Do Perceived Obstacles Deter Innovation Efforts of Firms? Micro-Evidence from India

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Abstract

Firm size and access to finance have been accepted as critical factors that can affect a firms' likelihood to innovate. However, there is little or no analysis about how a firm-owner's perceptions about obstacles, like accessing credit or having to deal with corruption, affect the probability of innovation. For countries like India where a large number of small and medium sized entrepreneurs cannot access formal credit and are exposed to widespread corruption, survival of firms and related welfare implications are both substantially important. Using the World Bank Enterprise Survey for the year 2014, across 23 major states in India and 9000 plus observations, we explore if perceived obstacles about accessing credit and corruption jointly affect their likelihood to innovate. We establish identification via multiple estimators – probit fixed effect estimates, instrumental variable estimators and inverse probability weight estimator. Most importantly, we show that the perceived obstacles do jointly reduce the firm's probability to innovate. In the face of rising corruption levels as perceived by the firms, they are less likely to innovate as perceptions about difficulties in accessing finance rise as well. In other words, the marginal impact of perceived obstacles about accessing finance, on the probability to innovate is strictly negative as firms perceive greater corruption. The same is true about the marginal impact of corruption. Indeed, our results point out that when firms face only one of the obstacles their probability to innovate is not likely to be hampered. We offer robustness analyses in support of these results.

JEL Classifications: *D52, D73, L26, O31*
Keywords:*Innovation, entrepreneurship, finance constraint perceptions, corruption perceptions, India; firm level data*

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1. Introduction

A growing literature is bestowing greater attention to what constitutes the perception of obstacles to innovation for firms and, consequently its implications for the propensity and the degree to which firms engage in innovation activities and the likelihood to innovate (Pellegrino and Savona, 2017; Mancusi and Vezzuli, 2014; Iammarino *et al*., 2009; Tiwari *et al*., 2008; Savignac, 2008; Galia and Legors, 2004; among others). As pointed out by (D'Este *et al*., 2008, 2012, 2014), comprehending and subsequently, empirically investigating the impact of obstacles on the rate of innovation has clear policy implications since mitigating or completely removing these obstacles will certainly boost innovation.

In the context of perceptions about obstacles, there are two distinct strands of literature. One line of research focuses on how firm and industry characteristics[1] can affect perception of different types of obstacles. The second line of research investigates how perceived obstacles facing firm owners can influence their probability to innovate. In this paper, we add to the second group of studies by exploring how such perceptions about obstacles affect firms' probability to innovate. The main contribution of the paper is therefore about exploring this question for Indian firms, which to the best of our knowledge, is the first such attempt.

The present paper empirically estimates as to how the perceptions about obstacles in accessing finance and rent seeking in India affect a firm's likelihood to innovate. Such questions become pressing especially for countries like India that struggle with policies to improve the access to formal sources of credit. It is well known that even in recent times as low as 10% of the population has access to formal credit (World Bank, 2017) in India. With a tightly controlled and risk-averse banking (overwhelmingly nationalized public sector undertakings) practice in India

[1] Studies like Galia and Legros (2004), Tourigny and Le (2004), Baldwin and Lin (2002), Mohnen and Rosa (2000) and Arundel (1997) among others have studied the reasons for firms to perceive obstacles differently and the associated complementarities, if any, using French and Canadian innovation survey data.

(see Bhaumik and Piesse, 2005), shallow stock markets (Bombay Stock Exchange and National Stock Exchange together has less than a fifth of the domestic market capitalization of NYSE; *World Federation of Exchanges*, 2018), and negligible presence of corporate debt market (Guha-Khasnobis and Kar, 2007) firms in India, particularly medium to small firms, are usually credit constrained. The apprehension about facing credit constraints, in turn, is likely to affect a firm's ability to innovate as evident in the existing studies (Pellegrino and Savona, 2017; Savignac, 2006). The available literature does not offer any connection between these in the context of Indian firms and we aim to fill the gap by exploring how perceptions of firm owners about obstacles jointly with their (lack of) access to finance shape the probability to innovate.

Why are these questions important in the Indian context? First of all, corruption in India is a major issue with a long history widely documented in the literature (Heston and Kumar, 2008; Krueger, 1974). Indeed, India continues to be one of the more corrupt countries in the world (Transparency International, 2018; it ranks at 78 along with countries like Kuwait, Turkey, Ghana, Burkina Faso, etc). At the same time, studies have emphasized that innovation plays a major role in India's economic growth (World Bank 2007; National Knowledge Commission, 2007). Access to finance, with or without the effects of corruption, has also been a perpetual challenge facing small and medium sized firms in India. A survey by the American Express[2] finds that 42% of small and medium enterprises (SMEs) consider access to finance to be a vexing problem. Recent improvements via promotion of numerous microfinance institutions like MUDRA (Micro Units Development and Refinance Agency) banks that provide loans to SMEs (Ravi, 2019) have eased the situation to some extent and yet the depth of banking practice remains quite shallow. Moreover, the coverage and outcome show a lot of variation across states (Ravi, 2019).

[2] https://www.financialexpress.com/economy/42-smes-in-india-find-accessing-finance-difficult/1398758/

Do these countrywide shortcomings affect innovation by firms? In other words, does the firm's probability to innovate become low when they face at least one of the perceived obstacles? Or, do perceptions about both obstacles bind when it comes to the probability to innovate? For example, in the literature on innovation and corruption, Holmstrom (1989) find that innovative firms might be most willing to bribe and move ahead of other firms. Ayyagari, Demigurc-Kunt, and Maksimovic (2014) support similar findings. So, perceptions about higher corruption (as compared to the difficulty associated with getting finance) might make a firm innovate more, or at least, not dampen the probability significantly. So, there is a case for exploring both these obstacles and observing if the degree of innovation has increased or decreased over time, especially in view of potential counter-effects associated with each. Therefore, our principal contribution to the literature is about the effects of implementation failure for India when it comes to containing petty corruption and improving the formal financial depth. Literature-wise, let us re-emphasize why this paper is distinct. First, while access to finance as a constraint or corruption as a stifling factor has been studied separately in many occasions, how the perceptions about these factors affect the innovation possibility of a firm has not been studied for India.

Generally, however, some studies have looked into the relationship between firms' perceptions about accessing finance and their effort to innovate (Malmström, Johansson and Wincent, 2017; Canton, Grilo, Monteagudo and Zwan, 2013; Kwong, Jones-Evans and Thompson, 2012). Second, none of the above has brought together the cross-effects of perceptions about obstacles to finance and the perception about corruption at the sub-national level to study innovation potential. Indeed, there is no prior about whether the situation worsens when both (negative) perceptions get stronger, and lead to decay of firms. Since various welfare impacts are associated with it, connections with policy propositions are unavoidable.

One of the main hurdles we face while trying to explore this question is that of establishing identification. Identification issues can arise because of endogeneity, omitted variable bias or sample selection bias. We try to establish identification by resorting to multiple estimation techniques and provide robustness of our findings by showing that our conclusion remain unaltered for all the different estimators. We start our analysis with probit fixed effect estimators following Piesse and Webster (2018). In order to establish identification, we resort to Instrumental variable (IV) estimates, inverse probability weight estimates and estimates employing the Heckman selection model. Our results show that perceptions about obstacles like access to finance and corruption either does not hamper firm's probability to innovate or actually benefit the process.Yet, they do jointly decrease a firm's likelihood to innovate. In the face of rising perceptions about corruption, a firm is less likely to innovate when it senses higher obstacles to getting finance. The same is true about the marginal impact of corruption perceptions on probability to innovate as perceived difficulties to access finance gets stronger. Importantly our results point out when firms face only one of the obstacles, their probability to innovate is not likely to be hampered. Other than our results being robust to a varied set of estimators establishing identification strategies, the findings are also robust to an actual measure of corruption.

