Business and Politics (2022), **24**, 151–170
doi:10.1017/bap.2021.20

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Innovation and Perceived Corruption: A Firm-Level Analysis for India

Nabamita Dutta[1]*, Saibal Kar[2] and Hamid Beladi[3]

[1]Department of Economics, College of Business Administration, 1725 State Street, University of Wisconsin-La Crosse, La Crosse, Wisconsin, 54601 USA, [2]Centre for Studies in Social Sciences, Calcutta and IZA, Bonn. R 1, B.P. Township, Kolkata 700 094, West Bengal, India and [3]University of Texas at San Antonio, San Antonio, Texas, USA
***Corresponding author:** Nabamita Dutta, Email: ndutta@uwlax.edu

Abstract
Do perceived obstacles about corruption matter for Indian firms when it comes to their probability to innovate? Using World Bank Enterprise Survey firm-level data, we show that a unit rise in corruption perception of firms in India lowers innovation rate by about 1 percent. The result is important in terms of policy implementation because recent studies have shown that perceived obstacles can affect firms' probability to innovate. Such analysis is missing in the Indian context where both big and petty corruption is rampant. Our results further show that perceptions about financial barriers matter only when firms also view corruption to be bad. Perceived difficulty in accessing credit in conjunction with corruption perception lowers probability of innovation by 4 percent. This is also true for nonfinancial perceived obstacles of firms. The results remain robust to alternate identification strategies.

Keywords: innovation; entrepreneurship; information; corruption perceptions; perceived obstacles; access to credit; India

Introduction

How does perception of obstacles by firm owners affect their probability to innovate? In recent decades, studies have not only shown that perceived obstacles matter for firms' probability to innovate but also the extent to which perceptions determine firm's engagement in innovation (Pellegrino and Savona, 2017; Mancusi and Vezzuli, 2014; Iammarino et al., 2009; Savignac, 2008; Tiwari et al., 2008; Segarra-Blasco et al., 2008; Canepa and Stoneman, 2008; Galia and Legros, 2004; and Baldwin and Lin, 2002). Many of these studies employing Community Innovation Survey (CIS) data published by the European Union (EU) have empirically assessed the role of both financial and nonfinancial perceived barriers for firms in terms of their efforts to innovate (viz., Pellegrino and Savona, 2017; Mancusi and Vezzulli, 2014; Blanchard et al., 2013; D'Este et al., 2012; Iammarino et al., 2009; Mohnen and Röller, 2005; and Galia and Legros, 2004). To the best of our knowledge, such empirical studies looking at implications of perceived barriers by firms and employing data for countries outside the EU or ESS (European Social Survey) member countries are scarce.

We therefore contribute to this literature by empirically assessing the role of perceived corruption as an obstacle for Indian firm owners. It is well known that corruption remains a daunting problem in India's path toward growth and development. Based on Transparency International's (TI) Corruption score rankings, India has always been around 80th rank amid 170–75 countries with its rank dropping in recent years (TI, 2021). Following TI, about 89 percent of surveyed individuals think that *government corruption is a big problem* in India (Asia, 10th ed., TI, 2021). Further, the Trace Bribery Risk Matrix, measuring bribery risk in 194 countries, considers India's score to be a high risk (ranks 77 out of 194). Related studies have previously pointed out the associated challenges in terms of the corruption in India (viz. Dutta et al., 2013), but none discusses the implications for innovation by firms under the perception of corruption. Given that the nonfinancial barriers as perceived by firms are deemed important for their innovation efforts (Pellegrino and Savona, 2017) and that the corruption

© The Author(s), 2022. Published by Cambridge University Press on behalf of V.K. Aggarwal

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

environment faced by Indian firms is complex, we attempt to explore if perceived corruption dampens the probability to innovate.

In addition, we look into other perceived obstacles and if they interact with perceived corruption to affect the outcome. Specifically, because the literature has documented the impact of financial obstacles to innovation quite well (Mancusi and Vezzulli, 2014; Blanchard et al., 2013; Tiwari et al., 2008; Savignac, 2008; Tourigny and Le, 2004), we also start by exploring the role of financial barriers. Indeed, only a few studies thus far explore a firms' perceptions about financing constraints in the context of innovation efforts (Hottenrott and Peters, 2011; Savignac, 2008; Canepa and Stoneman, 2008). Other than testing if perceived financial barriers matter on their own, we are particularly interested in seeing if it indirectly affects the probability of innovation through perceived corruption.

However, the existing literature does not offer an unambiguous conclusion about corruption's impact on entrepreneurial endeavors. In particular, prevalence of high corruption can dissuade firms from innovations because corruption in general hurts growth and lowers the returns from innovations for entrepreneurs (Dutta and Sobel, 2016; Anokhin and Schulze, 2009; Glaeser and Saks 2006, to mention a few). Yet, Holmstrom (1989) shows that innovative firms might be the ones that are more willing to bribe their way ahead of other firms. Later, Ayyagari, Demigurc-Kunt, and Maksimovic (2014) also offer similar findings. Because actual corruption's impact can be ambiguous, following similar reasoning, greater perceived corruption might help or hurt the probability to innovate for firms. Thus, the outcome for Indian firms is open to empirical analysis.

To this effect we choose and control for a range of variables at the firm level by using the World Bank Enterprise Survey (WBES) 2014 wave. The present contribution lies in observing the own impact of these variables and for some the joint impact if interacted with the corruption perception. Specifically, we are interested in estimating marginal effects of perceived corruption on firms' probability to innovate as the perceptions about financial or other nonfinancial barriers changes. To offer an early glimpse, we find that the nonfinancial barriers like corruption along with financial barriers as regarded by firm owners support the observations in Pellegrino and Savona (2017). Starting with logit specifications incorporating industry and state fixed effects, we establish identification by mitigating omitted variable bias, employing inverse probability weight (IPW) estimates to take into account simultaneous sample selection, and dealing with sample selection bias using the Heckman model.

"Conceptual Framework and Related Literature" presents a brief analytical basis of this study and the general literature surrounding it. "Data and the Sources" presents the data. "Empirical Methodology" offers the detailed empirical methodology and "Benchmark Results" presents the benchmark analysis followed by robustness checks in "Robustness Analysis." The last section concludes.

Conceptual framework and related literature

Innovation at the firm level is driven primarily by research and development (R&D) and by various conditions that govern the business prospects. We argue that if a firm anticipates a highly corrupt bureaucracy, red tapes, and rent-seeking behavior on the part of the public authorities that independently or collectively hurts productivity and profitability, then these enterprises might choose not to innovate and grow. Coupled with this, firms may also face the problem of credit constraints that deter investments for R&D and therefore, independently as much as because of the impact of corruption, underperform on innovative abilities. The flow of information regarding perception of corruption and probable hindrances lead to adverse outcomes as much as these factors hurt innovation in their material forms. The issue at hand is information theoretic and includes effects of negative externality on firm behavior. Indeed, many studies have shown strong association between innovation activities and survival chances of firms (Cefis and Marsili, 2005; Pérez et al., 2004; Ericson and Pakes, 1995; Hall, 1987, etc.). However, the conclusions with respect to innovation's effect on firm growth are ambiguous. For example, Hölzl (2009) does find that R&D efforts are bigger for high-growth firms, but the relationship is still dependent on the average technological capability of the country. Conversely, studies have also explored the effects of innovation on firm productivity (Mairesse and Mohnen, 2010; Griffith et al., 2006; Mohnen et al., 2006; Griffith et al., 2004).

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

When it comes to exploring the link between corruption and innovation, as suggested by Xu and Yano (2017), very few studies have explored the association. Innovators can be vulnerable to the presence of corruption especially involving government services because they depend on such services for permits and licenses (Murphy et al., 1993). Some other studies, employing both micro and macro samples, that have tested the detrimental impact of corruption for innovative firms are Paunov (2016), Waldemar (2012), and Anokhin and Schulze (2009).The outcome is not always negative, as Xu and Yano (2017) find that anticorruption efforts make Chinese firms invest more in R&D activities.

