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[Political Connections and Technological Change: Evidence from Non-Financial Firms in Pakistan]

Zia ur Rehman
Ph.D. Economics/Visiting Faculty Member, International Institute of Islamic Economics, International Islamic University, Islamabad (IIUI). E-mail: ziaurrehman315@gmail.com
Abdul Rashid
Director General/Professor, International Institute of Islamic Economics, International Islamic University, Islamabad (IIUI). E-mail: abdul.rashid@iiu.edu.pk
Muhammad Imran*
Ph.D. Economics/Visiting Faculty Member, International Institute of Islamic Economics, New Campus, International Islamic University, Islamabad (IIUI). E-mail: muhammademrran@gmail.com. https://orcid.org/0000-0002-0126-8311
Rashid Rauf
PhD (Economics) & Lecturer, International Institute of Islamic Economics, International Islamic University, Islamabad (IIUI). E-mail: rashid.rauf@iiu.edu.pk

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ABSTRACT

This study investigates the impact of political connections (PC) on technological change (TC) for manufactured firms listed on the Pakistan Stock Exchange (PSX) from 2001 to 2020. We select 221 firms, purely based on the availability of data. In addition political connection data is obtained from the Election Commission of Pakistan (ECP), and a dummy variable is constructed to show whether a firm is politically connected. In this study, dynamic panel data model utilized through the two-steps System GMM method. Empirical findings show that politically connected firms demonstrates significantly higher technological change. However, this positive association can be due to the; by preferential access to domestic credit, government official support due to their interest in the firm, and reduced barriers to importing advanced equipment for the sample non-financial firms. Moreover, the leverage, firm size, ROA, and firm age are negatively associated with TC, while cash flow has a significant positive impact on the TC. These findings highlight both political and financial drivers of technological advancement in Pakistan's manufacturing sector.

Key words: Technology, Political, Growth
JEL Classification: O14, D27, O40

Introduction

In general, the political connections influence a firm's technological improvement by providing access to financial resources, regulatory advantages, and strategic collaborations. Further, firms with strong political connections frequently secure government grants, favourable loan terms, and subsidies which gives advantageous position in the industry and thus, allowing them to invest relatively more in research and development (R&D) and implement advanced technologies (Cull et al., 2015; Liu et al., 2021; Bulfone, 2023). Furthermore, these firms benefited from relaxed regulatory requirements, which also provide quicker approval of new technologies and facilitating smoother operations. In addition to that, the politically connected firms can also promote partnerships with state-owned firms, R&D institutions, providing more access to progressive innovations and more expertise (Zhong & Zheng, 2025; Zou & He, 2025). However, while these advantages can accelerate technological progress, they may also discourage competition and innovation if firms rely excessively on political influence rather than market-driven efficiency (Chen et al., 2014).

The extent to which firms give rise to economic productivity and efficiency is associated with the size of efficiency and productivity by which the firms work. Arjomandi et al. (2012) stated that the growth of an economy depends on the efficient utilization of scarce resources. Similarly, Adler et al. (2017) said that the efficiency assists to accomplish the ideal distribution of resources and achieve an advanced output level with the prevailing scarce resources. The inefficient performance of firms ascends several consequences. For instance, Kumbhakar and Sun (2012) documented that inefficiency not only adversely affects firms' performance but also puts at risk its existence in a competitive market. In the same way, due to inefficiency, scarce resources are not being employed appropriately and firms cannot achieve an ideal and desired productivity level (Anders, 2012; Palombi et al., 2023).