Section 2 presents a short analytical formulation and the general literature surrounding it. Section 3 presents the data. In Section 4 we offer the empirical methodology and section 5 presents the benchmark results. Robustness check is conducted in Section 6. Finally, Section 7 concludes.

2. Conceptual Framework and Related Literature

Analytically, two outcomes are possible. One, perception about difficulty to acquire finances might restrict most firms from innovating either via R&D or through hiring talents and

further training (Hottentrot and Peters, 2012). If firms exit the market it could lead to higher concentration and consequently higher product prices with negative welfare impact (Fernandes and Paunov, 2015) show that innovating firms are less likely to exit the market). Corruption affecting access to finance acts as a stumbling block in this case. Two, if bribes allow firms to access finance despite negative perceptions, then more innovations are likely. These innovations, often sensitive to firm size, are also expected to generate a price effect if firms transfer part of the cost over to the market - unless, innovation makes the commodity considerably cheaper. Thus, without an empirical investigation it is not possible to conclude if perceptions about corruption completely obstruct the chances of the firm to innovate or that innovation remains steady despite the dampening role of corruption.

The concerned literature has long agreed both theoretically and empirically, that, technological innovation has an undisputed positive influence on economic growth (Gao, *et al*. 2017; Nadiri, 1993; Romer, 1986; Mansfield, 1972; Solow, 1956). The post-Solovian endogenous growth models emphasize the role of entrepreneurship in economic growth by focusing on the process of innovation (see, Romer, 1990, among others). Subsequently, the literature has addressed innovation as one of the most important conduits of entrepreneurship that influences growth and development (for recent work see, Chatterji, Glaeser and Kerr, 2014; Doepke and Zilibotti, 2014, etc).

Regarding obstacles to accessing credit, seminal papers (viz. Jaffee and Russell, 1976; Weiss 1981; Stiglitz and Weiss, 1982, etc.) have talked about frictions in the capital market which make it harder for firms to obtain external finance.[3] Subsequently, an extensive literature has talked

[3]New technology-based firms (NTBFs) are the ones that might suffer from these capital market imperfections, most. In turn, the fact that poor access to credit may limit growth and even threaten the survival of NTBFs is a policy concern because of the key role these firms play in achieving dynamic efficiency and employment growth in the economic system (Audretsch, 1995, Acs 2006).

about capital market imperfections and how it hampers firms' growth (namely, Hartmann *et al*., 2007, seeking financial innovations in Europe to reduce asymmetric information and greater engagement with financial transactions; Hubbard, 1998 on the core testable relations between financial frictions and investments; Blundell *et al*. 1992, providing an early evidence for UK; etc.). It seems that, innovation as an important function of entrepreneurship should also suffer if firms face financial challenges. Yet, theoretically it is plausible that firms in the face of credit constraints try harder to innovate in order to remain competitive and salient as successful entrepreneurs. In fact, an important recent finding (Gao *et al*., 2017) show that even democracy cannot impart direct positive effects on innovation. This is a particularly worrisome for firms in poorer countries that already perform below efficiency frontiers owing to many institutional weaknesses. Innovations at the firm level should offer non-negligible implications for entrepreneurship and growth (see Barasa *et al.*, 2017 for a number of East African countries where respective institutional qualities further offset innovation performance at the firm level).

As regards the dampening effects of corruption on business the literature is voluminous. Earlier attempts suggest that corruption is harmful for growth, prosperity and entrepreneurial outcomes of a country (viz., Dutta and Sobel, 2016; Glaeser and Saks, 2006; Treisman, 2000; La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1999; Ehrlich and Lui, 1999; Shleifer and Vishny, 1993, Mauro, 1995, etc). But it also suggests that (see, Dreher and Gassebner, 2013 and Rose, 2000) that corruption allows entrepreneurs to bribe their way through the startup process. Whether corruption as a perceived obstacle deters firms from innovating is much less clear.

A review of the literature suggests that the present paper pioneers exploration of the interlinkages between innovation, access to credit and corruption by using firm level data for India. Given that India continues to be one of the more corrupt countries in the world (vide Transparency

International, 2018, India ranks at 78 along with Kuwait, Turkey, Ghana, Burkina Faso etc.), one expects reasonable responses from relevant variables. For example, in a recent analysis of corruption among states in India [India Corruption Study (CMS), 2018], states like Karnataka were found to have moderate levels of corruption[4], and according to our results, it is also one of the high achieving states in terms of firms' ability to innovate. In view of the complex overlaps between access to credit and corruption in affecting the propensity to innovate, we directly estimate if corruption in a given state affects firms' ability to innovate or conversely, it influences innovation when exposed to credit rationing.

To achieve this, we use probit specifications and employ marginal analysis for the 2014 Enterprise Survey across major states in India. Briefly, our results show that greater difficulty in accessing credit actually enhances the probability to innovate. However, we find that higher perceptions of corruption among firm owners lower the beneficial impact of access to credit on probability to innovate. Thus, corruption acts as a hindrance even when the access to credit is less restrictive. Our results are robust to the identification strategies adopted, such as, instrumental variable estimations. Additionally, we also check the robustness of our findings to a vast set of controls and alternate channels like source of funding for firms that can affect both obstacles – access to finance and corruption – which in turn can affect the probability to innovate for firms.

3. Data Source, Sample and the Controls

3.1. Dependent and Independent Variables

[4]https://timesofindia.indiatimes.com/city/hyderabad/telangana-second-and-andhra-pradesh-fourth-most-corrupt-states-survey/articleshow/64230040.cms. Accessed, November 23, 2018.

Our main data source for all the variables in the paper is the World Bank Enterprise Survey Database. The specific data set considered from the database is the 2014 Enterprise Survey data for India. The firm level data for India has been collected between June 2013 and December 2014. Although the data is at the firm level, we are unable to incorporate time component in our analysis since the data is collected over the 2013-14 period only. The firms interviewed belong to the manufacturing and service sectors and the collected data aims to quantitatively assess firm performance, firm structure and firms' perceptions to the obstacles in their growth process.[5] Formal (registered) companies with 5 or more employees are part of the sample. As stated by World Bank Enterprise Survey (2014), the survey used stratified random sampling method making sure that the collected sample provides unbiased estimates for the whole population and that the sample is representative of industries, sectors and regions. The data set consists of 9281 firms from 23 major states of India. Firms, as represented in the sample, belong to 26 different industries like food, textiles, garments, leather, wood, paper, chemicals, etc. Among service industries, major services like hotels and restaurants are included.

Our main dependent variable is a dummy based on the question 'In the last three years, has this establishment introduced new products or services?' (World Bank Enterprise Survey, 2014). The dummy takes the value 1 if the answer is *yes*; 0 otherwise. Out of the 9281 observations, approximately 44% of data points take the value 1 (See Appendix 1 for summary statistics). Looking across industries, we find that some of the most innovative industries are leather (56%), hotels and restaurants (54%), garments (52%), electronics (57%), and so on.

[Insert Appendix 1 about here]

[5] Private contractors were hired by the World Bank to conduct the surveys. Since the survey consist of interactions between businesses and the government as well as topics on bribery, private contracts rather than government agents were hired.

In Figure 1, we present state-wise innovation rates of firms. The mean of innovation as measured on the *y-axis* reflects the percentage of firms that innovate in each state. As we can see from the figure, states like Karnataka, Kerala, Rajasthan and a few others have firms that are most innovative. On the other hand, in states like Arunachal Pradesh, Gujarat and Chhattisgarh, firms are less likely to innovate.