Presently, we explain why exploring this question offers significant importance for India. First of all, starting from the seminal paper of Krueger (1974), corruption has been undeniably considered a major obstacle for growth and development outcomes of India. In more recent years, Heston and Kumar (2008) have stressed the crucial role of corruption in affecting economic growth of India. But more topically, a few recent studies have explored corruption's impact on firm performance for India. For example, Sharma and Mitra (2015) use bribe data as a measure of corruption to show that while corruption affects firms' efficiency negatively, it does help with respect to export and product innovation. However, with respect to the probability of innovation by firms facing high degrees of corruption across states in India, there is a serious gap in the literature. As mentioned in the preceding text, we explore this relation but also extend it beyond perceived corruption only. We consider other obstacles as viewed by firms starting with financial barriers and account for interactive effects of corruption with the other perceived obstacles. The idea is to see if other perceived obstacles accentuate the damaging impact of corruption perceptions on probability to innovate for firms. The infrastructure-related barriers like unsteady and fluctuating power supply, transport, and customs-related obstacles feature in this group.

Data and the sources

Data source

The data for this study comes from the World Bank Enterprise Survey (WBES) database. For India, the most recent wave of data is from the year 2014. While data for India has been collected over the waves 2005, 2009, and 2010, our variables of interest are either missing in the earlier surveys or are not comparable across waves. For example, our main dependent variable of interest, a measure for innovation, is based on whether the firm has invented a new product or service in the last three years. The 2010 wave does not ask any such question. For the 2005 wave, the question wondered if the firm has discovered an important product line in the last two years. While both can be used as a measure of innovation, they are not exactly comparable and, thus, building a panel over time becomes difficult. While the question on perceived corruption of firms, our main independent variable of interest, has been asked in both 2005 and 2014 waves, the number of firms in 2005 wave is much less than those covered in the 2014 wave (2,200 firms for 2005 vs. 9,281 for 2014). Finally, other variables of interest, namely, the perceived obstacle in accessing finance, has also been asked differently across the waves making them hard to compare across the samples. Thus, we stick to firm-level analysis based on the 2014 wave.

The data covers twenty-three out of twenty-nine states of India. Based on 2011 census, the twenty-three states comprise of about 97 percent of the Indian population. The remaining six states that are not covered in the sample along with seven Union Territories comprise about 3 percent of Indian population. Data availability for northeast states along with the Union Territories is a major challenge for most empirical studies on India. The firm-level data for India has been collected between June 2013 and December 2014. The sample includes firms in the manufacturing and the service sectors and aims to quantitatively assess firm performance, firm structure, and firms' perceptions of the obstacles in their growth process. A three-level stratified random sampling method has been employed for the data collection to ensure that the collected sample provides unbiased estimates for the whole population and that the sample is representative of industries, sectors, and regions (WBES, 2014).

Due to the sensitive nature of the questions touching the business-to-government interactions, private contractors were preferred to government agencies conducting the surveys (WBES, 2014). A two-stage procedure was implemented while collecting the responses. The first stage consisted of a screening questionnaire, applied over the phone to schedule appointments and also to assess

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

eligibility. A face-to-face interview was conducted in the local language in the second stage with the manager or the owner, alternatively with the director of the firm (establishment). The sample, consisting of 9,281 firms, spans across twenty-six industries. Major manufacturing and service industries like food, textiles, garments, leather, wood, paper, chemicals, hotels, and restaurants are included.

Dependent and independent variables

Our dependent variable is a dummy based on the question "In the last three years, has this establishment[1] introduced new products or services?" (WBES, 2014). The dummy takes the value 1 if the answer is yes; 0 otherwise. The summary statistics of our main variable of interest are presented in table 1. Out of the 9,281 observations, approximately 44 percent of data points take the value 1. Looking across industries, we find that some of the most innovative industries are leather (56 percent), hotels and restaurants (54 percent), garments (52 percent), electronics (57 percent), and so on.
States like Karnataka, Kerala, Rajasthan, and a few others have firms that are most innovative.

Regarding the main independent variable of interest, which is a measure of firms' perception of corruption, we find that the specific question asked to firm owners is: How much of an obstacle is corruption? The question aims to assess the extent to which firm owners consider corruption as an obstacle to current operations of the establishment. The survey categorizes corruption as an obstacle in five levels. These are no obstacle, minor obstacle, moderate obstacle, major obstacle, and very severe obstacle. We construct an ordered dummy variable ranging from 1 to 4 with 0 indicating no obstacle and higher numbers representing greater perceived obstacle. The mean for our sample is around 2.1. About 33 percent of the firms categorize corruption as an obstacle to be 0 or 1 implying that they do not perceive corruption to be much of a hindrance. About 43 percent of firms in the sample state that they perceive corruption as a major or very severe obstacle in their operations. The average score for the variable in states like Uttar Pradesh, Uttaranchal, Punjab, Tamil Nadu, Rajasthan, and Odisha is relatively high (close to 3 or higher).

Other independent variables and controls

Next, access to finance stands out as an important perceived obstaclefor firms. We discuss shortly if access to finance and corruption are related. However, the variable measuring an obstacle to financial access is as similarly constructed as corruption. As stated in the survey, difficulty in accessing finance by firms includes availability as well as cost, interest rates, fees, and collateral requirements. An ordered dummy variable is constructed like before; it varies from 0 to 4, where 0 indicates responses stating no obstacle. Higher numbers indicate greater obstacle. The mean is smaller than that in the case of corruption (1.2) suggesting that for our sample firms in general perceived corruption as more of an obstacle relative to that of acquiring finance. Almost 85 percent of the firms report no obstacle, minor obstacle, or moderate obstacle.

Our benchmark control variables include firm size, location of the firm, percent of the firm's sales that are exports, if the firm belongs to a larger company, and number of years the firm is in business. As pointed out by Schumpeter (1942), larger firms are more likely to engage in innovation activity because their chances of facing liquidity constraints are likely to be lower than small and medium-sized firms. At the same time, they can also enjoy economies of scale (Mairesse and Mohnen, 2002; Cohen and Klepper, 1996). We control for dummies indicating small[2] and medium firms with "large firm"

[1]The study is designed to survey an establishment, which is a physical location where business is carried out, industrial operations take place, or services are provided. A firm may be comprised of one or more establishments; for instance, a brewery may have several bottling plants and several establishments for distribution. To qualify for this survey, an establishment must have its own management and control over its workforce. In practical terms, all establishments from multiestablishment firms are included except headquarters that have no production or sales or establishments that do not have their own management and control over their workforce; in those cases, the establishment should be substituted. Unit of analysis, WBES: https://www.enterprisesurveys.org/content/dam/enterprisesurveys/documents/methodology/ES_QuestionnaireManual_2019.pdf (accessed September 17, 2021).

[2]The survey categorizes small firms as those with more than five but less than nineteen employees, medium firms as having more than twenty but less than ninety-nine employees, and large firms have more than ninety-nine employees.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Table 1: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Innovation	9,270	44.9%	49.7%	0%	100.0%
Corr. (perceived)	9,281	2.1	1.3	0	4
Finance obs. (perceived)	9,244	1.2	1.1	0	4
Firm (small)	9,281	33.6%	47.2%	0%	100.0%
Firm (med)	9,281	43.7%	49.6%	0%	100.0%
Firm (large)	9,281	22.6%	41.9%	0%	100.0%
Export (sales%)	9281	6.1%	20.3%	0%	100%
Cap. city	9,281	5.7%	23.1%	0%	100.0%
Business city	9,281	81.3%	39.0%	0%	100.0%
Yrs. in operation	9260.0	19.6	14.3	1.0	70.0
Part of larger est.	9,281	21.5%	41.1%	0%	100.0%

Note: Innovation is a dummy taking the value 1 "if in the last three years, the establishment has introduced new products or services?" *Corr. (perceived)* is a variable representing corruption perceptions of firms. The question asked is *How much of an obstacle is corruption? Finance obs. (perceived)*is a variable based on the question *How much of an obstacle is access to finance*? *Firm (small)* represents the dummy for small-sized firms, *Firm (medium)* indicates medium-sized firms and *firm (large)* indicates dummy for large firms. *Cap city* denotes if the firm is in the official capital city. *Business city* denotes if the firm is in the main business city or not. *Export (sales %)* denotes the percent of sales constituting of exports. *Years in operat*ion is the number of years the firm has been in operation. *Part of large est.* denotes if the firm is part of a larger company (establishment) or not.

dummy as the baseline. About 34 percent of the firms in our sample are small sized and about 44 percent are medium sized.