In Pakistan, the association between politically connected firms and technological improvement shows a multifaceted dynamic that considerably impacts industrial performance and economic growth (Ali & Mohsin, 2023; Rathore et al., 2023). On the one hand, firm with politically connection often provide privileged access to government incentives, provision of the subsidies, and ease in regulations, which can ease technological upgrades and innovations (Zhou et al., 2017). However, on the other hand, this advantage is often escort by production and technical inefficiencies. One of the explanations can be that politically firms often focus more on sustaining political relationships rather than developing actual technological progress. The dependence on political ties rather than innovation based on market-based R&D can lead to more distortion in allocation of resources, in which politically connected firms obtain support despite of their technological capabilities, while more innovative but not politically connected firms struggle to compete. Further, non-financial firms in Pakistan face several structural challenges in adopting advanced technologies (Naeem et al., 2024). Many firms in Pakistan still operate with obsolete technology, inadequate investment in R&D, and a lack of skilled worker which is considered indispensable for innovations (Younas, & Rehman, 2021). In general, the governing bodies and regulatory setting, though supporting, the politically firms, create uncertainties that discourages long-term technological investment (Chen et al., 2014; Ahmed et al., 2023). In addition to that, weak intellectual property rights and inadequate collaboration between industry and R&D institutions further hinder the technological progress of these firms (O'Dwyer et al., 2023;). Therefore, addressing these challenges require prudent policy intervention that promote fair competition, create opportunities to incentivize independent technological adoption, and reduce dependence on political association for business success.

The association between politically connected firms and the technological advancement is a vital issue with considerable implications for economic growth, industrial competitiveness, and policy formulation (Desheng et al., 2021; Bulfone, 2023). In general, manufacturing sectors, where technological advancement is very essential for efficient production and global competitiveness, political influence can possibly either facilitate or hinder innovation (Sahoo & Lo, 2022; Grazini et al., 2024). Governments often play a central role in shaping technological progress through policies, funding, and regulatory frameworks, making political connections a key determinant of firms' ability to access resources and implement advanced technologies (Khan, 2023). Understanding this dynamic is crucial for policymakers aiming to design effective industrial policies that balance support for innovation with fair market competition. Additionally, for businesses and investors, recognizing the role of political ties in shaping technological strategies can help navigate risks and opportunities in technology-driven markets. Analyzing this intersection is particularly relevant for emerging economies, where institutional frameworks and political dynamics heavily influence industrial development and technological diffusion.

Despite the rising importance in the role of political connections in business performance, the existing literature offers limited insight into how these politically connections affects technological advancement, primarily in the context of non-financial firms of Pakistan. However, several studies emphasize the gains of political ties in offering financial resources and regulatory rewards, there is a limited amount of studies

on whether these benefits convert into consequential technological progress or purely strengthen market inefficiencies. In addition, most of the existing literature mainly focuses on developed economies, leaving a significant gap in understanding how political influence shapes technology adoption in emerging markets like Pakistan. Further, the existing literature remained silent on the topics such as structural barriers; lower investment in R&D, the poor and obsolete industrial practices, and poor policy frameworks that hamper technological advancement particularly in the politically connected firms. Thus, this study fill this gap in the literature whether political connections facilitate or hamper technological transformation among the firms, and provide the insight to the policy makers to how policy measures can be designed to guarantee that firms leverage their political connections for innovation rather than rent-seeking behavior.

Literature Review

There is consensus among the researchers that the importance of efficiency changes and technical change as the core determinant of the productivity change in addition to this political connection of firms may be considered as another important determinant of productivity change because political connection (PC) impacts the efficiency of firms and also the adoption of new technology[1]especially in developing countries. Several studies have been carried out in the literature (Zhu et al., 2021; Gogokhia & Berulava, 2021; Demir et al., 2022; Wan et al., 2023), which discusses the influence of political connection on efficiency and TFP change. However, the literature is far from any consensus, on where there is any positive or negative relationship among the said variables. We conclude this because the prevailing empirical evidence concerning political connection and its impact on corporate productivity, efficiency, and profitability acknowledges both positive and negative impact (Fan et al., 2008; Dombrovsky, 2008). There are numerous explanations behind this reason why PC firms, concerning productivity, have inferior performance as compared to their counterpart's firms. The politically connected firm manager and the board does not have managerial incentives to improve overall firm performance and to maximize shareholder wealth (Boubakri et al., 2008).

