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ABSTRACT

We develop a framework for quantifying barriers to labor force participation (LFP) and entrepreneurship faced by women in developing countries, and apply it to the Indian economy. We find that women face substantial barriers to LFP. The costs for expanding businesses through the hiring of workers are also substantially higher for women entrepreneurs. However, there is one area in which female entrepreneurs have an advantage: the hiring of female workers. We show that this is not driven by the sectoral composition of female employment. Consistent with this pattern, we find even without promoting female LFP, policies that boost female entrepreneurship can significantly increase female LFP. Counterfactual simulations indicate that removing all excess barriers faced by women entrepreneurs would substantially increase the fraction of female-owned firms, female LFP, earnings, and generate substantial gains in aggregate productivity and welfare. These gains are due to higher LFP, higher real wages and profits, and reallocation: low productivity male-owned firms previously sheltered from female competition are replaced by higher productivity female-owned firms previously excluded from the economy.

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1 Introduction

Low female labor force participation coupled with a sustained lack of female entrepreneurs have been a policy concern in many developing countries, especially in South Asia. Figure 1(a) plots the fraction of female-owned firms across 25 sectors using a sample of around 140k firms, surveyed under the Enterprise Surveys (World Bank, 2020), which covers 141 countries across 13 years (2006-2018).[1] The lack of business ownership by women is striking. On average, less than a quarter (22.5% to be exact) of businesses across the world are owned by women, with women's share of ownership ranging from 3-6% in petroleum, leather and wood products to at most 35% in textiles, services and garments. Using the same sample, Figure 1(b) plots the fraction of female workers in male-owned versus female-owned firms, as well as the probability that the top manager in the firm is a woman. While 25% of employees in male-owned firms are women, the share of female employees is 43% in female-owned firms. More strikingly, while only 6.2% of male-owned firms have a woman as their top manager, the probability of a top manager being a woman is over 50% in women-owned firms. These patterns suggest that female entrepreneurship may have important implications for women's employment patterns.

Taking the above observations as a starting point, this paper develops a framework for examining potentially differential barriers to entry and operation faced by female-owned as opposed to male-owned firms in developing countries, as well as their aggregate implications. Earlier work has shown that eliminating distortions in the allocation of talent can result in sizeable productivity and welfare gains in advanced economies[2]. Such gains could be even more important in settings characterized by misallocation of resources, low productivity, and low per capita income levels, as in many developing economies (Hsieh and Klenow, 2009; Restuccia and Rogerson, 2017). While there are many sources of identity-based distortions, gender-based distortions are a common theme in developing countries[3]. With around half of the world's population women, such distortions are

[1] The Enterprise Surveys are firm-level surveys of a representative sample of the economy's private sector. More details on the methodology and data can be found in: https://www.enterprisesurveys.org.

[2] Hsieh, Hurst, Jones, and Klenow (2019) estimate large such gains for the U.S. between 1960 and 2010. Their study focuses on race- and gender-based distortions. Bento (2020) and Morazzoni and Sy (2021) focus on entrepreneursip in the U.S., and estimate large productivity and welfare gains associated with the elimination of gender-specific distortions.

[3] See Jayachandran (2020), Quinn and Woodruff (2019), and Cuberes and Teignier (2014) for reviews.

likely to have important aggregate implications. If it were possible to improve aggregate productivity and welfare in developing countries by allocating the talent available in such economies efficiently, irrespective of gender, then policies promoting gender equality would be more than human rights initiatives, they would be effective development policies.

In the vein of this proposition, this paper aims to identify and analyze a particular type of distortion, namely gender-based distortions that affect female entrepreneurship. The focus of our analysis is India, a country in which female labor participation and entrepreneurship are particularly low (Fletcher, Pande, and Moore, 2019; Deshpande and Kabeer, 2019; Lahoti and Swaminathan, 2016). While total female labor force participation has remained stagnant in India in the past three decades (Fletcher, Pande, and Moore (2019), Figure 1), female entrepreneurship, has shown signs of progress, as we show in this paper. Moreover, female entrepreneurs tend to hire more female than male workers. Therefore, the advancement of female entrepreneurship could offer a way to promote general participation of women in the labor market. We utilize data from two waves of the Economic Census, which–in contrast to the World Enterprise Surveys–are nationally representative, and include the informal sector. The latter feature of the Census offers an important advantage relative to other data sets given that the majority of female-owned businesses are informal. Using this data and a model-based approach, we identify entry and operation frictions faced by female-owned firms and use counterfactual simulations to assess the productivity and welfare implications of various policy interventions.

Our analysis is guided by a stylized model of occupational choice along the lines of Roy (1951) and Banerjee and Newman (1993) that captures some important features of developing economies. The model features an economy with multiple industries and a mass of individuals (men and women), who decide whether to participate in the labor force, and conditional on participation, whether to start a business as entrepreneurs or earn wages as workers. Within each industry, there are two sectors, a formal and an informal sector. Accounting for the informal sector is important, as it commands a large share of economic activity in developing countries.[4] Moreover, women, while under-represented among entrepreneurs, are over-represented in the informal sector (World Bank,

[4]See LaPorta and Shleifer (2014); Ulyssea (2018, 2020); Dix-Carneiro, Goldberg, Meghir, and Ulyssea (2021); Rao, Verschoor, Deshpande, and Dubey (2008).

2012). Firms (entrepreneurs) need to pay an entry cost to operate in either sector and an additional registration cost to formalize.[5] Firms in the informal sector avoid paying the registration cost as well as taxes, but face a size-dependent penalty. This penalty captures both the cost of the actual penalty firms may have to pay if they are caught evading taxes and the implicit cost informal firms face by being denied access to formal finance, for which they have to be registered with a government agency.[6] There is only one input in production: labor. Entrepreneurs choose the sector (i.e., formal versus informal) and industry in which they operate. Conditional on these choices, they make hiring decisions. We assume perfect competition in both product and labor markets.

Gender enters the model in four ways: First, we allow for male and female workers to be imperfect substitutes in the production function and to have different productivities. Second, we allow for men and women to face different costs of participating in the labor force. Third, we allow men and women entrepreneurs to face different costs to start their business, and formalize/register it with the government. Fourth, we assume that there are hiring frictions in the labor market that prevent firms from expanding, and allow these frictions to differ both by the gender of the firm owner and by the gender of the worker, i.e., we allow for women entrepreneurs to face different hiring frictions than men, and we also allow frictions to be different depending on whether the (male or female) entrepreneur hires a man versus a woman. We then use the structure of the model, in conjunction with the rich data of the Census to estimate these frictions, and examine their implications for various aggregate outcomes (such as labor force participation, wages, productivity, income, etc.). This formulation is general and covers many of the factors that the literature has offered as potential explanations for gender inequality (e.g., legal barriers, cultural norms and attitudes, comparative advantage).[7] While we do not measure these factors directly (but model them as "wedges"),[8] our estimated frictions are correlated with various indices of women empowerment across regions

[5]The importance of these fixed entry and registration costs has been emphasized across many contexts. See comprehensive reviews by Jayachandran (2020) and Quinn and Woodruff (2019).

[6]See Beck and Hoseini (2014), Nikaido, Pais, and Sarma (2015), Chaudhuri, Sasidharan, and Raj (2020), Raj and Sasidharan (2020) and Morazzoni and Sy (2021).

[7]For comprehensive surveys of this literature, see Altonji and Blank (1999), Bertrand (2011), Blau, Ferber, and Winkler (2014).

[8]Some of the most important drivers of gender inequality in developing countries, i.e., norms and culture, may be difficult to measure. For the importance of such factors, see the work of Fernández (2013), Fernández and Fogli (2009), Fernández, Fogli, and Olivetti (2004), Deshpande and Kabeer (2019) and Ashraf, Bau, Nunn, and Voena (2020) among others.

in India, such as measures of women vulnerability and empowerment constructed on the basis of comprehensive indicators (such as inputs in household decisions, patriarchal norms, asset ownership patterns, access to education and health, etc.), as well as with gender quotas for women in elections. This increases our confidence that our estimates are meaningful in capturing various underlying barriers and frictions that women face in the labor force.

We have three key findings. First, the excess costs faced by women are substantial. Labor force participation costs are roughly 2.5 times larger for women than for men on average despite a significant decline over time. Similarly, women entrepreneurs face a 10-20 percent higher cost of expanding their business through hiring (both in the informal and formal sectors), as compared to their male counterparts. Second, average numbers mask substantial heterogeneity across regions and industries. For example, the excess labor force participation costs are concentrated geographically in the Northern states of India, consistent with what is reported in Evans (2020). Third, the only area where female entrepreneurs seem to have a significant advantage over their male counterparts is in hiring female workers (particularly in the informal sector). We show that this advantage is not driven by sectoral effects, i.e., it holds even within narrowly defined industries (at the 4-digit National Industry Classification level). This is especially important in a context like India, where female labor force participation is low and women workers are scarce. Put together, our results suggest that while there has been progress over time, women entrepreneurs face substantially larger costs to operate both on the extensive (labor force participation) and intensive (hiring workers) margins.

