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Environmental innovation and firm value: The moderating role of organizational capital

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ABSTRACT

Since last decade, firms are facing the challenge of strict compliance in response to the stakeholders' awareness about climate change and environmental degradation. Considering these trends, we examine the effect of environmental innovation such as product innovation and process innovation on firm value and the moderating effect of organizational capital on environmental innovation-firm value nexus. Using the data of U.S. listed firms from 2002 to 2019, we find a significantly positive impact of environmental innovation on firm value. Our findings also reveal that organizational capital strengthens the positive association between environmental innovation and firm value, suggesting that firms with higher organizational capital are more likely to consider the demands of stakeholders to be environment friendly which in turn enhances their market value. These findings are aligned with the resource-based view (RBV) and highlight that organizational capital can play a significant role to increase the firm value through environmental innovation. Our results remain robust to subsample analyses, alternative proxies of main variables and are not subject to potential endogeneity concerns. Our study provides new insights into the environmental innovation–firm value nexus and presents important policy implications.

1. Introduction

The issue of global warming has received immense attention from academic researchers, regulator and stakeholders since last decade (Shahab et al., 2022; Nadeem et al., 2020a). The major concern of global warming is to control the emission of greenhouse gases through different sources i.e., electricity and heat, transportation, solid waste generation, forestry, and manufacturing. The challenge of global warming leads to the concern of changing environment which increases the significance of preservation and efficient use of natural resources (Martínez-Ros and Kunapatarawong, 2019; Silva et al., 2019). The reduction in global warming and the actions of corporations to reduce the emission of greenhouse gases has become the key agenda among all stakeholders (Doran and Ryan, 2016). In industrial settings, the environmental management has now become a strategic phenomenon. Consequently, firms are using proactive approach towards environmental innovation (hereafter, EI) strategies to address the issue of climate change (Alt et al., 2015; Aragón-Correa and Rubio-Lopez, 2007; Bhupendra and Sangle, 2015; Porter and Kramer, 2006). For this purpose, firms may apply new methods of production process and up-to-date technology to reduce the environmental pollution (Eiadat et al., 2008). The environmental management system ultimately increases the efficiency of other aspects of firm such as production methods, energy utilization and maximum output from minimum raw material usage which eventually increases the firm value (hereafter, FV). Consequently, greater FV is considered as the output of EI (Glavas and Mish, 2015; Nidumolu et al., 2009; Porter and Kramer, 2006; Sharma, 2017).

The process and implementation of EI is risky for firms amid the uncertainty of (i) future financial and nonfinancial sustainable advantage, (ii) complex dynamics and (iii) commercial viability (Alt et al.,

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2015; Eiadat et al., 2008; Poskela and Martinsuo, 2009; Sharma, 2017). These dilemmas fabricate the disagreement and ambiguity for firms to manage their approaches for implementation of EI. Failure to opt and implement the EI strategy may have adverse consequences for firms, which may lead to the loss of affluent resources, competitive advantage, potential customers and eventually decrease in FV (Alt et al., 2015; Sharma, 2017). For example, due to the unprecedented attention of governments, media and NGOs to climate change and environmental pollution, many countries have formulated the legislation and implemented strict measures regarding the EI and industrial performance. However, many firms has experienced high cost of EI implementation which significantly decreases the firms' financial performance (Forsman et al., 2013; Poskela and Martinsuo, 2009), and their motivation to adopt EI measures. Previous literature has focused on many firm-level determinants of EI, including the firms' objectives to increase the FV through EI. Indeed, the relationship between EI and FV has also been investigated in a meaningful way with divergent results, suggesting that the findings of prior studies are still vague. These studies mainly find three types of relationship between EI and FV, (i) negative relationship (Horváthová, 2012; Sarkis and Cordeiro, 2001), (ii) positive relationship (Eiadat et al., 2008; Li, 2014; Porter and Van der Linde, 1995; Rexhäuser and Rammer, 2014) and (iii) no relationship (Doran and Ryan, 2016; Lanoie et al., 2011). These divergent results warrant reexamination of the EI-FV nexus by using a novel perspective to build consensus among existing literature.

Nonetheless, the significance of EI has increased immensely for firms and environment, the existing literature ignores some key factors while examining the relationship between EI and FV which may drive the association between EI and FV. In line with the resource-based view (hereafter, RBV), we argue that organizational capital is an important missing link of this puzzle which may help resolve the issue of inconclusive findings regarding the association between EI and FV. Organizational capital represents the expertise of employees in their domain to run organization efficiently and effectively. The expertise includes the human working skill, communication, knowledge management, opinion based decision-making and tangible assets. From the investors and financial analysts perspective, efficient utilization of tangible and physical assets is one of the significant factors to attain higher FV (Golec and Gupta, 2014). Implementation of EI also involves the use and handling of physical assets, for instance, latest machinery, up to date technology and refined raw material which can be acquired by any firm to achieve higher FV.

In this modern era, firms are not only relying on physical and tangible assets, but also on intangible assets. The ultimate purpose to employ intangible assets is to utilize tangible assets efficiently and vice-versa, to attain the competitive advantage through RBV. For firms, RBV identify intangible assets such as organizational capital (Barney, 2001), which is a missing component in EI-FV relationship. The basic argument regarding firm's competitive advantage is that it requires both tangible and intangible assets (Nadeem et al., 2018), and intangible assets in this view are unique and inimitable.

In RBV, tangible and physical assets are considered as strategic resources of firm. Nevertheless, RBV significantly lies in both tangible such as land, machinery, building and intangible resources of firm i.e., organizational capital (Reed et al., 2006). Prior literature has documented that firms are more likely to achieve competitive advantage through intangible assets/organizational capital. The literature argue that firms can replace or acquire physical assets such as plant, machinery, and financial assets at any time because of the generic nature of these assets. However, intangible assets/organizational capital is not easily replaceable and contribute significantly to achieve organizational goals. In this regard, Youndt et al. (2004) report that organizational capital is the only factor that significantly contribute to value creation and help to achieve sustainable competitive advantage in knowledge economy era. Prior literature (Delgado-Verde et al., 2014; Dost et al., 2016; Secundo et al., 2018) has also documented that knowledge flow in firms enhances the organizational competencies required to design innovative (environmental) policies, and knowledge flow consists of intangible factors, culture, structures, and formal procedures. It is further argued that environmental commitment is a significant factor to formulate innovative environmental strategies but firms' knowledge play a significant role in effective implementation of environmental strategies (Christmann, 2000).

Organizational capital is one of three components of intellectual capital (hereafter, IC) - the other two are human capital and relational capital (Kannan and Aulbur, 2004) - is described as the largest part of novel industrial operating procedures, knowledge, and products which provide operating, investing and industrial superiority in business practices and design (Lev et al., 2009). Previous literature also implies organizational capital as sub-dimension of IC which enhances the creative capability of organization (Bozbura and Beskese, 2007). Organizational capital, being one of the most important components of IC, stays in the organization till the end of operations while other factor e.g., human capital leaves the organization when employees exits (de Pablos, 2002).