[Insert Figure 1 about here]

One of our main independent variables is the one assessing perceived difficulties in accessing finance for firms. The variable is constructed based on the question: 'how much of an obstacle is access to finance?'. As stated in the survey, difficulty in accessing finance by firms includes availability as well as cost, interest rates, fees and collateral requirements. The survey categorizes difficulty in accessing finance under 5 heads -- no obstacle, minor obstacle, moderate obstacle, major obstacle and very severe obstacle. An ordered dummy variable is constructed ranging from 0 to 4 with higher numbers indicating greater difficulty in accessing finance. The mean for the variable is about 1.2. Almost 60% of the firms in our sample have access to finance scores of 0 and 1 suggesting that more than half of our sample face relatively low difficulty in accessing finance. Very few firms have a score of 4 implying that the percent of firms in India facing extensive difficulty in accessing finance is rather small. This is evident from figure 2 where we plot mean access to finance scores for firms in each state.

[Insert Figure 2 about here]

We find that no state has a mean score of 4 since, as mentioned above, very few firms have a score of 4 and, thus, state averages are always less than 4. We find that states like Bihar, Rajasthan, Tamil Nadu, Uttaranchal and Uttar Pradesh face challenges in terms of accessing finance. In comparison, states like Chhattisgarh, Orissa and Punjab face relatively less obstacles.

Another variable of interest is the perception of corruption among firm owners. The specific question asked to firm owners is 'how much of an obstacle is corruption?'. The question aims to assess to what extent the firm owners consider corruption as an obstacle to current operations of the establishment. Analogous to the other variable i.e., difficulty in accessing finance, the survey categorizes corruption as an obstacle in 5 levels. These are:no obstacle, minor obstacle, moderate obstacle, major obstacle and very severe obstacle. The mean for our sample is around 3.2 units. About 33% of the firms categorize corruption as an obstacle to be 0 or 1 implying that they do not perceive corruption as much of a hindrance. A large majority of firms (approximately 46%) putup scores of 2 and 3 suggesting that they perceive corruption as a moderate to major obstacle. Finally, 20% of the firms perceive corruption as a very severe obstacle. As evident from Figure 3, states like Uttaranchal, Uttar Pradesh, Haryana and Punjab have scores of 4 or above suggesting that the perception of corruption among the firm owners in these states is very high.

[Insert Figure 3 about here]

On average, no state has a score below 2 implying that the perception of corruption among firm owners' in India is relatively high.

3.2. Controls

We fall back on existing studies when it comes to selecting controls for our analysis. As pointed out by Schumpeter (1942), larger firms are more likely to engage in innovation activity since 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 incorporate dummies indicating firm size – small, medium and large. Large firms are considered the baseline in our specifications. According to the survey,

a firm is considered small if there are 5 to 19 employees, medium if there are 20 to 99 employees and firms with more than 100 employees are categorized as large. About 34% of the firms in our sample are small sized and about 44% are medium sized. Another control incorporated 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, since it involves greater market competitiveness. Accordingly, we control for the extent of exports at the firm level. 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.

Age of the firm has been emphasized as yet another determinant of innovation. The conclusion in the literature with respect to age's impact on innovation abilities of firms 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 firms' innovation abilities. Recent studies like Pellegrino and Savona (2017) and Bertoni and Tykvovà (2015) have considered a non-linear impact of age. For our main specifications, we do not include a square term but we have checked the results by including a non-linear term as part of robustness analysis. The information about age present in the survey is the year the establishment began its operations. We construct age up to the year 2014. The average age is about 20 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 via networking, proximity to many 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. While 81% of the firms are located in the main business city, only 5% are located in the capital city.

4. Empirical Methodology

4.1. Specification Estimated

Based on our hypothesis, we want to assess how perceptions about obstacles such as accessing finance and corruption affect firm's probability to innovate. To reiterate, the question we ask is - does firms' perceptions about obstacles – meaning, difficulties in accessing finance and facing corruption – interact in affecting the probability to innovate? The following probit specification is empirically tested:

$$\mathrm{Inno_{ijs}} = \alpha_0 + \alpha_1 \mathrm{Accessfin_{ijs}} + \alpha_2 \mathrm{Corr}_{ijs} + \alpha_3 (\mathrm{Accessfin} * \mathrm{Corr})_{ijs} + \sum_{k=1}^{K} \beta_k \mathrm{X_{kijt}} + \rho_i + \theta_s + \epsilon_{it} \quad (1)$$

where, $\mathrm{Inno_{ijs}}$ is the dummy variable suggesting if firm i in industry j in state s innovates or not. $\mathrm{Accessfin_{ijs}}$ is the ordered dummy variable ranging from 0 to 4 for firm i in industry j in state s. It represents firms' perceptions about difficulties in accessing finance. Likewise, $Corr_{ijs}$ is the perception of corruption by firm owners ranging from 0 to 4. $\mathrm{X_{kijt}}$ denotes the matrix of control variables. The benchmark controls, as stated earlier, are firm size, whether the firm is located in the official capital city or not, whether the firm is located in the main business city or not, export share in sales of firms and years in operation. $\rho_i$represents the industry fixed effects and θ_s represent the state fixed effects.

A negative coefficient of α_1 suggest that perceiving greater difficulty in accessing finance for firmsshould lower their probability of innovation. A positive coefficient will suggest otherwise. Likewise, a negative coefficient of α_2 will imply that when firms perceive corruption as a stronger obstacle, their likelihood of innovation goes down. A positive coefficient will suggest otherwise. We are particularly interested in the coefficients:α_1,$\alpha_2$and α_3. The overall impact of perceived difficulty in accessing finance is given by $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}} = \alpha_1 + \alpha_3 Corr_{\text{ijs}}$. Whether $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}}$ is > or < 0 will depend on the sign and magnitude of $\alpha_1$and α_3. Further, it will also depend on the magnitude of $corruption$. $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}} > 0$will imply that as firms perceive facing greater corruption, perceiving difficulty in accessing finance enhances innovation efforts. This will support the 'grease the wheels' phenomenon in the literature wherein corruption allows access to credit or license, etc., when unproductive and inefficient institutions create roadblocks.[6] If $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}} < 0$, corruption will hurt and, thus, it will aggravate the damaging impacts of difficulty in accessing finance on innovation efforts. Likewise, the overall impact of perceived obstacle in the form of corruption is given by $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Corr_{\text{ijs}}} = \alpha_2 + \alpha_3 Accessfin_{\text{ijs}}$.

4.2. Empirical Models

4.2.1. *Probit Fixed Effect Model*

Probit fixed effect model is the benchmark estimator. Studies dealing with binary dependent variables, similar to ours, have also employed such estimators (viz., Dutta and Mallick, 2019; Piesse and Webster, 2018; Swamy et al., 2001 to mention a few). Ordinary least square (OLS) regressions will suffer from challenges like predicted probabilities lying outside the unit

[6]To the extent prevailing rules and regulation create such roadblocks one need not worry about endogenous relations between poor institutions and rent seeking officials (as distinct from lawmakers).

interval, when the dependent variable is dichotomous in nature. Limited dependent variable (LDV) models like probit or logit are the standard estimators to use under such circumstances. While both probit and logit estimators use Maximum Likelihood Estimation (MLE) and the errors terms of both models are dichotomous in nature, the difference lies in the assumption about the distribution of the errors. A normal distribution of error is assumed for a probit model.