Another control incorporated here is the percentage of sales amounting to exports. As suggested by Pellegrino and Savona (2017) and Narula and Zanfel (2003), firms operating in the international market are more likely to innovate because it involves greater market competitiveness. The mean of our sample is about 6 percent with a high standard deviation suggesting that there is greater variation in terms of exports among the firms. Next, the conclusion in the literature with respect to impact of firm's age on innovation abilities is ambiguous. For example, Klepper (1996) argued that innovations per firm should be higher for the younger firms, theoretically speaking. However, studies like Galende and De la Fuente (2003) explain that a firm's knowledge and experience accumulated over time can play a positive role in innovation abilities. Recent studies like Pellegrino and Savona (2017) and Bertoni and Tykvovà (2015) have considered a non-linear impact of age. Based on survey information, we construct age of firms as being the number of years it is has been in operation as of 2014. The average age is about twenty years. We further control for dummy variables suggesting if the firm is located in the capital city and whether it is the main business city or not. Location factors bring advantages in the form of positive externalities through networking, proximity to lenders, and availability of skilled workers. All these, in turn, should increase the likelihood of innovation by firms. Apart from these, we control for state and industry fixed effects.

Empirical methodology

Benchmark specifications

The first part of our hypothesis explores how perception of corruption among firm owners in India affects their probability to innovate. The following logit specification is empirically tested:

$$\mathrm{Inno}_{\mathrm{ijs}} = \alpha_0 + \alpha_1 \mathrm{Corr}_{\mathrm{ijs}} + \delta Controls_{ijs}\rho_{\mathrm{i}} + \theta_{\mathrm{s}} + \epsilon_{\mathrm{it}} \quad (1)$$

Where, $\mathrm{Inno}_{\mathrm{ijs}}$ is the dummy variable suggesting if firm *i* in industry *j* in state *s* innovates or not. $Corr_{ijs}$ is the perception of corruption by firm owners ranging from 0 to 4. The benchmark controls, as stated earlier, are firm size, firm location, export share in sales of firms, and years in operation. ρ_{i} represents

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

the industry fixed effects and θ_s represent the state fixed effects. A negative coefficient of α_1 will imply that when firms perceive corruption as a stronger obstacle, their likelihood of innovation goes down. A positive coefficient will suggest otherwise.

The second part of the analysis aims at estimating the following equation

$$\text{Inno}_{ijs} = \alpha_0 + \alpha_1 \text{Corr}_{ijs} + \alpha_2 \text{Fin}_{ijs} + \alpha_3 (Corr * Fin)_{ijs} + \delta Controls_{ijs} \rho_i + \theta_s + \epsilon_{it} \quad (2)$$

For the second part of our analysis, we are particularly interested in the coefficients: α_1, α_2, and α_3. Specifically, we are interested in estimating the overall impact of perceived corruption on probability to innovate. In the presence of interaction terms, the marginal estimate is given by $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}} = \alpha_1 + \alpha_3 Fin_{ijs}$. Whether $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}} > 0$ or <0 will depend on the sign and magnitude of α_1 and α_3 as well as on the magnitude of Fin_{ijs}. If for greater values of Fin_{ijs}, $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}} < 0$ that would imply that as firms perceive greater obstacles in accessing finance, a rise in corruption perception lowers the probability to innovate. For greater values of Fin_{ijs}, $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}} > 0$ will imply the opposite. As described in the "Robustness Analysis," we also interact perceived corruption with other nonfinancial obstacles as perceived by firms.

Empirical methodology

Our benchmark model consists of logit specifications. Studies dealing with binary dependent variables and considering firm-level analysis have usually employed limited dependent variable (LDV) models like probit or logit (Webster and Piesse, 2018; Swamy et al., 2001). Ordinary least square (OLS), under these circumstances, suffer from challenges like predicted probabilities lying outside the unit interval. Logit estimators, similar to probit, use Maximum Likelihood Estimation (MLE). But they use a logistic distribution function of the error terms.

The initial specification can be written as

$$\Pr(Inno = 1) = F(\hat{X}\Omega) \quad (3)$$

$\Pr(Inno = 1)$ is the probability whether a firm innovates or not. While F is the cumulative standard logistic distribution, X is the vector of explanatory variables and Ω is the vector of coefficients to be estimated. When firms do respond yes to innovate, the event is categorized as a success. y^* is the latent continuous metric that underlies theobserved responses by the analyst. Firm's probability to innovate will depend on an unobservable latent (utility) index I_i which, in turn, is determined by an array of explanatory variables. Finally, the model we estimate can be written as $\Pr(Inno_{ijs} = 1|X_{ijs}) = \Phi(\beta X_{ijs})$. We formulate our hypothesis in the equations (1) and (2) that is empirically tested using a logit fixed effect model. Fixed effects take into account invariant industry and state fixed effects. As we know that for logit regressions, the estimated coefficients cannot be meaningfully interpreted. We, thus, report marginal estimates for all the variables because average coefficients have the potential to be biased (Webster and Piesse, 2018; Fernández-Val, 2009). Additionally, as elaborated later we also need to estimate marginal effects for concluding meaningfully the overall impact of corruption on probability to innovate (Dutta and Sobel, 2021; Berry et al., 2012; Braumoeller 2004). After presenting our benchmark results, we elaborate on our identification strategies in "Robustness Analysis."

Benchmark results

In table 2, we present our first set of benchmark results corresponding to equation (1). We present the logit estimates along with the marginal effects in table 2. In column (1), we start with exploring a binary relationship by including only the variable of interest: perceived corruption of firms. We control for industry and state fixed effect in column (1). Based on marginal estimates in column (2), a unit rise in corruption score reduces probability to innovate by firms by 1 percent.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

In column (3), we add all the benchmark controls. The marginal estimates corresponding to the specification in column (3) are presented in column (4). The probability fora unit rise in corruption perception score remains the same. But the significance of the coefficient of corruption perception becomes stronger after the inclusion of benchmark controls. In terms of controls, smaller firms are 16 percent less likely to innovate relative to large firms. The probability is about 4 percent for medium-sized firms. Being part of larger firm enhances the probability to innovate by about 5 percent. We also find that location of the firm significantly helps in terms of its probability to innovate. Thus, in general, we find that the sign and significance of the control variables add support to existing findings.

In table 3, we estimate specification (2). In column (1), we rerun specification from table 1 and include another perceived obstacle for firm owners—that of acquiring finance. We find that the variable measuring perceived difficulty in accessing finance is not significant while corruption perception continues to remain significant. This is also reflected in the marginal estimates in column (2). In column (3), we introduce the interaction term, Corr*Fin over the previous specification. As evident from the results, corruption perception loses its significance and the interaction term is negative and significant. Thus, it would imply that in presence of greater perceived obstacle about acquiring finances, a firm is less likely to innovate when its corruption perception rises. Yet, in the presence of interaction terms, the individual significance of the coefficients is not the appropriate consideration. The joint significance of the terms matter in this case. As Brambor, Clark, and Golder (2006) point out, the magnitude and statistical significance usually vary for different values of the interacted variables (Dutta and Sobel, 2021). For example, it is quite possible that the combination of effects is statistically significant or insignificant at different values of perceived difficulty in accessing finance, regardless of the individual significance of either coefficient in the regression. Thus, we need to examine the conditional effect for a range of values of the perceived obstacle in accessing finance (Dutta and Sobel, 2021; Berry et al., 2012; Braumoeller, 2004). Additionally, because our specifications are logit estimates, we need to calculate the marginal effects for all the variables.

The marginal estimates for column (3) specification are presented in column (4). $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}}$ is estimated for the minimum and maximum values of access to finance (perceived) score and the results are presented at the bottom of the table. We find that when firms perceive no obstacle in accessing finance, a rise in perceived corruption does not affect their probability to innovate. But for very severe perceived difficulties in accessing finance, a rise in perceived corruption lowers their probability to innovate by 4 percent. Thus, our analysis so far strongly suggests that perceived corruption is what firms care for when it comes to their decision to innovate or not. Higher perceived corruption lowers the probability to innovate. But perceived difficulty in accessing finance is not a hindrance on its own. Stronger perception about difficulties in acquiring finance affects a firm's probability to innovate through the channel of perceived corruption. Most of the controls retain the expected signs and significance in terms of the marginal effects as evident in column (4).