Organizational capital is the core competency of firm which includes individual skills of employee and physical assets (Evenson and Westphal, 1995). The latest industrial revolution not only needs physical assets such as labor, land and capital but also requires human abilities i.e., communication, learning environment, culture, organizational structure and processes (Brynjolfsson et al., 2002). The accumulation of intangible knowledge i.e., organizational capital of firm helps to achieve superior operating, investment and innovation process (Penman, 2009). These superior traits of organization are termed as RBV through which firms attain competitive advantages.

In the field of accounting and finance, organizational capital arises as a significant strand of FV (Nadeem et al., 2018). Hence, while employing RBV, firms attain superior financial performance and gain competitive advantage by efficiently using their strategic assets (Wernerfelt, 1984). The nature of strategic assets in the firm is tangible and intangible, which equally hold significant acceptance towards FV (Brennan and Connell, 2000). For instance, highly competitive firms such as Proctor and Gamble in FMCG and Dell Inc. in computers and IT are enjoying sustainable competitive advantage only because of organizational capital (Li et al., 2018). In comparison to tangible assets in the US National Income, organizational capital is contributing one-third and 40% in revenues and cash inflows, respectively (Atkeson and Kehoe, 2005). Conversely, the inefficient use of these strategic assets decreases FV and negatively impact the environment. Nadeem, Gyapong, et al. (2020) suggest that societies are now more concerned about environment and pressurize firms to reduce emission and harmful industrial waste. We therefore contend that environmental innovation, through which firms may produce products without having less or no negative impact on the environment has become an important policy agenda for the firms. Prior literature reports a positive, negative or no association between EI and FV without considering the influence of organizational capital on this relationship (Horváthová, 2012; Sarkis and Cordeiro, 2001). However, this study goes beyond the existing literature and examines the impact of an important factor (i.e., organizational capital) which is largely ignored by scholars while exploring the EI-FV nexus.

To empirically examine whether EI has any effect on FV, we use two proxies of EI based on the prior literature i.e., (i) process innovation which indicates the processes e.g., green energy, cleaner technology, recycling of industrial waste and efficient use of natural resources and

(ii) product innovation which employs green product, echo-labelling and comprehensive material saving plans (Lin et al., 2014). We therefore contribute to the existing literature on EI and FV. Extant studies (Crook et al., 2011; Fu et al., 2016) have already shown that organizational capital moderate the relationship between firm level policies and firm performance. However, existing literature on EI and FV has largely ignored this aspect. We therefore examine whether organizational capital has any impact on the association of EI and FV.

Using the data of US listed firms over the period 2002–2019, we examine the association between EI and FV as well as the moderating effect of organizational capital on the EI-FV nexus. We find a significantly positive relationship between EI and FV. Concerning the moderating effect, we find that organizational capital strengthens the positive association between EI and FV. These results support our hypotheses that FV increases because of increase in EI (i.e., Process innovation and Product innovation) and organizational capital positively moderates the relationship of EI and FV. We also ensure that our main findings are not subject to any potential endogeneity issues using the system-GMM and 2SLS estimates.

Our findings offer several policy implications as well as contributes to the existing literature. First, global warming through industrialization and its negative effect on environment has emerged as a major concern for stakeholders i.e., customers, investors, regulators, and society at large. Therefore, firms are under immense pressure to minimize the negative effect of their activities on the environment. In this regard, our findings show that EI not only reduce the negative impact of firms' activities on the environment but also improves the firm value. We also show that organizational capital enhances the positive effect of EI on FV, suggesting that firms should adopt the EI and may enhance their organizational capital to maximize their market value while being environment friendly.

The remainder of the paper proceeds as follows. Section 2 covers the literature review and hypotheses. Section 3 presents the methodology. Section 4 outlines the results and discussion. Finally, section 5 concludes.

2. Literature review and hypothesis development

2.1. Environmental innovation and firm value

In the recent trend of environmentalism, the stakeholders including regulatory bodies compel the firms' management to implement EI in industrial processes to reduce the impact of production emission on the environment (Cai and Zhou, 2014; Lamond et al., 2010). Intense pressure from the regulators and increasing awareness of consumers lead firms to change their conventional production methods to sustainable and innovative processes. The up to date and sustainable production methods are also known as green innovation (Awan et al., 2019). In the existing literature, EI and green innovation have been considered as the same phenomenon (Ghisetti et al., 2015; Lanoie et al., 2011; Tseng et al., 2013) and exhibit various industrial functions i.e., production management, latest technology, and manufacturing processes (Schiederig et al., 2012). Hence, EI help firms to reduce the use of raw material, emission of greenhouse gases and adverse effect on environment through sustainable industrial processes (Horváthová, 2012). Implementation of EI optimize the effect of organizational activities on the environment because of the efficient use of resources, minimizing waste and emission, among others. The scenario of EI implementation ultimately has a positive effect on firm value and profitability because of innovative processes of manufacturing and operations, therefore the positive relationship helps firms to get competitive and sustainable advantage (Eiadat et al., 2008; Przychodzen and Przychodzen, 2015).

Increasing stakeholder interest and consumer awareness are the key reasons that EI is getting considerable attention from both the industry and academia. Number of existing studies focus on firms' decision of EI implementation. The stakeholders' pressure of environmentalism stimulate corporate managers to drive the proactive approaches of EI implementation (Sharma, 2000; Spangenberg, 2003). This strategic drive of EI implementation requires not only affluent resources but it also needs a comprehensive plan and strong commitment from the top management (Tseng et al., 2013). Thus, firms can implement EI process by utilizing their organizational capabilities.

Organizational capability is a significant dimension of firms that helps management to utilize valuable resources efficiently (Cuerva et al., 2014). The initiative of EI help firms to gain legitimacy which increases the FV (He and Jiang, 2019). It shows the true intention of firms to improve the environment and sends a positive signal to stakeholders. While facing the environmental legitimacy crisis, firms are more keen to implement EI to sustain their positive image in the market (Berrone et al., 2013; Frondel et al., 2008). The positive image maintains the good gesture in consumers' opinion about organization which may lead to increase in sales and FV (Berrone et al., 2013).

EI gives a sustainable advantage to product lifecycle through decreasing environmental pollution which increases the cash flows and firm value (Lin et al., 2014). The firms' initiative to manufacture products using efficient processes which prevents the environmental pollution, create a positive gesture in the mind of consumers which ultimately result in increased sales and cash flows. Investment in EI and the advantage of low-cost is conducive to produce innovative and better products which provide a competitive advantage (Liao, 2016). EI implementation in firms through the development of green technology and low-cost eco-products may also create a sustainable positive image and good reputation in the society and eyes of the policy makers. Customer satisfaction of low-cost and eco-friendly products also increases the market share of products and improves the FV (Ghisetti et al., 2015).

The RBV can be explained as a firm's superiority in operation, methods of production, exceptional capabilities and non-replicable resources (Barney, 2001; Wernerfelt, 1995). Dynamic and Complex nature of EI helps firms to figure out novel resources on continuous basis, so that firms can enhance their value. Taken together, above discussion suggests that EI is a significant strategic mechanism for the firms and society to ensure the efficient resource utilization, protect the environment and maximize firm value. We therefore propose the following hypothesis:

H1. Environmental innovation has positive effect on firms' value.