The initial specification can be written as

$$\Pr(\ Inc\ Inq. = 1\ )\ =\ \ F\ (\widehat{X}\,\Omega) \qquad (3)$$

$\Pr(IncInq. = 1)$is the probability that the binary variable indicating whether a firm innovates or not is equal to 1 when the firm has introduced a new product or service in the last three years. While *F* is the cumulative standard normal 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 the observed 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. The Index function can be written as$I_i = X_i\beta + u_i$. $X_i$is the set of explanatory variables and u_i follows a normal distribution. We can write the probit model as

$$Y_i \ = \ 1 \qquad if\ I_i = X_i\beta + u_i > 0 \qquad (4a)$$

$$= \ 0 \qquad if\ I_i = X_i\beta + u_i < 0 \qquad (4b)$$

We can finally arrive at

$$\Pr(\ Y_i = \ 1) = \ \Phi\left(-X_i\frac{\beta}{\sigma}\right) \qquad (5)$$

When we estimate the probit model, we actually estimate $\hat{\beta}_i$ where$\hat{\beta}_i = \frac{\widehat{\beta}}{\sigma}$. Thus, the model we estimate is $\Pr(Innovation_i = 1|X_i) = \ \Phi(\beta X_i)$.We formulate our hypothesis in the equation (1)

above that is empirically tested via a probit fixed effect model. Fixed effects take into account invariant industry and state fixed effects. We report marginal coefficients, since average coefficients have the potential to be biased (Webster and Piesse, 2018; Fernández-Val, 2009; Greene, 2004).

4.2.2. Identification – Instrumental Variables Estimation

The probit fixed effects model helps us overcome challenges involving models with binary dependent variables. But one of the main hurdles we face is that of identification. Endogeneity with respect to corruption can arise due to reverse causality, simultaneous determination of variables or,simply due to sample selection bias. Corruption can be endogenous, since higher probability to innovate can change perception of corruption for firms. For example, firms that are poor innovators shall be more inclined to outsource production to smaller units to keep cost lower or would undermine certain regulations blatantly until penalized for violations. This should offer a signal regarding level of corruption among firms.

In our search for instruments, we fall back on the literature dealing with the determinants of corruption in the context of business. We consider an array of instruments and employ them in different combinations to ensure robustness. One of the instruments we consider is a dummy that asks the firms if in the last year 'they have paid for security or not'. To motivate this problem briefly, one could use information from developing countries where a section within the unorganized sector is often known to extract rents from businesses (see Kar *et al*, 2019), often under the protection of political power. It takes the form of threat of disruption, encroachments, occasional break-ins, theft, etc. and is contained often by settling for a regular rent paid to the intruders along with arrangement made for private protection, because the law enforcement is either weak or party to such actions (for more on this, see Dixit, 2004). In other words, if the root

of such lawlessness is in deep-seated corruption, then a firm pays for private security.A variable ranging from 1 to 4 capturing the perceptions of crime is considered as yet another instrument for corruption perception. This variable provides a direct measure of lawlessness for a region. While these variables should affect corruption perceptions, these should not necessarily be correlated with the probability to innovate. For countries like India where incidences of corruption and crime are rampant, arrangement for private protection is pretty common. Thus, firms' probability to innovate is much more dependent on other factors like source of financing and size of firms.

Studies have also shown that firms are more likely to bribe if faced with corrupt judicial systems (Wu, 2008). A dummy is considered that indicates if firm owners strongly agree that the court system is fair and impartial. Again, this variable should not affect a firm's probability to innovate. Further Wu (2008) also points out that firms are more likely to bribe when faced with inefficient delivery of public services. We consider a dummy that takes value 1 if senior managers of the firm did not have to spend any time dealing with public officials. Finally,we consider a dummy that states if firms have female ownership or not. Studies like Torgler and Valev (2006), Swamy *et al*. (2001) and Dollar *et al*. (2001) show that women are less frequently involved in corrupt activities than men. We consider a two-step instrumental variable (IV) model and report all tests that prove the validity of the instruments as well as meet the externality conditions.

4.2.3. Identification – IPW estimates

As explained, we consider all tests to make sure that our instruments for the IV model are valid, and exogenous and uphold the theoretical arguments as rationale for the instruments. We maintain caution nevertheless with the IV estimation results. This is because in spite of the validity of all the tests there might be some chance that these instruments are correlated to some extent with the dependent variable. Thus, we check our results with alternate estimators. If both

probability to innovate and corruption perceptions are co-determined, endogeneity can arise out of sample selection bias. Propensity score matching or inverse probability weights estimation can resolve this problem. Borin and Mancini (2016) also advocates employing such estimation methods to resolve sample selection bias.Under such scenarios, a carefully matched control group can also resolve the problem. However, it is not possible to observe the same firm in two different scenarios –innovating and not innovating. Yet, we can create a counterfactual that implies having firms with all the matching characteristics except differing in terms of perceptions about difficulties in accessing finance and corruption.

The Inverse Probability Weight (IPW) estimators correct for missing data problem arising from the fact that each firm is only observed in one of the potential outcomes, as stated above, by using estimated probability weights. In our case, the outcome is the probability of the firm to innovate. The treatment group consists of firms perceiving higher levels of obstacles in accessing finance as well as the levels of corruption. A two-step approach is used for estimatingthe 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 ATEs (STATA, 2019). The treatment is assumed to be independent of the potential outcomes after conditioning on the covariates and, thus, the estimates of the parameters are consistent. The overlap assumption ensures that the inverse-probability weights do not get too large.

4.2.4. Identification – Heckman Selection model

Yet, another sample selection bias can arise from the fact that the firms need for loans or not can dictate their on difficulties in accessing finance. There might be the possibility of observing a non-

random sample. Firms who might have sufficient internal funds might not need much financing and, thus, might report lower obstacle in accessing finance (Muravyev et. al., 2009). On the other hand, firms may not apply for loans at all since they perceive a higher obstacle. We check the robustness of our findings with a Heckman correction. Based on this, we can fit the regression model ($y = X\beta$) which consists of our dependent and independent variables. The variable(s) Z determines whether the dependent variable is observed or not. In the selection equation, we consider different variables related to the loan process – we consider if the firm has an established line of credit or not and if the firm has applied for a loan recently or not.

5. Benchmark Results

Table 1 presents the first set of benchmark results under different specifications. We start by including only industry and state fixed effects and then introduce the controls in subsequent regressions. This is to make sure that our main coefficients of interest are not influenced by the inclusion of the controls. Thus, in column (1), we include the perceived obstacles, the interaction term between them and state and industry fixed effects only. We find that the coefficients of both terms – access to finance and corruption – are not significant. Thus, these variables do not significantly affect firm's probability to innovate on their own. Based on existing studies and as explained by our theoretical framework, corruption's insignificant effect on Indian firms' probability to innovate is not surprising. As explained in our theoretical framework, corruption's impact on economic outcomes including entrepreneurial endeavors can be positive or negative depending on the situation. Likewise, since a significant part of the country still does not have access to formal credit, the perceived obstacle of accessing finance may lead to various cost-saving innovations also.

Importantly, the coefficient of the interaction term supports our hypothesis. When firms perceive both obstacles, they are less likely to innovate. We find that the coefficient of the interaction term is negative and significant. Thus, with rising perception of corruption, firm's probability to innovate goes down as it senses greater difficulties in accessing finance. We analyze the implications in greater detail in Tables 2A and 2B.

