Credit Contract Enforcement and Income Disparities across Indian States: A Heterogeneous Agents Framework with Formal and Informal Firms

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Abstract

This paper evaluates the role of enforcement of credit contracts in explaining the income per capita disparities across Indian states—by studying its impact on access to credit and occupational choices of individuals, and therefore, the overall allocation of factors of production in state economies. First, I estimate the impact of credit contract enforcement on the occupational choices of the working population in India by exploiting the variation in implementation of a major judicial reform policy across Indian states in 2002. Then, I develop and calibrate for each state a heterogeneous-agents model with heterogeneous firms of formal and informal types. In the model, the state-specific ability to enforce credit contracts imposes an endogenous borrowing constraint—which affects the borrowing ability of individuals, the potential size of firms they can run, and the profits they can earn. Combined with labor market frictions and the general equilibrium effects on economy-wide wages and interest rates, individuals sort into different occupational types. Overall, improved enforcement of credit contracts reduces the misallocation of factors of production—entrepreneurial skills, capital, and labor across production units—leading to increased aggregate productivity and output per capita of the economy. Calibrating the model for each Indian state, with states varying on parameters of credit enforcement and availability of labor opportunity, I find that the model explains 19.74 percent disparities across Indian states in 2017-18.

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1 Introduction

Research over the past several decades has pointed to the importance of financial frictions, broadly, in explaining a significant part of the disparities in per capita incomes across countries. A key challenge remaining from this research is identifying the particular frictions and assessing their quantitative importance. In this paper, I address this challenge by studying empirically and theoretically the importance of enforcement of credit contracts in driving per capita income differences across Indian states.

In my empirical analysis, I estimate the impact of enforcement of credit contracts on the occupational choices of the working population of India. The identification strategy used in the empirical analysis involves the use of difference in differences—I exploit the cross-state variation in the implementation of the Civil Procedure Code Amendment Act of 2002 in India. I find strongly significant effects of improved enforcement on occupational choices. In my theoretical analysis, I develop and calibrate a dynamic heterogeneous-agents three-occupation type general equilibrium model with an endogenous borrowing constraint based on enforcement of credit contracts, and firms of formal and informal types. I use this model to quantitatively evaluate the importance of enforcement of credit contracts in explaining the observed per capita income disparities across Indian states. The data on speed of resolution of civil suit cases by state courts is used as a proxy for enforcement of credit contracts, and is incorporated in the calibration exercise.

A key feature of my empirical analysis and theoritical model is the presence of both formal and informal firm owners. This is motivated by the fact that India has a large number of very small firms (informal firms), typically owned by individuals who cannot find employment as a wage worker. The share of informal firm owners in the working population varies roughly between 20 and 60 percent across Indian states. Hence, informal employment is large and it varies considerably across states. There is clear evidence in the literature that enforcement of credit contracts affects access to credit and performance of both formal and informal firms in India (Lilienfeld-Toal et al. (2012), Chemin (2012)).[1]

Using multinomial logit regressions, I estimate the impact of the speed of resolution of civil cases on courts on the likelihood of choosing particular occupations—formal firm owner, informal firm owner, and worker by the working population in India. The identification strategy is a difference-in-differences based strategy as used in Chemin (2012) and it uses the cross-state variation in the implementation of the Civil Procedure Code Amendment Act of 2002 in India. The Code

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[1]Lilienfeld-Toal et al. (2012) find an increase in the borrowings and profits of formal firms on average with better enforcement of credit contracts. Chemin (2012) finds improved access to credit and investment for informal firms with improved judicial speed.

of Civil Procedure contains procedures and practices followed by civil courts in India. The amendments in the 2002 act included multiple measures to improve judicial speed, including—mandatory time limits at each stage of litigation, restrictions on the right to appeal, courts being given the power to refer the disputes to alternative resolution mechanisms and reducing adjournments. The states in India individually have the power to make amendments to the code. Some states had already implemented amendments similar to those in the 2002 Amendment Act in years prior to 2002, which affected the effective policy dose they received with the act. Hence, there was a cross-state variation in reform implementation in 2002, which I use to identify the impact of the speed of civil courts on the occupational choices of individuals.

For the regression exercises, I use the 55th and 61st rounds of the Employment and Unemployment Surveys of the National Sample Surveys for data on occupation choices. These surveys are for years 2000 and 2005, respectively, which are suitable pre- and post- years for the difference in differences exercise. The regression results indicate that the share of formal firm owners on average falls with improved judicial speed, although the average education levels of individuals choosing formal firm ownership increases. The share of workers increases with improved judicial speed, and the impact on the share of informal firm owners is insignificant.

The theoretical model evaluates the effect of credit contract enforcement on per capita GDP and other macroeconomic outcome variables by aggregating its impact on individual incomes and other individual-level variables. In the model, state-specific ability to enforce credit contracts affects the ability of individuals to rent capital, the potential size of firms they can run, and the profits they can earn. Occupational choices lie at the core of the model mechanisms—in a general equilibrium set-up where economy-wide interest rates and wages change simultaneously, a change in enforcement of credit contract has a heterogeneous impact across individuals on the potential incomes they can get from different occupations, leading to a reallocation of individuals across occupations—further determining their actual incomes and contribution to the GDP. The model predictions for the impact of changing the degree of enforcement of credit contracts on the likelihood of being in particular occupations are in alignment with the results of the empirical analysis for formal firm owner and worker categories.

Informal firm owners are introduced in the model by adding labor market frictions—these frictions govern an individual's ability to find a job.[2] Individuals who wanted to work but cannot find a job end up setting these very small size firms. These individuals could have contributed more to the GDP of the economy if they were wage workers, but these labor market frictions limit their contribution. Informal firm owners also depend on credit, the large share of these individuals in

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[2]This model is a modification of the model in Buera et al. (2011) with the informal sector added. There is no separation between manufacturing and services sectors unlike the Buera et al. (2011) model.

the working population increases the relevance of enforcement of credit contracts in determining the output per capita of states.

In the model, each period, individuals are heterogeneous on entrepreneurial productivity, assets and availability of labor opportunity. There are three key individual decisions: the choice of capital and labor as a potential firm owner, the occupational choice, and the consumption-savings choice. Assets are determined endogenously every period in the forward looking consumption-savings problem. Every period, individuals also make an occupational choice. If individuals have a labor opportunity, they compare the potential incomes between becoming a worker (fixed wage rate) and a firm owner (constrained optimal profit) to choose their occupation. If individuals do not have a labor opportunity, they have no option but to set up a firm. If firm owner's profits are less than wages it means that they took up firm ownership involuntarily and are characterised as informal firm owners, otherwise, they are formal firm owners.

In equilibrium, improved enforcement of credit contracts leads to a rise in interest rates and wages, mainly because of the increased aggregate demand for capital and labor. In terms of access to credit, the impact is heterogeneous across individuals. Better enforcement of credit contracts loosens the borrowing constraint on capital, but the economy-wide increase in interest rates makes credit more expensive. Access to credit improves the most for talented asset-constrained individuals. For low-skilled individuals, since their unconstrained optimal amount of capital is already low, credit becoming expensive may worsen their access to credit. With changed borrowing abilities and an increased wage rate, there is a change in the expected incomes of individuals from various occupations, leading to a reallocation of individuals across occupations in the economy. The model predicts an average falling trend in the share of formal firm owners and an increase in the share of workers with improved enforcement of credit contracts. This is because of the increased demand for labor and a rise in wages —worker share increases and only individuals making profits greater than wages are in the formal firm category—these are individuals with high entrepreneurial talent and who run large-size firms. Overall, the reduced misallocation of factors of production—entrepreneurial talent, capital, and labor across production units—improves the aggregate output per capita of the economy.

Studying disparities across Indian states can contribute to the macro-development literature for two reasons. First, the disparities are large—there is a factor of seven difference between the three richest and three poorest states—and second, by studying disparities across states, I can implicitly control for a range of cross-country factors and influences that cannot be as convincingly controlled for in cross-country research.[3] A positive correlation of 0.39 between the speed of resolution of civil

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[3]in 2017-18, the average GDP per capita of the top 3 richest states (Goa, Sikkim, Delhi) was almost 7 times that

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suits cases and per capita GDP of states in India in 2017-18 provides an additional motivation for this analysis and performing a calibration exercise across Indian states.[4]

The calibration exercise involves calibrating the state-specific model parameters, evaluating the model outcomes for each state with these parameters, and then comparing them to data outcomes. The state-specific credit contract enforcement and labor opportunity parameters are calibrated by matching to external finance to GDP ratio and share of workers, respectively, for each state. The correlations between model predicted and data numbers for GDP per capita, share of informal firms, share of workers, and formal firm sizes are 0.44, 0.97, 0.36, and 0.14, respectively. A regression of data GDP per capita on model predicted GDP per capita has an R squared of 0.1974, indicating that the degree of enforcement of credit contracts and labor market frictions jointly predict 19.74 percent disparities across Indian states in 2017-18. There is also a positive correlation of 0.34 between the model calibrated state degree of enforcement of credit contract parameters and their data proxy—the speed of resolution of civil suit cases by state courts.

This paper contributes to two streams of literature—one to quantitative models linking financial development and aggregate output of economies, and second to the empirical literature on the effect of credit contract enforcement on access to finance, firm performance and occupational choices of individuals.

Other quantitative models have explained the link between financial development and aggregate economic output in forward-looking agents set-ups with occupational choices. Buera et al. (2011) explain cross-country differences in output per capita by calibrating a heterogeneous-agents two-occupational choice model, with an endogenous borrowing constraint based on enforcement of credit contracts. They make a separation between manufacturing and services sectors operating at different scales. Dabla-Norris et al. (2017) link financial inclusion to GDP by modelling three types of financial frictions—participation cost to borrow, limited commitment and asymmetric information, in a heterogeneous-agents general equilibrium framework. Their model predicts varied implications on the access to credit at the intensive and extensive margins, based on whether these frictions are relaxed jointly or separately. Giné and Townsend (2003) build a general equilibrium model with two sectors, one without intermediation, and the other with borrowing and lending. Studying Thai data from 1976 to 1996, they find that financial liberalization has varied welfare gains

of the bottom 3 poorest states (Bihar, Uttar Pradesh, Manipur).

The speed of judiciaries is a good proxy for enforcement of credit contracts. In a cross Indian state exercise with disparities in judicial efficiency, I can identify the effect of judicial efficiency independent of country-wide common characteristics such as legal origins, common rules and procedures that courts follow when resolving cases, qualifications of judges etc.

[4]The speed of resolution of of civil suits cases is measured as the reciprocal of average age of disposed cases by the District and Sessions courts of states. Data is from NJDG—this is a comprehensive database containing information on performance of courts in India.

and losses across the distribution of population, most benefited are talented would-be entrepreneurs who lack credit and cannot otherwise establish businesses.

The idea of adding the informal sector in these types of models has been discussed in Buera et al. (2020). The paper studies the aggregate and distributional effects of microfinance in both partial equilibrium and general equilibrium settings. In their model, informal firm owners are added with the help of a labor productivity shock—this shock gives rise to "necessity entrepreneurs" who start businesses not because they are particularly productive as an entrepreneur, but because their labor productivity is low. The labor productivity is a two-state markov process determined by two parameters—one which determines the probability of getting a particular outcome (high or low labor productivity) every period, and the other which determines the relative wage under both outcomes. My model incorporates a similar labor opportunity shock process to generate informal firm owners—although, unlike Buera et al. (2020), individuals have no option to work if they get a bad labor opportunity shock, and can only set up firms.

Regarding empirical evidence of the impact of enforcement of credit contracts on access to finance, La Porta et al. (1997) show that weak investor protection is correlated with thinner debt markets across countries. Gropp et al. (1997) show that limited liabilities of borrowers work against the availability of credit for poor borrowers. The impact of credit contract enforcement on the performance of both formal and informal firms has been studied in the Indian context. Lilienfeld-Toal et al. (2012) exploit the state-time variation in establishment of Debt Recovery Tribunals across Indian states, they find that the reform increased borrowing, plants, machinery and profits for all firms on average. They find evidence of increased interest rates for all categories of borrowers with improved credit contract enforcement. They also highlight the differential impact of an improvement in credit contract enforcement across formal firms of different sizes in India, finding that the reform increased borrowing for the largest firms but decreased borrowing for the smallest firms. Chemin (2012) uses the cross-state variation in the implementation of a 2002 national judicial reform policy in India to identify the effect of court speed on the behaviour of unregistered small firms. He finds that on average, the reform encouraged investment and facilitated access to finance for these firms. Levine and Rubinstein (2018) study a three-occupational choice multinomial logistic model with incorporated and unincorporated firm owners to study the important characteristics of individuals—such as human capital traits, labor market skills, and liquidity constraints, relevant in choosing particular occupations. The empirical analysis in this paper is an adaptation of their model combined with a difference in differences strategy to identify the impact of judicial speed.