2.2. Environmental innovation and firm value: the role of organizational capital

Organizational capital is considered as an intangible asset integrated with the firms' systems, structures, processes, values, and culture which are viewed as essential resources for the firms (Subramaniam and Youndt, 2005). It also encompasses formal business procedures, working style, and organizational culture, developed by individual employees and teams (Wang and NOE, 2010), and provide comprehensive support to gain competitive advantage (Kang and Snell, 2009). The interaction among employees is fundamental action to develop organizational capital over time. In this procedure, employees share their knowledge and experiences which transform into organization's knowledge and subsequently deemed as the part of healthy working environment (Attig and Cleary, 2014).

Prior literature viewed organizational capital of firm through two different believes. The first believe defines organizational capital as an integrated part of employees' behaviour and a built-in component of social network of organization - Considering organizational capital as a loss if employees leave the organization. The second believe describes organizational capital as a significant component of system and processes that embedded in the organization itself and remain in the system even when employees leave (Atkeson and Kehoe, 2005; Lev and Radhakrishnan, 2005). Following Hasan (2018), this study employ latter believing that organizational capital is rooted in processes and system of organisation since this perception is more aligned with RBV which defines the inimitable characteristic that enhances the competitive advantage of firms.

The narrative regarding organizational capital has documented supportive results in relation to firm outcomes. For instance, Atkeson and Kehoe (2005) document the significant positive association between organizational capital and firm's productivity. Moreover, during mergers and acquisition process, organizational capital plays a vital role to enhance firm performance (Li et al., 2018), firm value and better stock returns (Awan et al., 2019), and lower cash flow sensitivity (Attig and Cleary, 2014). Furthermore, organizational capital leads the firm's life cycle from one stage to other and also negatively associated with cash holdings (Marwick et al., 2020).

The RBV draws attention to the significance of organizational capital (Barney, 2001). The use of organizational capital in terms of financial and nonfinancial assets lead a firm to get the sustainable advantage. Bueno et al. (2014) report that firms can achieve the competitive advantage by using unique intangible assets. Regarding aforesaid argument, Lev et al. (2009) document that organizational capital empowers optimum benefit of all industrial resources to produce superior economic activity. Organizational capability is one of the significant drivers of EI since it includes efficient working system, knowledge and skills of employees developed over time (Cuerva et al., 2014), and this capability of organization is recognized as organizational capital (Nadeem et al., 2020).

EI practices provide sustainable competitive advantage to firms; however, it requires significant financial and nonfinancial resources (Alt et al., 2015). The risk of low productivity, and failure in financial viability due to lack in EI efficiency also decreases firm value (Sharma, 2017). Nevertheless, these risks can be reduced if firms have resources to implement EI procedures effectively (Tang et al., 2018). In terms resources, we argue that organizational capital is one of the significant resources required to implement the EI. Higher organizational capital is likely to enable firms to implement EI procedures efficiently which may translate into higher FV. Based on these conjectures, we expect organizational capital to strengthen the positive relationship between EI and FV. We therefore hypothesize:

H2. Organizational capital positively moderate the relationship of environmental innovation and firm value.

3. Methodology

3.1. Sample

To empirically test the hypotheses, we obtain the data of environmental factors from widely used database namely, ASSET4. We begin by downloading the data for all US listed firms[1] included in the ASSET4 database for the period 2002–2019. Our sample period starts from 2002 because data on environmental factors are not available for earlier years and ends in 2019 to avoid the impact of COVID-19 pandemic. Our initial sample includes 46,000 firm-year observations. We then exclude the firm-years with missing data required to perform the analysis and financial firms (SIC 6000–6799) to reach a final useable sample of 8511 firm-year observations. Table 1 present further details on sampling criterion.

Table 1
Sample description.

Description	Observations
Initial observations from ASSET4 (2002–2019)	46,000
After dropping missing values for main variables	11,668
After dropping observations from financials (SIC 6000–6799)	8914
After dropping missing values for control variables	8511

3.2. Dependent variables

Based on the prior literature (Iqbal et al., 2019), We use two proxies to capture FV such as Tobin's q and Market-to-Book ratio. Tobin's q is measured as the market value of equity plus the book value of assets minus the sum of book value of equity plus deferred taxes, all divided by book values of assets, whereas Market-to-Book ratio is the total market value equity divided by total book value of equity.

FV notifies to all stakeholders based on the historic financial information which includes several components of firm like share prices, sources of financing and their cost, sales of finish goods and purchases of raw material (Gulen and Ion, 2016). FV is one of the significant strand of corporate finance in which all stakeholders have substantial interest because of their financial concerns and to maximize FV (Gulen and Ion, 2016; Iqbal et al., 2019; Nadeem et al., 2018).

3.3. Independent variables

Several prior studies employ the questionnaire/survey methodology to quantify the EI (Huang and Li, 2018; Peng and Liu, 2016). Nonetheless, this method may have major shortcomings and biasness in appropriate objectivity from the respondent due to their personal beliefs (Arena et al., 2018). Therefore, Arena et al. (2018) uses the EI score from ASSET4 database to form their proxy of EI because this database supplies the authentic, objective, audited and systematic ESG information.

Following Arena et al. (2018), Tseng et al. (2013) and Cuerva et al. (2014), we measure EI through process innovation (*PRC_INNV*)[2] and product innovation (*PRD_INNV*).[3] Asset4 is used to obtain the data of process and product innovation. This database is very accurate and reliable (Cheng et al., 2014) because of relevancy with objectivity, auditability and systematic information. Under four main pillars such as environment, social, governance, and economic performance score, especially trained researchers organized 18 categories of 250 key performance indicators of firms.

3.4. Organizational capital

Sustainable competitive advantage of a firm arises through organizational capital which can be developed through integrating knowledge,

[1] US is one of the countries, for which the firm-level environmental innovation data are available for the whole sample period from Asset4.

[2] Process innovation is based on the following indicators: (a) Resource Efficiency Objectives/Energy Efficiency (ENRRDP0192); (b) Resource Efficiency Objectives/Water Efficiency (ENRRDP0191); (c) Eco-Design Products (ENPIDP069); (d) Emission Reduction Processes/Emissions (ENERDP0051); (e) Resource Reduction/Policy (ENRRD01V); (f) Waste Reduction (ENERDP062). The final *PRC_INNV* value is the sum of all six (6) indicators above.

[3] Product innovation is based on the following indicators: (a) Product Environmental Responsible Use (ENPIDP048); (b) Sustainable Building Products (ENPIDP068); (c) Organic Products Initiatives (ENPIDP045); (d) Product Access Low Price (SOPRDP025); (e) Product Quality and Responsibility Monitoring (SOPRDP016). The final *PRD_INNV* value is the sum of all five (5) indicators above.

culture, human skills, and physical capital into the process of delivering satisfying goods and services. Following Lev and Radhakrishnan (2005) and Eisfeldt and Papanikolaou (2013), we employ the sales, general and administrative expenses (hereafter, SG&A) because it shows the investment in organizational capital. According to the International Accounting Standard 1 (IAS1), all the expenses related to the on-job training, workplace restructuring, development of new internal control system, internal and external communication, and public relations should be included into the subsection of income statement which is SG&A expenses. Many research studies document the validity of this measure. SG&A expenses contain many characteristics of the organizational capital. For instance, Eisfeldt and Papanikolaou (2013) document that investment in organizational capital are positively related to the management quality score developed by the Bloom and Van Reenen (2007). We use the cumulative deflated values of SG&A expenses in equation (1) to quantify the organizational capital: Org_Cap_i, recursively followed by Li et al. (2018).

$$ORG\_CAP_{i,} = (1-\delta_0) * ORG\_CAP_{i,-1} + SGA_{i,t} / CPI_t \quad (1)$$

where CPI_t is the consumer price index at time t and $SGA_{i,t}$ is SG&A at time t. δ_0 is depreciation rate of organizational capital. We use 15% depreciation rate (δ_0) following (Hasan, 2018). The ORG_CAP_{t-1} is calculated as follows

$$ORG\_CAP_{i,\ t-1} = SGA_{i,\ t_0} / g + \delta_0 \quad (2)$$

where g is growth rate of SG&A expenses and t_o is the first year of firm i. Lastly, we divide ORG_CAP to total assets.