Given these results, we investigate in a series of counterfactual scenarios the potential gains to the economy of eliminating these barriers. Specifically, we examine the impact of five affirmative action policies that aim to sequentially reduce the various excess costs faced by women entrepreneurs. We label these scenarios "affirmative action" policies because in all industry-regions where women entrepreneurs face higher costs than men, we equalize costs across women and men; however, in cases where women have an advantage over men (i.e., in attracting female workers for example), we do not eliminate this advantage. The first scenario we consider is a policy that eliminates excess fixed costs of entrepreneurship (entry and formalization costs). The second scenario leaves fixed costs unchanged, but eliminates all hiring frictions. The third scenario eliminates both the fixed costs of entrepreneurship and the hiring distortions. The three scenarios above affect the direct costs of entrepreneurship while keeping LFP costs constant. The fourth scenario does the opposite, namely it eliminates the excess LFP costs for women but keeps the direct costs of entrepreneurship constant. Finally, the last scenario considers the elimination of all excess costs (i.e., both entrepreneurship and LFP costs).

The counterfactual simulations lead to several policy-relevant insights. First, conditional on labor force participation, policies that target the intensive margin (hiring barriers) have substantially larger effects than policies that focus on the extensive margin (i.e., fixed costs) of entrepreneurship. Intuitively, eliminating entry and registration excess costs has little effect when barriers to operating and growing a business remain in place. Second, policies promoting female entrepreneurship can have large effects on female LFP, even when LFP is not directly targeted by policy makers. This is not only because more women become entrepreneurs, but also because female entrepreneurs tend to hire more female workers. Third, it is important to target distortions not only on the labor supply, but also on the demand side. Specifically, eliminating frictions to female labor force participation has – as expected – large effects on women's labor force participation. However, without any additional measures to boost demand for female workers, this increase implies a large decline in the real wages of women. In contrast, policies that target both labor supply and demand frictions boost female LFP while increasing real wages and profits of women entrepreneurs. Fourth, the counterfactual scenarios highlight the presence of low-productivity male entrepreneurs, who operate in the economy only because they do not face competition from more productive female-owned firms facing higher entry and operation barriers. Removing these barriers allows the marginal, higher-productivity woman entrepreneur to enter, thus reducing the misallocation of talent and resources in the economy. Lastly, this more efficient reallocation results in substantial gains in aggregate productivity and welfare (as measured by real income). Removing all types of barriers boosts labor force participation in the economy with female LFP more than doubling, raises real wages of both men and women, and raises aggregate productivity by 1.5 percent and welfare (real income) by around 40 percent. These gains are large and suggest that promoting gender equality in entrepreneurship can contribute meaningfully to economic development.

Our paper speaks to a nascent literature focusing on the aggregate implications of eliminating gender-based distortions. While the literature on gender-based disparities is voluminous, studies focusing on the macroeconomic implications of such disparities are relatively scarce. The three studies that are closest in spirit to our work are the U.S.- focused papers by Hsieh, Hurst, Jones, and Klenow (2019) and Bento (2020), and the cross-country analysis of Cuberes and Teignier (2016). However, our model differs from the models used in the aforementioned papers in several respects as it is geared towards capturing key features of developing economies, most importantly the prevalence of informality and its significance for women entrepreneurs.

The rest of the paper is organized as follows. Section 2 outlines the theoretical model. Section 3 discusses the data and provides descriptive evidence on the entrepreneurial landscape of India. Section 4 discusses the quantification of the model. Section 5 discusses the results, and in particular, the nature and extent of the barriers faced by women entrepreneurs. Section 6 examines the impacts of counterfactual affirmative action policies that eliminate these excess barriers. Section 7 concludes.

2 Theory

We present our theoretical framework as follows: Section 2.1, describes the economy setup. Section 2.2 discusses the production decisions and labor demand of incumbent entrepreneurs. Section 2.3 discusses the labor supply and entrepreneurship choices of individuals, and Section 2.4 characterizes the equilibrium in this model.

2.1 Setup

The economy consists of a mass of N_g individuals of a gender g (male and female) and J industries. Each industry j has two sectors (denoted by s), the informal (I) and formal sector (F). Firms in both sectors produce a homogeneous product that is sold in a competitive market at price p. Hence, we do not allow for product differentiation across the formal and informal sectors. The only difference between firms in the formal and informal sectors is in the distortions that they face in hiring workers (discussed below) and their compliance with regulations.

2.2 Entrepreneurs

Each entrepreneur or firm (we use these terms interchangeably throughout the paper) of gender g in industry j and sector s (we will subsequently drop the j and s indices for notational convenience) is indexed by his/her individual productivity $z \sim H(z)$. Labor is the only input in production. Entrepreneurs hire male and female workers to produce output that is sold in a competitive market. We allow for men and women workers to be imperfect substitutes in production with differential productivity across industry-sectors. For example, we allow for the productivity of a female worker (relative to male) to be different in informal agriculture as compared to formal services. A worker of gender $g \in \{m, f\}$ can be hired in a competitive labor market at a wage $\widetilde{w}^g$. The setup is static so that after entry, firms stay active forever.[9]

For notational consistency, we will henceforth use $x_{gsj}^{g'}$ to denote a variable x (e.g., wages, labor, etc.) that refers to an entrepreneur of gender g, in sector s and industry j, and a worker of gender g' (that is, the subscripts in our notation will refer to the gender of entrepreneurs and the superscripts to the gender of workers). Output y of a firm with productivity z is given by:

$$y = zl^{\rho}$$
$$l = \left[\sum_g (A^g)^{\frac{1}{\gamma}} (l^g)^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}}$$

where: $0 < \rho < 1$, A^g is the productivity of a gender g worker, and γ is the elasticity of substitution between male and female workers in production.

The distinction between firms in the formal and informal sectors is that firms in the formal sector have to pay a per-unit sales tax t, while firms in the informal sector do not pay any taxes, but face

[9]In fact, as reported by Hsieh and Klenow (2009), most firms in India are born small, never grow, and never die.

a size-dependant penalty of being informal.[10]

Entrepreneurs in the Informal Sector: The profit maximization problem of a firm in the informal sector of industry j (dropped for notational convenience), owned by an entrepreneur of gender g with productivity z, is given by:

$$\max_{\{l^m, l^f\}} \pi_{gI}(z) = pzl_{gI}^{\rho_I} - \frac{1}{T}\left[w_{gI}^m l_{gI}^m - w_{gI}^f l_{gI}^f\right]$$

where: $\rho_I = \lambda\rho < \rho$ captures a size-based penalty faced by firms operating in the informal sector.[11] This penalty implies that it is less desirable for larger firms to remain informal, which is plausible in the Indian context given that informal firms are more constrained in their access to formal channels of finance (Beck and Hoseini, 2014), and that large informal firms have a higher probability of being detected and penalized for failing to register their business.[12] T is an industry-sector specific technology parameter.

The terms w_{gI}^m and w_{gI}^f denote the *effective* wages facing entrepreneurs in the informal sector. Entrepreneurs, especially women, may face frictions in growing their businesses. We capture these in a reduced form way, as "wedges", i.e., additional costs over and above the nominal wages paid to workers. We assume that an entrepreneur with gender g, may face an additional per-unit cost τ_{gI} for hiring a worker in the informal sector, and a further cost τ_{gI}^f for hiring a female (relative to male) worker. These additional costs serve as a shorthand for many factors that may affect the hiring experience of women, on both sides of the labor market. For example, cultural norms may make it hard for some men to work for women, so that women entrepreneurs may have a harder time

[10] In reality, firms in the formal sector face many regulations in addition to sales taxes. We do not model these regulations in this paper, but use the per-unit sales tax as a shorthand for all measures that effectively reduce the net revenues of formal firms.

[11] An alternative way to model the size-based penalty is as a convex cost (as in Ulyssea (2018), for example). However, without separate data on revenues and costs, these two will be isomorphic in the model.

