmental Tax X SME financing constraint | 0.656*** (11.23) | 0.605*** (9.15) | 0.567*** (7.97) | 0.703*** (10.53) | 0.560*** (7.40) | 0.209*** (2.73) | 0.447*** (4.50) | 0.289* (1.81) | 0.455*** (3.62) | 0.368** (2.44) |
| SME financing constraint | 0.0637 (0.49) | 0.103 (0.84) | 0.0812 (0.57) | 0.106 (0.70) | 0.0630 (0.49) | 0.366*** (4.94) | 0.654*** (3.21) | 0.568** (2.57) | 0.686*** (2.90) | 0.571*** (2.69) |
| Governance Indicator | | 0.0669 (0.53) | 0.0359 (0.26) | -0.135 (-1.02) | -0.00494 (-0.00) | | -0.0425 (-1.40) | -0.0343 (-0.93) | -0.134 (-0.43) | -0.0279 (-1.11) |
| Environmental Tax X Governance Indicator | | 0.00463 (0.26) | 0.0106 (0.57) | 0.0109 (0.67) | 0.0646 (0.78) | | 0.358* (1.78) | 0.438 (1.59) | 0.0166 (0.39) | 0.265 (1.41) |
| Constant | 24.86* (1.87) | 15.50 (1.06) | 8.604 (0.56) | 29.40** (2.06) | 12.76 (0.86) | 17.55*** (2.68) | 11.96 (0.77) | -3.389 (-0.20) | 10.46 (0.69) | 7.686 (0.46) |
| Control Variables Included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year dummy Included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country dummy Included | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 216 | 216 | 216 | 216 | 216 | 478 | 478 | 478 | 478 | 478 |
| R-Squared | 0.57 | 0.58 | 0.58 | 0.57 | 0.58 | 0.56 | 0.67 | 0.64 | 0.66 | 0.65 |
| ATT (Nearest Neighbour) | | | | | | 2.912*** | | | | |
| Std. err. | | | | | | 0.029 | | | | |
| # treated | | | | | | 2.923 | | | | |
| # control | | | | | | 2.317 | | | | |
| Std. err. | | | | | | 0.0197 | | | | |

Table 12: Robustness Test: Alternative measure of Innovation

This table reports a cross-country panel data fixed effect regression results of model (1) on the relationship between SME financing constraint, environmental tax and SME Innovation using innovation rate as an alternative measure of Innovation. A detailed definition of all the variables is in Table 1. T statistic is in brackets. Degrees of freedom are in brackets. ***, **, and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

| | Innovation | Political Stability | Government Effectiveness | Regulatory Quality | Control of Corruption |
|--|--------------------|---------------------|--------------------------|--------------------|-----------------------|
| Environmental Tax | 1.336* (1.92) | 1.196* (1.66) | 1.111 (1.61) | 1.319* (1.89) | 1.284* (1.83) |
| SME financing constraint | 2.599* (1.77) | 3.486** (2.36) | 3.496** (2.11) | 2.828 (1.62) | 2.940* (1.83) |
| GDP | 0.790 (0.40) | 0.271 (0.13) | -0.535 (-0.25) | 0.256 (0.12) | -1.417 (-0.61) |
| Interest Rate | -0.112 (-0.89) | -0.0178 (-0.14) | -0.0754 (-0.60) | -0.0791 (-0.61) | -0.0872 (-0.68) |
| Inflation | 0.00864 (0.07) | -0.00580 (-0.05) | 0.0179 (0.15) | -0.0166 (-0.14) | -0.0125 (-0.10) |
| Governance Indicator | | -3.586 (-1.47) | -1.471 (-0.52) | 1.114 (0.39) | 1.088 (0.63) |
| Environmental Tax X SME financing constraint | 0.781*** (0.31) | 0.468*** (1.23) | 0.396** (0.91) | 0.715** (0.19) | 0.67** (1.52) |
| Environmental Tax X Governance Indicator | | 0.779** (2.34) | 0.467 (1.37) | 0.128 (0.34) | 0.170 (0.78) |
| Constant | 19.44* (1.94) | 14.84* (1.18) | 15.74* (1.10) | 21.76* (1.62) | 15.80* (1.20) |
| Year dummy Included | Yes | Yes | Yes | Yes | Yes |
| Country dummy Included | Yes | Yes | Yes | Yes | Yes |
| N | 480 | 480 | 480 | 480 | 480 |
| R-Squared | 0.10 | 0.13 | 0.17 | 0.25 | 0.13 |