3.5. Empirical models

To empirically investigate the association between environmental innovation and firm value, we use the following regression model:

$$FV_{i,\ t} = \alpha_0 + \beta_1 ENV\_INNV_{i,t} + \beta_2 CSR\_COMM_{i,t} + \beta_3\ CG\_COMM_{i,t} + \beta_4 F\_SIZE_{i,t} + \beta_5 ROE_{i,t} + \beta_6\ LEV_{i,t} + \beta_7 S\_GROWTH_{i,t} + \beta_8 CAPEX_{i,t} + \beta_9 ATO_{i,t} + \beta_{10} R\&D_{i,t} + INDUSTRY + YEAR + \varepsilon_{i,t} \quad (3)$$

To examine the moderating effect of organizational capital on the association between environmental innovation and firm value, we use the following regression model:

$$FV_{i,t} = \alpha_0 + \beta_1 ENV\_INNV_{i,t} * ORG\_CAP_{i,t} + \beta_2 ENV\_INNV_{i,t} + \beta_3 ORG\_CAP_{i,t} + \beta_4 CSR\_COMM_{i,t} + \beta_5\ CG\_COMM_{i,t} + \beta_6 F\_SIZE_{i,t} + \beta_7 ROE_{i,t} + \beta_8\ LEV_{i,t} + \beta_9 S\_GROWTH_{i,t} + \beta_{10} CAPEX_{i,t} + \beta_{11} ATO_{i,t} + \beta_{12} R\&D_{i,t} + INDUSTRY + YEAR + \varepsilon_{i,t} \quad (4)$$

where *FV* represents the market to book ratio and Tobin's q, *ENV_INNV* represents process innovation *(PRC_INNV)* and product innovation *(PRD_INNV)* and *ORG_CAP* is organizational capital. We also control for several firm specific and governance variables which may affect the *FV* (Tang et al., 2018). We control the effect of corporate social responsibility committee and corporate governance committee through two indicators i, e., *CSR_COMM* (equals to 1 if the firm has a CSR committee, 0 otherwise) and *CG_COMM* (equals to 1 if the firm has a CG committee, 0 otherwise). We also use firm specific variables such as, total assets of firm as *F_SIZE*, return on shareholders' equity as *ROE*, leverage as *LEV*, sales growth as *S_GROWTH,* capital expenditure as *CAPEX*, assets turn over as *ATO*, research and development as *R&D*, number of board members as *B_SIZE*, ratio of females on the board as *BGD*, percentage of independent board members as *B_INDE* and *CEO* as chairperson defined as *DUALITY*. All these variables are defined in the Appendix.

Table 2
Descriptive statistics.

	Mean	Median	Min	Max	SD
Tobin's q	2.018	1.287	1.003	4.600*	2.447
MTB	3.245	2.565	13.43	14.07	37.86
PRC_INNV	1.934	2.000	0.000	6.000	1.879
PRD_INNV	0.632	0.000	0.000	4.000	0.825
ORG_CAP	0.175	0.129	0.000	1.976	0.174
CSR_COMM	0.346	0.000	0.000	1.000	0.476
CG_COMM	0.949	1.000	0.000	1.000	0.219
F_SIZE	15.18	15.16	8.772	20.49	1.601
ROE	8.888	11.73	−240.0	1040	33.59
LEV	88.31	56.02	−124.0	173.7	28.46
S_GROWTH	1.844	0.059	−1.000	127.0	19.18
CAPEX	5.536	3.600	0.000	289.1	7.446
ATO	0.917	0.741	0.000	10.28	0.723
R&D	0.042	0.000	0.000	5.548	0.114

Note: All financial variables are winsorized at 1st and 99th percentiles.

4. Results

4.1. Descriptive analysis

Table 2 shows the descriptive statistics of dependent and independent variables. The mean (standard deviation) values of *Tobin's q* and *Market-to-Book ratio* are 2.018 (24.47) and 32.45 (37.46), respectively. The mean (standard deviation) values of *PRC_INNV* and *PRD_INNV* are 1.9340 (1.8790) and 0.6320 (0.8250), respectively. The mean value of *ORG_CAP* is 0.1750 with standard deviation of 0.1740. The mean values of *PRC_INNV* and *PRD_INNV* are consistent with those reported by (Nadeem et al., 2020).

The correlation coefficients among variables are shown in Table 3. It shows that the correlation between proxies of FV (*Tobin's q & MTB),* EI (*PRC_INNV & PRD_INNV)* and organizational capital (*ORG_CAP*) is positive and statistically significant. Hence, providing some initial support to our hypotheses. In general the correlation among all variables do not exceeds the critical value of 0.80 which confirms that multicollinearity is not a concern (Nadeem et al., 2020).

4.1.1. Empirical results

Table 4 shows the results of the ordinary least square (OLS) regression analysis for the relationship between environmental innovation (*EI*) and firm value (*FV*). We use two different proxies of *FV*: we measure *FV* in Models (1–2) using *Tobin's q* and in Models (3–4) using the market to book ratio (*MTB*). Here, our main variable of interest is EI which is measured through process innovation (*PRC_INNV*) and product innovation (*PRD_INNV*). The results reported in Models (1–2) shows that coefficient on *PRC_INNV* and *PRD_INNV* for *Tobin's q* is 0.326 and 0.697, respectively, and significant at the 1% level. Similarly, Models (3–4) shows that coefficients of *PRC_INNV* and *PRD_INNV* for *MTB* are 2.824 and 2.927 and significant at the 5% and 1% level, respectively. These findings are in line with prior studies (Cheng et al., 2014; Lanoie et al., 2011; Li, 2014) and support our first hypothesis by showing that EI is positively associated with FV. The positive association between EI and FV can be explained through the lens of resource based-view which argue that firms attain superior financial performance by utilizing novel and exceptional methods of production, knowledge and capabilities in business operations (Barney, 2001; Wernerfelt, 1995). In other words, complex execution of EI processes, provide firms a distinct resource and competitive advantage to maximize FV.