[Insert Table 1 about here]

The results remain robust when we include controls in subsequent regressions. In column (2), we include dummies for small and medium sized firms holding large sized firms as the baseline. Based on the marginal estimates, we find that in relation to large firms, small firms are 15 percentage points less likely to innovate. In the case of medium firms, the likelihood is 4 percentage points less. In Column (3), we add the percentage of sales that constitute of exports as another control. The variable is not significant. The coefficient of the interaction term continues to remain negative and significant. Dummies for capital city and main business city are incorporated in Column (4). Finally, in Column (5), the variable indicating the age of the firm is added.

To interpret the interaction term suitably, we estimate marginal impacts. In Table 2A, we

[Insert Table 2A about here]

consider the impact of perceptions about difficulties in accessing finance on the probability to innovate for different levels of corruption. Specifically we present the results for $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}} = \alpha_1 + \alpha_3 Corr_{\text{ijs}}$. Corruption perceptions take values from 0 to 4. We find that $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}}$ mostly remain insignificant unless corruption perceptions are very strong. When firms perceive corruption to be the strongest, their probability to innovate go down. The probability to innovate goes down by about 7 percentage points when firms face corruption perceptions scores of 4.

In Table 2B, we present the marginal estimates in terms of the impact of corruption perception on probability to innovate for different levels of obstacles that firms perceive about accessing finance.

[Insert Table 2B about here]

Here, we find that while the impacts are similar in magnitude, $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Corr_{\text{ijs}}}$ becomes negative and significant when access to finance corruption score reaches 3. Overall the results suggest that firms' probability to innovate depends more on other factors like firm size and location. Perception to obstacles start to matter when firms face both obstacles at severe to very severe levels.

5.1. Identification –IV Estimates

In Table 3A and 3B, we present our instrumental variable estimation results. As mentioned in earlier sections, we instrument corruption with different instruments to correct for endogeneity arising out of reverse causality or omitted variables bias. We instrument for corruption and the interaction term. We consider all instruments (as described in 4.2.2) in different combinations to ensure our results are not sensitive to a particular instrument. The first stage and second stage results are presented in Table 3A and Table 3B, respectively. In column (1) of both Tables, the considered instruments are dummy for crime perceptions, dummy for female ownership and time spent dealing with government officials. Column (2) considers all instruments from Column (1) as well as dummy for security. In Column (3) of both tables, the considered instruments are security dummy, crime perceptions and time spent dealing with government officials. The instruments considered in Column (4) are security dummy, crime perceptions and female ownership dummy. Finally, in Column (5), we include all the instruments – all the instruments in the four specifications and a dummy indicating if the court process is fair or not. Keeping space

constraint in mind, we report only the excluded instrumentsconsidering corruption as the dependent variable.

[Insert Table 3A about here]

We find that the expected perceptions about crime affect perceptions about corruption positively. Likewise, perceptions about crime also positively affects the interaction term of difficulty in accessing finance perceptions and corruption perceptions. Likewise, if firms agree that the court system is fair, then they have lower perceptions of corruption. The same is true when the interaction term is the dependent variable. The security dummy is not significant. We find that greater time spent in dealing with government officials actually reduces the perception of corruption. This can happen when firms feel satisfied by answering all questions of the officials and coming out with a clean record. Using Sanderson-Windmeijer *F*-statistic, the *chi square* values obtained are above the expected thresholds indicating that the exclusion restrictions have been met. Besides, Cragg-Donald-Wald *F*-statistic is above the threshold for all the specifications confirming that excluded instruments are not correlated with the endogenous regressors.

As we see from the second stage regressions, the coefficients of the interaction term remain negative and significant for all the different specifications. This conforms to our main findings. What is interesting is that in isolation both perceptions – access to finance and corruption – have a positive impact on the probability to innovate. Thus, when firms face only one obstacle, they try harder in the market to stay afloat by attempting to innovate. Yet, when they face both obstacles,

[Insert Table 3B about here]

their probability to innovate goes down. Thus, our general conclusion remains the same. Keeping space constraint in mind, we do not present the marginal estimates but they are available on request. The marginal estimates overall provide us with the same conclusions. When firms have

no perception of facing obstacles either in the form of corruption or accessing finance, then their probability to innovate actually goes up. But with perceptions about both obstacles getting stronger, their probability to innovate goes down.

6. Robustness Analysis

6.1. Inclusion of controls

We start our robustness analysis by including additional controls to our benchmark findings to make sure our results are not subjected to omitted variables bias. As mentioned earlier, it is important to capture the effect of such variables that can potentially affect the variables of interest like perceptions about access to credit or corruption and, thus, bias our results. As part of our robustness analysis, we control for other variables that can potentially affect both perceptions. These variables consist of source of funding for firms. The source can be banks, own-funds or borrowed from informal sources like relatives and friends. Each of these variables represents the contribution of each source by a percentage. We also control for a dummy indicating if the firm is part of an establishment or not. Being part of an establishment might give the firm greater abilities to access finance and, thus, in most likelihood it will enhance their chances to innovate. We checked our benchmark probit specification by including the additional controls. The results remain robust. Keeping space constraint in mind, we do not report them but they are available on request. The interaction term retains its sign and significance. Internal borrowing enhances the probability of firms to innovate. We also test the IV estimates with the inclusion of these additional[7] variables. We again use the instruments in different combinations and the results remain robust.

[7] They are available on request but are not reported.

6.2. Identification

6.2.1. Inverse Probability Weight (IPW) Estimates

For the IV estimates, all tests are considered to make sure that our instruments are valid, exogenous and uphold the theoretical arguments as rationale for the instruments. Yet, we maintain caution nevertheless with the IV estimation results. This is because in spite of the validity of all the tests there might be some chance that these instruments are correlated to some extent with the dependent variable. Thus, we check our results with alternate estimators. As we have mentioned in Section 4, if both probability to innovate and corruption perceptions are co-determined, endogeneity can arise out of sample selection bias. 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 (Webster and Piesse, 2018). Under such scenarios, a carefully matched control group can also resolve the problem. However, it is not possible to observe the same firm in two different scenarios – innovating and not innovating. Yet, we can create a counterfactual 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 problem arising from the fact that each firm is only observed in one of the potential outcomesby using estimated probability weights. The treatment group consists of firms perceiving higher levels of obstacles in accessing finance as well as the levels of corruption.

We present the IPW estimates in Table 4A with different treatment groups. All the treatment groups consider firms some level of obstacles in terms of accessing finance or corruption. The extent of perception about obstacles vary to consider different treatment groups

[Insert Table 4A about here]

makingsure our results are not sensitive to one particular treatment group. In column (1), the treatment group consists of firms which perceive major or very severe obstacles in accessing finance as well as major or very severe obstacles in the form of corruption. The treatment group considered in Column (2) consists of firms perceiving moderate obstacles in accessing finance as well as major or very severe obstacles in the form of corruption. In Column (3), firms perceiving major obstacle in accessing finance and major or very severe obstacles in the form of corruption are considered in the treatment group. As we find from the ATEs, they are significant for all the treatment groups. Based on column (1), firms in the treatment group are 3 percent less likely to innovate compared to the average 45 percent for firms that are not in the control group. The number is almost similar for Column (2). In column (3), for the treatment group, the probability goes down by 4 percent.

In Table 4B, we present the augmented inverse probability weight (AIPW) estimates. AIPW estimates, similar to IPW estimates, correct for the missing data problem arising from the

[Insert Table 4B about here]

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 mis-specified. These estimators use a model to predict treatment status, and they use another model to predict outcomes. The format of Table 4B is similar to that of Table 4A. As evident from the results, our conclusions remain unchanged.