Note that, perceptions of firms about obstacles can potentially be correlated. For example, perception about corruption can be correlated with a firm's experience in terms of acquiring finance. We address this in three possible ways. First, while it is true that many borrowers have to pay bribes to access credit from financial institutions in India, especially from those owned and managed by public authorities, a large private sector has emerged since the 1990s that extend credit lines often at higher rates of interest and hidden charges, but mostly free of problems with rent seeking. We have shown that corruption perception by itself (negative significant, Table 2) hurts innovation. Subsequently, when we include access to finance (Table 3, positive significant) it helps innovation, but renders corruption perception insignificant. However, its interaction with corruption (Table 3, negative significant) is again damaging for innovation, while corruption perception is itself statistically insignificant. So, it is possible that access to finance is capturing some part of the corruption perception, although we find the correlation coefficient between these two variables to be 0.29. And, once again we remind our readers that in the presence of interaction terms, the explanatory power of the variables is of little significance as explained above. We therefore need to estimate the conditional effects (Dutta and Sobel, 2021; Berry et al., 2012; Braumoeller, 2004). The obstacle to finance has a mean value of 1.2 (Table 1), which implies a low degree of perceived obstacle among the respondents.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Table 2: Logit Specifications: Probability to Innovate for Firms and Perceived Corruption

	(1)	Marginal Effects	(2)	Marginal Effects.
Corr. (perceived)	−0.035*	−0.009*	−0.045**	−0.011**
	(0.021)	(0.005)	(0.021)	(0.005)
Firm (small)	—	—	−0.672***	−0.165***
			(0.072)	(0.017)
Firm (medium)	—	—	−0.167**	−0.041***
			(0.064)	(0.016)
Exports (sales %)	—	—	0.002	0.001*
			(0.001)	(0.0003)
Capital city	—	—	13.95***	3.431***
			(1.023)	(0.250)
Business city	—	—	0.452***	0.111***
			(0.070)	(0.017)
Years in operation	—	—	0.001	0.0003
			(0.002)	(0.0004)
Part of large co.	—	—	0.189***	0.046***
			(0.061)	(0.015)
Constant	−0.754***	—	−1.124***	—
	(0.178)		(0.207)	
Observations	9,270		9,250	
Industry F.E.	Yes	—	Yes	—
State F.E.	Yes	—	Yes	—

Note: The dependent variable is *Innovation*: a dummy taking the value 1 "if in the last three years, the establishment has introduced new products or services?" *Corr. (perceived)* is our variable of interest representing corruption perceptions of firms. It is coded from 0 to 4. The question asked is *How much of an obstacle is corruption? Firm (small)* represents the dummy for small-sized firms and *Firm (medium)* indicates medium-sized firms. *Capital city* denotes if the firm is in the official capital city. *Business city* denotes if the firm is in the main business city or not. *Export (sales %)* denotes the percent of sales constituting of exports. *Years in operation* is the number of years the firm has been in operation. *Part of large co.* denotes if the firm is part of a larger company (establishment) or not. Robust Standard Errors are in parenthesis. We control for state and industry fixed effects.
***p < 0.01; **p < 0.05; *p < 0.1.

Secondly, it would have been useful if obstacle to finance had questions regarding perceived corruption which WBES does not include at present. This should help with qualifying the present surmises regarding how much of the obstacle to finance is owing to the perceived corruption. Third, in order to check whether the correlation can be a potential concern for bias, we consider variance inflation factor (VIF). Usually, a VIF higher than 10 for a variable warrants further investigations. Sometimes, the considered threshold is Tolerance which is 1/VIF and, thus, the critical number becomes 1/10. For our regressions in both columns (1 and 2), we check the VIFs. For both corruption perception and access to finance variables, the VIF is less than 2 suggesting that the correlation between the variables is not a cause for concern. Yet, to further mitigate concerns, we construct a dummy for finance perception variable. The dummy takes 1 for above average values of accessing finance difficulties, 0 otherwise. We interact the dummy with corruption perception variables. The results are presented in column (5) of table 3. We find that the interaction term (findummy*corr) is negative and significant similar to our results in column (3). The marginal estimates for column (5) specification are presented in column (6). As evident from the marginal estimates, as perceived corruption rises, firms experiencing above average perceived obstacles in accessing finance are about 2 percent less likely to innovate. This effect is lesser in magnitude relative to marginal estimates in

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Table 3: Logit Specifications: Probability to Innovate for Firms and Perceived Corruption, and Accessing Finance Obstacles (Perceived)

	(1)	Marginal Effects	(2)	Marginal Effects	(3)	Marginal Effects
Corr. (perceived)	−0.043**	−0.011**	0.015	—(#)	0.009	—(2)
	(0.021)	(0.005)	(0.027)		(0.025)	
Access to fin. (perceived)	−0.032	−0.008	0.099**	−0.005	—	—
	(0.023)	(0.006)	(0.043)	(0.006)		
Corr*Fin.	—	—	−0.057***	—(#)	—	—
			(0.016)			
Fin. dummy	—	—	—	—	0.217**	−0.025*
					(0.107)	(0.014)
Corr*Fin. dummy	—	—	—	—	−0.150***	—(2)
					(0.039)	
Firm (small)	−0.666***	−0.159***	−0.639***	−0.154***	−0.638***	−0.159***
	(0.072)	(0.016)	(0.070)	(0.016)	(0.069)	(0.016)
Firm (medium)	−0.162**	−0.039***	−0.151**	−0.037**	−0.157**	−0.040**
	(0.064)	(0.015)	(0.064)	(0.016)	(0.064)	(0.016)
Exports (sales %)	0.002	0.001*	0.001	0.0002	0.001	0.001**
	(0.001)	(0.0003)	(0.001)	(0.0002)	(0.001)	(0.0003)
Capital city	12.91***	0.729***	14.22***	0.740***	14.20***	0.736***
	(1.020)	(0.012)	(1.014)	(0.012)	(1.008)	(0.012)
Business city	0.442***	0.106***	0.515***	0.123***	0.526***	0.109***
	(0.070)	(0.016)	(0.068)	(0.016)	(0.068)	(0.016)
Years in operation	0.0012	0.0003	0.002	0.001	0.002	0.0003
	(0.002)	(0.0004)	(0.001)	(0.0004)	(0.001)	(0.0004)
Part of large co.	0.177***	0.046***	0.186***	0.046***	0.195***	0.048***
	(0.062)	(0.015)	(0.061)	(0.015)	(0.061)	(0.016)

(*Continued*)

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Table 3: (*Continued.*)

	(1)	Marginal Effects	(2)	Marginal Effects	(3)	Marginal Effects
Constant	−1.091***	—	−0.983***	—	−0.967***	—
	(0.208)		(0.141)		(0.138)	
Observations	9,213	9,213	9,213	9,213	9,250	9,250
Industry F.E.	Yes	—	Yes	—	Yes	—
State F.E.	Yes	—	Yes	—	Yes	—
$\frac{\partial Inno_{ijs}}{\partial Corr_{ijs}}$						
Access to fin. = 0 (min.)/ Fin. Dum. = 0	—	—	—	0.003 (0.005)	—	0.002 (0.005)
Access to finance = 4 (max)/ Fin. Dum. = 1	—	—	—	−0.042*** (0.010)	—	−0.025*** (0.006)

Notes: The dependent variable is *Innovation:* a dummy taking the value 1 "if in the last three years, the establishment has introduced new products or services?" *Corruption* is our variable of interest representing corruption perceptions of firms. It is coded from 0 to 4. The question asked is *How much of an obstacle is corruption? Access to fin. (perceived)* is our second variable of interest. It assesses perceived difficulties by firm owners in accessing finance based on the question *How much of an obstacle is access to finance*? It is coded from 0 to 4 with higher numbers representing stronger perceptions. *Fin. Dummy* is constructed based on *access to finance*, taking 1 for above averages values for the sample, 0 otherwise. *Firm (small)* represents the dummy for small-sized firms and *Firm (medium)* indicates medium-sized firms. *Capital city* denotes if the firm is in the official capital city. *Business city* denotes if the firm is in the main business city or not. *Export (sales %)* denotes the percent of sales constituting of exports. *Years in operat*ion the number of years the firm has been in operation. *Part of large co.* denotes if the firm is part of a larger company (establishment) or not. Robust Standard Errors are in parenthesis. We control for state and industry fixed effects.
(#) the marginal effects with respect to corruption are given at the end of the table.
***p < 0.01; **p < 0.05; *p < 0.1.

column (4) as described in the preceding text. Yet, that is not surprising because above average values of the finance dummy will imply severe as well as very severe obstacles based on our sample.