The remainder of the paper is organized as follows: Section 2 describes the empirical analysis on the impact of judicial speed on occupational choices of the working population in India. Section

3 describes the model and its mechanisms. Section 4 describes the calibration strategy and results. Section 5 concludes.

2 Empirical Impact of Judicial Speed on Occupational Choices

The goal of this section is to empirically analyze the impact of judicial speed on the occupational choices of individuals (speed of resolution of civil cases by courts is a good observable proxy for credit contract enforcement). The identification strategy used is a difference-in-differences strategy similar to the one employed by Chemin (2012), which is based on the cross-state variation in implementation of the Civil Procedure Code Amendment Act of 2002 in India. Subsection 2.1 below describes characteristics and data definitions of the three occupation types. Subsection 2.2 gives an overview of the identification strategy. Subsection 2.3 lays out the empirical model. Subsection 2.4 gives details of the datasets and variables used in the empirical exercise. Subsection 2.5 describes the regression results.

2.1 Occupation Type Categorization

In this subsection, I discuss the definitions and characteristics of the three main occupation types: formal firm owner, informal firm owner, and worker.

Formal firm owners are the traditional entrepreneurs—the epitome of "modern capitalist development", the "agents of innovation", the disruptive economic leaders (Schumpeter (1911)) who undertake costly and risky investments (Knight (1921)) and develop new goods, services, and production processes (Schumpeter (1911)). They shape the productivity of firms (Murphy et al. (1991)), facilitate economic growth and create jobs.

The concept of an "informal sector" was originally introduced in the mid-1950's by W. Arthur Lewis, referring to the vast pool of surplus labor in developing countries who are self-employed outside of the formal sector. Even though multiple definitions and terminologies are associated with the concept of informal firm ownership in recent literature, the general understanding converges to an entity that has no official status, is unrecognised and is unregulated by state institutions —often these attributes are present because these firms are very small in size(Amin and Singh (2002)).[5] Tokman (2007) believes that informal firm owners exist because of a "failure of the economic system to create enough productive employment", and given the opportunity for salaried

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[5]A very small firm size would reflect an unsteady, limited means of living. "Informality" may be a strategy to economize on costs or avoid taxes, regulation and control or may simply reflect a lack of awareness or the wish to avoid complications in the process of officially registering a firm.

work, these individuals would prefer to work. De Mel et al. (2010) find that on scores of ability measures and cognitive tests, informal firm owners fall way below entrepreneurs operating larger enterprises, reflecting the poor skills of informal firm owners on average. In an alternate view, De Soto et al. (1989) consider these micro-enterprise owners to be "capitalists-in-waiting" held back by credit constraints, weak property rights, and burdensome regulation.

In terms of the classification between formal and informal firms in the Indian data, there are two possible approaches, one based on the "enterprise approach" and another based on the "labor status approach". The enterprise approach is based on the firm size and registration status of the firm. According to this approach, informal firms comprise all "unincorporated private enterprises owned by individuals or households engaged in the sale and production of goods and services with less than ten total workers" (NCEUS (2008)).[6] Formal firms, as in the ASI firm data, comprise all registered firms with ten or more workers.[7] In the "labor status approach" the classification is based on the work status of the firm owner as classified in the labor force surveys. If the work status of the firm owner is "employer"—a person who operates his own enterprise or with one or a few partners and who by and large runs his enterprise by hiring labor—he falls into the formal firm owner category. If the work status of the firm owner is "own-account type"—a person who operates on his own enterprise or with one or a few partners and who by and large runs his enterprise without hiring labor—he falls into the informal firm owner category. In this section as I work with the labor-force data, I stick to the classification based on the labor status approach.

The third category of occupation is worker. Workers are persons working in the enterprises of others in return for a salary. The work status of being a worker can be clearly identified in the labor-force surveys.

2.2 Identification Strategy

To identify the impact of judicial speed on the occupational choices of individuals, I follow the identification strategy as employed in Chemin (2012). This strategy is based on the cross-state variation in implementation of the Civil Procedure Code Amendment Act of 2002 in India. This act sought to simplify and shorten the procedural handling of civil court cases as specified in the Code of Civil Procedure.[8] I briefly summarize the identification strategy in this section.

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[6]Unincorporated or unregistered firms in India are those which are not registered under the Indian Companies Act of 1956. Registering/Incorporating under the Companies Act gives a company a separate legal identity from its owners.

[7]ASI stands for Annual Survey of Industries. It is the key source of data on formal firms in India.

[8]Originally created in 1908, the Code of Civil Procedure is a procedural law related to the administration of civil proceedings in India. Its main objective is to consolidate procedures and practices followed by civil courts in India. The contents of the code include—procedures for filing civil cases; the jurisdiction within which civil courts must

The 2002 Amendment Act comprised of 88 Amendement to the the Code of Civil Procedure applicable to the functioning of civil courts in all States in India.[9] The amendments included providing a time limit for the plaintiff to serve a summons on the defendants; courts being given the power to refer the disputes to alternative resolution mechanisms such as Lok Adalats, arbitration, conciliation and mediation; restrictions on right to appeal; mandatory time limits at each stage of litigation; and reducing adjournments and frivolous litigation. Even though this act applied to improving the procedures for resolving a broader range—all types of civil cases, it can be assumed to apply for a subset of civil cases related to credit contract enforcement.[10]

The states individually have the power to make amendments to the code, which affects the procedures applicable to the courts of that state. Several different amendments to the code were made by different States in years prior to 2002. Some states had already implemented amendments in previous years to different orders (rules) amended by the act in 2002. This affected the effective dosage of policy received by each state with the 2002 Act. Hence, there was cross-state variation in reform implementation in 2002, which is used to identify the impact of judicial speed on the occupational choices of individuals.

Chemin (2012) examines each of the 88 amendments in the 2002 Amendment Act and recognises that 57 of those amendments are likely to influence court speed. He goes through each of these 57 amendments and assigns a particular amendment a score of +1 if he thinks it increases court speed [11] and a score of -1 if he thinks that the amendment reduces court speed. Totaling this score for each of these 57 amendments gives a score of +38, so Chemin concludes that the amendment is likely to increase court speed overall. Initially all States are assigned a score of +38 as total impact of the 2002 Amendment Act. Then, Chemin goes through each and every order and rule in the Code amended by the Act of 2002 and checks if it was amended by any State in previous years. If a state had passed the exact same amendment in previous years, the total impact of the 2002 Amendment Act for that particular state is decreased by one point.[12] If a similar (but not exactly the same) amendment(s) to an order(rule) was(were) passed in previous years in a state,

function; specific rules, steps and time limits for proceedings and resolution of cases; plaintiff's and defendant's rights to cases; powers and criteria for courts to pass various decrees and orders; and criteria for appeal, review and revision of decrees etc.

[9]In terms of structure, the code comprises of 158 sections and 51 orders with rules. The sections contain general principles related to powers of courts, whereas the orders and rules prescribe detailed procedures and methods that govern civil proceedings in India. Every order has an associated section that explains the original jurisdiction of the court to which the order is related. Any amendment to the code is an amendment to a rule(s) within an order.

[10]This assumption is made because a big majority of cases on credit contracts are resolved by the civil courts, and the amendments to the procedures in 2002 would impact the speed of resolution of credit contract cases as well. Moreover, a speedy resolution of other types of civil cases are resolved speedily, it would reduce the waiting time for the resolution of credit contract cases.

[11]Change of speed here is evaluated as for a state that would not have implemented an amendment to the same order(rule) in the previous years

[12]An example of an exact same amendment implemented in years prior to 2002 is given in Chemin(2012, p. 467)

then Chemin makes an appropriate adjustment to the total impact of the 2002 Amendment Act for that state, so that the net effect of the particular amendment in 2002 is valued.[13]

In this way, Chemin evaluates a total impact score of the 2002 Amendment Act for each state.[14] These scores lie in the range 34-40.[15] [16] This variation in the total impact of the 2002 amendment act can be incorporated in a difference-in-differences exercise to isolate the impact of judicial speed on economic outcomes. Taking differences in the outcomes of interest, between states which are less and more influenced by the 2002 Amendment Act, before and after the reform—and then differencing them, we can identify the causal impact of the judicial speed on the probabilities of choosing particular occupations.

2.3 Occupational Choice Regressions

To identify the causal impact of the improvement in judicial speed on the probabilities of choosing various occupations, using the difference in differences based identification strategy discussed in section 2.2, I use the 55th and 61st rounds (years 2000 and 2005 respectively) of the employment and unemployment surveys of the NSS (National Sample Survey) conducted by the NSSO.[17] These surveys are the primary source of data on various indicators of labor force at national and state levels in India. Since the amendment act in consideration was imposed in 2002, the year 2000 can be considered as the pre-year and the year 2005 can be considered as the post-year for the

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[13]Example from Chemin(2012): "Order 20, Rule 1, describes a timeline for a judgment to be pronounced. A court must pronounce judgment within 15 days from the date on which the case hearing was concluded or 30 days in exceptional circumstances. The 2002 Amendment Act changed these two numbers to 30 and 60, respectively. This amendment is contrary to the objective of facilitating swift disposal of cases and, thus, is coded as a -1. However, the states of Tamil Nadu, Pondicherry, and Andhra Pradesh passed an amendment in 1930 specifying that no time limits are to be imposed on courts. As the 2002 Amendment Act overrules all previous legislation, the impact in these three states will be positive as time limits are now imposed, whereas the impact of the reform in other states will as longer time limits are imposed. Therefore, I placed a +2 for these three states in order to specify that the overall impact on them should be positive (-1+2) as opposed to all others which received a -1."

[14]The states of Jammu & Kashmir and Nagaland are not a part of this calculation in my paper as the Code of Civil Procedure was not applicable in these States.

[15]The states of Uttaranchal, Jharkhand and Chattisgarh were newly created out of Uttar Pradesh, Bihar and Madhya Pradesh respectively in November 2000. Also, no related amendments were passed in Uttaranchal, Jharkhand, Chattisgarh and new Uttar Pradesh, Bihar, and Madhya Pradesh between 2000 and 2002. Chemin assumes no prior amendments to Uttaranchal, Jharkhand and Chattisgarh between 1908 and 2002 and makes no adjustment to their total impact scores. But since Uttaranchal, Jharkhand and Chattisgarh were old parts of Uttar Pradesh, Bihar and Madhya Pradesh, I assign scores of Uttar Pradesh, Bihar and Madhya Pradesh to Uttaranchal, Jharkhand and Chattisgarh respectively, reflecting the improvement in the judicial speed of the courts in these States.

[16]Chemin(2012) gives a detailed example of a how he gets a score of 34 for Uttar Pradesh, taking into account all previous related amendments implemented in the state, see his Table A1 on page 484.