[12] We later show in Appendix Section C.2 that this size-based penalty can be re-written as a per-unit tax of operating in the informal sector. As we explain in the Data Section, firms with fewer than 10 workers or fewer than 20 workers and no electricity do not have to pay taxes in India. Hence, failing to register is not illegal for such small firms. Nevertheless, such firms face an economic penalty in that they do not have access to formal credit channels. The parameter λ captures both the actual penalty larger firms may have to pay if they are caught evading taxes and the implicit penalty smaller informal firms may face because of financing constraints.

recruiting employees. Conversely, in some environments, cultural norms may inhibit women from working outside the home. But outside work may be considered more acceptable if the employer is a woman, making it easier for female entrepreneurs to recruit female workers. While such "cultural" factors and norms are considered important for employment decisions, they are difficult, if not impossible, to credibly quantify based on existing data. Accordingly, we do not attempt to measure them in this paper, but model them in a reduced form way as distortions that increase the effective cost of labor. We will later correlate our estimates of these wedges with measures of social norms in these regions, such as gender vulnerability and women empowerment indices. It is important to note that since these additional costs will be estimated in the empirical part of the paper, in principle, they could also be zero or negative. While the model structure allows for them, it does not impose them.

The *effective* wages paid by an entrepreneur g in the informal sector are therefore given by $\boldsymbol{w_{gI}} \equiv \{w^m_{gI}, w^f_{gI}\} = (1+\tau_{gI})\{\widetilde{w}^m, (1+\tau^f_{gI})\widetilde{w}^f\}$. The first order conditions imply that demand for male and female workers, optimal firm size, and profits (dropping j for notational convenience) are given by:

$$l^{g'}_{gI}(z) = A^g_I \left(\frac{w^{g'}_{gI}}{w_{gI}}\right)^{-\gamma} \times l_{gI}(z) \tag{1}$$

$$l_{gI}(z) = \left[\rho_I \frac{T}{w_{gI}/p} \times z\right]^{\frac{1}{1-\rho_I}} \tag{2}$$

$$\pi_{gI}(z) = \frac{1-\rho_I}{\rho_I} \times \frac{w_{gI} l_{gI}(z)}{T} \tag{3}$$

$$\text{where: } w_{gI} = \left[\sum_{g'} A^{g'} {w^{g'}_{gI}}^{1-\gamma}\right]^{\frac{1}{1-\gamma}}$$

Mathematical proofs are provided in Appendix C.1.

Entrepreneurs in the Formal Sector: A firm in the formal sector, owned by an entrepreneur g with productivity z, chooses labor to maximize profits given by:

$$\max_{\{l^m, l^f\}} \pi_{gF} = (1-t)pl^{\rho}_{gF} - \frac{1}{T}\left[w^m_{gF} l^m_{gF} - w^f_{gF} l^f_{gF}\right]$$

As with the informal sector, we assume that an entrepreneur g faces hiring frictions, modeled as an additional cost τ_{gF} and τ_{gF}^{f} of hiring a worker and female worker respectively in the formal sector. Therefore, the *effective* wage is given by $\boldsymbol{w_{gF}} \equiv \{w_{gF}^{m}, w_{gF}^{f}\} = (1+\tau_{gF})\{\widetilde{w}^{m}, (1+\tau_{gF}^{f})\widetilde{w}^{f}\}$. The first order conditions imply that demand for workers of gender g', optimal firm size, and profits (dropping j for notational clarity) are given by:

$$l_{gF}^{g'}(z) = A_F^{g}\left(\frac{w_{gF}^{g'}}{w_{gF}}\right)^{-\gamma} \times l_{gF}(z) \tag{4}$$

$$l_{gF}(z) = \left[\rho\frac{(1-t)T}{w_{gF}/p} \times z\right]^{\frac{1}{1-\rho}} \tag{5}$$

$$\pi_{gF}(z) = \frac{1-\rho}{\rho} \times \frac{w_{gF}l_{gF}(z)}{T} \tag{6}$$

$$\text{where: } w_{gF} = \left[\sum_{g'} A^{g'} {w_{gF}^{g'}}^{1-\gamma}\right]^{\frac{1}{1-\gamma}}$$

Mathematical proofs are provided in Appendix C.1.

2.3 Labor Supply Decisions

We now turn to the labor supply choices of individuals. We consider not only the choice of an individual to become an entrepreneur or a worker, but also the decision whether to participate in the labor force or not. Capturing both these margins is important since policies that aim to mitigate gender-specific barriers to work/entrepreneurship can not only change the allocation of individuals across wage- and self-employment, but also induce more individuals to participate in the labor force.

To model the decision to participate in the labor force, we adopt a structure similar to Bick, Fuchs-Schündeln, Lagakos, and Tsujiyama (2021), and assume that an individual consumes a bundle of consumption goods $C = \prod_j C_j^{\alpha_j}$ $(\sum_j \alpha_j = 1)$ and has a disutility of working, so that:

$$U(x,\eta) = \max_{C} C - \mathbf{1}_{LFP} \times \eta\overline{u}_g$$
$$\text{s.t.} \sum_j p_j c_j \leq I(x) + b$$

where: $I(x)$ is the income earned by an individual if (s)he participates in the labor force either as a worker or an entrepreneur, x denotes entrepreneurial ability and its role in the model will be explained shortly, b are benefits received by all agents in the economy from the government (financed through taxes), and $\eta\overline{u}_g$ are gender-specific utility costs of working (this term subsumes cultural and social norms discouraging women from participating in the labor force). $\eta \sim F_\eta(\eta)$ are idiosyncratic utility costs that vary across individuals, while $\overline{u}_g$ captures average differences across gender.

Let $P = (p_j/\alpha_j)^{\alpha_j}$ be the price index of the economy. We assume that individuals cannot save, and hence consume their entire income. An individual will therefore participate in the labor force as long as the real-income from working is greater than the disutility of participating in the labor force, i.e., $\eta\overline{u}_g < \frac{I(x)}{P}$. This implies that the labor force participation rate for gender g will be given by $F_\eta(\eta^*)$, where $\eta^* = \frac{I(x)}{P\overline{u}_g}$ is – according to the LFP indifference condition – the threshold disutility of working for an individual who is indifferent between working or not. All individuals with $\eta < \eta^*$ will participate in the labor force, while those with $\eta > \eta^*$ will not.

Entrepreneurship and Wage Employment: Conditional on participating in the labor force, individuals choose between being entrepreneurs or wage earners. Individuals draw an entrepreneurial ability x from an ability distribution $x \sim G(x)$. We assume that $G(x)$ is continuous with support $(0, \infty)$, has finite moments, and is identical and independently distributed for all individuals within an industry, but can vary across industries. An entrepreneur of gender g and ability x earns an expected profit denoted by $E(\Pi_{gs}(x))$ in sector s.

An entrepreneur g pays a fixed sunk cost of entry E_{gI} to enter the informal sector, and $E_{gF} = E_{gI} + E_{gR} > E_{gI}$ to enter the formal sector, where E_{gR} is a fixed cost of formalization/registration of the business. As the notation suggests, we allow entry and formalization costs to differ by gender to accommodate the possibility that women face higher costs of bureaucracy, and more difficulty getting access to credit, electricity, and other services associated with formality (see the descriptive results based on the World Enterprise Surveys presented in Appendix B, as well as comprehensive reviews by Jayachandran (2020) and Quinn and Woodruff (2019)). This implies that the expected income for an individual with entrepreneurial ability x who chooses to participate in the labor force is given by:

$$I(x) = \begin{cases} b + \widetilde{w}^g & \text{(Wage employment)} \\ b + E(\Pi_{gI}(x)) - \widetilde{w}^g E_{gI} & \text{(Informal entrepreneurship)} \\ b + E(\Pi_{gF}(x)) - \widetilde{w}^g E_{gF} & \text{(Formal entrepreneurship)} \end{cases} \tag{7}$$

An individual will choose the occupation that maximises his/her expected income. Since we observe non-zero entry in both sectors, there is a (gender-specific) threshold level of entrepreneurial ability in each sector x^*_{gs}, such that:

$$\begin{aligned} E(\Pi_{gI}(x^*_{gI})) &= \widetilde{w}^g(1 + E_{gI}) \\ E(\Pi_{gF}(x^*_{gF})) - E(\Pi_{gI}(x^*_{gI})) &= \widetilde{w}^g E_{gR} \end{aligned} \tag{8}$$

Lastly, from the LFP indifference condition discussed above, the threshold disutility that determines participation in the labor force is given by $\eta^*_g = (\widetilde{w}^g/P)/\overline{u}_g$, and the fraction of individuals who participate in the labor force is given by $F(\eta^*_g)$.