In numerous cases R&D has no deductable impact on firm efficiency (Wang et al.., 2020). R&D has a positive impact on firm productivity and efficiency. For instance, Saleem et al. (2019) have acknowledged that R&D is not only beneficial for innovation but also for the firm TFP. Huang et al. (2019) have reported that the impact of R&D on firm TFP in China is positive. Gogokhia et al. (2021) have reported an increase in R&D induces firm TFP. Zhu et al. (2021) has concluded that R&D spending has a positive link with firm TFP. Sharma et al. (2020) have reported that leverage is negatively related with firm performance. Shahzad et al. (2021) found that the impact of leverage on firm performance is negative. Wang et al. (2021) found that the impact of leverage on firm TFP is negative. Rahmanian and Bahremandjouy (2022) reported that leverage is negatively related with firm efficiency. Several other studies have also documented the negative association between leverage and firm TFP and efficiency (see, for example, Thakur & Kannadhasan, 2019; Hasanuddin, 2021; Pang & Wang, 2021; Huynh et al., 2022).

The mechanism is belonging to resource reallocation effect elaborated by trade

[1]Technology means new way of production, which help us to produce things better, faster, and less costly.

liberalization. The "self-selection" hypothesis proposed that only more productive firms will be preferred to go into the international market because mainly productive firms could be able to meet the expense of the sunk costs that ingoing into an export market entails. On the contrary, after entering in the international market, the firms with high productivity will have to retain more market share and resources, whereas firms with lower productivity are too uncompetitive to survive in the market, both of which augment the entire industry's productivity. Wang et al. (2021) documented that there a positive relationship between size and firm TFP. Li et al. (2019) found that there a positive relationship between size and firm efficiency. Song et al. (2015) explored the contact of size on the firm efficiency and concluded that size has a positive impact on efficiency.

Giang et al. (2019) have accomplished that age has a positive relationship with firm total factor productivity for Vietnams firms. Xu et al. (2020) have concluded that firm age has a positive impact of TFP. Gogokhia & Berulava (2021) have also reported that age is positively related with firm productivity. Few researchers have recognized positive impact of age on firm TFP (Shahzad et al., 2021; Wang et al., 2021; Spithoven & Merlevede, 2023). However, several other researchers have documented an uncertain impact of age on firm TFP and efficiency (see, for example, Gogokhia & Berulava, 2021; He et al, 2022; Rahmanian & Bahremandjouy, 2022). Firm return on asset (ROA) is a crucial determinant of firm TFP. He et al. (2022) found the negative impact of ROA on firm total factor productivity. Huynh et al. (2022) reported that ROA and firm performance are negatively linked. On the other hand, Song et al. (2015) reported a positive impact of ROA on firm efficiency. He et al. (2022) found the positive impact of ROA on firm total factor productivity. Similarly, Wang et al (2021) also reported a positive impact of ROA on firm TFP. However, Dicko et al. (2021) do not find any significant association between firm efficiency and return on assets. Boubakri et al. (2008) defined the political connection of the firm as its linking between a firm and politicians, through shareholding, and directors. It is regarded as a firm's relational asset that ties with an incumbent politician that utilizes to obtain favors' having some pecuniary value. Mainly, the firm endeavors to create a PC as this improves its chance to flourish. At a firm level, financial resources, size of the firm, and international diversification are a vital determining factor of PC, while competition and industry meditation are observed as central industry-specific factors that determine the prospect of firms' PC. Lastly, at an institutional level, PC is regarded as an endogenous retort of insufficiencies in the system.

Methodology and Data

This study adopts a non-parametric DEA method, the technique is more useful and efficient when we are dealing with small sample size. In contrast, the stochastic frontier analysis method is generally applied to compute when the size of a sample is comparatively huge, for example, in the context of advanced economies like the USA. The DEA method has also few more advantages. For instance; DEA doesn't involve any preventive supposition concerning a firm's behavior, no restraint regarding the functional sort relating to efficiency or technology dispersal. This utilizes numerous inputs and outputs data and shows the magnitude of inefficiency.