[17]NSSO stands for National Sample Survey Office. It falls under the Ministry of Statistics and program implementation. NSSO conducts socioeconomic surveys on various subjects such as employment, consumer expenditure, health, unemployment and medical services etc.

exercise.[18] [19] I use multinomial logit regressions of the following form for my analysis:

$$Ln\frac{p_{Jist}}{p_{Wist}} = \alpha_{J0} + \alpha_{Js} + \lambda_J \cdot 2005_t + \beta_J \cdot 2005_t \cdot 2002AmendmentAct_s + \gamma_J \cdot edu_{ist}$$

$$+\eta_J \cdot 2005_t \cdot 2002AmendmentAct_s \cdot edu_{ist} + \mathbf{x}_{ist} \cdot \delta'_J + \epsilon_{ist} \tag{1}$$

In equation (1), the subscript J refers to formal firm owner (or informal firm owner), W to worker, i corresponds to the individual, s to the State, t to time. p_{Jist} is an individual's probability of choosing to be a formal firm owner (if J=Formal Firm owner) or an informal firm owner (if J= Informal Firm Owner) at time t. p_{Wist} is an individual's probability of choosing to be a worker at time t. The dependent variable $Ln\frac{p_{Jist}}{p_{Wist}}$ is the log odds-ratio of the probability of an individual i choosing to be a formal firm owner (if J=formal firm owner) or an informal firm owner (if J= informal firm Owner) rather than a worker at time t. The term α_{J0} is the constant term for the regression, and α_{Js} controls for constant state unobserved heterogeneity (state fixed effects). The dummy variable 2005_t ($2005_t = 1$ if t = 2005 and $2005_t = 0$ if t = 2000) controls for the common time trend across states. The value of the variable $2002AmendmentAct_s$ is equal to the total impact score of the 2002 Amendment Act as calculated in Section 2.2. The coefficient β_J of the interaction of variables 2005_t and $2002AmendmentAct_s$ captures the causal impact of a unit improvement in judicial speed on the log odds-ratio of choosing formal firm ownership over worker (or informal firm ownership over worker). The variable edu_{ist} is a categorical variable with a value between 0 and 5, a higher value reflecting a higher level of education of an individual. The coefficient η_J of the interaction of variables 2005_t , $2002AmendmentAct_s$, and edu_{ist} captures whether better judicial enforcement makes individuals with a higher level of education choose formal firm ownership over worker (or informal firm ownership over worker). The variable $\mathbf{x}_{ist}$ denotes a vector of other individual specific controls such as age, gender, religion, marital status, social group etc.

2.4 Data

The NSS employment and unemployment surveys were the primary source of data on various indicators of labour force at National and State levels in India until 2012. These surveys were con-

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[18]The act was implemented specifically on July 1, 2002

[19]The 55th and 61st rounds of the survey were specifically conducted over the period July 1999-June 2000 (55th round) and July 2004-June 2005 (61st round).

ducted once every five yrs(roughly).[20] They contain information on the economic activity status of individuals, their household and demographic characteristics, particulars of the enterprises workers are employed in, etc. I use the 55th(July 1999-June 2000) and 61st round (July 2004-June 2005) of surveys for my analysis. These survey datasets are repeated cross-sections and not panel surveys; i.e: not the same set of individuals are interviewed in each round. [21]

The surveys contain detailed information on the occupation of the individual, the key variable of our interest for measuring occupational outcomes is the "Activity Status". The categories in "Activity Status" "employed", "unemployed" and "not being in the labour force" are further subdivided into detailed activity categories such as "own-account type", "employer", "helper", "regular worker", "casual worker", "not working but seeking or available for work(unemployed)", and "not working and also not available for work (not in labor force)". My structural model has three occupational types—formal firm owner, informal firm owner and worker, there are no unemployed or non-working population in the model. I assign "employers" persons who operate their own enterprises or with one or a few partners and who by and large run their enterprise by hiring labour—to the formal firm owner category. I assign "own-account type"—persons who operate their own enterprises or with one or a few partners and who by and large run their enterprise without hiring labor—to the informal firm owner category. I create a combined category of casual and regular workers [22]. I consider both the separated and combined category of workers for my regression analysis. I drop the "helper" (individuals assisting family members in running the household enterprise, but not receiving any wages in return), "unemployed" and "not in labor force" activity categories. I create a dummy variable capturing the occupational choice —taking value 1 for informal firm owner, 2 for formal firm owner and 3 for worker, respectively. This dummy variable is used as the dependant variable in the regression exercises.

In the model, individuals are heterogeneous on entrepreneurial ability, assets and availability of labor opportunity. The literature on entrepreneurship identifies various components to entrepreneurial ability including cognitive and non-cognitive traits (eg., Levine and Rubinstein (2017)). Cognitive skills include aptitude and trainability, things like arithmetic reasoning, world

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[20]The NSS employment and unemployment surveys have now been replaced by NSS Periodic Labor Force Surveys, planned to be conducted annually since 2018-2019.

[21]The only limitation for not having panel data is that individual fixed effects cannot be controlled for in a difference-in-differences exercise. This does not matter as much, as the identification strategy requires controlling for state fixed effects at the minimum, and this condition is fulfilled as data on individuals in the same states are available in every survey.

[22]Regular workers are persons working in others enterprises and receiving wages on a regular basis (and not on the basis of a daily or periodic renewal of work contract). Casual workers are persons casually engaged in others enterprises and receiving wages according to the terms of the daily or periodic work contract.

knowledge, paragraph comprehension, and numerical operations. Non-cognitive skills relevant to entrepreneurship include inter-personal communication, risk-taking ability, self-esteem, internal locus of control, engagement in illicit activities etc. In terms of measures of entrepreneurial skills, the NSS Employment-Unemployment dataset only contains a measure of general education (levels include not literate, literate without formal schooling, less than primary, primary, middle, secondary, higher secondary, graduate and above). General education would be only a partial measure of entrepreneurial skills, but since it is the only measure available, I test it nevertheless. I create a categorical variable of education in the range 0-5, a higher value reflecting a higher level of education. The dataset contains no measures of individual assets, and there are no variables to directly identify the availability of labor opportunity. [23] Other individual-specific variables I use from the dataset include age, sex, marital status, religion and social group. [24]

2.5 Results

2.5.1 Summary Statistics

Table 1 summarises the outcome and independent variables in both pre-year 2000 and post-year 2005 by low and high policy dose categories. The low policy dose category comprises of individuals belonging to a State which got a impact score between 34 and 37 with the 2002 Amendment Act, the high-policy dose category comprises of individuals belonging to a State which got a impact score between 38 and 40. Clearly, formal firm owners are on average 2 percent, informal firm owners roughly 40-45 percent, and workers roughly 50-60 percent of the working population in India[25]. In the pre-policy period 2000, the interaction variable $2005 \cdot 2002 Amendment Act$ is on average zero as the dummy variable $2005_t = 0$. In the post-policy period 2005, this interaction variable takes a value between 34 and 40 based on the impact score of the state to which the individual belongs. Education is a categorical variable on a scale of 0-5 (0 = not literate, 1 = upto primary , 2 = middle, 3 = secondary, 4 = higher secondary, 5 = graduate and above). On average, people seem to have finished up to middle school, and there is a huge variation in the education levels. Sex is a categorical variable which takes a value 0 or 1 (0 is for females and 1 is for males). Female representation in the workforce is on the lower side, less than 25 percent.[26]

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[23]The dataset contains information on land ownership, but it may not be truly reflective of individual wealth. Since a large population of individuals in developing countries are involved in agriculture, land owned may be reflective of agricultural land owned and not the true wealth of an individual.

[24]Social group includes classifications such as scheduled tribe, scheduled caste, other backward class, and others.

[25]In the data, workers are roughly equally distributed in the regular and casual categories.

[26]The percentage of females in the working population shown here is slightly on the lower side, considering I am dropping the "helper" category, which is another 12 percent of the working population demonstrated here and women

Table 1: Summary Statistics

Year	2000		2005	
	High Dose (38-40)	Low Dose (34-37)	High Dose (38-40)	Low Dose (34-37)
Formal Firm Owner	0.0187 (0.135)	0.0121 (0.109)	0.0228 (0.149)	0.0164 (0.127)
Informal Firm Owner	0.398 (0.490)	0.430 (0.495)	0.443 (0.497)	0.478 (0.500)
Workers	0.583 (0.493)	0.558 (0.497)	0.535 (0.499)	0.506 (0.500)
$2005 \cdot 2002 AmendmentAct$	0 (0)	0 (0)	38.022 (0.208)	35.834 (1.083)
Education	1.652 (1.435)	1.693 (1.477)	1.977 (1.552)	2.052 (1.584)
Sex	0.772 (0.420)	0.835 (0.371)	0.759 (0.427)	0.831 (0.374)

Note : Standard deviation in parentheses

2.5.2 Regression Results

Table 2 summarizes the results of impact of judicial speed on probabilities of choosing particular occupations—formal firm owner, informal firm owner and worker.

The regressions in table 2 control for state and time fixed effects. Columns (1) and (2) look at the impact of judicial speed on probability of owning a formal firm. The negative coefficient on the interaction variable $2005 \cdot 2002 AmendmentAct$ in columns (1) and (2) reflect a fall in the probability of owning a formal firm with an increase in judicial speed for an average individual in a particular state. The positive coefficient on the interaction variable $2005 \cdot 2002 AmendmentAct \cdot edu$ in Column (2) reflects that improved judicial speed improves an individual's probability to own a formal firm if he is more educated. Columns (3) and (4) show that the probability of becoming an informal firm owner decreases with improved judicial speed, although the coefficients are insignificant. The negative coefficient on the interaction variable $2005 \cdot 2002 AmendmentAct \cdot edu$ in Column (4) reflects that improved judicial speed decreases an individual's probability to own an informal firm if he is more educated. Columns (5) and (6) consider the impact of judicial speed on the probability of being a worker. The positive coefficient on the interaction variable $2005 \cdot 2002 AmendmentAct$ in columns (5) and (6) reflects a rise in the probability of being a worker with improved judicial speed.

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are roughly 55 percent of this category.

Table 2: Impact of Judicial Speed on Occupation type - Multinomial Logit Regressions

	Formal Firm Owner (Employer)		Informal Firm Owner (Own-Account type)		Worker	
	(1)	(2)	(3)	(4)	(5)	(6)
$2005 \cdot 2002 A Act$	-0.0014***	-0.0014***	-0.0018	-0.0011	0.0032**	0.0026**
	(0.0004)	(0.0004)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
Edu	0.0021***	0.0011***	-0.0331***	-0.0244***	0.0310***	0.0233***
	(0.0001)	(0.0002)	(0.0006)	(0.0008)	(0.0006)	(0.0008)
$2005 \cdot 2002 A Act \cdot Edu$		0.0001***		-0.0004***		0.0003***
		(0.0000)		(0.0000)		(0.0000)
Time, State FE	Yes	Yes	Yes	Yes	Yes	Yes
Indiv Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	286165	286165	286165	286165	286165	286165
Pseudo R^2	0.0804	0.0809	0.0804	0.0809	0.0804	0.0809

Values in the table indicate the affect on probabilities of choosing particular occupations

Standard errors are in parentheses

* $p < .1$, ** $p < .05$, *** $p < .01$

3 The Model

This section describes the structure of the model and explanations of its mechanisms.

Each Indian state is considered as a separate model economy. A model economy has measure N of infinitely lived individuals. Each period, every individual consumes and saves, and earns an income by either running a firm or working for a firm owner. The firms in the economy are classified into two categories—formal and informal firms. The economy has a consumption goods market, a labor market, and a capital rental market. The consumption goods are the numeraire; they are produced by both types of firms and consumed by all individuals in the economy. Firm owners demand capital and labor, workers supply labor, and individual assets(savings) contribute to the supply of capital. Individuals work or produce in their own states, and labor and capital markets clear within the economy (states).

Each period, individuals get a draw of vector $\mathbf{z} = \{z, \ell\}$ where z is their entrepreneurial productivity, ℓ is the availability of labor market opportunity. z follows an AR(1) process with persistence ρ and variance of error term σ.[27] The availability of labor opportunity $\ell \in \{0, 1\}$ —with probability χ, $\ell = 1$ and the individual can find a job as a wage worker; with probability $1 - \chi$, $\ell = 0$ and the individual cannot find wage work. Individuals choose assets and make occupational choices each period so that they maximize their sum of expected utility over the infinite horizon. Apart from these individuals, there are competitive financial intermediaries, such as banks, who receive deposits and rent capital to entrepreneurs.

I discuss details of the model design in Subsections 3.1 and 3.2. Subsection 3.3 discusses the model mechanisms.

3.1 Individual's Optimization Problem

3.1.1 Preferences and Technology

Individuals choose a sequence of consumption c_t in order to maximise the expected utility function over the infinite horizon:[28]

$$U(c) = E \sum_{t=0}^{\infty} \beta^t u(c_t))$$

(2)

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[27]The assumption of z following an AR(1) process is made so that the firm size distributions generated have fat tails, as is the case of Indian states.

[28]The t in the subscript refers to time

$$u(c_t) = \frac{1}{1-\gamma}(c_t^{1-\gamma} - 1) \tag{3}$$

where β is the discount factor, γ is the coefficient of relative risk aversion.

Individuals earn an income each period through their choice of occupations. If $\ell = 1$, the individual's occupational choice set is $\{W, F\}$, where W = Worker and F = Firm Owner. If $\ell = 0$, the individual's occupational choice set is $\{F\}$.