Entrepreneurial choice across industries: We now turn to the decision of an entrepreneur to enter a particular industry j in sector s. We assume that an entrepreneur with entrepreneurial ability x and conditional on starting a firm in sector s, draws his/her ex-post industry-specific productivity $z_j = x\varepsilon_j$, where ε_j is drawn from a gender-specific Frechet distribution, i.e., $\varepsilon_j \sim Frechet(\theta_g)$ with a CDF given by $F(\varepsilon) = e^{-\varepsilon^{-\theta_g}}$.

Proposition 1. *For each gender g, the share of entrepreneurs, their average firm size and profits* *in a sector s and industry j are given by:*

$$(a)\varphi_{gsj} = \frac{\left[\frac{p_{sj}}{(w_{sj}/T_{sj})^{\rho_s}}\right]^{\theta}}{\sum_k \left[\frac{p_{sk}}{(w_{sk}/T_{sk})^{\rho_s}}\right]^{\theta}} \qquad \text{[\textit{Share of Firms}]}$$

$$(b)E[l_{gsj}(x)] = \varphi_{gsj}^{-1/\widetilde{\theta}_s}\Gamma_{\widetilde{\theta}_s}\left[\rho_s \frac{T_j}{w_{gsj}/p_{sj}} \times x\right]^{\frac{1}{1-\rho_s}} \qquad \text{[\textit{Avg. Firm Size}]}$$

$$(c)E[\pi_{gsj}(x)] = \frac{1-\rho_s}{\rho_s} \times \frac{w_{gsj}E[l_{gsj}(x)]}{T_{sj}} \qquad \text{[\textit{Avg. Profits}]} \tag{9}$$

where: $\widetilde{\theta}_s = (1-\rho_s)\theta$, $\Gamma_a = \Gamma(1-1/a)$, $\{\rho_I, p_{Ij}\} = \{\lambda\rho, p_j\}$ *and* $\{\rho_F, p_{Fj}\} = \{\rho, (1-t_j)p_j\}$

Mathematical proof provided in Appendix C.3.

Summary: The above discussion can be summarized in Figure A1 in the Appendix. Each individual in this economy is indexed by $\{g, x, \eta\}$, i.e., gender g, entrepreneurial ability x and disutility of labor force participation η. An individual will enter the labor force as long as $\eta < \eta_g^*$. Conditional on working, individuals with $x < x_{gI}^*$ will enter wage employment, those with $x \in [x_{gI}^*, x_{gF}^*]$ will enter the informal sector as entrepreneurs, and those with $x > x_{gF}^*$ will enter the formal sector as entrepreneurs. Conditional on sector choice, entrepreneurs draw an ex-post productivity signal z_j that determines the industry j in which they operate.

2.4 Equilibrium

To close the model, we aggregate across all agents in the economy. Total income in the economy is given by $I = \widetilde{\boldsymbol{w}}\bar{\boldsymbol{L}} + \Pi + B$. The first term, $\widetilde{\boldsymbol{w}}\bar{\boldsymbol{L}}$, is the income received by the workers in the economy, and it is equal to $\sum_g \widetilde{w}^g L^g_{supply}$, where $L^g_{supply} = F(\eta_g^*)G(x_{gI}^*)N^g$. The second term, Π, denotes the total profits of the firms in the economy net of their entry costs, i.e. it consists of profits of the firms in the informal sector $\Pi_I = \sum_g \sum_j N^g F(\eta_g^*) \times \int_{x_{gI}^*}^{x_{gF}^*} \varphi_{gIj}(E\Pi_{gIj}(x) - \widetilde{w}^g E_{gI})$ and the profits of the firms in the formal sector $\Pi_F = \sum_g \sum_j N^g F(\eta_g^*) \times \int_{x_{gF}^*} \varphi_{gFj}(E\Pi_{gFj}(x) - \widetilde{w}^g E_{gF})$. The third term, B, denotes total benefits.

The total taxes collected in the economy are given by $TX = \sum_g \sum_j t_j p_j Y_{gjF}$, where $p_j Y_{gjF}$ is the total revenue of formal firms of gender g in industry j. Taxes are redistributed as benefits b across all individuals in the economy. Given the utility function, individuals spend a share α_j of their income on consuming goods from industry j. Labor demand for workers of gender g across all firms in the economy, denoted by L^g_{demand}, is given by $L^g_{demand} = \sum_{g'} \sum_j \sum_s L^g_{g'sj}$, where $L^g_{g'sj}$ is the total labor of gender g, demanded by entrepreneurs of gender g' in sector s and industry j given by Equations (1), (4) and (9). The equilibrium in this economy is defined by the following conditions:

(i) the labor markets clear for both genders, i.e., $L^g_{supply} = L^g_{demand}$, $\forall g = \{m, f\}$.

(ii) the zero-profit conditions in Equation (8) for the formal and informal sectors, and the LFP indifference condition (that determines η^*) hold with equality for both genders.

(iii) the goods market clears for each industry, i.e., $\sum_g \sum_s Y_{gsj} = \alpha_j I / p_j$, $\forall j$.

(iv) the total benefits received by individuals are equal to the taxes collected, i.e., $TX = b \sum_g N_g$.

3 Data

Our primary data comes from two rounds of the Economic Census of India (EC) for 1998 and 2005.[13] The EC is meant to be a complete enumeration of all (formal and informal) non-farm business establishments in India in a given year. It is the only database in India that measures the unconditional distribution of establishment size. Other databases such as CMIE's Prowress Database, the Annual Survey of Industries (ASI) or the National Sample Surveys (NSS) only cover certain parts of the distribution and hence are unsuitable for our analysis.

Though it has uniform coverage, the EC has information only on a handful of variables, such as total number of workers, workers by gender, registration status, identity of the firm owner, 4-digit NIC industry code, and the source of finance for each establishment. It does not have information

[13] We do not use the 2013 round of the Economic Census since it does not report whether a firm has registered or not. Hence in the 2013 data, we cannot measure informality, which is an important feature of India as well as most developing countries (LaPorta and Shleifer (2014), Ulyssea (2018), Ulyssea (2020)).

on output, capital, or profits, and the data are cross-sectional. We use the 1998 and 2005 rounds of the ASI and NSS to complement the EC when necessary. Formality in the model relates to firms paying taxes to the government. Accordingly, we define as "informal", those firms who have either not registered with the government or do not have to pay taxes (i.e., firms with fewer than 10 workers or fewer than 20 workers and no electricity). We omit public-sector firms and co-operatives from our analysis since they do not have information on gender-ownership. We restrict our sample to the 18 major states of India[14], which cover 94.6 (97.25) percent of firms and 96 (97.5) percent of female-owned firms in 1998 (2005). Lastly, we define a "firm" as an establishment that hires at least one worker and hence we do not consider "owner-only" enterprises. Our final sample consists of 12.48 million firms in 1998 and 17.22 million firms in 2005.

Table 1 presents summary statistics from the Economic Census data. We classify each firm into four categories based on gender (Male or Female) and formality (Formal or Informal). Columns (1), (3) and (5) report on the 1998 round of the EC, while Columns (2), (4) and (6) report on the 2005 round. Four stylized facts stand out. First, more than 99 percent of firms (both male and female) operate in the informal sector; the fraction of informal firms has decreased very slightly between the two rounds of the EC from 99.33 percent in 1998 to 99.14 percent in 2005. Second, female-owned firms account for less than 10 percent of the total firms (6.59 percent in 1998 and 7.25 percent in 2005). Third, as reported in Columns (3) and (4), female-owned firms are smaller than male-owned firms in the informal sector, but larger than male-owned firms in the formal sector. Lastly, from Columns (5) and (6), female-owned firms employ more female workers compared to male-owned firms, and more so in the informal sector.

A comparison between 1998 and 2005 reveals further interesting patterns. The average number of workers (Columns (3) and (4)) decreased for all categories between 1998 and 2005, suggesting a decline in entry costs; but the decline is particularly pronounced for formal firms (both male- and female-owned) suggesting a decline in the costs of formalization, especially for women. This is consistent with a package of policy reforms (fiscal, financial, technology and infrastructural support)

[14] These states are Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh (including Uttarakhand) and West Bengal.

implemented in the early 2000s primarily for the micro, small and medium firms (Govt. of India, 2000). The fraction of female employees (Columns (5) and (6)) has remained relatively stable for female-owned firms in both the formal and informal sectors, with a slight increase for male-owned firms, particularly in the formal sector.