6.2.2. Identification – Heckman Selection model

In yet another effort to establish identification, we resort to Heckman selection model as mentioned before. The results are presented in Table 5. In the case of Model 1, the selected variable in the

second equation is if the firm has an established line of credit or not. For Model 2, the variable is if the firm has applied for a loan in the last fiscal year or not. We present the main results that is results from the first equation keeping space constraint in mind. As we can see from the results, our coefficient of interest – the interaction term – is negative and significant suggesting that our main conclusions remain robust. This is true for both of our selection variables as seen from the estimates in both columns. The significance of the Chi-square from the Wald test of significance suggest the appropriateness of the Heckman estimates.

We next consider alternate measures of corruption. Instead of considering perceptions about corruption, we take up actual measures of corruption to check the robustness of our findings. We construct a dummy taking value 1 if no gift or informal payment was requested by tax officials visiting the firms in the last fiscal year. The dummy is interacted with the variable representing perceptions about difficulties in accessing finance. We run IV results and the estimates are reported in Table 5. Interestingly the coefficients of both variables indicating perceptions about obstacles are negative and significant. Thus, with higher perceptions about obstacles, firms are less likely to innovate. We find the interaction term to be

[Insert Table 5 about here]

positive and significant. To interpret what this means, we present the estimated marginal impacts in the table as well. $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}} = \alpha_1 + \alpha_3 gift_{\text{ijs}}$ is evaluated at the value of the dummy 0 and 1. Reiterating, 0 indicates that no gift or informal payment was requested and, thus, presence of corruption is negligible. 1 indicates either gift was requested by visiting tax officials or the firms refused to pay a gift. In either case, there is presence of corruption. Accordingly, we find $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}}$ is negative and significant when gift takes the value 0. Thus, when firms actually face corruption, their probability to innovate goes down as perceived notion about accessing credit

rises. This conforms to our benchmark findings. When the gift dummy takes value 1, we find $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}}$ to be positive and significant indicating enhanced likelihood to innovate in the event of facing no corruption.

7. Conclusion

A country like India, or comparably, China has traditionally harbored millions of small and mid-sized enterprises (popularly, MSMEs). Following government specification of what constitutes MSMEs, several policies are regularly proposed, modified and experimented within the public circles to ensure smooth functioning of such units - whether engaged with production of various tools, fragments, handicrafts, restaurants, hotels, financial services, insurance schemes, maintenance and repair, etc., or as the main link between producers and consumers via retail trade. India witnesses growth of MSME activities at a steady rate round the year mainly as a reaction to the rising unemployment among the youth population, in urban and semi-urban areas. The government often lays out elaborate plans to accommodate such entries in the labor force via access to small businesses. The two main obstacles that the pursuant of small businesses face are obviously access to credit and impediments from various 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. The present paper looked precisely at these two sources as facilitating or hampering growth of entrepreneurship in India. In the process, we explored a different possibility hitherto ignored in the related literature: whether constraints lead firms to innovate more?

Indeed, we have established both as the mainstay of the paper as well as through multiple

robustness checks, that innovation by MSMEs is the most viable route to escape the dual prongs of rationed credit and corruption rent. Using the World Bank Enterprise Survey that accommodates firm level information from 23 major states in India conducted during mid-2013 and early 2014, and encompassing 9300 observations approximately, we proved that if financial constraint risesby one point, firms' probability of innovation rises by 20%. Analogously, a rise in the perception of corruption also raises innovation significantly, albeit by a smaller percentage. One of the main contributions of this study is that we interacted the financial constraint with the corruption perception and found that rise in corruption for a given level of access to finance lowers innovation. This is particularly strong for smaller firms, such that pushing financial institutions to deliver lager amounts of credit to such firms might not help as long as corruption is not contained. We showed that innovation potential is quite strong for cities that harbor businesses mainly, as well as the capital cities in respective states. Some of the states that are less industrialized register larger cases of corruption and may be responsible for low growth of enterprises. Finally, we used appropriate robustness checks by choosing alternative questions entered in to the survey. We found that even for products that are absolutely new to the market, financial constraints continue to pose serious stumbling blocks forcing firms to accentuate the rate of innovations. Overall, the results explain how firms adjust to mounting problems of credit constraints and rent seeking practices in India. Importantly, it estimates the marginal effects directly to identify the magnitude of countervailing factors that should ideally minimize the negative impact across states in India.

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Figure 1: Innovation percentage rates among states