A description of these occupational choices is the following:

1. Worker (W): Individual provides one unit of labor and earns fixed wage w. An individual may choose to work if he can find a job opportunity, which is possible only if he gets $\ell = 1$.[29]

2. Firm owner (F) : Individual sets up a firm, hires capital and labor, earns a profit.

I make a further distinction between 2 types of firm owners:

i) Formal firm owner: A firm owner earning a profit greater than the ongoing wage rate w.

ii) Informal firm owner: A firm owner earning a profit less than the ongoing wage rate w.

Individuals who decide to set up a firm rent capital k, hire labor l in that period. Production function of a firm owner with entrepreneurial productivity z is given by:

$$f(k, l, z) = zk^\alpha l^\theta \tag{4}$$

where α and θ are the elasticities of output with respect to capital and labor, respectively. $\alpha + \theta < 1$, which means there are diminishing returns to scale in capital and labor.

The rental price of capital is R, wage rate is w.

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[29] All individuals are assumed to have the same productivity as a worker.

Profit of a firm owner is given by:

$$\pi(k, l, R, w, r) = zk^{\alpha}l^{\theta} - Rk - wl \tag{5}$$

3.1.2 Financial Intermediaries and Imperfect enforcement of Credit Contracts

There are competitive financial intermediaries, such as banks, who receive deposits from individuals and pay on them an interest rate r, rent capital k at rate R. Individuals are assumed to not have negative assets in a period, i.e: a $\geq$ 0 and capital rental is within a period. Financial intermediaries are assumed to earn no profits. If δ is the rate of depreciation, as banks earn zero profits, the following condition holds:

$$R = r + \delta \tag{6}$$

That is, if banks pay interest rate r on deposits, the rental rate only compensates for depreciation on top of the interest rate —on net, banks earn no profits.

Parameter ϕ captures the degree in enforcement of credit contracts. $\phi \in [0, 1]$, a higher ϕ denotes better efficiency in enforcement of credit contracts. If $\phi = 1$ there is perfect enforcement of contracts. If $\phi < 1$, there is imperfect enforcement of contracts, and firm owners may renege on contracts. They can keep a fraction (1-ϕ) of undepreciated capital and revenue net of labor payments if they have the incentive to do so; in that case, the only punishment they face is to loose their assets a, which they have deposited as collateral with the financial intermediaries. Even if the firm owners renege, it is assumed that they suffer no consequences in future periods and they regain access to credit markets even if they default.

To ensure that the firm owners do not have an incentive to renege on their contracts and that they abide by their contracts, financial intermediaries set an upper bound to the quantity of capital $\bar{k}(a, z, \phi)$ they rent to them in a period, satisfying the following incentive compatibility condition:

$$\underbrace{\max_{l}\{zk^{\alpha}l^{\theta} - wl\} - Rk + a(1+r)}_{\text{Gain from Not Reneging}} \geq \underbrace{(1 - \phi)[\max_{l}\{zk^{\alpha}l^{\theta} - wl\} + (1 - \delta)k]}_{\text{Gain from Reneging}} \tag{7}$$

This condition states that the amount of capital rented to firm owners by financial intermediaries must ensure that the gain to firm owners from not reneging—which equals the sum of profit and assets recovered (which were deposited as collateral) must be greater than the gain from reneging on contracts—which equals to the sum of $(1-\phi)$ times revenue net of labor payments and undepreciated capital. The constraint on capital $\bar{k}(a, z, \phi)$ is increasing in a, z and ϕ—appendix C.1 presents graphical explanations of these relationships.

3.1.3 Individual's dynamic optimization problem

An individual's optimization problem is to maximize (2); in doing so they choose assets, occupations, capital and labor if they are firm owners—for each period over the infinite horizon. At the beginning of each period, an individual with state variables a, z, and ℓ makes an asset choice a' and an occupational choice o. If $\ell = 0$, an individual can only be a firm owner in the current period, so $o = F$ and the value he gets at this stage is $v^F(a, z, \ell)$—which is the total utility obtained by choosing to set up a firm in the current period. If $\ell = 1$, the value he chooses to get is the higher between being a firm owner or worker, i.e: between $v^F(a, z, \ell)$ and $v^W(a, z, \ell)$, and the corresponding occupational choice in the current period is is either $o = F$ or $o = W$ respectively. Equations (8) - (13) describe the individual's dynamic optimization problem:

$$v(a, z, \ell) = max\{v^W(a, z, \ell), v^F(a, z, \ell)\} \cdot 1\{\ell = 1\} + v^F(a, z, \ell) \cdot 1\{\ell = 0\} \tag{8}$$

$$v^W(a, z, \ell) = \max_{c,a' \geq 0} u(c) + \beta E_{z'\ell'}[v(a', z', \ell')] \tag{9}$$

$$c + a' \leq w + (1 + r)a \tag{10}$$

$$v^F(a, z, \ell) = \max_{c,a',k,l \geq 0} u(c) + \beta E_{z'\ell'}[v(a', z', \ell')] \tag{11}$$

$$c + a' \leq zk^\alpha l^\theta - Rk - wl + (1 + r)a \tag{12}$$

$$k \leq \bar{k}(a, z, \phi) \tag{13}$$

19

The occupational choice problem is static in nature. The choice of occupation in a given period is completely determined by a comparison of income earned in that period between the different occupations. This income is completely independent of the future state variables (wages are fixed and the profit maximization problem has no future state variables), and so is the occupational choice. If $\ell = 1$, an individual would choose to set up a firm in the period if it gives him more profits than w; otherwise he would choose to be a worker. All firm owners will be called formal firm owners in this case. If $\ell = 0$, an individual can set up a firm only. If it gives him more profits than w he is a formal firm owner, otherwise he is an informal firm owner. If individuals set up a firm, they rent capital and hire labor to maximize their profits as defined in equation (5), under the constraint to rental of capital determined by equation (7) [30]

Let k^u and l^u denote a firm owner's unconstrained profit maximizing choices of capital and labor. The choices k^u and l^u will be the optimal choices of capital and labor for the firm owner if $\phi = 1$.

$$k^u, l^u = \operatorname*{argmax}_{k,l} zk^\alpha l^\theta - Rk - wl \tag{14}$$

The choices k^o and l^o denote the firm owner's profit maximizing value of capital and labor under the imperfect credit contract enforceability constraint (7)

$$k^o, l^o = \operatorname*{argmax}_{k \leq \bar{k}(z,a,\phi)} zk^\alpha l^\theta - Rk - wl \tag{15}$$

$$k^o = \min(k^u, \bar{k}(z, a, \phi)) \tag{16}$$

3.2 Stationary Competitive Equilibrium

The stationary competitive equilibrium comprises of the invariant joint distributions of assets, entrepreneurial productivity and labor opportunities $G(a, z, \ell)$, policy functions $a'(a, z, \ell), o(a, z, \ell)$, $l(a, z, \ell), k(a, z, \ell)$, rental limits $\bar{k}(a, z, \phi)$, and prices w, R and r such that:

i) Given w, R and r and $\bar{k}(a, z, \phi)$, policy functions $a'(a, z, \ell), o(a, z, \ell), l(a, z, \ell)$, $k(a, z, \ell)$ solve (8) - (13).

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[30]The profit maximization problem of choosing capital and labor is a static problem. Individuals do not accumulate capital; they only rent capital and hire workers for a given period, they do that every period.

ii) Capital Markets clear:

The demand for capital comes from all firms, and the supply of capital comes from the accumulated wealth of individuals. The capital market clearing condition is:

$$\underbrace{\sum_{\ell=0}^{1} \int k(a,z,\ell)G(a,z,\ell)dadz}_{\text{Demand for Capital}} = \underbrace{\sum_{\ell=0}^{1} \int aG(a,z,\ell)dadz}_{\text{Supply of Capital}} = \frac{K}{\sum N} \qquad (17)$$

iii) Labor Markets clear:

The demand for labor comes from all firms, the supply of labor comes from all the individuals choosing to be workers. The labor market clearing condition is:

$$\underbrace{\sum_{\ell=0}^{1} \int l(a,z,\ell)G(a,z,\ell)dadz}_{\text{Demand for Labor}} = \underbrace{\sum_{\ell=0}^{1} \int_{o(a,z,\ell)=W} G(a,z,\ell)dadz}_{\text{Supply of Labor}} \qquad (18)$$

3.3 Model Mechanisms

The focus of this paper is to evaluate the impact of credit contract enforcement on aggregate outcomes of every Indian state, given the prevailing level of labor frictions there. In doing so, we need to understand the impact of changing parameters ϕ and χ—which determine the degree of credit contract enforcement and the availability of labor opportunities/labor frictions respectively. The general equilibrium solution of the model essentially entails simultaneously solving for the general equilibrium prices w and r and the policy functions k, l, o, a' at these prices. The model outcomes of interest—income per capita, capital per capita, occupational shares, and firm size statistics are aggregates —which are computed using these policy functions and the simulated stationary joint distribution at the general equilibrium prices r and w. Clearly, if we want to understand the impact of changing ϕ and χ on model outcomes, we need to understand the impact of changing ϕ and χ on these policy functions and prices r and w.

In the below subsection, I explain the impact of changing ϕ on model outcomes. I explain the

impact of changing χ on model outcomes in appendix C.2. To simplify the understanding of the model mechanisms, for ϕ, I proceed stepwise—I start with explaining the impact of ϕ on the policy functions given r and w, and then proceed to discussing its impact on general equilibrium prices r and w, and further aggregate outcomes.

3.3.1 Impact of changing ϕ

### 3.3.1.1 Impact of ϕ on policy functions (interest rate and wage fixed)

I begin by explaining how changing ϕ affects policy functions - k, l, o and a' given r and w.

In solving the occupational choice policy functions, the first step is to solve for policy functions k and l. If $\ell = 1$, then for a particular individual with unique a and z, if the potential profits by being a firm owner are less than w (individual chooses to be a worker) then k=0 and l=0; otherwise k and l are the optimal choices of capital and labor given the constraint on renting capital. If $\ell = 0$, setting up a firm is the only option that the individual has, so k, l are always the optimal choices of capital and labor given the constraint on renting capital. For every combination of a and z, k and l are increasing in ϕ, as $\bar{k}$ is increasing in ϕ (see figure 7 in appendix C).

Figure 1 presents the occupational choice policy functions for 4 combinations of ϕ's and ℓ's respectively: (i) $\ell = 1$, $\phi = 1$, (ii) $\ell = 0$, $\phi = 1$, (iii) $\ell = 1$, $\phi = 0.5$, (iv) $\ell = 0$, $\phi = 0.5$ for a given fixed set of w and r. Each of these policy functions is a function from the state variables: assets a (represented on the x-axis), entrepreneurial productivity z (represented on the y-axis), labor opportunity ℓ (columns in figure 1) to the occupation as chosen by the individual. The areas shaded in pink represent the occupational choice of being a worker, the areas in blue represent the choice of being a formal firm owner, and the areas shaded in brown represent choice of being an informal firm owner. An individual with $\ell = 1$ would choose to set up a firm if the profits are greater than w, otherwise he would choose to work. If $\ell = 0$, the individual has no option but to be a firm owner. In this case if profits are greater than w he is a formal firm owner, otherwise he is an informal firm owner.