Table 5 shows the results of the ordinary least square (OLS) regression analysis for the moderating effect of organizational capital (*ORG_CAP*) on the relationship between environmental innovation (*EI*) and firm value (*FV*). Here, our main variables of interest are interaction terms of process innovation and product innovation with organizational

Table 3
Pearson correlation analysis.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	*Tobin's q*	1													
2	*MTB*	0.125**	1												
3	*PRC_INNV*	0.146**	0.038**	1											
4	*PRD_INNV*	0.125**	0.027**	0.610**	1										
5	*ORG_CAP*	0.186**	0.036**	0.111**	0.064**	1									
6	*CSR_COMM*	0.112**	0.025*	0.625**	0.475**	−0.110**	1								
7	*CG_COMM*	−0.020*	−0.003	0.098**	0.084**	−0.014	0.119**	1							
8	*F_SIZE*	0.247**	0.049**	0.584**	0.428**	−0.382**	0.514**	0.054**	1						
9	*ROE*	0.002	0.037**	0.005	−0.004	0.017	0.007	0.014	0.005	1					
10	*LEV*	0.007	0.081**	0.058**	0.028**	−0.085**	0.064**	0.010	0.122**	0.407**	1				
11	*S_GROWTH*	−0.037**	−0.003	−0.014	−0.011	−0.001	−0.010	0.003	−0.026*	0.000	−0.004	1			
12	*CAPEX*	0.003	−0.003	−0.037**	−0.081**	−0.111**	−0.021*	−0.010	0.052**	−0.010	0.060**	−0.010	1		
13	*ATO*	0.217**	0.036**	0.028**	0.062**	0.368**	0.001	0.010	−0.098**	−0.010	−0.056**	−0.020	−0.057**	1	
14	*R&D*	−0.714**	−0.111**	−0.130**	−0.097**	0.410**	−0.130**	0.023*	−0.337**	0.018	−0.061**	0.024*	−0.079**	−0.172**	1

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 4
The impact of environmental innovation on firm value.

	DV = Tobin's q		DV = MTB	
	(1)	(2)	(3)	(4)
PRC_INNV	0.326***		2.824**	
	(4.024)		(1.971)	
PRD_INNV		0.697***		2.927***
		(5.035)		(2.943)
CSR_COMM	0.241	0.062	−4.419	−1.279
	(0.881)	(0.250)	(-0.448)	(-0.106)
CG_COMM	−0.462	−0.469	−3.101	−2.899
	(-0.836)	(-0.844)	(-0.551)	(-0.529)
F_SIZE	0.105	0.153	−0.975	−0.051
	(0.785)	(1.176)	(-0.436)	(-0.028)
ROE	0.013**	0.013**	−0.009	−0.010
	(2.913)	(2.918)	(-0.086)	(-0.090)
LEV	−0.003***	−0.003***	0.079**	0.079*
	(-5.315)	(-5.272)	(2.318)	(2.325)
S_GROWTH	0.002***	0.002***	0.001	−0.001
	(4.751)	(4.747)	(1.011)	(-1.021)
CAPEX	0.102***	0.108***	−0.660	−0.631
	(4.849)	(5.080)	(-1.196)	(-1.158)
ATO	2.817***	2.792***	4.747	4.945
	(9.314)	(9.228)	(0.644)	(0.638)
R&D	−91.920***	−91.920***	−459.592***	−458.531**
	(-15.074)	(-15.062)	(-2.711)	(-2.690)
CONS	4.871*	5.001*	38.647**	29.991*
	(1.670)	(1.957)	(1.985)	(1.777)
INDUSTRY	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes
N	8511	8511	8511	8511
Adj. R^2	0.340	0.340	0.016	0.016

Note: This table presents the results of the impact of environmental innovation (process innovation and product innovation) on firm value (*Tobin's q and MTB*). t stats in parenthesis are based on robust standard errors corrected for heteroscedasticity and clustered at the firm level. *, ** and *** represent significance at 10%, 5% and 1% levels, respectively. All variables are defined in the appendix.

capital (*PRC_INNV*ORG_CAP & PRD_INNV*ORG_CAP*). Models (1–2) Table 5 show that coefficient on *PRC_INNV*ORG_CAP* and *PRD_INNV*ORG_CAP* for *Tobin's q* is 3.490 and 7.230, respectively, and significant at the 1% level. Similarly, Models (3–4) reveal that coefficient on *PRC_INNV*ORG_CAP* and *PRD_INNV*ORG_CAP* for *MTB* is 6.080, and 9.493, respectively, and significant at the 5% level. Here, it is worth noting that coefficients on interaction terms (*PRC_INNV*ORG_CAP & PRD_INNV*ORG_CAP*) for *Tobin's q* and *MTB* in Table 5 increases 10 and 3 times, respectively than the coefficient on *PRC_INNV* and *PRD_INNV* for *Tobin's q* and *MTB* in Table 4. Hence, validating our second hypothesis. Aligned with the RBV and prior studies (Li et al., 2018), these findings suggest that organizational capital strengthen the positive relationship between environmental innovation and firm value.

Prior research suggests that because of their higher impact on environment, the sensitive industries are more concerned about environmentalism and are likely to pay greater attention towards EI (Boiral and Heras-Saizarbitoria, 2017). Therefore, in further analysis, we segregate our sample into two categories i.e., (i) sensitive industries, and (ii) non-sensitive industries. The industries that have greater impact on environment are considered as sensitive industries and those with relatively less impact on environment are considered as non-sensitive industries. Following, Boiral and Heras-Saizarbitoria (2017) and Lu and Herremans (2019) industries like mining, agriculture, livestock, oil and gas, and construction are specified as environmentally sensitive industries and rest of the industries as non-sensitive. The results of this analysis reported in Table 6 shows that EI has a positive and statistically significant impact on FV irrespective of the nature of the industry. Hence, reaffirming our main finding.

4.1.2. Additional control

To further validate our findings, we use additional control variables such as board gender diversity *(BGD)*, board size *(B_SIZE)*, board

Table 5
Environmental innovation and firm value: the moderating effect of organisational capital.

	DV = Tobin's q		DV = MTB	
	(1)	(2)	(3)	(4)
*PRC_INNV*ORG_CAP*	3.490***		6.080**	
	(5.604)		(2.390)	
*PRD_INNV*ORG_CAP*		7.230***		9.493**
		(5.418)		(2.345)
PRC_INNV	0.267**		3.751**	
	(2.230)		(2.003)	
PRD_INNV		0.599**		1.020**
		(2.419)		(2.158)
ORG_CAP	6.447***	4.422**	29.760**	15.366***
	(2.930)	(2.390)	(2.538)	(3.558)
CSR_COMM	−0.215	−0.068	−4.859	−1.834
	(-0.794)	(-0.274)	(-0.477)	(-0.149)
CG_COMM	−0.470	−0.512	−2.809	−2.640
	(-0.850)	(-0.921)	(-0.488)	(-0.466)
F_SIZE	0.104	0.136	−0.383	0.575
	(0.745)	(0.980)	(-0.183)	(0.368)
ROE	0.014***	0.014***	−0.012	−0.010
	(3.048)	(3.183)	(-0.111)	(-0.091)
LEV	−0.003***	−0.003***	0.079**	0.079**
	(-5.379)	(-5.417)	(2.334)	(2.333)
S_GROWTH	0.002***	0.002***	−0.001	−0.001
	(4.965)	(4.909)	(-0.654)	(-0.829)
CAPEX	0.101***	0.099***	−0.659	−0.646
	(4.786)	(4.652)	(-1.196)	(-1.190)
ATO	2.803***	2.846***	3.460	3.520
	(8.506)	(8.594)	(0.445)	(0.416)
R&D	−88.543***	−90.130***	−480.894**	−473.818***
	(-16.063)	(-15.644)	(-2.458)	(-2.600)
CONS	5.404*	5.769*	27.728***	19.710***
	(1.789)	(1.844)	(2.780)	(2.596)
INDUSTRY	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes
N	8511	8511	8511	8511
Adj. R^2	0.345	0.345	0.016	0.016

Note: This table presents the results of the moderating effect of organisational capital on environmental innovation and firm value relationship. t stats in parenthesis are based on robust standard errors corrected for heteroscedasticity and clustered at the firm level. *, ** and *** represent significance at 10%, 5% and 1% levels, respectively. All variables are defined in the appendix.

independence *(B_INDE)* and CEO role duality *(DUALITY)* and reperform the baseline analysis to corroborate whether governance structure of the firms affect the EI-FV nexus. The results of this analysis reported under Table 7 shows that EI is positively and significantly associated with FV even after controlling for the governance structure of the firms. Hence, suggesting that our findings are not sensitive to omitted governance structure variable-bias.