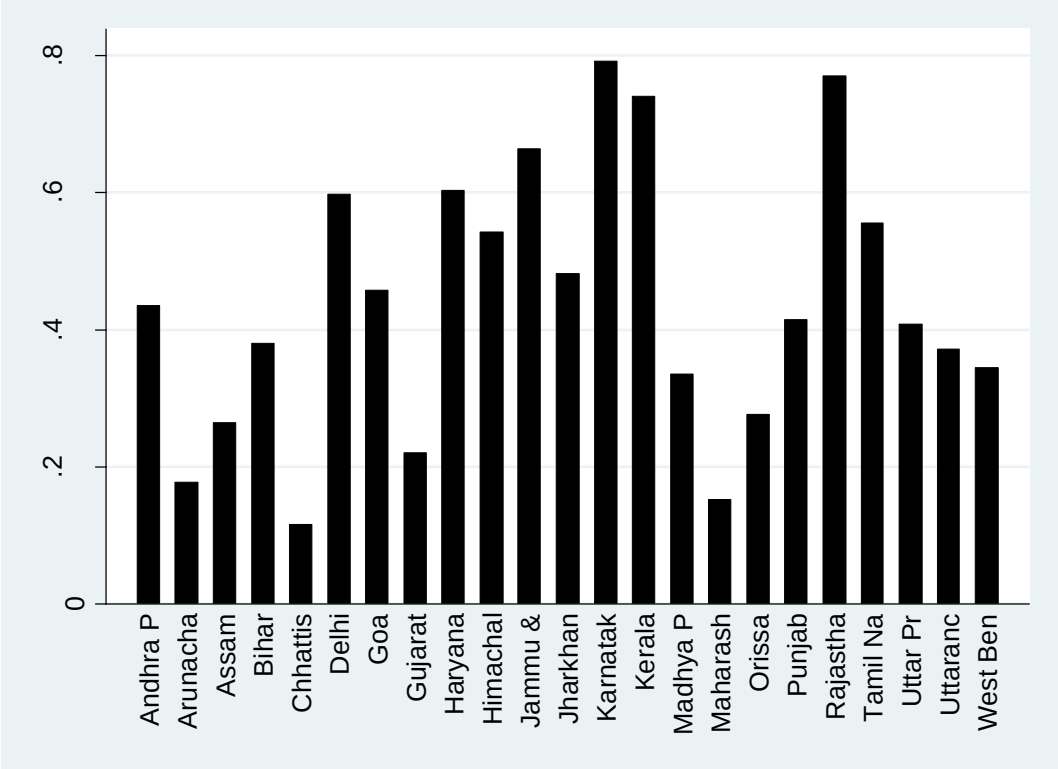

Figure 2: Difficulty in accessing finance average scores across states

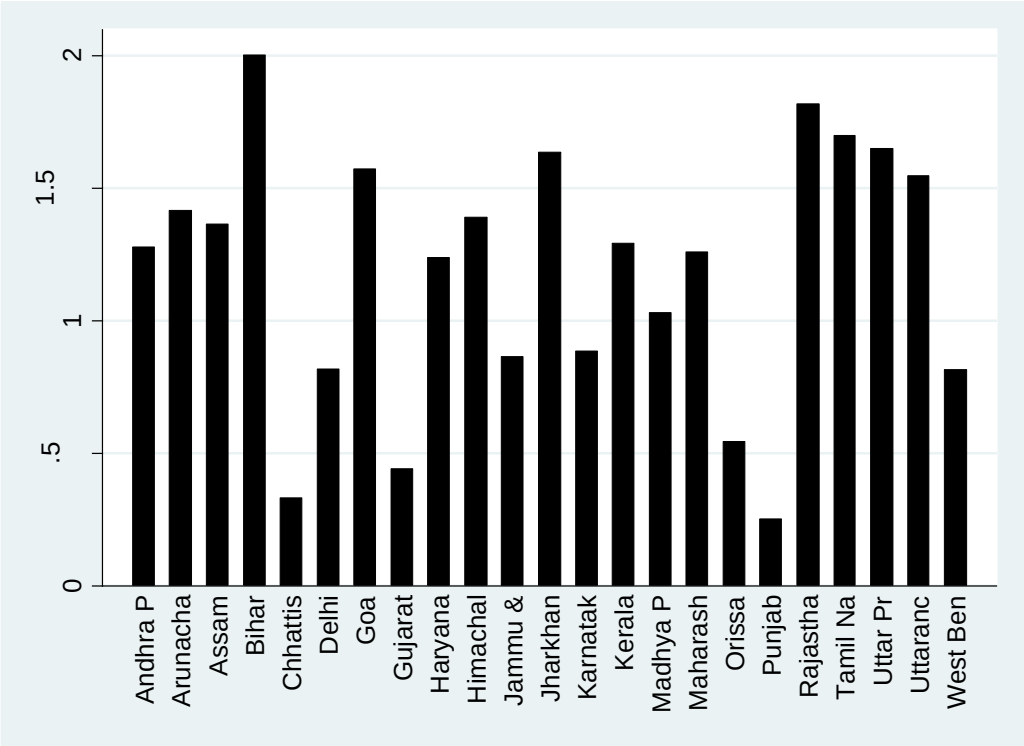

Figure 3: PerceivedCorruption average scores across states

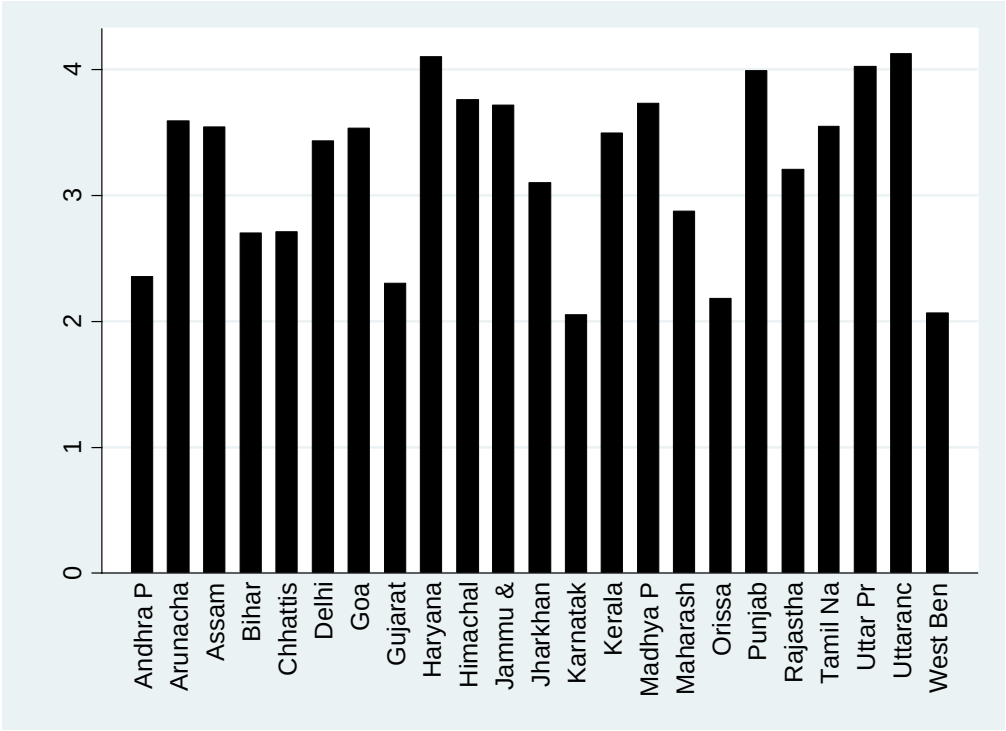

Table 1: **Innovation and Perceived Difficulties – Access to Finance and Corruption**
All specifications are probit fixed effect specifications. *Innovation* is the dependent variable, a dummy taking the value 1 'if in the last three years, the establishment has introduced new products or services?' *Access to finance* is one of the main independent variable indicating perceived difficulties by firm owners in accessing finance. It is coded from 0 to 4 with higher numbers representing stronger perceptions. *Corruption* is the second independent variable also coded from 0 to 4. It represents corruption perceptions of firms. The question asked is *how much of an obstacle is corruption? Fin*Corr* is the interaction term. *Firm (small)* represents the dummy for small sized firms and *Firm (medium)* indicates medium sized firms. *Capital* denote 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 %)* denote the percent of sales constituting of exports. Years in operationis the number of years the establishment has been in operation. Robust Standard Errors are in parenthesis. *** p<0.01, **

	(1)	(2)	(3)	(4)	(5)
Access to finance	0.0349	0.0431	0.0442	0.0493	0.0489
	(0.0428)	(0.0416)	(0.0415)	(0.0415)	(0.0416)
Corruption	0.0133	0.00787	0.00794	0.00761	0.00733
	(0.0272)	(0.0275)	(0.0276)	(0.0275)	(0.0274)
Fin*Corr	-0.0289*	-0.0286*	-0.0289*	-0.0297*	-0.0298*
	(0.0160)	(0.0160)	(0.0161)	(0.0160)	(0.0160)
Firm (small)		-0.456***	-0.441***	-0.436***	-0.435***
		(0.0772)	(0.0757)	(0.0778)	(0.0791)
Firm (Medium)		-0.141*	-0.132*	-0.127*	-0.127*
		(0.0779)	(0.0767)	(0.0765)	(0.0768)
Exports (sales %)			0.00149	0.00123	0.00122
			(0.00123)	(0.00123)	(0.00122)
Capital				4.678***	4.659***
				(0.187)	(0.190)
Business city				0.263***	0.262***
				(0.0800)	(0.0809)
Years in operation					0.00106
					(0.00249)
Constant	-0.500***	-0.376**	-0.416**	-0.645***	-0.666***
	(0.137)	(0.166)	(0.169)	(0.169)	(0.166)
Observations	9,244	9,244	9,244	9,244	9,223

p<0.05, * p<0.1. We control for state and industry fixed effects.