Diagrams (i) and (ii) in figure 1 represent the case of perfect enforcement of credit contracts (i.e, $\phi = 1$). When $\phi = 1$, there is no upper bound to renting capital, and the profits on setting up a firm are obtained by renting the unconstrained optimal amount of capital and labor (eqn (14)). These profits are independent of the individual's assets a, as the constraint on capital which is dependent on a, is not involved in the profit maximisation problem. Given fixed w and r, in both cases $\ell = 0$ (i) and $\ell = 1$ (ii), the profit and the occupational choice only depend on z, and the

Figure 1: Occupational Choice Policy Functions (interest rate and wage fixed)
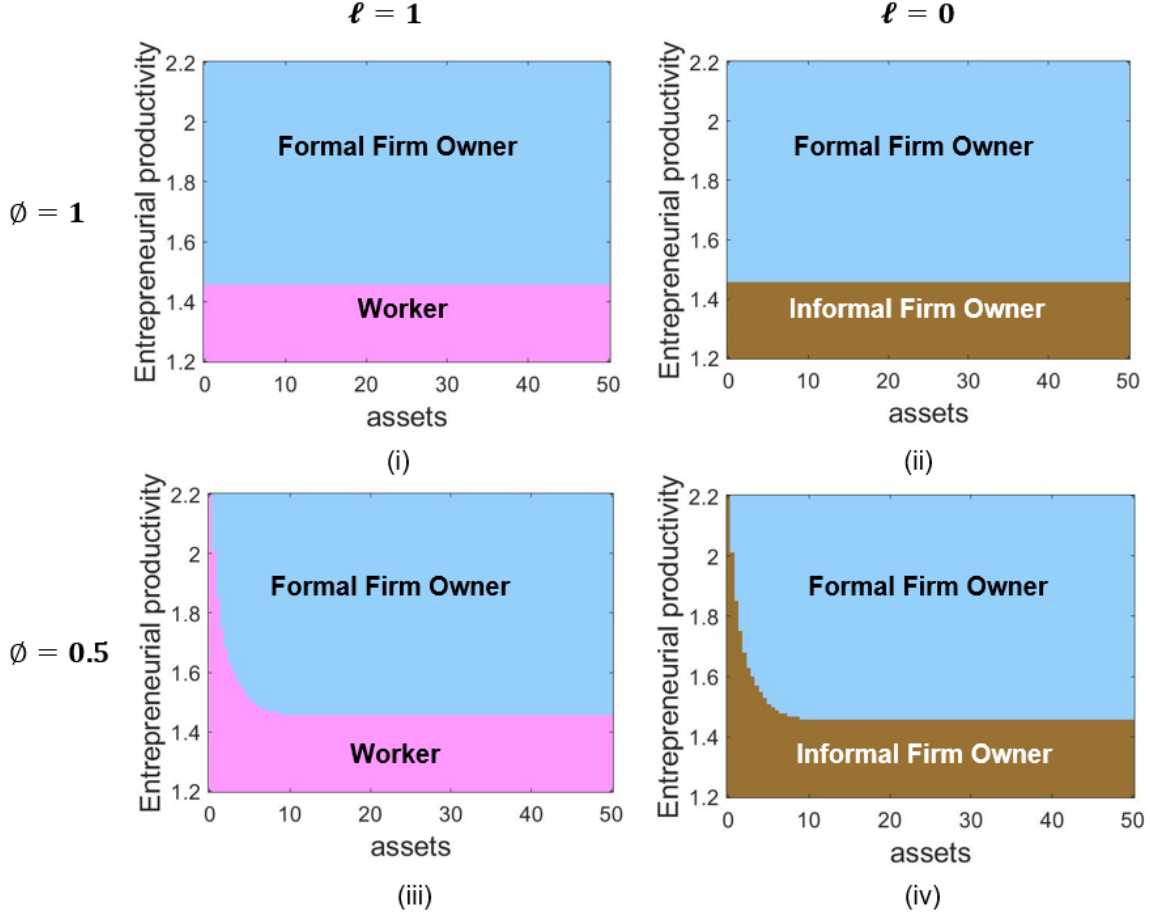
For the above policy functions, r = 0.0067 and w = 1.1958 - these are the general equilibrium interest rates at ϕ =0.50 . χ is set to 0.64 to match the share of workers in the Indian working population. Values of other parameters are given in Table 5.

condition $z(k^u)^\alpha (l^u)^\theta - Rk^u - wl^u$ [31] $> w$ determines the cut-off of z for separating workers from formal firm owners when $\ell = 1$ (or informal firm owners from formal firm owners in case $\ell = 0$). In cases (iii)-(iv), there is imperfect enforcement of contracts and the profits on setting up a firm are obtained by renting the constrained optimal amount of capital and labor (eqs (15)-(16)). In these cases, the profits and hence the occupational choice may be dependent on both a and z as the constrained profit maximization problem contains both a and z. If assets are high, then the constraint on capital from condition (7) may not be binding, the optimal amount of profits will be equal to the unconstrained optimal amount of profits, and there will be a z only cut-off as in cases (i) and (ii) separating workers from formal owners (and informal firm owners from formal firm owners). If assets are low, the constraint on capital becomes binding, and now both a and z

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[31] k^u, l^u can be expressed as a function of z, R, r, w and κ

jointly determine profits as a firm owner and hence the occupational choice. The lower the assets a, the higher the z required to have profits > w and choose to become a formal firm owner. Lower the ϕ, an even higher z is required to compensate for low assets to earn profits more than w and the choice to become a formal firm owner.

Given fixed w and r, on increasing ϕ, the increase in k and l leads to an increase in the incomes of all firm owners (with increase in their profits) and those who would now choose to become firm owners over workers. If people earn more and know that they would also be earning more in subsequent periods, their savings increase, a' increases. Although when ϕ is low, people with low assets but high z will have an incentive to save for self-financing—they may want to accumulate collateral to be able to rent more capital —this effect would push a' to go up with decreasing ϕ for those individuals. The effective direction in which a' moves for an individual with changing ϕ depends on whichever of the two effects dominates.

### 3.3.1.2 Impact of ϕ on general equilibrium r and w

At the stationary equilibrium, prices r and w clear the capital rental and labor markets jointly, wherein aggregate demand for capital equates to its aggregate supply in the capital market, and aggregate demand for labor equates to its aggregate supply in the labor market. Given r and w, the aggregate of all firm owner demands for capital and labor account for the aggregate demand for capital and labor, respectively, at those prices. The aggregate of all individual assets accumulated accounts for the aggregate supply of capital, the aggregate of individuals choosing worker as an occupation accounts for the aggregate supply of labor.

A change in ϕ shifts all aggregate demand and supply curves for capital and labor. The aggregate demand curves for capital and labor shift up with increasing ϕ. Given r and w, on increasing ϕ, individuals can rent more with loosening of the incentive compatibility constraint, can set up bigger sized firms or choose being a firm owner over worker, leading to an upward shift in the aggregate demand curves for capital and labor. The aggregate supply of capital shifts down, with individuals saving more with increased incomes. The aggregate supply of labor on the other hand shifts upward, with more individuals choosing to set up firms over working given r and w, with the greater ability to borrow. With the upward shift in the aggregate demand of capital and labor being much larger than their shifts in supplies, r and w increase overall with increasing ϕ.

3.3.1.3 Impact of ϕ on general equilibrium outcomes

Figure 2 presents the occupational choice policy functions in the general equilibrium case, the constrained and unconstrained formal and informal firms owners areas are additionally separated. Panels (i) and (ii) present individual choices when they get $\ell=1$ and $\ell=0$, respectively, and the economy wide ϕ equals 1, figures (iii) and (iv) present similar choices but for the case $\phi=0.5$. The key distinct observation in these figures with respect to those in Figure 1 is that with increasing ϕ, because of a rise in w, the z cutoff of entry into formal firm ownership increases. In panels (i) and (ii), because of perfect enforcement, there are no constrained or unconstrained firm owners. Panels (iii) and (iv) are cases with imperfect enforcement. Individuals with lower assets are more likely to be constrained on capital. Additionally, higher the z, higher the amount of unconstrained optimal capital, and the higher the likelihood of being capital constrained.

Figure 2: Occupational Choice Policy Functions - General Equilibrium
(includes separation between constrained and unconstrained firm owners)
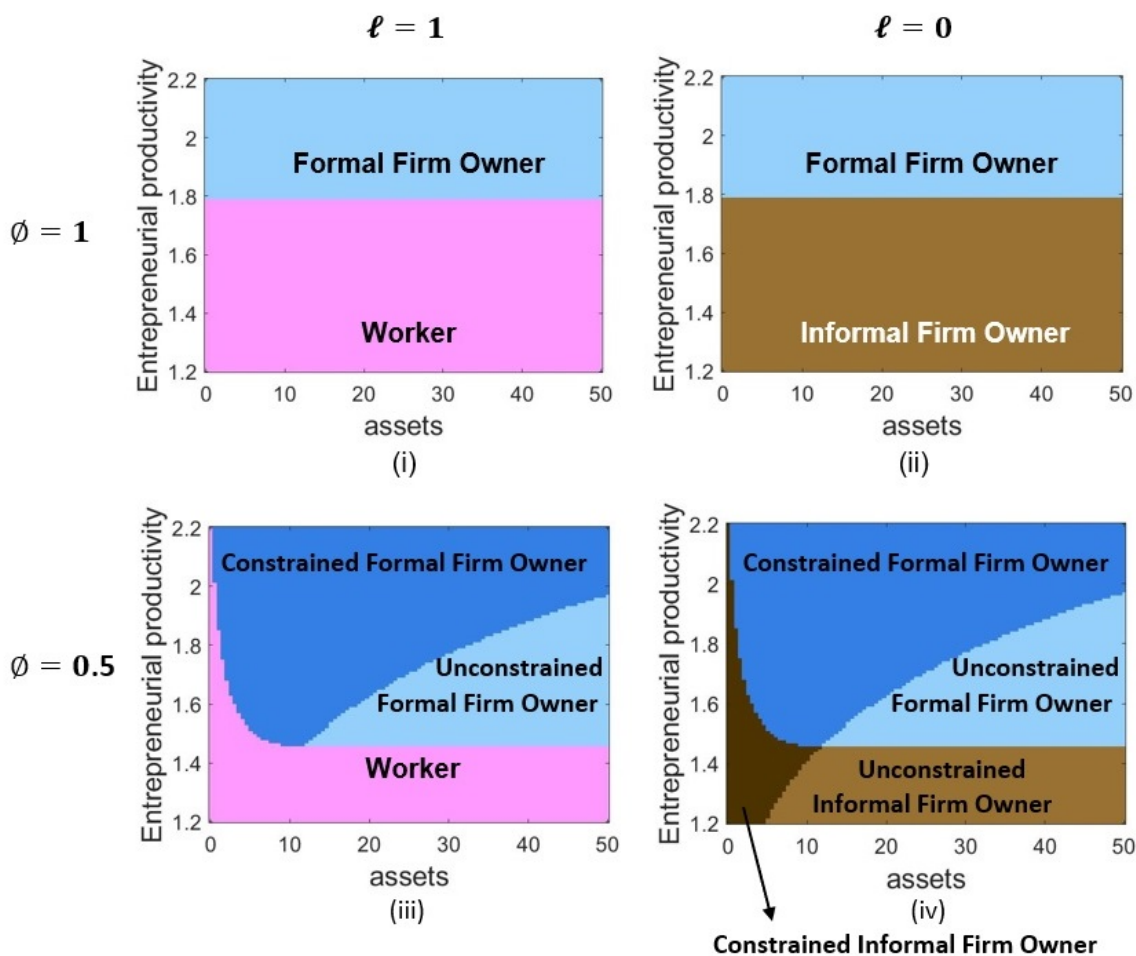
For the above policy functions, χ is set to 0.64 to match the share of workers in the Indian working population. Values of other parameters are given in Table 5.

Table 3 presents the model-generated simulations for different ϕ's. In both capital and labor

markets, the impact of shifts in aggregate demand outweighs the shifts in supply, and so the general equilibrium allocation of aggregate capital and labor in the economy increases with increasing ϕ. In terms of access to credit, the impact of increasing ϕ is heterogeneous. An increase in ϕ loosens the borrowing constraint but leads to an increase in r; these two effects have an opposing impact on the access to credit. Most benefited are talented individuals, especially those with low assets, access to credit improves for them as the first effect is stronger. For low skilled individuals, since their unconstrained optimal amount of capital is already low, the increase in r effect may be stronger, and their credit access may actually fall for them with increasing ϕ. Overall, with changed borrowing abilities and a changed wage rate, there is a reallocation of individuals across occupations in the economy. There is an average trend of percentage formal firm owners falling with increasing ϕ. Only individuals who can earn profits greater than the increased wages (and can pay the increased interest rates and wages) operate as formal firms, and their abilities, profits, scale of operation and output on average is much larger than when ϕ was lower. Talented individuals who were earlier constrained on assets in the informal firm owner/worker categories may now be able to own formal firms because of better borrowing ability. The output of firms remaining in the informal category may increase or decrease, and the output of formal firms with low skill owners may fall because of the high r effect overweighing. Given fixed parameter χ determining availability of jobs, the share of firms and total output of firms in the informal category may increase or decrease with improved enforcement.[32] In total, the output per capita in the economy rises with increasing ϕ, with firms on average operating at higher scales and more productive individuals operating formal firms. The ratio of external finance to GDP increases with increasing ϕ, with greater availability of credit.