To explore whether these patterns are driven by firm sorting either across space (districts in India), or across industries, we estimate regressions of the form:

$$\begin{aligned} y_{fjd} = \alpha_d + \beta_1 \text{Female}_f + \beta_2 \text{Formal}_f + \beta_3 \text{Female}_f \times \text{Formal}_f \\ + \delta X_{fjd} + \alpha_j + \varepsilon_{fjd} \end{aligned} \tag{10}$$

where y_{fjd} is an outcome variable (either log-labor or fraction of female employees) for a firm f that operates in industry j and district d. "Female" and "Formal" are dummy variables that take the value 1 if the firm is female-owned and operates in the formal sector respectively, and 0 otherwise. Industry j is the 4-digit National Industry Classification (NIC) code, and X_{fjd} are a set of firm controls, such as access to electricity, dummy variables for different forms of financial access (formal, informal, government etc.), a dummy for whether the firm is primarily agriculture-based, and a dummy for whether the firm operates in a rural or urban area. We cluster standard errors at the district level.

Table A1 in the Appendix reports the results. Panel A of Table A1 reports the regressions with district fixed effects (α_d), but without industry fixed effects (α_j), whereas Panel B adds industry fixed effects. Columns (1) and (3) report the results for the 1998 round of the EC while columns (2) and (4) report results for the 2005 round. The findings are consistent with the simple descriptive patterns discussed earlier. For example, as we can see from Panel B, in 2005, within each district and industry, female-owned informal firms are 4.5 log-points (or 4.4 percent) smaller in size than male-owned informal firms, but 12.8 log-points (or 12 percent) larger than male-owned formal firms. In both the formal and informal sectors, female-owned firms employ more female workers than male-owned firms; in 2005, this difference is 23.6 pp in the informal sector, and 17.28 pp in the formal sector. Interestingly, a comparison of the estimates in Panel A to those in Panel B shows that the magnitude of these differences is hardly affected by the inclusion of industry fixed effects. This indicates that the advantage that female entrepreneurs have in hiring female workers is not driven by sectoral composition effects.[15]

4 Model Estimation

The purpose of quantifying the model is twofold. First, we estimate the hiring wedges and excess fixed costs of entry and registration. Second, we evaluate the impact of counterfactual policies that eliminate the entry, registration and hiring barriers faced by female entrepreneurs. Table 2 lists the model parameters. Given data limitations, we use a combination of calibration and estimation to set their values. Section 4.1 discusses the parameterization of the model, Section 4.2 discusses the parameters determined using statutory values in the literature, and Section 4.3 provides the details of the model estimation.

4.1 Parameterization

We treat every state in India as a separate closed economy (or region r) and aggregate all four-digit industries into three broad industries (denoted by j), namely (i) agriculture and mining; (ii) manufacturing and (iii) services[16]. As noted earlier, we use the 1998 and 2005 rounds of the Economic Census and allow for different parameters for each round.

We classify our parameters into two sets:

[15]These results are also robust to excluding "family-owned" firms, which are defined as those where more than half the employees are not hired on wage contracts. The results are reported in Table A2.

[16]In principle, our data allows for a more disaggregate analysis at the 4-digit NIC level, and we have in fact experimented with specifications based on this more disaggregate industry definition. However, because there are very few formal female firms (and female firms more generally) in several of these industries, the disaggregate analysis is not particularly meaningful as we cannot recover the entry costs, hiring frictions, etc., in those 4-digit NIC industries that have very few or no female entrepreneurs. For those disaggregate industries for which we can recover the barriers facing female entrepreneurs, the results do not vary much across 4-digit industries, while they vary considerably across regions (this is also reflected in the descriptive results of Table A1 where the estimates are hardly affected by the inclusion of industry fixed effects). For these reasons, and also to facilitate presentation of the estimates, we have opted to aggregate the 4-digit level NIC data to three broader "industries": Agriculture; Manufacturing; and Services.

(a) Fundamental parameters $\{\Gamma, \Psi\} = \Big\{\{\rho, \gamma, \alpha_j, t_{jr}\}, \{\lambda_j, A_{sjr}, T_{jr}, \sigma_x^2, \theta_g\}\Big\}_{\forall g,j,r}$

(b) "Barriers" faced by entrepreneurs, such as fixed costs $\Upsilon = \{\overline{u}, E_I, E_R\}_{\forall g,r}$ and hiring wedges $\Theta = \{\tau_{fI}, \tau_{fF}, \tau_{fI}^f, \tau_{fF}^f\}_{\forall j,r}$.

The parameters in Γ are determined based on statutory values or taken from the literature. The parameters in Ψ and all barriers faced by entrepreneurs (Υ,Θ) are estimated.

Similar to Bick, Fuchs-Schündeln, Lagakos, and Tsujiyama (2021), we assume the individual disutility of work follows a uniform distribution, i.e., $\eta \sim U(0, 1)$. This implies that the average disutility by gender, $\overline{u}_g$, is distributed according to $\eta\overline{u}_g \sim U(0, \overline{u}_g)$. We assume that the entrepreneurial ability distribution for an entrepreneur g follows a log-normal distribution with mean 0 and variance σ_x^2, i.e., $x \sim \log N(0, \sigma_x^2)$. Further, we assume the realized industry-sector specific productivity $z_{sj} = x\varepsilon_{sj}$, where $\varepsilon \sim Frechet(\theta_g)$.

Lastly, we normalize the productivity of male workers A^m to be 1, and the hiring barriers faced by male entrepreneurs to be zero, i.e., $\tau_{mI} = \tau_{mF} = 0$ and $\tau_{mI}^f = \tau_{mF}^f = 0$. These normalizations are harmless, but imply that the productivity of female workers as well as the hiring barriers faced by female entrepreneurs (i.e., τ_{fs} and τ_{fs}^f) are to be interpreted *relative to* their male counterparts.

4.2 Exogenous model inputs from the literature

The parameters in Γ are determined using statutory values or values taken from the literature as follows: We fix the share of consumer expenditure on an industry, i.e., $\{\alpha_j\}_{\forall j}$, to be the total sales across all firms (as reported in the ASI and NSS) in a particular industry as a fraction of the total sales in the economy. This yields values of 0.216, 0.357, and 0.427 for agriculture and mining, manufacturing, and service industries respectively. The parameter $\rho = 0.738$, capturing (decreasing) returns to scale in the production function, is calibrated as the average labor share across firms in the ASI and NSS. The parameter γ measures the elasticity of substitution between male and female workers in production. A rich literature[17] estimates this elasticity of substitution

[17] See Hamermesh (1996); Udry (1996); Weinberg (2000); Acemoglu, Autor, and Lyle (2004); De Giorgi, Paccagnella, and Pellizzari (2013); Johnson and Keane (2013); Olivetti and Petrongolo (2014); Ghosh (2018).

and the values typically vary between 1.7 to 2.3 across studies and contexts. We set $\gamma = 2.1$, which the average of the values estimated in this literature. Lastly, the sales tax (t) for each industry j in region r is taken to be the average tax paid by a formal firm in that industry-region as reported in the ASI, which is a representative dataset for formal firms in India. The tax rates are between 5-8 percent across industries and are consistent with the sales tax on most products in India during that period.

4.3 Estimation Strategy

This section outlines the estimation procedure and provides some heuristic arguments of how the remaining parameters are identified (conditional on the parameters in Γ)[18]. In a nutshell, we jointly use moments from male- and female-owned firms to estimate the parameters in Ψ and Υ, and then use the differences between moments of male-owned and female-owned firms to identify the parameters in Θ. We use our model to simulate moments that we can observe in the data. We employ a Simulated Minimum Distance (SMD) estimator, which minimizes the distance between the simulated and actual moments in the data. Table 2 provides a list of all the parameters along with the moments that are targeted to identify them.

We first discuss the moments in the data we target to estimate the parameters in Ψ. We normalize the productivity of female workers (relative to male) in services to equal 1 in both the formal and informal sectors, i.e., we set $A_{s,Services,r} = 1$. From Equations (1) and (4), the ratio of female to male workers in a given sector, industry (and region) is given by $A_s(w^f_{gs}/w^m_{gs})^{-\gamma}$. We target the ratio of female to male workers in male-owned firms in agriculture and manufacturing (relative to services) ($2\times 2\times R$ moments) to estimate $\{A_{Ijr}, A_{Fjr}\}_{\forall j,r}$. Similarly, we normalize $T_{Services,r} = 1$ and identify $\{T_{jr}\}_{\forall j,r}$ for agriculture and manufacturing using the ratio of the average firm size of male-owned firms in the formal sector in these industries (Equation 5), relative to services ($2\times R$ moments). The penalty of informality $\{\lambda_j\}_{\forall j}$ is identified using the average ratio (across all regions) of firm-size of

[18]We discuss identification more systematically in Section 5.4 where we employ an approach similar to Kaboski and Townsend (2011) and Bick, Fuchs-Schündeln, Lagakos, and Tsujiyama (2021) to establish identification.

male-owned firms in the informal to formal sector (Equations 2 and 5) for each industry separately (3 moments). Lastly, we use the variance of firm-size for male-owned and female-owned firms in the formal sector (2 moments) to estimate $\{\sigma_x^2, \theta_g\}_{\forall g}$.