Table 2A: Innovation and Perceived Difficulties – Marginal Estimates

We estimate $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}} = \widehat{\alpha_1}\ and\ \widehat{\alpha_3}\, Corr_{\text{ijs}}$ for the different values of Corruption. $\widehat{\alpha_1} + \widehat{\alpha_3}$ corresponding to estimates from Table 1. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Perceived Corr.	$\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Accessfin_{\text{ijs}}}$
0	0.048
	(0.041)
1	0.019
	(0.033)
2	-0.017
	(0.036)
3	-0.04
	(0.036)
4	-0.07*
	(0.05)

Table 2B: Innovation and Perceived Difficulties – Marginal Estimates

We estimate $\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Corr_{\text{ijs}}} = \widehat{\alpha_2} + \widehat{\alpha_3} Accesstofin_{\text{ijs}}$ for the different values of Access to finance perception scores. $\widehat{\alpha_2}$ and $\widehat{\alpha_3}$ corresponding to estimates from Table 1. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Perceived Corr.	$\frac{\delta \text{Innovation}_{\text{ijs}}}{\delta Corr_{\text{ijs}}}$
0	0.007
	(0.027)
1	-0.022
	(0.027)
2	-0.052
	(0.035)
3	-0.082*
	(0.047)
4	-0.111*
	(0.061)

Table 3A: First Stage Results

First stage IV specification results. We instrument both corruption and the interaction term. We present here estimates with corruption as the dependent variable *The external instruments considered are a dummy indicating if the firm has paid for security in the last year or not, perception about obstacles in the form of crime, dummy indicating if a firm thinks the court system is fair and impartial, a dummy if the firm has spent no time dealing with government officials and finally a dummy indicating female ownership.*

	(1)	(2)	(3)	(4)	(5)
Security	---	0.04	0.040	0.038	0.04
		(0.028)	(0.02)	(0.028)	(0.028)
Crime	0.38***	0.38***	0.38***	0.37***	0.38***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Court	---	---	---	---	-0.06**
					(0.028)
Govt. officials	-0.06**	-0.07**	-0.06**	---	
	(0.03)	(0.03)	(0.027)		
Fem. ownership	0.06*	0.054	0.016	0.05	0.049
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
Observations	9167	9167	9223	9167	9167
F test for excluded instruments	6.55***	5.44***	6.23***	5.28***	5.35**
Instruments	govt. officials, Crime, female ownership	Security, Crime, govt. officials, fem. ownership	Security, Crime, govt. officials	Security, Crime, fem. ownership	Security, Crime, fem. ownership, court dummy
Sargan (Chi-sq p val.)	0.18	0.15	0.10	0.49	0.13

Table 3B: IV estimates: Innovation and Perceived Difficulties

All specifications are IV estimates with two step. *Innovation* is the dependent variable, a dummy taking the value 1 'if in the last three years, the establishment has introduced new products or services?' *Access to finance* is one of the main independent variable indicating perceived difficulties by firm owners in accessing finance. It is coded from 0 to 4 with higher numbers representing stronger perceptions. *Corruption* is the second independent variable also coded from 0 to 4. It represents corruption perceptions of firms. The question asked is *how much of an obstacle is corruption? Fin*Corr* is the interaction term. *Firm (small)* represents the dummy for small sized firms and *Firm (medium)* indicates medium sized firms. *Capital* denote 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 %)* denote the percent of sales constituting of exports. Years in operation is the number of years the establishment has been in operation. Robust Standard Errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. We control for state and industry fixed effects.

	(1)	(2)	(3)	(4)	(5)
Access to finance	1.360	0.855**	0.839*	0.689**	0.439**
	(0.993)	(0.373)	(0.459)	(0.329)	(0.209)
Corruption	-0.401*	-0.281***	-0.280**	-0.293***	-0.247***
	(0.241)	(0.0950)	(0.110)	(0.0820)	(0.0593)
Fin*Corr	0.773*	0.556***	0.555***	0.612***	0.539***
	(0.448)	(0.185)	(0.207)	(0.161)	(0.121)
Firm (small)	-0.0785	-0.105***	-0.101***	-0.115***	-0.129***
	(0.0655)	(0.0332)	(0.0367)	(0.0289)	(0.0217)
Firm (Medium)	-0.0697*	-0.0602**	-0.0600**	-0.0566***	-0.0517***
	(0.0403)	(0.0253)	(0.0254)	(0.0219)	(0.0175)
Exports (sales %)	0.000555	0.000576	0.000615	0.000692	0.000732**
	(0.000735)	(0.000500)	(0.000493)	(0.000434)	(0.000351)
Capital	-0.00947	0.278	0.292	0.533	0.719
	(1.400)	(0.898)	(0.904)	(0.781)	(0.622)
Business city	0.0825**	0.0848***	0.0814***	0.0876***	0.0893***
	(0.0395)	(0.0268)	(0.0266)	(0.0231)	(0.0187)
Years in operation	0.00321	0.00214**	0.00208*	0.00182**	0.00129**
	(0.00233)	(0.00104)	(0.00118)	(0.000910)	(0.000653)
Constant	-1.069	-0.604*	-0.603	-0.514*	-0.301
	(0.921)	(0.351)	(0.427)	(0.305)	(0.203)
Observations	9,167	9,167	9,223	9,167	9,167
Instruments	govt. officials, Crime, female ownership	Security, Crime, govt. officials, fem. ownership	Security, Crime, govt. officials	Security, Crime, fem. ownership	Security, Crime, fem. ownership, court dummy
Sargan (Chi-sq p val.)	0.18	0.15	0.10	0.49	0.13

Table 4A: Inverse Probability Weights Estimates: Innovation, Access to Finance Obstacles perceptions and Corruption perceptions

All data are considered from World Bank Enterprise Surveys. *Innovation* is the binary dependent variable.We consider different treatment groups in the columns. We report the ATE (Av. Treatment effect)s. Access to finance perception scores range from 0 to 4 with higher numbers indicating stronger perceptions about difficulties in getting credit. Similarly, corruption perceptions also range from 0 to 4 with higher numbers indicating firms strongly agreeing to the presence of corruption.

	(1) Access>2; Corr>2	(2) Access=2; Corr>2	(3) Access=3; Corr>2
ATE_ high vs. low obstacle perceptions (1 vs. 0)	-0.034* (0.018)	-0.033** (0.017)	-0.047** (0.022)

Table 4B: Augmented Inverse Probability Weights Estimates: Innovation, Access to Finance Obstacles perceptions and Corruption perceptions

All data are considered from World Bank Enterprise Surveys. *Innovation* is the binary dependent variable. We consider different treatment groups in the columns. We report the ATE (Av. Treatment effects). Access to finance perception scores range from 0 to 4 with higher numbers indicating stronger perceptions about difficulties in getting credit. Similarly, corruption perceptions also range from 0 to 4 with higher numbers indicating firms strongly agreeing to the presence of corruption.

	(1) Access>2; Corr>2	(2) Access=2; Corr>2	(3) Access=3; Corr>2
ATE_ high vs. low obstacle perceptions (1 vs. 0)	-0.033*	-0.028*	-0.046**
	(0.019)	(0.016)	(0.022)

Table 5: Heckman Selection Model

	Model (1)	Model (2)
Access to finance	0.208***	0.108***
	(0.023)	(0.023)
Corruption	0.044***	0.035***
	(0.011)	(0.013)
Fin*Corr	-0.039***	-0.034***
	(0.008)	(0.008)
Firm (small)	-0.505***	-0.267***
	(0.039)	(0.039)
Firm (Medium)	-0.248***	-0.041***
	(0.037)	(0.036)
Exports (sales %)	0.002***	0.001***
	(0.006)	(0.006)
Capital	0.266***	0.322***
	(0.052)	(0.052)
Business city	0.292***	0.429***
	(0.0395)	(0.035)
Years in operation	-0.00003	0.00002
	(0.001)	(0.001)
Bank borrowed	0.002***	0.002*
	(0.009)	(0.001)
Informal borrowed	-0.0004	0.001
	(0.002)	(0.001)
Internal funds	0.002	-0.004
	(0.001)	(0.001)
Establishment part	0.231***	0.102***
	(0.035)	(0.003)
Constant	-0.036	-0.036
	(0.055)	(0.055)
Observations	9226	9226
Selected variable	If the firm has an established line of credit or	If the firm has applied for a loan in the last fiscal year or not
Wald test of independence (Chi-sq)	27.7***	1.8***