We then ensure the robustness of our main findings by employing the alternative proxies of FV and EI. Following existing studies (Donker et al., 2008; Iqbal et al., 2019), return on equity *(ROE)* is used as an alternative proxy for firm performance. We use the industry-adjusted environmental innovation as an alternative proxy for EI. Specifically, we use industry adjusted value of process innovation (*ADJ_PRC_INNV)* and product innovation (*ADJ_PRD_INNV)*. Following Nadeem et al. (2020)a, we subtract the value of *PRC_INNV* and *PRD_INNV* of each focal firm from the value of industry-year average of *PRC_INNV* and *PRD_INNV* to quantify *ADJ_PRC_INNV* and *ADJ_PRD_INNV*. Table 8 reports the results using alternate proxies. In Models (1–2), the coefficient on *PRC_INNV* and *PRD_INNV* are significant and positive for *ROE* which indicates that our main findings are robust to alternative proxy of *FV*. In Models (3–4), the coefficient on *ADJ_PRC_INNV* and *ADJ_PRD_INNV* is also significantly positive for *Tobin's q*, indicating that our key results are also robust to alternate measures of *EI*.

4.2. Endogeneity tests

Following (Nadeem et al., 2020), we use OLS estimation to examine the effect of EI on FV. However, the firm value in previous year ($FV_{i,t-1}$) may also affect the firm value in current year ($FV_{i,t}$) (Iqbal et al., 2019; Nadeem et al., 2018), which clearly indicates the presence of endogeneity (Wintoki et al., 2012). In unreported results, R^2 increases while taking $FV_{i,t-1}$ as regressor. Further, $FV_{i,t-1}$ has significant relationship as a regressor with $FV_{i,t}$ which further confirms the presence of endogeneity. Therefore, to further corroborate our main findings in presence of endogeneity, we employ advanced panel data estimations i.e., (i) the system generalized method of moment (SGMM) and, (ii) two-stage least square (2SLS) as suggested by prior studies (Iqbal et al., 2019; Nadeem et al., 2018).

Advanced panel data estimations have at least two distinctive aspects (Baltagi, 2008), for instance, (i) these estimations address the problem of autocorrelation among the lagged dependent variable and regressor, (ii) these estimations are also characterized by endogeneity (mainly because of unobserved firm specific heterogeneity and simultaneity). To apply 2SLS, we use industry average of *PRC_INNV^* and *PRD_INNV^* as valid instrumental variables because industry average of process and product innovation may affect the firm level of process and product innovation but highly unlikely to impact FV (Nadeem et al., 2020a). Table 9 reports the results of SGMM and 2SLS, which documents the significant and positive relationship between EI and FV. Hence, showing that our main

Table 6
Sensitive and non-sensitive industries subsamples analyses.

	Sensitive industries				Non-sensitive industries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tobin's q	Tobin's q	MTB	MTB	Tobin's q	Tobin's q	MTB	MTB
PRC_INNV	0.166**		2.408**		0.364***		3.460**	
	(1.999)		(2.350)		(3.169)		(2.508)	
PRD_INNV		0.485**		1.495**		0.616***		4.530***
		(2.400)		(2.043)		(3.353)		(3.370)
CSR_COMM	−0.582	−0.538	−12.830	−9.770	0.109	0.378	6.643	9.957
	(-1.422)	(-1.427)	(-0.761)	(-0.495)	(0.320)	(1.243)	(1.330)	(1.659)
CG_COMM	1.670**	1.654*	6.100*	6.403***	2.305***	2.295***	−12.400*	12.223*
	(1.984)	(1.959)	(1.716)	(2.760)	(3.390)	(3.359)	(1.668)	(1.661)
F_SIZE	0.414**	0.419**	−0.232	0.860	−0.037	0.026	−2.124	−1.326
	(2.072)	(2.165)	(-0.066)	(0.278)	(-0.237)	(0.170)	(-0.807)	(-0.588)
ROE	0.012	0.013	0.032	0.032	0.011**	0.011**	−0.124	−0.126
	(1.608)	(1.613)	(0.161)	(0.156)	(2.336)	(2.374)	(-0.763)	(-0.761)
LEV	−0.002***	−0.002***	0.091	0.091	−0.003***	−0.003***	0.075**	0.075**
	(-2.673)	(-2.684)	(1.339)	(1.335)	(-4.023)	(-3.932)	(2.143)	(2.138)
S_GROWTH	0.002***	0.002***	−0.001	−0.001	−0.625	−0.634	6.169	6.001
	(4.496)	(4.495)	(-0.686)	(-0.676)	(-0.483)	(-0.490)	(1.628)	(1.608)
CAPEX	0.129***	0.136***	0.221	0.238	0.070**	0.071**	−1.710	−1.691
	(5.002)	(5.109)	(1.166)	(1.461)	(2.273)	(2.336)	(-1.298)	(-1.293)
ATO	4.695***	4.651***	−0.458	0.264	1.737***	1.719***	6.670**	6.593**
	(7.773)	(7.653)	(-0.022)	(0.012)	(5.844)	(5.796)	(2.371)	(2.363)
R&D	−95.982***	−95.942***	−526.741**	−524.952**	−71.922***	−72.059***	−305.561***	−305.150***
	(-12.736)	(-12.717)	(-2.082)	(-2.065)	(-9.791)	(-9.809)	(-3.430)	(-3.416)
CONS	−3.392	−2.971	12.273	−0.910	9.134***	8.793***	57.124	50.389
	(-0.800)	(-0.717)	(0.193)	(-0.013)	(3.186)	(3.065)	(1.173)	(1.094)
INDUSTRY	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4912	4912	4912	4912	3598	3598	3598	3598
Adj. R^2	0.386	0.386	0.014	0.014	0.248	0.248	0.041	0.041

Note: This table presents results of the impact of environmental innovation on firm value in sensitive and non-sensitive industries subsamples. t stats in parenthesis are based on robust standard errors corrected for heteroscedasticity and clustered at the firm level. *, ** and *** represent significance at 10%, 5% and 1% levels, respectively. All variables are defined in the appendix.

Table 7
Additional control variables.