Regarding the parameters in Υ, we identify the fixed costs of labor force participation, entry, and registration, i.e., $\{\overline{u}_{gr}, E_{I,gr}, E_{R,gr}\}_{\forall g,r}$ using the labor force participation rate for men and women ($2 \times R$ moments) and the number of male-owned and female-owned firms (as a fraction of the gender-specific labor force) in the informal and formal sectors ($2 \times 2 \times R$ moments).

Turning to identifying the hiring frictions faced by female entrepreneurs (Θ), since we normalize τ_{mI} and τ_{mF} to be equal to zero, we use the ratio of the average firm size of male-owned and female-owned firms in the formal and informal sectors ($2 \times J \times R$ moments) to identify $\{\tau_{fI,jr}, \tau_{fF,jr}\}_{\forall j,r}$. Similarly, we use the ratio of the ratio of female to male workers in male-owned and female-owned firms in the formal and informal sectors ($2 \times J \times R$ moments) to identify $\{\tau^f_{fI,jr}, \tau^f_{fF,jr}\}_{\forall j,r}$.

Given a guess of the parameter vector $X = \{\Psi, \Upsilon, \Theta\}$, we simulate the above moments from the structure of the model to obtain the vector $M(X)$. The data counterpart is denoted by M_{data}. We then choose the parameter vector $\hat{X} = \arg\min g(X)'g(X)$, where $g(X) = (M(X) - M_{data})/M_{data}$. We compute standard errors using a bootstrapping method that allows for sampling as well as simulation error.[19]

5 Parameter Estimates

We start by discussing the parameter estimates for entrepreneurial ability, technology, worker productivity, and penalty of informality (i.e., Ψ) in Section 5.1, fixed costs of entrepreneurship and LFP (i.e., Υ) in Section 5.2, and finally the barriers faced by women entrepreneurs (i.e., Θ) in Section 5.3. In Section 5.4 we discuss identification, in Section 5.5 we discuss model fit, and in Section 5.6 we correlate our estimates with existing measures of women empowerment and gender-specific policies and show that they are consistent with common wisdom.

[19]Specifically, we repeat the estimation process 50 times, replacing M_{data} with $M_{Boot.Sample}$ to generate standard errors.

5.1 Entrepreneurial Ability, Technology and Informality

Table 3 reports the estimates for the parameters of the productivity of female relative to male workers in production in the informal and formal sectors (A), technology (T), penalty of operating in the informal sector (λ), and entrepreneurial ability distribution $\{\sigma_x^2, \theta\}$. Columns 1-3 of Panel A report results across industries for 1998, while Columns 4-6 report results for 2005.

The estimates for A_I and A_F imply that women have a comparative advantage in services compared to agriculture and manufacturing. The estimates are 0.65 and 0.66 (0.16 and 0.33) in the informal (formal) agriculture and manufacturing industries in 1998 respectively, and 0.64 and 0.67 (0.42 and 0.29) in the informal (formal) agriculture and manufacturing industries in 2005. This is consistent with a large literature that examines the importance of brawn versus brain (Pitt, Rosenzweig, and Hassan, 2012) as well as the impact of the rise of service industries on female labor force participation (Rendall, 2013; Olivetti and Petrongolo, 2014, 2016; Ngai and Petrongolo, 2017). Relative to services, the technology parameter (T) is around half in agriculture and twice as large in manufacturing. The size-based penalty of operating in the informal sector (λ) is around 0.8 in 1998 and 0.85 in 2005. In Appendix C.2, we discuss how these estimates relate to size-based penalties (such as the probability of detection for example). Lastly, despite allowing for the ability distribution to vary across years, the parameter estimates are remarkably similar between 1998 and 2005. Moreover, despite allowing for the shape parameter of the Frechet distribution to vary by gender, we get very similar results for men and women. The parameter $\widetilde{\theta}_g$ is 2.74 (2.61) for men (women) in 2005, which is consistent with estimates from Hsieh, Hurst, Jones, and Klenow (2019), who using a similar modeling structure estimate a value of 2.57.

5.2 Fixed costs of entrepreneurship and LFP

We now turn to examining the fixed costs of entrepreneurship, which include those for entry and formalization as well as the disutility of participating in the labor force (which we shall call LFP costs). We report the values in Table 4. Column 1 reports the values for 1998, Column 2 reports the values for 2005, and Column 3 reports the difference between the first two columns. We estimate these costs separately for male and female entrepreneurs, region (r), and year (t). To make meaningful comparisons, we normalize the cost for a male entrepreneur in 1998 to have mean 1, so that relative comparisons across gender and over time can be easily made.

As shown in Panel A of Table 4, women faced over three times the cost of entering the labor force that men faced in 1998. While LFP costs have been reduced for both men and women over time, we find that in 2005, women still face around 2.5 times higher costs of participating in the labor force compared to men. Conditional on participating in the labor force, we find that women actually faced lower entry barriers to start informal businesses (Panel B). In fact, we find that the fixed costs to start informal businesses were around 20 percent lower for women compared to men in 2005. In contrast, in the formal sector, women face around 1.5 times the cost faced by men to formalize/register their business (Panel C). This is consistent with the nature of informal businesses owned by women across many countries (Bardasi, Blackden, and Guzman, 2007; World Bank, 2020), gendered labor laws (Hyland, Djankov, and Goldberg, 2020), as well as quantitative (Ghani et al., 2013; Deshpande and Sharma, 2013; Rao et al., 2008) and qualitative studies (Basu and Thomas, 2009) for India.

The average numbers reported in Table 4 mask considerable heterogeneity across Indian states. Using the 2005 estimates, we plot the distribution of the ratio of female to male LFP, entry, and formalization costs (Figure 2). A ratio less than 1 indicates that female entrepreneurs face lower costs relative to their male counterparts, while a ratio greater than 1 indicates the opposite. As shown in Figure 2(a), the ratio of female to male LFP costs is greater than 1 in all regions (except for one), with women facing more than three to four times the costs of men to enter the labor force in some regions. Figure 3(a) shows this visually on a map, where we can see a stark geographical divide: relative to the Southern states, women face larger relative LFP costs in the the Central and Northern states, which is consistent with the evidence on geographical differences highlighted by Evans (2020) and Rao, Verschoor, Deshpande, and Dubey (2008).

The relative fixed costs of starting informal businesses are generally lower for women (relative to men) across most states (Figure 2(b)). Figure 3(b) suggests that *conditional on participating in the labor force*, women in the North are more likely (relative to men) to start informal businesses compared to those in the South. Similarly, women in many states face lower formalization costs compared to men as well (Figure 2(c)). Formalization costs are much higher in relative terms for women in the Western and Southern states as compared to the Northern ones (Figure 3(c)).

5.3 Distortions in Hiring Workers

For each industry j, region r, and year t, we quantify two types of barriers that distort the hiring decisions of women-owned firms as compared to their male counterparts. First, τ_{fsj} is the additional cost of hiring a worker for a female entrepreneur in sector s and industry j, relative to her male counterpart. We remind the reader that we have normalized $\tau_{msj} = 0$. Accordingly, the marginal cost faced by female entrepreneurs (relative to male entrepreneurs) is expressed in relative terms as $1+\tau_{fsj}$. Similarly, $1+\tau^{f}_{fsj}$ is the additional marginal cost incurred by women entrepreneurs relative to male entrepreneurs, in hiring female workers relative to male workers, in sector s and industry j (again, we remind the reader that we have normalized $\tau^{f}_{msj} = 0$).

As shown in Panel D of Table 4, the cost of hiring a worker is on average around 10 (15) percent higher for women entrepreneurs in the informal (formal) sector compared to men. Figures 4(a) and 4(b) plot the distribution for $1 + \tau_{fI}$ and $1 + \tau_{fF}$ across regions and industries in 2005. A value greater than 1 implies female-owned firms face a higher marginal cost as compared to male-owned firms. As we can see from both figures, $1 + \tau_{fI}$ ranges from approximately 1-1.2, while $1 + \tau_{fF}$ ranges from 0.9-1.6 across most industries and states, indicating that women-owned businesses (both formal and informal) face substantial barriers in hiring workers, both across industries as well as states.