Robustness analysis

Other perceived obstacles by firms

Do other perceived obstacles by firms affect the relationship between probability to innovate and corruption perception? In table 4, we proceed to explore this question. The survey asks questions to the firm owners about their perceived obstacles related to electricity, telecommunication, transportation, and customs. The questions are structured similar to the other obstacle-related questions. Each obstacle measure ranges from 0 to 4 with 0 indicating at particular obstacle not being a hindrance according to the respondents representing these operations. Again 4 represents the strongest perceived obstacle. The logit estimates for electricity, telecommunication, transportation, and customs are presented in columns (1), (2), (3), and (4) of table 4, respectively. As before, we find that the interaction term of corruption perception with the alternate perception measures is negative and significant for each of the specifications.

Yet, to interpret the results properly, we need marginal estimates for our findings. Keeping space constraint in mind, we report marginal estimate for our variable of interest, $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}}$, as noted in table 4. The marginal estimates for our control variables[3] are available on request. The marginal estimates associated with the control variables support our benchmark findings. Here also, $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}}$ is estimated for the minimum and maximum values of the alternate perceived obstacle variables. Consequently, the overall conclusions remain the same. $\Delta \frac{\delta Inno_{ijs}}{\delta Corr_{ijs}}$ from the lowest obstacle to the most severe obstacle is always negative suggesting that probability to innovate is dampened for rise in the perceived corruption as firms apprehend obstacles in different forms. At the higher level of perceived obstacles, higher corruption perceptions lower probability to innovate between 5 and 7 percent.

Identification

Challenges with IV estimates

Corruption perception can be endogenous due to omitted variable bias, simultaneous sample selection bias, or reverse causality. As firms start innovating more, their perception of corruption might start changing. Although we have controlled for a vast array of variables, omitted variable bias can still arise due to factors that can still affect firms' probability to innovate. Finally, because a firm's decision to innovate can be co-determined with its corruption perception, our estimates can be biased. Instrumental Variable (IV) estimation is the ideal way to solve biases arising out of reverse causality. But such estimation needs efficient instruments that should fulfill the externality conditions. Instruments should be correlated with corruption perception but should be independent of the error term. While the existing cross-country studies on corruption provide us with many instrument choices like ethnolinguistic fractionalization, settler mortality, length of exposure to democracy, individualism, and power distance (Bentzen, 2012; Ahlin and Pang, 2008; Delavallade, 2006; Gupta et al., 2002; Treisman, 2000; Mauro, 1995), the survey does not include such questions. Because we use firm-level data for India and such measures are either not applicable for a single country or not available for Indian states, we cannot apply these to our analysis. Studies based on US state-level data have used instruments like number of days an individual needs to reside in a state to be able to vote and index of campaign finance restrictions (Johnson et al., 2011). Such state-level data is very hard to find for India. Additionally, if we find something similar, applying state-level data to firm-level analysis will result in data stretching and biasing our estimates. Therefore, we need to find firm-level instruments. Variables like number of days needed to get an electrical connection or a water connection for a firm can determine corruption

[3]We do remind our readers once again that for logit estimates, in addition to interaction terms, all variables need to be analyzed using marginal estimates. We stick to presenting only the marginal estimates related to the interaction term keeping space constraint in mind.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Table 4: Logit Specifications: Probability to Innovate by Firms, Perceived Corruption, and Other Perceived Obstacles

	(1)	(2)	(3)	(4)
Corr. (perceived)	0.077**	0.022	0.0559*	−0.007
	(0.032)	(0.024)	(0.029)	(0.027)
Electricity (perceived)	0.048	—	—	—
	(0.042)			
Corr*Elec.	−0.068***	—	—	—
	(0.014)			
Telecom (perceived)	—	0.114	—	—
		(0.074)		
Corr*Tele.	—	−0.103***	—	—
		(0.024)		
Transport (perceived)	—	—	0.160***	—
			(0.053)	
Corr*Trans.	—	—	−0.088***	—
			(0.018)	
Customs (perceived)	—	—	—	0.170***
				(0.062)
Corr*Cust.	—	—	—	−0.062***
				(0.020)
Firm (small)	−0.683***	−0.685***	−0.666***	−0.618***
	(0.072)	(0.072)	(0.072)	(0.073)
Firm (medium)	−0.176***	−0.172***	−0.160**	−0.103
	(0.065)	(0.064)	(0.065)	(0.065)
Exports (sales %)	0.001	0.002	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Capital city	13.80***	13.91***	13.89***	12.76***
	(1.018)	(1.017)	(1.017)	(1.020)
Business city	0.455***	0.461***	0.456***	0.366***
	(0.070)	(0.071)	(0.071)	(0.074)
Years in operation	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Part of large co.	0.178***	0.200***	0.195***	0.167***
	(0.061)	(0.06)	(0.061)	(0.063)
Constant	−1.230***	−1.189***	−1.325***	−1.141***
	(0.213)	(0.208)	(0.212)	(0.214)
Observations	9,245	9,246	9,191	8,606
Industry F.E.	Yes	Yes	Yes	Yes
State F.E	Yes	Yes	Yes	Yes
$\frac{\partial lnno_{ijs}}{\partial Corr_{ijs}}$				

(*Continued*)

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Table 4: (*Continued.*)

	(1)	(2)	(3)	(4)
Obstacles = 0	0.014**	0.004	0.011*	−0.001
	(0.005)	(0.005)	(0.006)	(0.005)
Obstacles = 4	−0.040***	−0.061***	−0.072***	−0.049***
	(0.008)	(0.011)	(0.016)	(0.014)

Note: The dependent variable is *Innovation:* a dummy taking the value 1 "if in the last three years, the establishment has introduced new products or services?" *Corruption* is our variable of interest representing corruption perceptions of firms. It is coded from 0 to 4. The question asked is *How much of an obstacle is corruption?* We consider different perceived obstacles of firms that are measured similarly. These are obstacles related to electricity (*Electricity [perceived]*), Telecoms (*Telecom [perceived]*), Transport (*Transport [perceived]*), and Customs (*Customs [perceived]*). *Corruption is interacted with each of these perceived obstacles.* We include the benchmark controls. Robust Standard Errors are in parenthesis. We control for state and industry fixed effects.
***p < 0.01; **p < 0.05; *p < 0.1.

perception but they are most likely to affect probability to innovate for a firm as well. Thus, for our present empirical analysis we are unable to employ IV estimation.

Inverse probability weight estimates

As mentioned earlier, endogeneity can also arise out of sample selection bias if both the probability to innovate and corruption perceptions are codetermined. Under such circumstances, Borin and Mancini (2016) advocate employing such estimation methods to resolve sample selection bias. Mallick and Yang (2013) point out that propensity score matching reduces sample selection bias by creating a carefully matched control group (Dutta et al., 2021; Webster and Piesse, 2018). Ideally, to resolve sample selection bias, we need to observe the same firm under two circumstances. The same firm under the two circumstances should have all attributes exactly the same except differing with regard to corruption perceptions. However, it is not possible to observe the same firm in two different scenarios. Yet, we can create a counter factual that implies having firms with all the matching characteristics except differing in terms of perceptions about difficulties in accessing finance and corruption. We consider Inverse Probability Weight (IPW) estimates that correct for missing data problems arising from the fact that each firm is only observed in one of the potential outcomes by using estimated probability weights. A two-step approach is used for estimating the treatment effects. In the first step, the parameters of the treatment model are estimated and then the estimated inverse probability weights are computed. In the second step, the weighted averages of the outcomes for each treatment level are computed using the estimated inverse probability weights. The contrasts of these weighted averages provide the estimates of the average treatment effects (ATE) (STATA, 2019).