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[32]This result will also depend on the other parameters in the model, also on the initial degree of contract enforcement which is improved upon

Table 3: Impact of changing ϕ: General Equilibrium

ϕ_S	0	0.25	0.5	0.75	1
r	0	0	0.006	0.041	0.049
w	0.958	1.048	1.183	1.317	1.317
Y	1.093	1.225	1.453	1.534	1.676
Y(formal)	0.917	1.033	1.219	1.377	1.535
Y(informal)	0.176	0.192	0.234	0.157	0.142
K	1.187	2.469	3.546	3.946	4.434
L/ Worker share	0.565	0.569	0.580	0.579	0.579
Share of Formal Firm owners	0.131	0.125	0.108	0.109	0.109
Share of Informal Firm owners	0.304	0.306	0.312	0.312	0.312
Mean talent of formal firm owners	1.885	1.926	2.030	2.030	2.030
Mean Formal Firm size	3.651	3.953	4.779	4.799	5.326

For the above simulations, $\chi = 0.65$, which matches the average share of wage workers
in the working population of India.
Share of formal firm owners is falling when $0 < \phi < 0.5$, model calibrated ϕ's for most
Indian States fall in this range (See table 6). Other parameters used are given in table 5

4 Quantitative Analysis

In this section, I first present the calibration strategy. The main parameters of interest for ex-
plaining the disparities in income across states are ϕ (degree of credit contract enforcement) and
χ (labor opportunity parameter), which I assume to vary across Indian states, I assume the other
model parameters to be the same for all states. I lay out my strategy for calibrating these state-
specific and national parameters. Then, in the results section, I compare the model predictions for
important outcomes—GDP per capita, occupation shares and size of formal firms —with the data
counterparts. Further, I evaluate the role of ϕ and χ jointly in explaining the disparities in income
per capita across Indian States. Finally, I analyse the relationship between the model calibrated
state credit contract enforcement parameters and the data variables on state-specific judicial speed.

4.1 Calibration Strategy

I assume that all model parameters except ϕ and χ are fixed across all Indian States, and have a
variable ϕ and χ for each State. I refer to the parameters fixed across all States to be national
parameters. There are seven national parameters: two technological parameters α and θ, two pa-
rameters of the AR(1) entrepreneurial productivity process e - ρ and σ, the discount factor β, the
coefficient of relative risk aversion parameter γ and depreciation δ . Among these, α and θ and
β are taken directly from Buera et al. (2011), which they calibrate by matching the key aspects

of the perfect-credit enforcement model to that of the US economy. ρ and σ is set to 0.9 and 0.2 respectively. The values of β,γ, and δ are taken from the literature. Table 5 lists the value of the national parameters.

I use S as a subscript to denote state-specific parameters. The parameter ϕ_S is calibrated by

Table 4: National Parameters

Parameter	Value	Source
α	0.29	Buera et al. (2011)
θ	0.5	Buera et al. (2011)
β	0.92	Buera et al. (2011)
γ	1.5	Standard value in literature
δ	0.06	Standard value in literature
ρ	0.9	
σ	0.2	

matching the model generated external finance[33]/GDP to the state specific sum of credit by scheduled commercial banks and regional rural banks[34]/GDP. The data source for credit by commercial banks and regional rural banks and the GDP of Indian states is the RBI handbook of statistics on Indian states.[35] I use the data for 2017-18. The parameter χ_S is calibrated by matching the model generated share of workers to the share of worker category in the working population of the states. The data source for computing the share of workers in the working population is the Periodic Labor Force Survey of India 2017-18. Table 6 lists the calibrated state specific - ϕ_S and χ_S.

4.2 Results

Table 7 presents the model predictions (based on the calibrated parameters) of outcomes of GDP per capita, the unmatched shares of formal and informal firms, and the average size of formal firms; and then compares them with the data on these variables.

Since the only parameters that are variable at the state level are ϕ and χ, the variation in the model-predicted outcomes of GDP per capita, share of formal and informal firms, and formal firm sizes are only because of the variation in these parameters across states. Simple correlations of model-generated and data outcomes reinforce the conclusions of the model. The model-predicted GDP per capita and the data on GDP per capita across States have a positive correlation of 0.44,

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[33]The aggregate external finance in the economy is given by $\int (k-a).1(k>a)dadz$.

[34]The sum of credit by scheduled commercial banks and regional rural banks is the empirical counterpart for External Finance available for Indian state-level data

[35]Link to RBI Handbook of Statistics on Indian states:
https://m.rbi.org.in/Scripts/AnnualPublications.aspx?head=Handbook+of+Statistics+on+Indian+States

Table 5: Calibrated ϕ_S and χ_S

State	Data Moment (Ext. Finance/ GDP)	Model Moment (Ext. Finance/ GDP)	Data Moment (Share of Workers)	Model Moment (No. of Workers/ Working Pop.)	ϕ_S	χ_S
Andhra Pradesh	0.42	0.42	0.62	0.62	0.20	0.71
Arunachal Pradesh	0.16	0.16	0.45	0.45	0.08	0.50
Assam	0.21	0.21	0.44	0.44	0.10	0.49
Bihar	0.25	0.25	0.45	0.45	0.12	0.50
Chhattisgarh	0.31	0.31	0.53	0.53	0.15	0.61
Delhi	1.5	1.5	0.67	0.67	0.68	0.76
Goa	0.25	0.25	0.70	0.70	0.13	0.82
Gujarat	0.37	0.37	0.55	0.55	0.18	0.63
Haryana	0.34	0.34	0.60	0.60	0.17	0.69
Himachal Pradesh	0.20	0.20	0.45	0.45	0.09	0.50
Jammu & Kashmir	0.33	0.33	0.56	0.56	0.16	0.64
Jharkhand	0.21	0.21	0.51	0.51	0.10	0.58
Karnataka	0.45	0.45	0.61	0.61	0.21	0.71
Kerala	0.43	0.43	0.66	0.66	0.21	0.76
Madhya Pradesh	0.32	0.32	0.53	0.53	0.16	0.61
Maharashtra	1.03	1.03	0.63	0.63	0.43	0.71
Manipur	0.16	0.16	0.40	0.40	0.08	0.44
Meghalaya	0.22	0.22	0.50	0.50	0.11	0.57
Mizoram	0.22	0.22	0.53	0.53	0.11	0.61
Nagaland	0.15	0.15	0.54	0.54	0.07	0.62
Odisha	0.25	0.25	0.48	0.48	0.12	0.53
Punjab	0.48	0.48	0.60	0.60	0.23	0.69
Rajasthan	0.33	0.33	0.48	0.48	0.16	0.53
Sikkim	0.09	0.09	0.50	0.50	0.05	0.57
Tamil Nadu	0.56	0.56	0.71	0.71	0.26	0.83
Telangana	0.62	0.62	0.61	0.61	0.29	0.70
Tripura	0.26	0.26	0.53	0.53	0.13	0.61
Uttar Pradesh	0.30	0.30	0.45	0.45	0.14	0.50
Uttrakhand	0.21	0.21	0.46	0.46	0.10	0.51
West Bengal	0.39	0.39	0.57	0.57	0.19	0.65

emphasising the model result that that the degree of credit contract enforcement and availability of labor opportunities have a strong impact on the GDP per capita of States. In terms of occupational shares, since the percentage of workers is a matched moment, the model and data outcomes are

perfectly correlated. The percentage of formal and informal firm owners are unmatched moments, I find that the model strongly predicts the trend in data of these variables across states. The percentage of informal firms predicted by the model and that in the data have a strong correlation of 0.97. The percentage formal firms predicted by the model and the data have a positive correlation of 0.36.[36] The data and model average firm sizes show a positive correlation of 0.14. The various panels in Figure 3 contain scatter-plots of these data vs model-predicted outcomes.

For computing the joint contribution of the degree of credit contract enforcement and the share of labor opportunities in explaining the disparities in GDP per capita across Indian states, I regress the data GDP per capita on the model-predicted GDP per capita. I get a R squared of 0.1974, indicating that ϕ and χ jointly predict roughly 19.74 percent of the disparities in GDP/income per capita across Indian States.

Finally, I assess the relationship between the model-calibrated ϕ_S and the variables on judicial speed; which are the observable indicators of the degree of credit contract enforcement across Indian states. The data source for these variables is the National Judicial Data Grid (NJDG). I use the variables "average age of disposed cases" in 2018 and "average age of pending cases" of civil suits in the district and session courts in Indian States.[37] [38] Table 8 contains statewise data on these judicial variables. The panels in Figure 4 contain plots of the model-calibrated $\phi'_S s$ vs the age of civil suit cases NJDG variables. For the measurement of judicial speed, I take the reciprocal of these time variables measuring the age of cases. The judicial speed variables - 1/(age of disposed cases) and 1/(age of pending cases) show a positive correlation with the model-calibrated ϕ's of 0.34 and 0.27, respectively. This indicates that the model results are a fair representation of the impact of credit contract enforcement (as measured by the speed of civil courts) on the GDP per capita across Indian states.

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[36]The correlation between the formal firm owners data vs model is not as large in comparison to correlation between the informal firm owners data vs model because the formal firm owners data shares are very small, and model matches worker shares only upto two decimal places—this may cause a discrepancy.

[37]I took the data on the average age of pending cases as on Aug 18, 2019

[38]The district an session courts in India account for 87.54 percent of pending cases in India, and the speed of these courts is a reasonable indicator of the speed of the judicial system in a state.

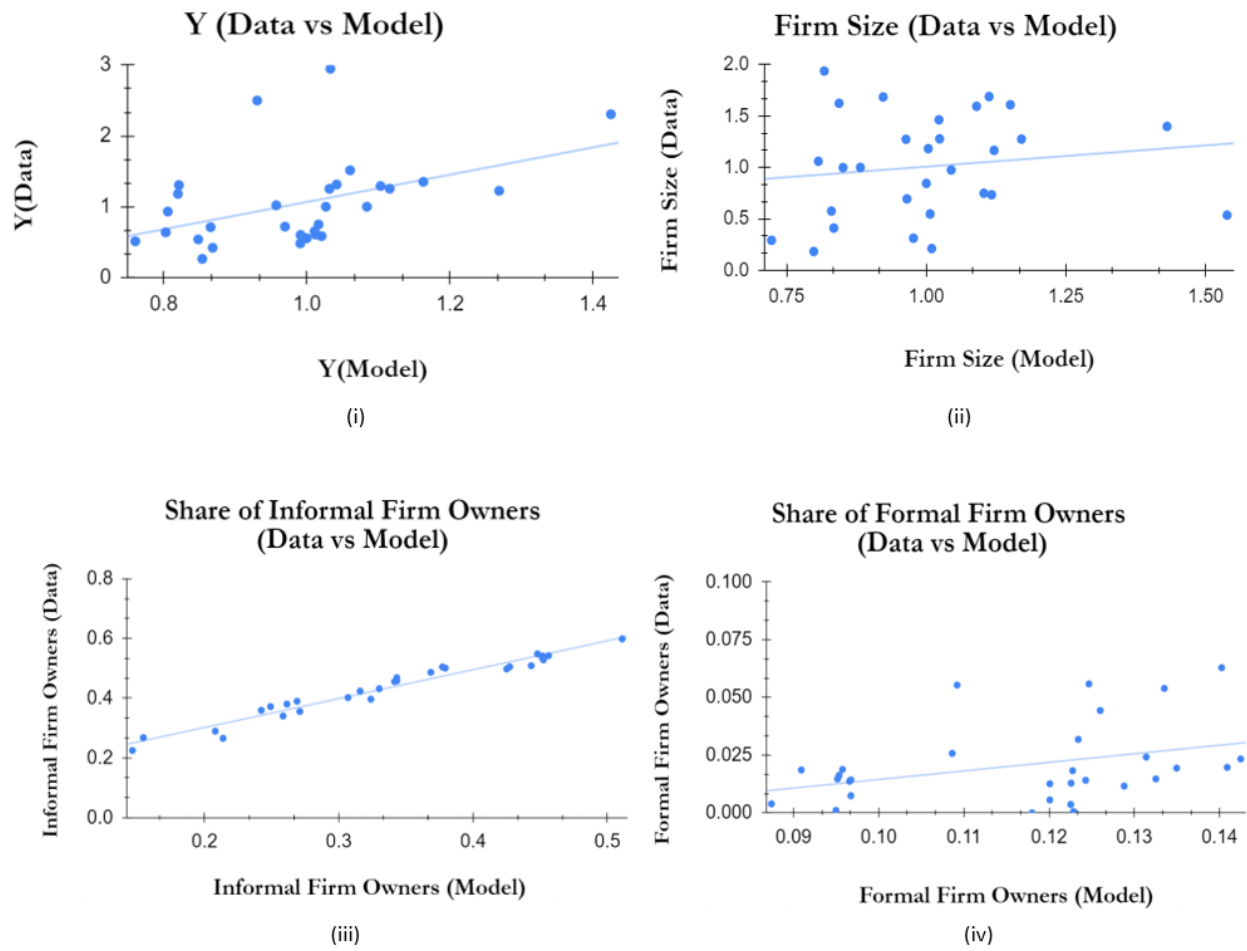Figure 3: Data vs. Model-Predicted Outcomes