Total Factor Productivity Index

The explanation of TFP used as following Jorgenson and Grilliches (1967) and O'Donnell (2010) in this study is $TFP_{nt} = Q_{nt}/X_{nt}$ where TFP_{nt} denotes the TFP of firm n during

time t, $X_{nt} = X(x_{nt})$ represents aggregate input $Q_{nt} = Q(q_{nt})$ represents an aggregate output. A parallel equation may be held for alternative firm m for time s. At that time, the index number which narrates the TFP of a firm n during time t with the TFP of firm m during time s is illustrated as:

$$TFP_{ms,nt} = \frac{TFP_{nt}}{TFP_{ms}} = \frac{Q_{nt}/X_{nt}}{Q_{ms}/X_{ms}} = \frac{Q_{nt}/Q_{ms}}{X_{nt}/X_{ms}} \quad (1)$$

where $X_{ms,nt} = X_{nt}/X_{ms}$ and $Q_{ms,nt} = Q_{nt}/Q_{ms}$ are input and output quantity index. Such description allows us to express the index number which calculates changes in TFP as the "ratio of an output to an input quantity index". The Fare-Primont TFP proved by O' Donnell (2012) is an individual index that encompassed the explanation and maybe measured deprived of price data. Precisely, the Fare-Primont TFP index may be defined as

$$TFP_{ns,nt} = \frac{D_0(x_0,q_{nt},t_0)}{D_0(x_0,q_{ms},t_0)} \times \frac{D_I(x_{ms},q_0,t_0)}{D_I(x_{nt},q_0,t_0)} \quad (2)$$

Where $D_I^T(x_{ms}, q_0, t_0) = max(\delta > 0: (x/\delta, q) \in P^T)$ indicates input distance function, $D_o^T(x_0, q, t_0) = min(\delta > 0: (x, q/\delta) \in P^T)$ indicates output distance function, and P^T denotes the time T PPT. We use the DEA approach suggested by O'Donnell (2010), Khan et al. (2015), Maziotis et al. (2017), Ilyas and Rajasekaran (2020), and Dakpo et al. (2019), to estimate this distance function. The DEA does not require such obstructive expectations concerning the behavior of a firm, and efficiency distribution.

In addition to that, in Appendix A (Table A1) we depict the measurements of total factor productivity change and also elaborates its components, which include technical change and change in efficiency for manufacturing industry. Changes in efficiency are further divided into three components. These components are: (1) technical efficiency change, (2) mix efficiency change, and (3) the residual scale efficiency change. The estimates are given in Appendix A. The estimated value greater than 1 depicts an improvement in productivity and on the contrary, whereas, estimated values less than 1 depicts deterioration in productivity. Based on our empirical analysis, our results for non-financial register firms shows TFP progress during the starting period, before 2011, the major reason behind this progress was sometime progress of TFPE and sometime due to technological progress and sometime due to both factors.

Efficiency Concepts

O'Donnell's (2010) described numerous decompose components of multiplicatively complete TFP indices. We define the concept of efficiency by a proportion of aggregate output to input similar to as demarcated by O'Donnell (2010). He defined the proportion degree of a scale, technical, and mix efficiency in a firm to selects an input with output combination (x_t, q_t) from the specific production possibility set in time t. Subsequently, technical and scale efficiency calculation going to be described as technically achievable input and output vectors which could be described as a scalar multiple of x_t and q_t which declares an input and output mixes are being apprehended static. Therefore, an illustration for mix efficiency going to be described by an input and output vector which is technically conceivable when an input and output mix is permitted to fluctuate.

Impact of Political Connection on Technological Change

The TC scores attain from DPIN useful for us in two aspects; first, the will indicates the level of TC of different firms. Second, they will identify the possibilities for enhancement. However, the TC scores alone deliver no information regarding why there occur TFP

disparities among different firms. To respond to the question, we will further run a regression by using System Generalized method of moments (GMM) in which TC results attaining from DPIN used as a dependent variable and we will check the impact of political connection on TC by considering political connection as a basis of TC disparities. The empirical model is as follows:

$$TC_{it} = \alpha_i + \beta_0 TC_{it-1} + \beta_1 Tobin's\ Q_{it} + \beta_2 PC_{it} + \beta_3 CR_{it} + \beta_4 CF_{it} + \beta_5 SIZE_{it} + \beta_6 LEVERAGE_{it} + \beta_7 ROA_{it} + \beta_8 R\&D_{it} + \beta_9 Age_{it} + f_i + Y_t + \varepsilon_{it} \quad (4)$$