We report the ATEs in table 5 based on IPW estimates. In column (1) of table 5, we present the average treatment effects with the treatment group being above average levels of corruption perception. For IPW estimates both the dependent and the independent variable need to be binary. We find the average treatment group is negative and significant suggesting that firms perceiving above average levels of corruption are about 1.8 percent less likely to innovate.

To test whether attitudes about accessing finance difficulties of firms matter along with corruption perceptions, we create the next treatment group in column (2) of table 5. In column (2), the treatment group consists of firms perceiving above average levels of corruption as well as above average levels of difficulties in accessing finance. The average treatment effect is negative and significant. Firms perceiving both above average levels of corruption and accessing finance obstacles are about 3 percent less likely to innovate. Finally, in column (3), we consider firms with above average perceptions about accessing finance but below average levels of perceived corruption. Because our earlier findings show that corruption perceptions hinder innovation and perceived obstacles in accessing finance is critical in the presence of corruption, we want to check the same with IPW estimates. Indeed, we find that ATE is positive and significant indicating that when corruption perceptions are low, even higher perceived obstacle in accessing finance by firms does not deter their innovation efforts. Overall, our conclusions remain unaltered.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Table 5: IPW and AIPW Estimates: Probability to Innovate for Firms and Perceived Corruption, and Accessing Finance Obstacles (Perceived)

IPW Estimates	(1) Corr. > above ave.	(2) Corr. > above ave.; Fin.> above ave.;	(3) Corr. < above ave.; Fin.> above ave.;
ATE_ high vs. low obstacle perceptions (1 vs. 0)	−0.018***	−0.031*	0.054***
	(0.010)	(0.016)	(0.014)
AIPW Estimates	**(1)** **Corr. > above av.**	**(2)** **Corr. > above av.; Fin.> above av.;**	**(3)** **Corr. < above av.; Fin.> above av.;**
ATE_ high vs. low obstacle perceptions (1 vs. 0)	−0.018*	−0.032**	0.055***
	(0.010)	(0.013)	(0.014)

Note: The dependent variable is *Innovation:* a dummy taking the value 1 "if in the last three years, the establishment has introduced new products or services?" The treatment group in column (1) includes firms that perceive above average corruption. In column (2), the treatment group includes firms perceiving both above average corruption and accessing finance obstacles. Finally, in column (3), the treatment group consists of firms that perceive below average corruption but above average obstacle in accessing finance (perceived). We include the benchmark controls. We control for state and industry fixed effects.
***p < 0.01; **p < 0.05; *p < 0.1.

In table 5, we present the augmented inverse probability weight (AIPW) estimates. AIPW estimates, similar to IPW estimates, correct for the missing data problem arising from the fact that each firm is observed in only one of the potential outcomes. The advantage of AIPW estimates is that it uses an augmentation term in the outcome model to correct the estimator in case the treatment model is misspecified. The format in table 5 of IPW estimates is similar to that of table 5 AIPW estimates. As evident from the results, our conclusions remain unchanged.

Omitted variable bias: Additional controls

Yet another way to handle endogeneity is to control for additional factors that can also affect the probability to innovate by firms. While we have included a series of benchmark controls as described in the preceding text, in this section we control for additional variables that can mitigate omitted variable bias further. Following Pellegriono and Savona (2017) and Bertoni and Tykvovà (2015), we control for square of age check for possible nonlinearity effects. Piva and Vivarelli (2009) have shown that presence of skilled workers can boost innovation efforts as they might be adept at coming up innovative ideas (Song et al., 2003). Our dataset does not provide breakdown of workers in a firm based on skill levels. The only variable we have at our disposal is years of education of an average worker in a firm. We control for the education variable. Because this variable results in loss of about 2,000 observations, as an alternate proxy of the education variable we control for the years of experience of the top manager. We also control for percent of losses in sales of the firm due to power outage. Percent share owned by the largest firm in the establishment is the next variable for which we control. Although not a direct proxy, it provides us with an indirect proxy for organization of the firm, Bresnahan, Brynjolfsson, and Hitt (2002) have stressed the importance of organizational structure in the context of innovation.

The results are presented in appendix 1 keeping space constraint in mind. We consider our benchmark specification from table 3, column (2) as specified in equation (2). In column (1), we control for the square of age. In columns (2) and (3), we control for education of workers years of experience of the top manager simultaneously. In column (4), we control for percent loss in sales due to power outage. Finally, in column (5), percent share of the largest firm in the establishment is considered. Keeping space constraint in mind, we present the log it estimates along with marginal estimates for $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}}$. But we do not present the marginal estimates[4] for our control variables and they are available on request. We find our results remain robust. The coefficient of the interaction term is negative and significant in all the specifications and the significance level is at 1 percent for three out of the five specifications. The marginal effects support our benchmark conclusions.

Identification: Heckman selection model

Finally, we consider Heckman selection model to take account nonrandom selection and, thus, the possible bias arising out of it. It can very plausible that firms' need for loans or not dictate their perception about corruption or financial barrier. Thus, there might be the possibility of observing a nonrandom sample. As Muravyev et al. (2009) points out, firms who do not need financing because of having sufficient internal funds are more likely to get a loan. However, firms may not apply for loans at all because they perceive a higher obstacle. Thus, we estimate our model with a Heckman correction. Based on this, we can fit the regression model ($y = X\beta$) that consists of our dependent and independent variables. The variable(s) Z determines whether the dependent variable is observed or not. Thus, we include the need for a loan in the second list and all other independent variables of interest including perceived corruption as well as perceived obstacle in accessing finance along with the interaction term in the first list.

[4]Once again, we do remind our readers that logit estimates cannot be directly interpretable without marginal estimates. We stick to presenting only the marginal estimates related to the interaction term keeping space constraint in mind.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Keeping space constraint in mind, we do not report the findings but they are available on request. The variables from the selection list or the second list that includes the need for loan variable is available on request. The loan variable is a dummy that indicates if the firm has applied for a loan in the last fiscal year or not. Our coefficient of interest—the interaction term—is negative and significant suggesting that our main conclusions remain robust. Interestingly both perceived obstacles—corruption and access to finance—are positive and significant. But as we know in the presence of an interaction term we have to meaningfully analyze the economic significance using the total effect as given by $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}} = \alpha_1 + \alpha_3 Fin_{\text{ijs}}$. Based on marginal effects, we find while $\frac{\delta Inno_{ijs}}{\delta Corr_{ijs}}$ is positive and significant at the lowest value of perceived difficulty in accessing finance, it does turn negative and significant for the strongest financial barrier as perceived by firms. The significance of the chi-square from the Wald test of significance suggests the appropriateness of the Heckman estimates.

Conclusion

A country like India, or comparably China, has traditionally harbored millions of small and mid-sized enterprises. These units provide important production support to larger firms, generate employment, and are not easily affected by business cycles. However, two main obstacles that the pursuant of small businesses face are obviously access to credit and impediments from government departments for procuring various licenses. While it seems that India has risen in the columns of ease of doing business as popularly published by the World Bank, there is not enough evidence that the dual obstacles of finance and corruption are easily surmounted, at least in terms of how the perception has changed. Realistically speaking, potentials entrepreneurs often perceive high orders of difficulty in approaching financial intermediaries, and those particularly in the public sector, for the fear of harassment and unforeseen delays. In addition, many perceive that the delays are related to manifestation of corrupt practices among those with financial authority leading to rent-seeking activities. The policy response on the part of the government, therefore, cannot be limited to easing out the business practices, but sensitizing that the system is also less corrupt.

Ideally, the business networks and peer-group experiences spread such positive perceptions. However, corruption in India is as deep-seated as the lack of interpersonal and institutional trust, and therefore the positive sentiments are slow to pervade, if at all. There has to be exemplary policies to counter the negative impression, which according to a large body of evolving literature on *sentiment analysis* seems quite damaging for many economic activities in a country.