	(1)	(2)	(3)	(4)
	Tobin's q	Tobin's q	MTB	MTB
PRC_INNV	0.329***		2.617**	
	(3.972)		(2.518)	
PRD_INNV		0.705***		2.724**
		(5.052)		(2.274)
CSR_COMM	−0.251	−0.083	−4.483	−1.762
	(-0.900)	(-0.322)	(-0.477)	(-0.151)
CG_COMM	−0.769	−0.768	−9.267	−9.230
	(-1.271)	(-1.266)	(-1.378)	(-1.379)
F_SIZE	0.210	0.253*	−1.032	−0.281
	(1.498)	(1.844)	(-0.412)	(-0.119)
ROE	0.013***	0.013***	−0.012	−0.013
	(2.957)	(2.962)	(-0.112)	(-0.117)
LEV	−0.003***	−0.003***	0.079**	0.079**
	(-5.289)	(-5.240)	(2.347)	(2.354)
S_GROWTH	0.002***	0.002***	−0.001	−0.001
	(4.821)	(4.822)	(-0.924)	(-0.936)
CAPEX	0.099***	0.104***	−0.723	−0.696
	(4.646)	(4.881)	(-1.285)	(-1.254)
ATO	2.818***	2.789***	4.053	4.175
	(9.368)	(9.267)	(0.520)	(0.513)
R&D	91.971***	91.939***	−458.432**	−457.156***
	(15.053)	(15.034)	(-2.732)	(-2.708)
BGD	0.015**	0.019**	0.020**	0.052**
	(2.054)	(2.277)	(2.103)	(2.262)
B_SIZE	−0.204***	−0.201***	−0.912	−0.822
	(-2.847)	(-2.818)	(-0.652)	(-0.613)
BINDE	0.016	0.015	0.339**	0.339**
	(1.345)	(1.248)	(2.198)	(2.131)
DUALITY	−0.189	−0.224	−11.464	−11.724
	(-0.704)	(-0.835)	(-1.404)	(-1.441)
CONS	4.191	4.410	36.746	29.349
	(1.430)	(1.541)	(0.899)	(0.689)
INDUSTRY	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes
N	8511	8511	8511	8511
Adj. R^2	0.341	0.341	0.016	0.016

Note: This table presents results of the impact of environmental innovation on firm value with additional control variables (*BGD, B_SIZE, BINDE and DUALITY*). t stats in parenthesis are based on robust standard errors corrected for heteroscedasticity and clustered at the firm level. *, ** and *** represent significance at 10%, 5% and 1% levels, respectively. All variables are defined in the appendix.

Table 8
Alternative proxies.

	DV = ROE		DV = Tobin's q	
	(1)	(2)	(3)	(4)
PRC_INNV	0.026***			
	(4.976)			
PRD_INNV		0.044***		
		(4.428)		
ADJ_PRC_INNV			0.473***	
			(5.821)	
ADJ_PRD_INNV				0.709***
				(4.852)
CSR_COMM	0.099***	0.119***	−0.354	−0.021
	(5.380)	(6.707)	(-1.307)	(-0.083)
CG_COMM	0.069*	0.070*	−0.486	−0.508
	(1.904)	(1.923)	(-0.881)	(-0.916)
F_SIZE	−0.067***	−0.061***	0.037	0.164
	(-9.369)	(-9.167)	(0.267)	(1.248)
LEV	0.001***	0.001***	−0.003***	−0.003***
	(16.647)	(16.824)	(-5.307)	(-5.286)
S_GROWTH	0.000***	0.000***	0.002***	0.002***
	(14.147)	(14.280)	(4.780)	(4.754)
CAPEX	0.001	0.001	0.106***	0.105***
	(0.404)	(0.609)	(5.052)	(5.026)
ATO	0.199***	0.198***	2.806***	2.832***
	(12.237)	(12.153)	(9.336)	(9.410)
R&D	2.579***	2.582***	−92.569***	−92.061***
	(12.794)	(12.801)	(-15.166)	(-15.081)
CONS	1.206***	1.184***	7.175**	4.794
	(4.136)	(4.039)	(2.187)	(1.529)
INDUSTRY	Yes	Yes	No	No
YEAR	Yes	Yes	Yes	Yes
N	8511	8511	8511	8511
Adj. R^2	0.448	0.448	0.341	0.340

Note: This table presents results of alternative measure to evaluate FV through other aspects e.g., firm performance. For this purpose, we employed the proxy of firm performance (i.e., *ROE* (Return on Equity)) and for environmental innovation (i.e., industry adjusted process innovation and product innovation). t stats in parenthesis are based on robust standard errors corrected for heteroscedasticity and clustered at the firm level. *, ** and *** represent significance at 10%, 5% and 1% levels, respectively. All variables are defined in the appendix.

results are robust even in presence of the endogeneity.[4]

5. Conclusion

Prior studies have documented mixed findings on the association between EI and FV (Horváthová, 2012; Sarkis and Cordeiro, 2001). We therefore re-examine the EI-FV nexus by introducing organizational capital as a missing piece of the puzzle. We expect EI to be significantly and positively associated with FV and organizational capital to further strengthen the positive association between EI and FV. We empirically test our predictions using the sample of the US listed firms from 2002 to 2019. As expected, results show a significantly positive association of EI with FV, and organizational capital also strengthens the positive association between EI and FV.

Prior literature also documents significantly positive association between EI and firm performance (Ar, 2012; Forsman, 2013; Horváthová, 2012; Lanoie et al., 2011), using accounting base performance measure such as return on assets or equity which are subject to earnings management. In contrast, we opt market bases performance measure i.e., FV proxied by Tobin's Q and Market-to-book ratio that responds more promptly in presence of symmetric and asymmetric information among stakeholders. Prior studies also report mixed results concerning the relationship of environmental innovation and financial performance, suggesting that this relationship shall be re-examined in different way. Hence, presenting an important domain for further research. We unfold this research gap after taking the role of organizational capital in consideration which is a missing component in aforesaid relationship. Nevertheless, when we include the organizational capital as moderator, the EI-FV association becomes highly positive and significant. This finding is consistent using all proxies of EI (process innovation and product innovation) and FV (Tobin's Q and Market-to-book ratio). Our finding that EI has positive impact on FV is consistent with prior research on eco-efficiency (Sinkin et al., 2008), corporate innovation (Simeth and Cincera, 2016), and environmental responsibility engagement literature (Li et al., 2020), documenting that firms' environment related initiative increases the FV and help resolve the inconclusive findings of prior studies, regarding the EI-FV relationship. Our second finding that organizational capital positively

[4] Unreported post-estimation diagnostics results of SGMM and 2SLS confirms that our instruments are correctly identified and valid. These results are available from corresponding author upon request.

Table 9
Endogeneity concerns: 2SLS and system-GMM estimations.