where the PC is a dummy variable representing the firm's political connections, whereas Tobin's Q shows the growth opportunities (GO) accessible to a firm. Tobin's Q is measured by the price-earnings ratio. Control variables for firm TFPE were nominated based on the results of prior empirical studies. We use six control variables influencing firm TFPE in the absence of PC. The variables are current ratio, cash flow, firm size (size), Leverage, return on assets (ROA), and firm age. Further, firms that were delisted during the study period are not included in the sample. Furthermore, the sample incorporates only non-financial listed firms from Pakistan Stock Exchange. The decision to incorporate only the non-financial firms is due to reason that the accounting treatment of profit and revenue for non-financial firms is significantly changed from financial firms. The sample period covers 2001–2020, there are three relevant national and state elections held during the study period.

Data

In this study, we use data for firms obtained from the annual reports of firms listed at Pakistan Stock Exchange (PSX) from 2001-2020. The choice of non-financial firms is on the availability of data during the study period, if any firms that do not have relevant data for the sample period is not included in the sample. However, firms that were delisted during the study period are also excluded from sample in the end we have incorporated only 221 firms. The decision to incorporate only the non-financial firms is due to reason that the accounting treatment of profit and revenue for non-financial firms is significantly changed from financial firms. Given that the sample period covers 2001–2020, there are three relevant national and state elections held during the study period. The data on politicians has been attained from the Election Commission of Pakistan (ECP) official website, which overlooks elections for the Provincial and National Assemblies and maintains information concerning the list of candidates with their parties' positions, full names, and electoral outcomes. Each politician is identified uniquely through a combination of first and last name. Following Khwaja & Mian (2005) and Faccio (2006), irrespective of the electoral outcome, all politicians are considered influential individuals who can benefit firms through preferential access to finance.

Estimation Method

The prior empirical studies suggest that the System Generalized Method of Moment (GMM) is a more suitable method for dynamic panel data estimation as compared to fixed effects, OLS, semi-parametric approaches, and instrumental variables, as it gives more reliable and consistent coefficient estimates of the variables. Our recommended models are the dynamic panel models. Firm TFPE is our dependent variable, which is influenced by lag value of firm TFPE. In our models first lag value of the dependent variable is also the independent variable. Therefore, these are the first order auto regressive (AR1) panel data models. In the presence of autocorrelation the use of lagged

dependent variable as an instrument becomes inappropriate. There is a possibility that the blind use of the instruments may raise questions regarding the validity reliability of the instruments (Rashid et al. 2021). So we have to check that the instruments are valid or invalid. Sargan and Hansen test for autocorrelation after the estimation of GMM is used. The most appropriate test for two steps system GMM is J-test of Hansen (1982).

Results and Discussion

Descriptive Statistics

Table 1 shows the summary statistics of full sample of micro level variables. In addition, Tobin's Q, which is a measure of market valuation, reflects a very limited dispersion with a mean value of 6.0733 and a tight interquartile range, reflecting relative consistency in firm valuation. Similarly, the technological change (TC) has a mean of 0.9922 and a standard deviation of 0.1139, suggesting firms differ slightly in adopting new technologies. In this empirical analysis we construct a dummy of political connections (PC) are present in about 32.75% of the sample firms, highlighting a significant subset with direct political affiliations. These summary statistics underline the variety in firm behavior and structure, which is fundamental to the analysis of how political connections influence technological advancement.