The present article looks precisely at two sources that facilitate or hamper growth of entrepreneurship in India. In the process, we explored a different possibility hitherto ignored in the related literature: whether perceived constraints lead firms to innovate more. Indeed, we have established both as the mainstay of the article as well as through multiple robustness checks, that innovation by small and medium-sized firms with large firms as the benchmark suffer if perception of corruption rises. Using the World Bank Enterprise Survey that accommodates firm-level information from twenty-three major states in India conducted during mid-2013 and early 2014, and encompassing 9,281 observations, we proved that if the difficulty to access financial resources rises by one point, firms tend to innovate less by 3 percent. Prior to this, we have shown that rise in the perception of corruption alone lowers innovation by 1 percent. As a combination, we show that for very severe perceived difficulties in accessing finance, a rise in perceived corruption lowers probability among firms to innovate by 4 percent. We supplement these results by developing a number of identification procedures such as Inverse Probability Weights and Heckman selection to minimize possible biases arising from omitted variables, simultaneity, and reverse causality among the set of variables chosen. These results may help to consider improving the perception about corruption and ease of access to credit for public institutions across states in India.

References

Ahlin, Christian, and J. Pang. 2008. "Are Financial Development and Corruption Control Substitutes in Promoting Growth?" *Journal of Development Economics* 86 (2): 414–33.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Anokhin, S., and W. S. Schulze. 2009. "Entrepreneurship, Innovation, and Corruption." *Journal of Business Venturing* 24 (5): 465–76.
Ayyagari, M., A. Demirguc-Kunt, and V. Maksimovic, 2014. "Who Creates Jobs in Developing Countries?" *Small Business Economics* 43 (1): 75–99.
Baldwin, J., and Z. Lin. 2002. "Impediments to Advanced Technology Adoption for Canadian Manufacturers." *Research Policy* 1 (1): 1–18.
Bentzen, J.S. 2012. "How Bad Is Corruption? Cross-Country Evidence of the Impact of Corruption on Economic Prosperity." *Review of Development Economics* 16 (1): 167–84.
Berry, D.W., Golder, M., and D. Milton. 2012. "Improving Tests of Theories Positing Interaction." *The Journal of Politics* 74 (3): 653–671.
Bertoni, F., and T. Tykvová. 2015. "Does Governmental Venture Capital Spur Invention and Innovation? Evidence from Young European Biotech Companies." *Research Policy* 44 (4): 925–35.
Blanchard, P., Huiban, J.-P., Musolesi, A., and P. Sevestre. 2013. "Where There Is aWill, There Is a Way? Assessing the Impact of Obstacles to Innovation." *Industrial and Corporate Change* 22 (3): 679–710.
Borin, A., and M. Mancini. 2016. "Foreign Direct Investment and Firm Performance: An Empirical Analysis of Italian Firms." *Review of World Economics* (*Weltwirtschaftliches Archiv*) 152 (4): 705–32.
Brambor, T., Clark, W., and M. Golder. 2006. "Understanding Interaction Models: Improving Empirical Analyses." *Political Analysis* 14 (1): 63–82.
Braumoeller, B. 2004. "Hypothesis Testing and Multiplicative Interaction Terms." *International Organization* 58 (4): 807–20.
Bresnahan, T. F., Brynjolfsson, E., and L. M. Hitt. 2002. "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence." *The Quarterly Journal of Economics* 117 (1): 339–76.
Canepa, A., and P. Stoneman. 2008. "Financial Constraints to Innovation in the UK: Evidence from CIS2 and CIS3." *Oxford Economic Papers* 60 (4): 711–30.
Cefis, E., and O. Marsili. 2005. "A Matter of Life and Death: Innovation and Firm Survival." *Industrial and Corporate Change* 14(6): 1–26.
Cohen, W.M., and S. Klepper. 1996. "A Reprise of Size and R&D." *The Economic Journal* 106 (437): 925–51.
Delavallade, C. 2006. "Corruption and Distribution of Public Spending in Developing Countries." *Journal of Economics and Finance* 30: 222–39.
D'Este, P., Iammarino, S., Savona, M., and N. Von Tunzelmann. 2012. "What Hampers Innovation? Revealed Barriers Versus Deterring Barriers." *Research Policy* 41 (2): 482–88.
de Waldemar, F. S. 2012. "New Products and Corruption: Evidence from Indian Firms." *The Developing Economies* 50 (3): 268–84.
Dutta, N., and R. S. Sobel. 2016. "Does Corruption Ever Help Entrepreneurship?" *Small Business Economics* 47 (1): 179–99.
Dutta, N., and R. S. Sobel. 2021. "Entrepreneurship, Fear of Failure, and Economic Policy." *European Journal of Political Economy* 66. https://doi.org/10.1016/j.ejpoleco.2020.101954.
Dutta, N, Kar, S, and R.S. Sobel. 2021. "What influences entrepreneurship among skilled immigrants in the USA? Evidence from micro-data." *Business Economics* 56: 146–154.
Dutta, N., Kar, S. and S. Roy. 2013. "Corruption and Persistent Informality: An Empirical Investigation for India." *International Review of Economics & Finance* 27 (C): 357–73.
Ericson, R., and A. Pakes. 1995. "Markov-Perfect Industry Dynamics: A Framework for Empirical Work." *Review of Economic Studies* 62 (1): 53–82.
Fernandez-Val, I. 2009. "Fixed effects estimation of structural parameters and marginal effects in panel probit models." *Journal of Econometrics* 150 (1): 71–85.
Galende, J., and J. M. De la Fuente. 2003. "Internal Factors Determining a Firm's Innovative Behaviour." *Research Policy* 32 (5): 715–36.
Galia, F., and D. Legros. 2004. "Complementarities between Obstacles to Innovation: Evidence from France." *Research Policy* 33 (8): 1185–99.
Glaeser, E., and R. Saks. 2006. "Corruption in America." *Journal of Public Economics* 90: 1053–72.
Griffith, R., Redding S., and J. Van Reenen. 2004. "Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries." *The Review of Economics and Statistics* 86 (4): 883–95.
Griffith, R., Huergo, E. Mairesse, J., and B. Peters. 2006. "Innovation and Productivity across Four European Countries." *Oxford Review of Economic Policy* 22 (4): 483–98.
Gupta, S., Davoodi, H., and R. Alonso-Terme. 2002. "Does Corruption Affect Income Inequality and Poverty?" *Economics of Governance* 3: 23–45.
Hall, B. H. 1987. "The Relationship between Firm Size and Firm Growth in the US Manufacturing Sector." *The Journal of Industrial Economics* 35 (4): 583–606.
Heston, A., and Kumar, V. 2008. "Institutional Flaws and Corruption Incentives in India." *Journal of Development Studies* 44 (9): 1243–61.
Holmstrom, B. 1989. "Agency Costs and Innovation." *Journal of Economic Behavior and Organization* 12 (3): 305–27.
Hölzl, W. 2009. "Is the R&D Behaviour of Fast-Growing SMEs Different? Evidence from CIS III Data for 16 Countries." *Small Business Economics* 33 (1): 59–75.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Hottenrott, H., and Peters B. 2011. "Innovative Capability and Financing Constraints for Innovation: More Money, More Innovation?" *Review of Economics and Statistics* 94 (4): 1126–42.

Iammarino, S., Sanna-Randaccio, R., and M. Savona. 2009. "The Perception of Obstacles to Innovation: Foreign Multinationals and Domestic Firms in Italy." *Revued'économie industrielle* 125 (1): 75–104.

Johnson, N. D., LaFountain C. L., and S. Yamarik. 2011. "Corruption Is Bad for Growth (Even in the United States)." *Public Choice* 147: 377–93.

Klepper, S. 1996. "Entry, Exit, Groxwth, and Innovation over the Product Life Cycle." *American Economic Review* 86 (3): 562–83.

Krueger, Anne O. 1974. "The Political Economy of the Rent-Seeking Society." *American Economic Review, June 1974*, 64 (3): 291–303.

Mairesse, J., and P. Mohnen. 2002. "Accounting for Innovation and Measuring Innovativeness: An Illustrative Framework and an Application." *American Economic Review* 92 (2): 226–30.

Mairesse, J., and P. Mohnen. 2010. "Using Innovation Surveys for Econometric Analysis." NBER Working Paper 15857.