(i)

(ii)

(iii)

(iv)

Table 6: Data vs. Model-Predicted Outcomes

State	Y_{Model}*	Y_{Data}*	Informal Firm Owners Share (Model)	Informal Firm Owners Share (Data)	Formal Firm Owners Share (Model)	Formal Firm Owners Share (Data)	Avg. Formal Firm Size* (Model)	Avg. Formal Firm Size* (Data)
Andhra Pradesh	1.08	1.00	0.242	0.359	0.134	0.019	1.16	0.73
Arunachal Pradesh	0.81	0.93	0.448	0.548	0.095	0.001	0.80	0.18
Assam	0.85	0.53	0.456	0.542	0.097	0.014	0.83	0.58
Bihar	0.85	0.26	0.452	0.534	0.097	0.014	0.83	0.41
Chhattisgarh	1.01	0.61	0.67	0.457	0.122	0.013	1.00	0.55
Delhi	1.42	2.31	0.214	0.265	0.109	0.055	1.54	0.53
Goa	1.03	2.95	0.154	0.267	0.142	0.023	1.12	1.16
Gujarat	1.03	1.25	0.323	0.396	0.125	0.056	1.02	1.46
Haryana	1.06	1.51	0.269	0.390	0.132	0.015	1.09	1.59
Himachal Pradesh	0.82	1.18	0.452	0.528	0.095	0.015	0.80	1.06
Jammu & Kashmir	0.99	0.60	0.316	0.423	0.123	0.015	1.00	0.84
Jharkhand	0.99	0.48	0.368	0.486	0.123	0.004	0.96	1.27
Karnataka	1.16	1.35	0.249	0.371	0.140	0.019	1.15	1.61
Kerala	1.04	1.31	0.208	0.289	0.134	0.053	1.10	0.75
Madhya Pradesh	1.02	0.58	0.34	0.456	0.12	0.014	1.00	1.18
Maharashtra	1.27	1.23	0.256	0.34	0.106	0.025	1.43	1.39
Manipur	0.76	0.51	0.371	0.598	0.123	0.004	0.72	0.29
Meghalaya	1.00	0.55	0.377	0.504	0.122	0.001	0.96	0.69
Mizoram	0.95	1.02	0.343	0.468	0.129	0.006	0.96	N.A.
Nagaland	1.02	0.75	0.330	0.431	0.131	0.024	1.01	0.21
Odisha	0.80	0.64	0.427	0.504	0.091	0.019	0.84	1.62
Punjab	1.02	1.00	0.271	0.355	0.126	0.044	1.04	0.97
Rajasthan	0.86	0.71	0.425	0.497	0.096	0.019	0.88	1.00
Sikkim	0.93	2.50	0.379	0.500	0.118	0.000	0.92	1.68
Tamil Nadu	1.12	1.25	0.146	0.225	0.140	0.062	1.17	1.27
Telangana	1.10	1.29	0.266	0.38	0.128	0.011	1.11	1.68
Tripura	0.97	0.72	0.343	0.457	0.120	0.012	0.97	0.31
Uttar Pradesh	0.87	0.42	0.451	0.541	0.097	0.007	0.85	0.99
Uttrakhand	0.821	1.31	0.443	0.508	0.095	0.016	0.81	1.93
West Bengal	1.01	0.66	0.306	0.401	0.123	0.032	1.02	1.27

Notes: *Re-scaled values, median State value set to 1

Table 7: Calibrated ϕ_S vs State-level data on Judicial Speed

State	ϕ_S	Avg. Age of Disposed Cases (in yrs.)	Avg. Age of Pending Cases (in yrs.)
Andhra Pradesh	0.20	2.72	2.25
Arunachal Pradesh	0.08	N.A.	N.A.
Assam	0.10	3.85	2.56
Bihar	0.12	7.17	5.46
Chhattisgarh	0.15	3.35	2.05
Delhi	0.68	2.18	1.50
Goa	0.13	7.66	5.25
Gujarat	0.18	4.60	4.65
Haryana	0.17	2.10	1.25
Himachal Pradesh	0.09	3.05	1.74
Jammu & Kashmir	0.16	2.70	2.13
Jharkhand	0.10	6.41	4.56
Karnataka	0.21	3.60	3.17
Kerala	0.21	2.50	2.05
Madhya Pradesh	0.16	3.05	2.46
Maharashtra	0.43	4.36	4.02
Manipur	0.08	2.35	2.62
Meghalaya	0.11	5.29	4.96
Mizoram	0.11	N.A.	N.A.
Nagaland	0.07	N.A.	N.A.
Odisha	0.12	4.99	4.39
Punjab	0.23	2.33	1.41
Rajasthan	0.16	5.33	3.98
Sikkim	0.05	N.A.	N.A.
Tamil Nadu	0.26	3.25	2.86
Telangana	0.29	3.28	2.70
Tripura	0.13	2.93	1.52
Uttar Pradesh	0.14	5.28	3.61
Uttrakhand	0.10	3.48	2.83
West Bengal	0.19	5.51	5.23

Figure 4: Model ϕ_s vs judicial speed variables
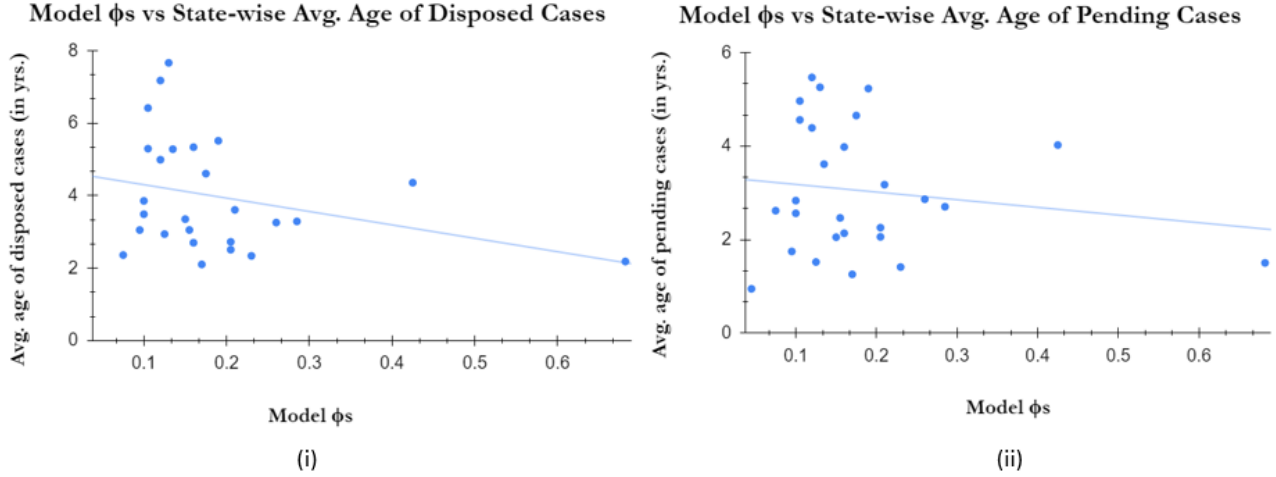
5 Conclusion

In this paper, I make an empirical contribution and a theoretical contribution to study the role of credit contract enforcement in explaining per capita income disparities—by studying its impact on the efficient allocation of resources in an economy with formal and informal firms.

First, I empirically estimate the impact of credit contract enforcement on the occupational choices of the working population of India. The identification strategy used involves the use of difference in differences—I exploit the cross-state variation in implementation of the Civil Procedure Code Amendment Act of 2002 in India. The regression results indicate that the share of formal firm owners falls with improved improved credit contract enforcement, although the average education levels of individuals choosing formal firm ownership increases. The share of workers increases with improved enforcement. The impact on the share of informal firm owners is insignificant, although the average education levels of individuals choosing informal firm ownership falls with improved credit contract enforcement.

Then, I develop a dynamic heterogeneous agents three-occupation type general equilibrium model to quantitatively evaluate the role of enforcement of credit contracts in explaining the per capita income disparities across Indian states. Key features of the model include an endogenous borrowing constraint based on enforcement of credit contracts, and the presence of both formal and informal firms; informal firms are introduced in the model with the help of an individual-specific labor market opportunity shock every period. Individuals make asset, optimal capital and labor, and occupational choices every period; there are three occupational types: formal firm owner, informal firm owner, and worker. The model predicts an improved allocation of resources and

an increased per capita GDP with improved credit contract enforcement. The theoretical model predictions for the impact of degree of enforcement of credit contracts on the likelihood of being in particular occupations align with the results of the empirical analysis for the formal firm owner and worker categories.

In the calibration exercise, the state-specific credit contract enforcement and labor opportunity parameters are calibrated by matching to external finance to GDP ratio and share of workers, respectively, for each state. Model predicted outcomes of per capita GDP, occupational shares, firm sizes, etc., have a strong positive correlation with their data counterparts across Indian states. The results indicate that the degree of enforcement of credit contracts and labor market frictions jointly predict 19.74 percent disparities across Indian states in 2017-18. There is also a strong positive correlation between the model calibrated state degree of enforcement of credit contract parameters and their data proxy - the speed of resolution of civil suit cases by state courts.

APPENDIX A: Additional Figures and Plots

Figure 5: GDP per capita of Indian States

GDP per Capita of Indian States (in Rs. 000's, year 2017-18)
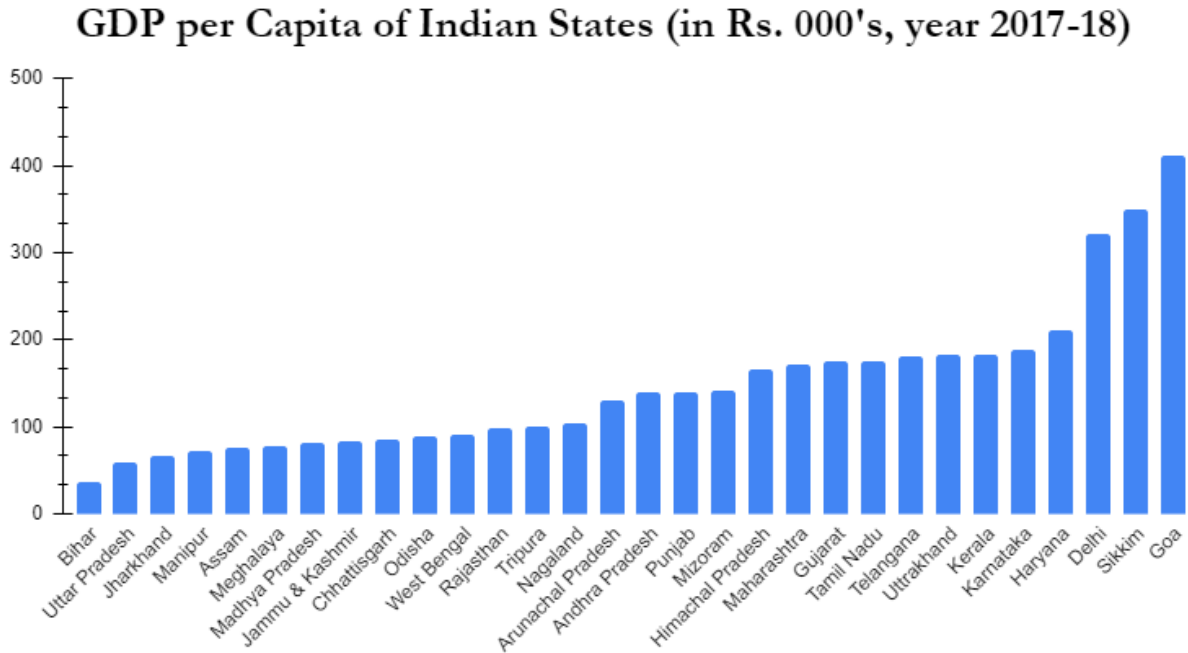
Source: Central Statistics Office, Ministry of Statistics and Programme Implementation, Government of India. Data available is for the financial year April-to-March.