Turning to the gender composition of hired workers, i.e., $1 + \tau^{f}_{fs}$, the estimates indicate that this is the only area in which female entrepreneurs have an advantage, and more so in the informal sector. From Panel D of Table 4, female entrepreneurs in the informal sector incurred 5-6 percent lower costs to hire a female (relative to male) worker, relative to male entrepreneurs. This advantage is still pervasive, but muted in the formal sector, where despite the average being greater than 1 in 2005, the median is less than 1 (0.86 to be exact). Figures 4(c) and 4(d) further examine the heterogeneity across industries and states. Of special note is that the advantage for female entrepreneurs in hiring women (relative to men) in the informal sector is quite substantial, over 15 percent in some industry-regions. This advantage is also present across most cases in the formal sector as well. The comparative advantage that female entrepreneurs have in hiring female workers may reflect social norms and attitudes. For example, women workers may feel more comfortable working for other women; or, to the extent that women face resistance from male members of their household if they seek work outside the home, such resistance may be less pronounced in cases where they work for other women. Note that as Figures 4(c) and 4(d), as well as the reduced form results of Table A1 indicate, this pattern is not driven by selection of female workers and entrepreneurs to a few industries.

To summarize the above discussion, these results suggest that while the excess barriers faced by female entrepreneurs have been reduced over time, there nevertheless remains a substantial gender gap across all industries and regions. The only exception is in the hiring of female workers, where female entrepreneurs appear to have an advantage.

5.4 Identification

Section 4.3 provides heuristic arguments of how various data moments help identify the key parameters of the model. We now adopt a more systematic approach for establishing identification in the spirit of Kaboski and Townsend (2011) and Bick, Fuchs-Schündeln, Lagakos, and Tsujiyama (2021). Specifically, for each of the eight sets of key model parameters, namely: hiring distortions faced by women entrepreneurs ($\{\tau_{fIj}, \tau_{fFj}\}$ and $\{\tau^f_{fIj}, \tau^f_{fFj}\}$), aggregate technology (T_j), relative productivity of female workers (A_{Ij} and A_{Fj}) and penalty of operating in the informal sector (λ_j), we compute the derivative of a moment with respect to each parameter.[20] To do so, we re-solve the model each time by increasing one parameter by 1 percentage point above its estimated value (keeping all others the same) and compute the resulting percentage changes in the simulated moments. We report the results in Table A3. Each number in a row r and column c is the percentage change

[20]Note that the fixed costs of entry and formalization are not identified directly from a data moment, but computed from the the zero-profit conditions. Accordingly, we do not consider them here.

in the moment in row r (averaged across regions, industries and gender) when the parameter in column c is increased by 1 percentage point (keeping all other parameters the same). We bold-face and underline the largest derivative in each column to highlight which moment responds the most when the parameter in that column is changed. Panel A (B) in Table A3 reports the results using the 1998 (2005) Round of the Economic Census.

As the table shows, the results are consistent with the discussion in Section 4.3. From Columns (1) and (2), we see that the ratio of female to male workers in a male-owned firm in the informal and formal sectors is sensitive to changes in the relative female to male worker productivity (A_I and A_F). On the other hand, from Columns (3) and (4), the ratio of female to male workers in female-owned (relative to male-owned) firms in the informal (formal) sector is substantially affected by the change in τ_I^f (τ_F^f). From Columns (5) and (6), the ratio of female to male firm-size in the informal and formal sectors is most responsive to the hiring barriers that female entrepreneurs face (τ_I and τ_F). Lastly, in Column (7), the ratio of firm-size of male-owned firms in the formal and informal sectors is most sensitive to the penalty of operating the informal sector (λ), while changes in the aggregate technology parameter T (Column 8) affects the firm-size of male-owned firms in the formal sector.

5.5 Model Fit

Tables A4 and A5 in the Appendix show the fit of the model for the 2005 data.[21] In Panel A of Table A4, we start by discussing the allocation of men and women across the economy. Since these moments are generated at the region-level, we average them across regions and report the standard deviations in parentheses. In particular, we show the model fit across four moments, the fraction of men and women in: (a) the labor force; (b) wage employment; (c) informal entrepreneurship and (d) formal entrepreneurship. In Panel B, we also examine the ratio of female to male workers in informal and formal male/female-owned firms. These sets of moments were directly targeted by the model, and we fit them very well.

[21]We show the fit only for 2005 since this is the data that we use to evaluate counterfactual policies in the next section.

In Table A5, we examine moments related to the distribution of firm size across the four types of firms in our data. In Panel A, we examine the fit of our model using moments related to the ratio of firm size of female-owned to male-owned firms in the informal/formal sector. We also examine the ratio of firm-size between the informal and formal firms for the same gender-owned firms. Our model fits these moments very well. Note that we do not target moments related to the ratio of formal to informal firm size for female-owned firms, yet our model fits those well. In Panel B of Table A5, we show the fit of the model for average firm size. Note that our estimation strategy only targets the *ratios* of firm size across gender/sector, but not the levels. However, the model does a good job at fitting the levels as well. Lastly, Panel C shows that the model under-performs in fitting the standard deviation of firm size in the formal and informal sectors. This is because our model predicts perfect sorting of firms in the informal and formal sectors, based on firm productivity. However, in the data, we observe some large firms that are informal an some small firms that are formal. This implies that our model underestimates the variance (and hence standard deviation) of firm size.

5.6 Correlating Estimates with Gender Policies and Indices of Women Empowerment

Our model estimates the differential barriers faced by women entrepreneurs (LFP disutility, fixed costs of entry and formalization, and hiring distortions). We use various region-specific measures of women empowerment from sources in the literature to examine whether our implied measures of these differential barriers correlate with the documented level of women empowerment in these regions. Specifically, we use three widely used measures of gender inequality and empowerment in India: (a) Women Empowerment Index (Bansal, 2017); (b) Gender Vulnerability Index (Plan International, 2017) and (c) Patriarchy Index (Singh et al., 2021).

The Women Empowerment Index (WEI), proposed by Bansal (2017) at the Hindustan Times (a widely circulated national daily) uses data from the National Family Health Survey (NFHS), a large, nationally representative survey conducted by the Health and Family Welfare Ministry. In particular, it is based on data for eight indicators, such as the participation of women in household decisions, ownership of land, cell phones and bank account, instances of spousal violence, etc., to construct a state-specific Women Empowerment Index.

The Gender Vulnerability Index (GVI), proposed by Plan International (2017), expands the scope of the WEI by using a set of 170 indicators constructed from large nationally representative data like the Population Census of India, National Family Health Survey (NFHS), Health Management Information System, District Information for School Education (DISE), Rapid Survey on Children, Annual Economic Survey, Annual Survey on Education Report and National Achievement Survey to construct a state-specific, comprehensive measure of gender parity along various dimensions, such as Social Protection (26 indicators), Education (68 indicators), Health (57 indicators), Poverty (19 indicators). These are then aggregated to construct a state-level index of Gender Vulnerability.

Lastly, the Patriarchy Index (PI), proposed by Singh et al. (2021), adapts the Patriarchy Index developed by Gruber and Szołtysek (2016) for Europe, to the Indian context. Using the NFHS data as well, the PI uses measures that span five domains: (1) domination of men over women; (2) domination of the older generation over the younger generation; (3) patrilocality; (4) son preference; and (5) socio-economic domination that recognizes the social and economic imbalances between men and women in households in terms of both earning and control over money and education.

Figure A2 shows the distribution of each of these indices across Indian states. There is a clear geographical pattern where the Northern and Central states fare much worse on each index compared to the Western and Southern states.

Fixed costs of entrepreneurship and LFP: We examine the correlation of our estimates of fixed costs and LFP costs with these three measures of women empowerment. A visual comparison of Figures A2 and Figure 3 shows a clear geographical pattern and strong correlation between the extent of women empowerment in these states and the fixed costs of LFP and entrepreneurship for women. We also examine this correlation by estimating the following regression:

$$Y_{st} = \alpha_t + \beta I_s + \gamma X_{st} + \varepsilon_{st} \tag{11}$$

where Y_{st} is the ratio of female to male LFP costs, i.e., excess costs faced by women. We pool the 1998 and 2005 estimates, and examine their correlation with state-specific measures of women empowerment $I_s = \{GVI, WEI, PI\}$. All indices are normalized to have mean 0 and standard deviation 1. We control for state-year-specific observables such as GDP, fraction of SC/ST population (backward castes), adult literacy rates, as well as year fixed effects that capture all observable and unobservable trends in India over this time period. Given the small sample size, we bootstrap our standard errors. Our coefficient of interest is β. As reported in Columns (1)-(3) of Panel A in Table A6, a one standard deviation increase (decrease) in WEI/GVI (PI) is correlated with approximately a 0.2-0.3 (or 8-12 percent) decrease in the ratio of female to male LFP costs.