Table 1: Descriptive Statistics of variables

Variable	Mean	Std. Dev.	P25	P75
TFPE	0.9992	0.3234	0.8783	1.0596
Tobin Q	6.0733	0.1228	6.0747	6.0758
TC	0.9922	0.1139	0.9298	1.0359
PC	0.3275	0.4693	0	1
R&D	0.4759	0.4994	0	1
Leverage	55.6745	23.5715	41.0068	70.5132
ROA	5.2689	0.1129	5.2417	5.2950
CR	0.8511	0.4233	0.6471	0.9895
Cash	17.8844	0.1343	17.8638	17.8782
Age	23.7510	0.3510	23.4657	24.0253

Impact of Political Connection on TC

Political connections play an important role to augment not only the firm performance but also facilitate firms to adopt new technology by providing them ease to access to credit. We test our hypothesis that PC has positive impact TC. We observe that the coefficient of political connection is statistically significant and positive. Which shows that with regard to adoption of TC, on average, politically connected is performing better as compared to non-connected firms. Higher TC of PC firms is mainly due to a range of benefits that is provided to politically connected firms, including superior treatment by state firms, preferential access to credit, collusive deals in tariff, tax evasion to import new advance machinery. Theoretically, the separation of firm control and ownership, according to agency theory, can leads toward contradicting preferences between

management and owners. Management can take a decision not to adopt advance equipment of production according to their preferences, which needs more effort and skills to operate in starting as compared to old equipment. To overcome this issue, politicians, as outside directors, may be able to control the management and take a decision to adopt new advance equipment, which ultimately improves firm performance because with passage of time, by way of learning by doing management and worker will be able to build their skills and become expert to use advance equipment. Besides this, politicians also facilitate firms in importing new advance equipment, which subsequently improve the performance of firms.

Our finding shows that PC firms depend on political interventions, which consequently outcome in the satisfactory performance of firms. Our empirical findings support our hypothesis that politically connected firms have positive impact on TC. The positive impact of PC on firm TC is accordance to the finding of Jou et al. (2017), Saleh et al. (2020), Khaliq et al. (2020), and Pang and Wang (2021), all of whom reported that PC have positive and significant impact on firm performance. The coefficient of lagged dependent variable is positive. Hence, it shows that this model is dynamic in nature. Positive coefficients of the lagged technological change are in accordance with other studies (Behrens & Trunschke, 2020; Chang, 2023).

Table2: Two step System-GMM Estimation for impact of PC on TC

VARIABLES	TC
L.TC	0.3953***
	(0.000)
PC	0.5377***
	(0.000)
R&D	0.0149
	(0.494)
Tobin Q	-0.8389***
	(0.000)
ROA	-0.0689***
	(0. 000)
CR	-0.0063*
	(0.088)
Cash	0. 0996***
	(0.000)
Size	-0.0234***
	(0.000)
Leverage	-0.0011***
	(0.000)
Age	-0.6414***
	(0.000)
Constant	6.9133***
	(0.000)
Obs.	1612
Firms	220

Instrument	159
Validity test	
AR(1)	-3.45
P-Value	(0.001)
AR(2)	0.63
P-Value	(0.532)
Sargan	618.90
P-Value	(0.000)
Hansen	166.81
P-Value	(0.138)

The link between R&D and firm TC is positive but insignificant. The outcome signifies that, on the average, an increase in R&D did not have any influence on the technological advancement of Pakistani firms. The effect of firm size on technological advancement is negative and statistically significant at the 1% level of significance. The negative impact of size on firm TC is consistent with other studies (Guo et al., 2021; Wu et al., 2021). The significant negative coefficient of size indicates that the Pakistani firms are, on average, bigger than the optimal size recommended by the classical theory. The classical theory of optimal size suggests that there is an optimal size of a firm. Firms' initially grow to achieve an optimal size. Furthermore, at the optimal point firms minimize average cost of production. It means that, the smaller firms tend to grow quickly as compare to their counterparts because larger firms are likely to take more time to replace old equipment with latest technological equipment.

The relationship among leverage and firm technological change is negative and significant. This indicates that high leveraged firms have negative effect on TC. Further, this shows that when firms have a political connection and easily access to debt financing. Due to surplus of financing, Manager will not use the resources more efficiently in the production process, which results in having a lower return. The negative connection between leverage and TC is consistent with Shahzad et al. (2021), and Goel et al. (2022). The rationale could be that extremely levered firms faces growing cost of debt, this departs fewer funds for equipment purchase. The association among ROA and firm TC is negative in our model. It shows that firms having higher ROA will contribute less toward firm TC. Our results are supporting the existing empirical literature and consistent with research performed by Mathew, 2017; Huynh et al., 2022. We observe that the link among CR and firm TC is negative and significant. Our outcome are consisting to the results Ali et al. (2018), Batubara and Ramadan (2021), He et al.(2022) and Huynth et al. (2022) whose findings concluded that liquidity is a significant interpreter of firms' TC. The possible explanation can be that the firms were investing more in inventories, which have been set aside at a high storage cost, which adversely influence the capability of firms to adopt new technological equipment.