Figure 5 presents a bar plot diagram of per capita GDP of all states in India for 2017-18.

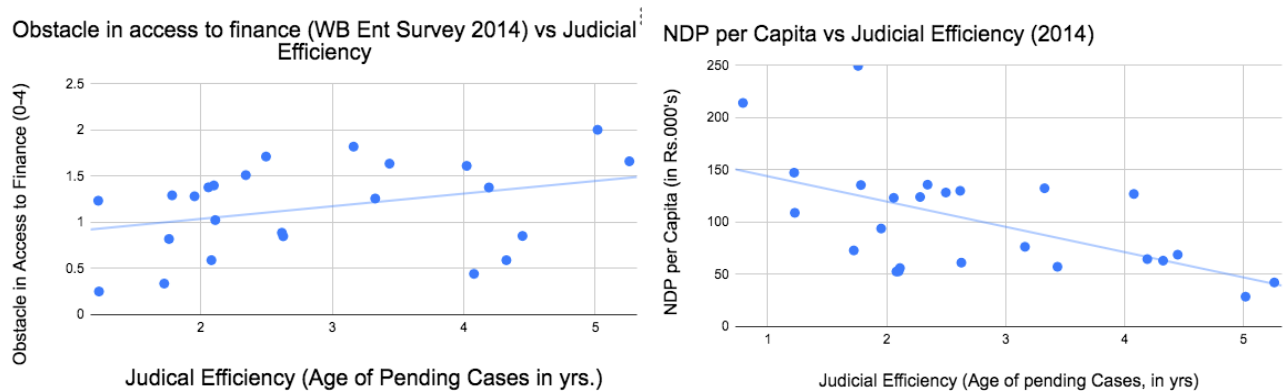Figure 6: Judicial speed vs access to credit and NDP per capita of Indian States

Figure 6 presents two scatter plots—for judicial efficiency vs access to finance, and judicial efficiency vs NDP per capita, respectively, of Indian states in 2014. A higher age of pending cases

reflects poor judicial efficiency. The diagrams indicate a positive correlation of judicial efficiency with both access to finance and per capita GDP.

APPENDIX B: Additional results from Empirical Analysis

Table 8: Impact of Judicial Speed on Occupational type - Linear Probability Model

	Firm Owner				Worker			
	Formal Firm Owner (Employer)		Informal Firm Owner (Own-Account type)		Worker (Regular+Casual)		Regular Worker	Casual Worker
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Act2002	-0.000634*	-0.000503	-0.00219*	-0.00246*	0.00283**	0.00296**	0.000605	0.00236**
	(0.000352)	(0.000350)	(0.00132)	(0.00128)	(0.00133)	(0.00129)	(0.00112)	(0.00111)
Education		0.00248***		-0.0334***		0.0309***	0.0821***	-0.0512***
		(0.000163)		(0.000599)		(0.000602)	(0.000522)	(0.000519)
Time, State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. Cntrls	No	Yes	No	Yes	No	Yes	Yes	Yes
Constant	0.0180***	0.0221	0.351***	0.257*	0.631***	0.721***	0.256**	0.465***
	(0.000925)	(0.0364)	(0.00348)	(0.134)	(0.00351)	(0.134)	(0.116)	(0.116)
Observations	286165	286165	286165	286165	286165	286165	286165	286165
R^2	0.013	0.023	0.053	0.107	0.043	0.105	0.139	0.183

Standard errors in parentheses
Source: auto.dta
* $p < .1$, ** $p < .05$, *** $p < .01$

Table 8 present results of the regression exercise with a Linear Probabilty Model (LPM). Results of the LPM model as regards the impact of credit contract enforcement on occupational choices are consistent with the multinomial-logistic model. The direction of impact on the subcategories of regular and casual workers are consistent with the total worker category.

APPENDIX C: Explanations of important model results

C.1 Capital constraint changing with a, z, and ϕ

I re-write the incentive compatibilty constraint equation (7) and further divide it into 2 parts—a concave part (concave function of k) and straight line part (linear function of k) , as given below:

$$\underbrace{\phi \max_{l}\{zk^\alpha l^\theta - wl\} - (1 + \bar{r})\kappa + a(1+r)}_{\text{Concave part}} - \underbrace{((1-\phi)(1-\delta) + R)k}_{\text{Linear part}} \geq 0 \qquad (19)$$

If both the concave part and the linear part of eqn (19) are plotted as functions of k, the intersection of the 2 functions gives the renting upper bound $\bar{k}(a, z, \phi)$.

In order to explain the impact of change in a, z and ϕ on $\bar{k}$, I consider each case one by one —make shifts in the concave part and the linear part based on changes in these variables, and compare the old and new intersection of the curves. Separate cases for changes in a, z and ϕ are discussed in the following subsections C.1.1 - C.1.3.

C.1.1 Relationship between $\bar{k}$ and a : $\bar{k}$ increases with increase in a

Figure 7: $\bar{k}$ vs a
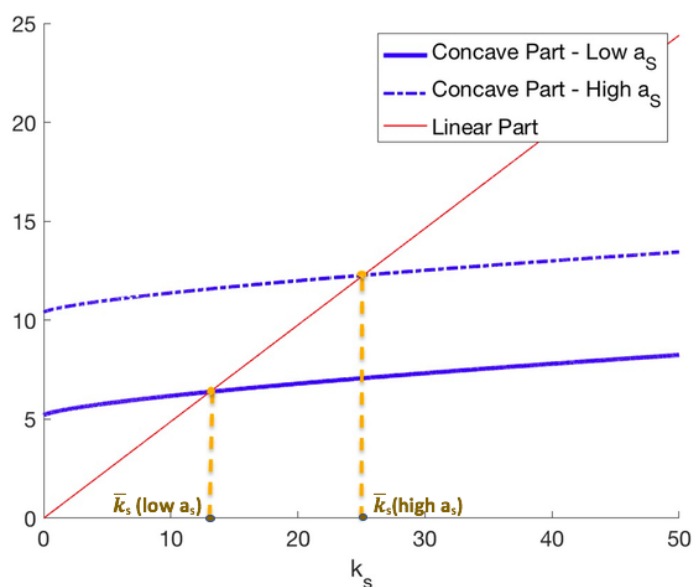
Increasing the amount of assets a increases the amount an individual can give as collateral, shifting the concave part of eqn (19) up. The intersection of the shifted concave part and unchanged linear part is at a higher $\bar{k}$ as shown in Figure 7. Therefore, within an Indian state S, if we consider two individuals with same productivity z_S but different assets a_s, the individual with greater assets has a higher upper limit of renting capital $\bar{k_S}$.

C.1.2 Relationship between $\bar{k}$ and z : $\bar{k}$ increases with increase in z
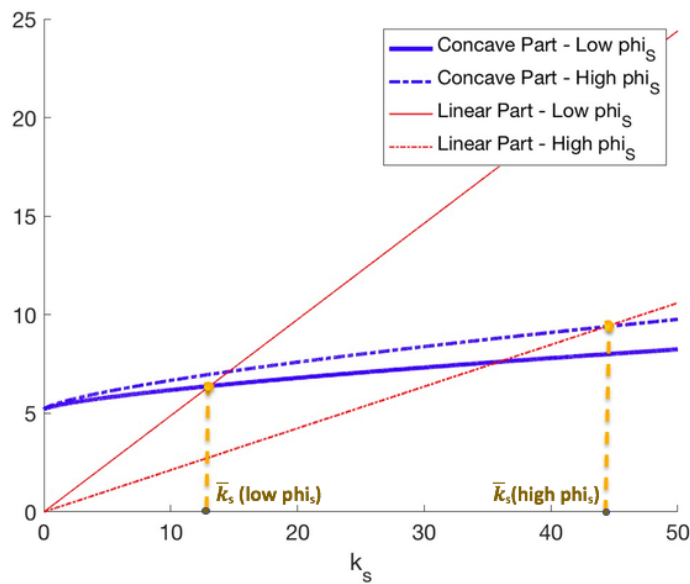
Increasing to a higher level of productivity z shifts the concave part of eqn (19) up. The intersection of the shifted concave part and unchanged linear part is at a higher $\bar{k}$ as shown in figure 8. Therefore, within an Indian State S, if we consider two individuals with same assets a_S but different productivity z_s, the individual with higher productivity has a higher upper limit of renting capital $\bar{k_S}$.

38

Figure 8: $\bar{k}$ vs z
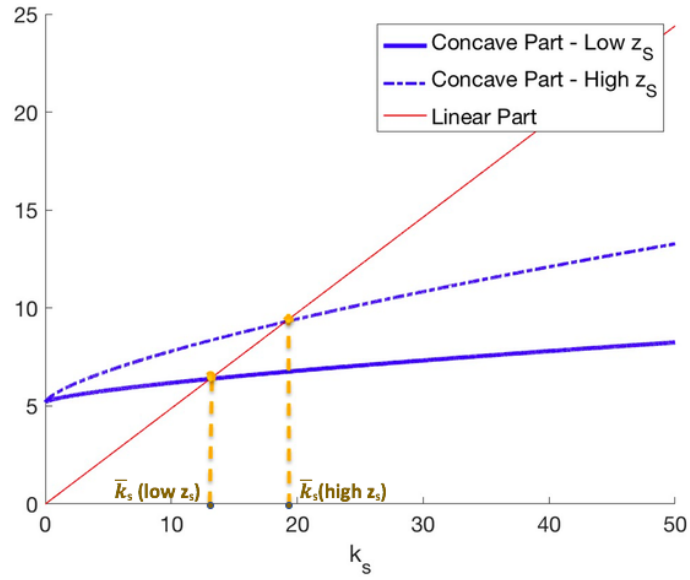
C.1.3 Relationship between $\bar{k}$ and ϕ : $\bar{k}$ increases with increase in ϕ

Figure 9: $\bar{k}$ vs z

Increasing to a higher level of efficiency in enforcement of credit contracts ϕ shifts both the concave part and linear part of eqn (19) up. The intersection of the shifted concave part and linear part is at a higher $\bar{k}$ as shown in figure 9. Therefore, comparing individuals with same a and z in two different states with different ϕ_S, the individual in the state with higher level of efficiency in enforcement of credit contracts ϕ has a higher upper limit of renting capital $\bar{k}$.

C.2 Impact of changing χ on model outcomes

Table 9 presents the model-generated simulations for different $\chi's$. The χ parameter controls the proportion of individuals getting a job, it is the most important determinant of the proportion of individuals between the worker and informal firm owner categories. Given fixed ϕ, an increase in χ increases the aggregate supply of labor as people can find more jobs, leading to decreased wages, an increased proportion of workers, and a decreased share and aggregate output of informal firm owners. The fall in wages increases the aggregate demand for capital (capital and labor are complements in the cobb-douglas production function), leading to an increase in r and aggregate capital with increasing χ. Decreased wages also lead to an increased share of formal firm owners (those who can make more profits than the decreased wages), and an increase in average firm sizes, with formal firms being able to hire more and produce more. The total output per capita of the economy increases with increased χ, as firms are able to produce more in aggregate.

Table 9: Impact of changing χ: General Equilibrium

χ	**0.3**	**0.6**	**0.9**
r	0	0.032	0.067
w	1.643	1.429	1.357
Y	1.428	2.164	2.705
Y(formal)	0.864	1.806	2.635
Y(informal)	0.565	0.358	0.071
K	4.603	5.817	6.538
L supplied/ Worker percentage	0.273	0.535	0.802
Percentage Formal Firm owners	0.090	0.109	0.109
Percentage Informal Firm owners	0.637	0.356	0.089
Mean Formal Firm size	2.288	4.518	6.922

For the above simulations, $\phi = 0.5$. Other parameters used are given in table 5

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