	2SLS		System-GMM	
	(1)	(2)	(3)	(4)
	Tobin's q	Tobin's q	Tobin's q	Tobin's q
*PRC_INNV^*	0.326***		0.235***	
	(3.488)		(4.821)	
*PRD_INNV^*		0.697***		0.550***
		(3.972)		(6.947)
LAG_Tobin's q			0.435***	0.444***
			(66.829)	(70.579)
CSR_COMM	−0.241	−0.062	1.670***	1.472***
	(-0.715)	(-0.198)	(13.949)	(13.750)
CG_COMM	−0.462	−0.469	2.305***	2.911***
	(-0.796)	(-0.808)	(6.307)	(8.082)
F_SIZE	0.105	0.153	0.786***	0.752***
	(0.899)	(1.384)	(7.761)	(8.062)
ROE	0.013***	0.013***	0.005***	0.005***
	(3.548)	(3.530)	(17.536)	(16.408)
LEV	−0.003***	−0.003***	−0.000**	−0.000***
	(-5.918)	(-5.861)	(-2.768)	(-7.872)
S_GROWTH	0.002**	0.002**	−0.018	−0.012
	(2.387)	(2.389)	(-0.955)	(-0.631)
CAPEX	0.102***	0.108***	0.035***	0.036***
	(5.049)	(5.316)	(3.040)	(3.126)
ATO	2.817***	2.792***	2.141***	1.489***
	(13.029)	(12.897)	(8.816)	(6.107)
R&D	−91.920***	−91.920***	−27.765***	−29.795***
	(-53.428)	(-53.450)	(-15.591)	(-16.650)
CONS	4.871	5.001	1.782	−9.982***
	(0.715)	(0.735)	(0.000)	(-5.638)
INDUSTRY	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes
N	8511	8511		
R^2	0.340	0.340		
AR1			0.000	0.000
AR2			0.615	0.572
Hansen test of over identification			0.154	0.689
Difference-in-Hansen test of exogeneity			0.652	0.681

Note: This table presents the system generalized method of moments (System-GMM) and two-stage least square (2SLS) estimations of the impact of environmental innovation on firm value. *LAG* is the lagged values for the dependent variables in System-GMM. *PRC_INNV^* and *PRD_INNV^* in 2SLS are instrumented with industry average *PRC_INNV* and *PRD_INNV*, respectively. For brevity, the results of the first stage of 2SLS are not reported. t stats are in parentheses. *, ** and *** represent significance at 10%, 5% and 1% levels, respectively. All variables are defined in the appendix.

moderates the association between EI and FV, is consistent with (Aldieri and Vinci, 2020; Nadeem et al., 2018, 2021) who argue that in the era of knowledge economy, firms rely on both tangible and intangible assets. This finding shed light on organizational capital literature by showing that intangible assets (i.e., organizational capital) ensure the efficient use of tangible assets to gain competitive advantage which translates into higher FV. This finding also reveals that firms' dependency on tangible assets alone may not help them to achieve better FV but lead to an impediment in EI's strategic goal.

In contrast with prior literature documenting negative relationship between EI and FV (Aibar-Guzmán and Frías-Aceituno, 2021; Lee and Min, 2015; Yao et al., 2019), we provide perspicuous evidence to the literature that EI is significantly and positively related to FV and organizational capital further strengthens this relationship. Taken together, the findings of this study offer novel insights by endorsing the intent that organizational capital has capacity to foster FV through stimulating EI practices efficiently. We conclude that EI positively impacts firm value, but the level of organizational capital determines the impact of EI on FV.

Our study further proffers in the resource-based view of firms and EI strategy literature in competitive industrial context. It is suggested that EI is based on strategic preference of the firms and in turn, increases the FV depending on the use of organizational capital. As revealed earlier, the degree to which firm increases organizational capital affirmatively enhances the impact of EI on FV. Aforesaid argument corroborates that generally EI per se does not always results in better FV. However, the structured systematic alignment establishes and increases FV (Wilden et al., 2013).

The findings of present study contribute to literature in several ways: (1) by operationalizing EI through process innovation and product innovation and measuring firm performance using both accounting and market-based measures of performance to develop consensus among existing literature; (2) by analyzing the moderating effect of organizational capital on the relationship of EI and FV using the RBV theory proposed by (Barney, 1991); (3) by employing board structure variables in additional analysis to examine the impact of top management's commitment towards EI using upper echelon theory as suggested by (Hambrick and Mason, 1984); (4) lastly, we address the potential endogeneity issue using advanced econometric specifications unlike prior studies.

5.1. Policy implication and direction for future research

Our findings offer some important policy implications to corporate managers and policy makers. First, corporate managers will get to know that implementation of EI helps firms to gain legitimacy from stakeholders by portraying firms as environment friendly and socially responsible. Second, the investments in EI are not only favorable for the environment and society at large but also have a positive impact on FV. Third, our findings suggest that corporate policy makers should focus on intellectual assets such as organizational capital, because it helps firms to execute novel and sustainable aspects such as EI which increases FV. Finally, we acknowledge some limitations of our study. Prior research document that EI is the combination of four industrial dimensions, for instance, (i) management innovation, (ii) process innovation, (iii) product innovation, and (iv) technological innovation. However, we employed only two dimensions i.e., process innovation and product innovation. It can be assumed that other dimensions might have collaborative impact on FV. Hence future studies may consider employing all dimensions of EI.

CRediT authorship contribution statement

Umer Iqbal: Conceptualization, Writing – original draft, Writing – review & editing. **Muhammad Nadeem:** Conceptualization, Data curation, Formal analysis, Methodology. **Ammar Ali Gull:** Supervision, Validation, Writing – original draft, Writing – review & editing. **Umar Nawaz Kayani:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

Appendix. : Variables' definition

Dependent variables	
Tobin's q	The market value of equity plus the book value of assets minus the sum of book value of equity plus deferred taxes, all divided by book values of assets.
MTB	Total market value divided by total book value.
ROE	Net income before extraordinary items divided by total equity.
Independent variables	
PRC_INNV	Process innovation is based on the following indicators: (a) Resource Efficiency Objectives/Energy Efficiency (ENRRDP0192); (b) Resource Efficiency Objectives/ Water Efficiency (ENRRDP0191); (c) Eco-Design Products (ENPIDP069); (d) Emission Reduction Processes/Emissions (ENERDP0051); (e) Resource Reduction/ Policy (ENRRD01V); (f) Waste Reduction (ENERDP062). The final *PRC_INNV* value is the sum of all six (6) indicators above. Further details are in the main manuscript.
PRD_INNV	Product innovation is based on the following indicators: (a) Product Environmental Responsible Use (ENPIDP048); (b) Sustainable Building Products (ENPIDP068); (c) Organic Products Initiatives (ENPIDP045); (d) Product Access Low Price (SOPRDP025); (e) Product Quality and Responsibility Monitoring (SOPRDP016). The final *PRD_INNV* value is the sum of all five (5) indicators above. Further details are in the main manuscript.
Moderating variable	
ORG_CAP	Organisational capital measure based on the perpetual inventory method, by accumulating the deflated value of SG&A. See methodology section of the manuscript for more details.
Control variables	
CSR_COMM	Takes the value of 1 when the company has a corporate social responsibility committee or team, 0 otherwise.
CG_COMM	Takes the value of 1 when the company has a corporate governance committee, 0 otherwise.
F_SIZE	Natural logarithm of total assets.
LEV	Total debt to total assets ratio.
SALES_GROWTH	Rate of change in sales.
CAPEX	Net property, plant and equipment scaled by total assets.
ATO	Asset turnover measured as total sales divided by total assets.
R&D	R&D intensity measured as R&D divided by total assets.
INDUSTRY	Industry dummy.
YEAR	Year dummy.
Variables for additional analysis	
B_SIZE	Total number of board members.
BGD	The ratio of female directors to total board members
B_INDE	Percentage of independent board members.
DUALITY	Equals 1 when the CEO holds the chair position, 0 otherwise.

Note: In parentheses are ASSET4 variables codes.

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