The coefficient of cash flow variable is positive and statistically significant at the 1% level of significance, which indicates that cash flow of the firms positively affects TC in our model. The significant positive association between cash flow and TC is in support of literature which finds that due to information asymmetry as capital market imperfection, firms face financial constraints due to an increased cost of capital in external funds which force firms to dispose of the adoption of better management, proficient human capital

and advance equipment which can be appoint, purchased and used in the presence of internal cash flows due to their lesser cost. We observe that the connection among age and firm TC is negative and highly significant indicating that, with the passage of time it become difficult for the firm to hold technology up to date, and with the passage of time these firms are overtake by those innovative productive firms, which described as a "vintage effect". The inverse effect of age on firm TC is consistent with Song et al. (2015). Their findings suggest with regard to TC, new industry entrants have better TC as compared to older firms. Further, their results indicated that adopting the new available latest technology by new firms make them more productive as compared to their counterparts within an industry and forcing them to exit from an industry.

Conclusion and Policy Recommendations

This empirical study investigates the role of political connections in driving technological change among manufactured firms listed on the PSE from 2001 to 2020. Study utilized two-steps System GMM approach, and finds that politically connected firms are considerably attains higher levels of TC. This positive impact can be associated with the availability of the domestic credit on special preferences, bearing less cost on the import of advanced machinery, and also conditional support from government administrator with vested interests. On the one hand, these benefits, the study also recognizes key firm-specific financial attributes for instance larger firm size, higher leverage, lower profitability, and older age as constraints to technological advancement. On the other hand, strong internal cash flows enhance a firm's ability to adopt new technologies. These empirical findings offer important insights for instance; while political connections can act as a means for innovation, sustainable technological advancement, also need to be financially sound. The empirical results underline the complex relationship between politics, finance, and innovation in Pakistan's manufacturing sector, offering critical insights for management, decision makers aiming to promote inclusive technological advancement.

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Appendix - A

Table A1: Changes in Total Factor Productivity for Non-financial PSX firms

Period	dTFP	dTech	dTFPE	dTE	dME	dRSE
2001	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2002	0.9995	1.0235	0.9984	1.0054	1.0046	0.9944
2003	1.0121	1.0123	1.0131	1.0079	1.0127	1.0090
2004	1.0331	1.0549	1.0104	1.0002	1.0035	1.0066
2005	1.0274	1.0210	1.0171	1.0081	1.0052	1.0199
2006	1.0245	1.0310	1.0073	1.0080	1.0079	1.0085
2007	1.0044	1.0050	1.0113	1.0071	1.0025	1.0178
2008	1.0201	1.0064	1.0280	1.0075	1.0092	1.0276
2009	1.0118	1.0205	1.0078	1.0079	1.0017	1.0162
2010	1.0101	1.0013	1.0242	1.0079	0.9995	1.0336
2011	0.9868	0.9752	1.0281	1.0076	1.0073	1.0287
2012	0.9921	0.9886	1.0213	1.0093	1.0088	1.0200
2013	0.9945	0.9908	1.0235	1.0089	1.0110	1.0215
2014	0.9716	0.9836	1.0063	1.0064	1.0128	1.0043
2015	0.9757	0.9855	1.0079	1.0063	1.0105	1.0078
2016	0.9861	1.0016	1.0001	1.0046	1.0045	1.0071
2017	0.9781	0.9826	1.0082	1.0037	1.0052	1.0172
2018	0.9596	0.9773	0.9979	1.0046	0.9958	1.0124
2019	0.9546	0.9693	0.9994	1.0069	0.9998	1.0072
2020	0.9252	0.9678	0.9705	0.9987	0.9859	1.0068