Mallick, S., and Y. Yang. 2013. "Productivity Performance of Export Market Entry and Exit: Evidence from Indian Firms." *Review of International Economics* 21 (4): 809–24.

Mancusi, M.L., and A. Vezzulli. 2014. "R&D and Credit Rationing in SMEs." *Economic Inquiry* 52 (3): 1153–72.

Mauro, P. 1995. "Corruption and Growth." *Quarterly Journal of Economics* 110 (3): 681–712.

Mohnen, P., and L.-H. Röller, 2005. "Complementarities in Innovation Policy." *European Economic Review* 49 (6): 1431–50.

Mohnen, P., Mairesse, J., and M. Dagenais. 2006. "Innovatively: A Comparison across Seven European Countries." *Economics of Innovation and New Technology* 15 (4–5): 391–413.

Muravyev, A., Talavera, O., and D. Schäfer. 2009. "Entrepreneurs'Gender and Financial Constraints: Evidence from International Data." *Journal of Comparative Economics* 37 (2): 270–86.

Murphy, K., Shleifer, A., and R. Vishny. 1993. "Why Is Rent-Seeking So Costly to Growth?" *American Economic Review* 83: 409–17.

Narula, R., and A. Zanfei. 2003. "The International Dimension of Innovation." In *The Oxford Handbook of Innovation*, edited by J. Fagerberg, D. C. Mowery, and R. R. Nelson, 318–345. Oxford University Press.

Paunov, C. 2016. "Corruption's Asymmetric Impacts on Firm Innovation." *Journal of Development Economics* 118: 216–31.

Pellegrino, G., and M. Savona. 2017. "No Money, No Honey? Financial Versus Knowledge and Demand Constraints on Innovation." *Research Policy* 46: 510–21.

Pérez, S.E., Llopis, A.S., and J. A. S. Llopis. 2004. "The Determinants of Survival of Spanish Manufacturing Firms." *Review of Industrial Organization* 25: 251–73.

Piva, M., and M. Vivarelli. 2009. "The Role of Skills as a Major Driver of Corporate R&D." *International Journal of Manpower* 30: 835–52.

Savignac, F. 2008. "Impact of Financial Constraints on Innovation: What Can Be Learned from a Direct Measure?" *Economics of Innovation and New Technology* 17 (6): 553–69.

Schumpeter, J. 1942. *Capitalism, Socialism, and Democracy*. New York: Harper and Bros.

Segarra-Blasco, A., Garcia-Quevedo, J., and M. Teruel-Carrizosa. 2008. "Barriers to Innovation and Public Policy in Catalonia." *International Entrepreneurship and Management Journal* 4 (4): 431–45.

Sharma, C., and A. Mitra. 2015. "Corruption, Governance and Firm Performance: Evidence from Indian Enterprises." *Journal of Policy Modelling* 37 (5): 835–51.

Song, J., Almeida, P., and G. Wu. 2003. "Learning-by-Hiring: When Is Mobility More Likely to Facilitate Interfirm Knowledge Transfer?" *Management Science* 49 (4): 351–65.

Swamy, A., Knack, S., Lee, Y., and O. Azfa. 2001. "Gender and Corruption." *Journal of Development Economics* 64 (1): 25–55.

Tiwari, A., Mohnen, P., Palm, F., and S. Schim van der Loeff. 2008. "Financial Constraint and R&D Investment: Evidence from CIS." In *Determinants of Innovative Behaviours: A Firm's Internal Practice and Its External Environments*. Edited by Cees van Beers, Alfred Kleinknecht, Roland Ortt, and Robert Verburg, 217–42. Palgrave Macmillan.

Tourigny, D., and C. D. Le. 2004. "Impediments to Innovation Faced by Canadian Manufacturing Firms." *Economics of Innovation and New Technology* 13 (3): 217–50.

Treisman, D. 2000. "The Causes of Corruption: A Cross-National Study." *Journal of Public Economics* 76 (3): 399–457.

Webster, A., and J. Piesse. 2018. "Are Foreign-Owned Firms More Likely to Pay Bribes Than Domestic Ones? Evidence from Emerging Markets." *World Development* 102: 142–61.

Xu, G., and G. Yano. 2017. "How Does Anti-Corruption Affect Corporate Innovation? Evidence from Recent Anti-corruption Efforts in China." *Journal of Comparative Economics* 45 (3): 498–519.

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Appendix 1: Logit Specifications: Probability to Innovate for Firms and Perceived Corruption, and Accessing Finance Obstacles (Perceived)

	(1)	(2)	(3)	(4)	(5)
Corr. (perceived)	0.014	0.003	0.014	−0.094**	0.014
	(0.028)	(0.033)	(0.028)	(0.039)	(0.027)
Access to fin. (perceived)	0.089**	0.072	0.089**	0.097*	0.095**
	(0.043)	(0.053)	(0.043)	(0.058)	(0.043)
Corr*Fin.	−0.051***	−0.034*	−0.051***	−0.033	−0.054***
	(0.016)	(0.019)	(0.016)	(0.021)	(0.016)
Firm (small)	−0.663***	−0.703***	−0.663***	−0.696***	−0.629***
	(0.072)	(0.084)	(0.072)	(0.095)	(0.072)
Firm (medium)	−0.161**	−0.173**	−0.161**	−0.150*	−0.142**
	(0.065)	(0.074)	(0.065)	(0.085)	(0.064)
Exports (sales %)	0.002*	0.001	0.002*	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Capital city	13.00***	1.001***	12.98***	13.98***	14.14***
	(1.020)	(0.161)	(1.021)	(1.032)	(1.009)
Business city	0.443***	0.498***	0.442***	0.413***	0.422***
	(0.070)	(0.077)	(0.070)	(0.091)	(0.069)
Years in operation	0.00001	0.007	−0.0003	−0.002	−0.001
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
Part of large co.	0.183***	0.278***	0.182***	0.298***	0.209***
	(0.062)	(0.072)	(0.062)	(0.082)	(0.061)
(Yrs. In Op.)^2	0.00002	−0.00001	0.00002	−0.0001	0.00002
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Worker edu.	—	−0.005	—	—	—
		(0.005)			
Manager exp.	—	—	−0.001	0.002	−0.001
			(0.001)	(0.001)	(0.001)
% sales loss (power)	—	—	—	−0.005*	—
				(0.003)	
% share of largest firm	—	—	—	—	0.002**
					(0.001)
Constant	−1.189***	−1.010	−1.168***	−0.550***	−0.883***
	(0.213)	(1.337)	(0.216)	(0.182)	(0.141)
Observations	9,213	7,107	9,213	5,107	9,212
Industry F.E.	Yes	Yes	Yes	Yes	Yes
State F.E.	Yes	Yes	Yes	Yes	Yes

(*Continued*)

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press

Appendix 1: (*Continued.*)

	(1)	(2)	(3)	(4)	(5)
$\frac{\partial Inno_{ijs}}{\partial Corr_{ijs}}$					
Access to fin. = 0 (min.)	0.002 (0.006)	0.001 (0.006)	0.002 (0.006)	−0.018* (0.007)	0.003 (0.006)
Access to fin. = 4 (min.)	−0.038** (0.012)	−0.025** (0.012)	0.038*** (0.001)	0.047*** (0.013)	−0.040*** (0.001)

Note: The dependent variable is *Innovation:* a dummy taking the value 1 "if in the last three years, the establishment has introduced new products or services?" *Corruption* is our variable of interest representing corruption perceptions of firms. *Access to fin. (perceived)* is our second variable of interest. The additional controls considered are square of years in operation, education of workers, experience of top manager, percent of loss in sales due to power outage, and percent share of the largest firm. Robust Standard Errors are in parenthesis. We control for state and industry fixed effects.
(#) – the marginal effects with respect to corruption are given at the end of the table.
***p < 0.01; **p < 0.05; *p < 0.1.

Cite this article: Dutta N, Kar S, Beladi H (2022). Innovation and Perceived Corruption: A Firm-Level Analysis for India. *Business and Politics* **24**, 151–170. https://doi.org/10.1017/bap.2021.20

https://doi.org/10.1017/bap.2021.20 Published online by Cambridge University Press