Turning to fixed costs of entrepreneurship (entry and formalization), the correlations are (with one exception) insignificant. However, it is less clear how women empowerment indices would affect such fixed costs given that they also depend on bureaucracy and interactions with officials and policy makers. We therefore turn to another source of variation, namely political reservations for women in India. Ghani, Kerr, and O'Connell (2013, 2014) use the differential timing of when states adopted political reservations for women between 1993-2005 (which overlaps with our data period as well) to show that women reservations in the political system increased female labor force participation and women entrepreneurship. Similar to their analysis, we construct an indicator variable I_{st} that takes the value 1 if a state s had adopted the reservation policy in year $t = \{1998, 2005\}$ and 0 otherwise. We then estimate Equation (11) with I_{st} as this dummy variable, instead of the norms variable, and report the results in Column (4) of Table A6. We do find that states where women were more likely to be policymakers (through political reservations) had lower excess formalization costs for women entrepreneurs.

Hiring distortions: We finally examine how hiring distortions (τ_{fs} and τ_{fs}^{f}) correlate with measures of women empowerment. Similar to Equation (11), we estimate the following regression specification:

$$Y_{jst} = \alpha_t + \alpha_j + \beta I_s + \gamma X_{st} + \varepsilon_{jst} \tag{12}$$

where Y_{jst} is the hiring distortion in industry j, state s and year t. In addition to the variables already described previously, we include industry fixed effects, α_j, to control for all observable and unobservable time-invariant differences across industries and control for the total labor force participation rate (which is driven by the fixed costs/disutility of work in our model). As reported in Table A7, we find a negative relationship between empowerment indices and distortions in the hiring of male workers in the informal sector, but no clear correlation between them in the formal sector. Regarding distortions in the hiring of female workers the correlations suggest an interesting pattern. We remind the reader that this is the only case where women entrepreneurs seem to have an advantage - hiring of female workers is relatively cheaper for female entrepreneurs, especially in the informal sector. The correlations with the indices suggest that this advantage is less pronounced in states where women are more empowered - this is especially the case with the WEI. A possible interpretation is that the "advantage" of female entrepreneurs in hiring female workers is itself a reflection of norms that constrain women's labor markets prospects (for example, in some settings, women may not be allowed to work with men side by side, or they may not feel comfortable doing so). Accordingly, in states where such norms are less pronounced, so that female workers can or want to be employed by male entrepreneurs, this "advantage" seems to be weaker.

Put together, the above analysis indicates that while the model treats barriers to entry and operation facing women as a black box, our estimates of such barriers do correlate with policy interventions, social norms and empowerment of women across Indian states.

6 Impact of Affirmative Action Policies

Apart from quantifying the various types of barriers faced by female entrepreneurs, the advantage of our theoretical framework is that it allows us to evaluate the aggregate effects of counterfactual affirmative action policies in general equilibrium. In particular, we evaluate the impact of five policies that sequentially eliminate the excess barriers faced by females n the economy on both the extensive margin (i.e., participation in the labor force and informal/formal entrepreneurship) and intensive margin (i.e., expansion through hiring workers). This exercise allows us to identify the barriers that are most consequential for aggregate productivity and welfare. We consider the following scenarios that eliminate:

(i) **Excess entrepreneurial costs:** We eliminate excess entry and formalization costs faced by women entrepreneurs, i.e., we set $E_{fI} = \min\{E_{mI}, E_{fI}\}$ and $E_{fR} = \min\{E_{mR}, E_{fR}\}$.

(ii) **Excess hiring barriers:** We set $\{E_{gI}, E_{gR}\}$ to their baseline values, but eliminate excess hiring barriers. That is, we set $\tau_{fs} = \min\{\tau_{fs}, 0\}$ and $\tau^f_{fs} = \min\{\tau^f_{fs}, 0\}$, for $s = \{I, F\}$.

(iii) **Excess entrepreneurial costs and hiring barriers:** We eliminate all excess entrepreneurial costs as well as all hiring barriers in (i) and (ii).

(iv) **Excess LFP costs:** In scenarios (i)-(iii), we do not change the excess LFP costs faced by women, which from Table 2 are substantial. In scenario (iv), we set all fixed entrepreneurial costs and hiring barriers to their baseline values, and remove only the excess costs faced by women for participating in the labor force i.e., set $\overline{u}_f = \min\{\overline{u}_f, \overline{u}_m\}$.

(v) **All excess barriers:** In a final counterfactual, we remove all excess barriers faced by women on labor force participation, fixed costs of informal and formal entrepreneurship, and intensive margin hiring barriers.

We examine the effects of these policies on a number of outcomes, such as the labor force participation rates for men and women, the allocation of men and women across wage employment and entrepreneurship, and the earnings of men and women workers (measured by real wages) as well as entrepreneurs (measured by average real profits). The results are displayed graphically in Figure 5. Then, for each region, we aggregate across workers to measure the impact of each policy on productivity, which we measure as the average productivity of firms in a region across sectors and industries, and real income, which given our preference structure, is a natural candidate for measuring welfare. These results are shown in Figure 6. We discuss the results of each policy in detail below.

Removing excess fixed costs of entrepreneurship: From Figures 2(b) and 2(c) we know that there are few regions where women face excess fixed costs to entrepreneurship (both in terms of entry and formalization costs). It is not surprising therefore that a policy that removes excess fixed entrepreneurial costs results in an increase in the fraction of females who are entrepreneurs (Figure 5(a)) and their earnings (Figure 5(d)), but does not significantly impact real wages (Figure 5(c)), productivity (Figures 6(a), 6(b), and 6(c)) or welfare (Figure 6(d)). Intuitively, given the large barriers women face in operating their businesses (see below), removing barriers to entry without any changes in the costs of operation has little effect on their labor allocation decisions and welfare.

Removing excess hiring frictions: As discussed in Section 5.3, hiring frictions for female-owned firms are substantial and quantitatively important, in both the formal and informal sectors. We now consider a counterfactual where we do not change the baseline fixed costs, but remove the excess hiring costs for female-owned firms. One of the most notable impacts of this policy is that the fraction of women who are now entrepreneurs doubles from 1.2 to 2.4 percent (Figure 5(a)). Moreover, there is an influx of women into the labor force, with the labor force participation rate for women increasing by 2 percentage points (from 27 percent to 29 percent), and the fraction of females who are wage earners increasing by 1 percentage point (from 25 to 26 percent). Furthermore, real wages for female workers increase by 5.3 percent (Figure 5(c)), while the average real profits of female entrepreneurs increase by ca. 50 percent. On the other hand, there is slight decline (around a 1 percentage point) in the fraction of men who are entrepreneurs (Figure 5(b)). These men switch from being entrepreneurs to becoming workers. There is no significant change in the real wages of male workers (Figure 5(c)) or average real profits of male-owned firms (Figure 5(d)). Put together, this suggests that both female workers and female entrepreneurs gain relatively more than male workers and male entrepreneurs.

Turning to productivity, from Figure 6(a), while the average productivity of male entrepreneurs increases by 0.7 percent (compared to the baseline), the average productivity of female entrepreneurs *decreases* by 3.4 percent. These effects are rationalized in Figure 6(b), which shows, for the baseline as well as for all counterfactual scenarios, the productivity of the marginal entrepreneur, i.e., the entrepreneur who is just indifferent between starting a firm or not. To make the comparison easier, we normalize the productivity of the marginal male entrepreneur to be 1 at baseline. It is interesting to note that at baseline, the marginal woman entrepreneur has to be almost 15 percent more productive than her male counterpart. The removal of hiring frictions allows more women to enter, presenting male entrepreneurs with more competition. Accordingly, the productivity of the marginal female (male) entrepreneur decreases (increases). This implies that the average female (male) entrepreneur is now less (more) productive compared to baseline. The set of female entrepreneurs who enter now are still more productive than their male counterparts, which translates into aggregate productivity gains, as shown in Figure 6(c). The median increase in the average productivity is 0.58 percent across all Indian states (with a 25th-75th percentile increase of 0.42-0.78 percent), and the median real income increase is 2.70 percent (with a 25th-75th percentile increase of 1.92-7.9 percent).

Removing both excess fixed costs of entrepreneurship and hiring frictions: We now consider a counterfactual that removes all excess costs faced by female entrepreneurs, while leaving the costs to labor force participation unchanged. From Figure 5(a), the effects are similar to the previous case. Female labor force participation increases by 3 percentage points compared to the baseline and the fraction of women who are now entrepreneurs increases to around 3 percent (from around 1 percent at baseline). Real wages for women increase by 9 percent (Figure 5(c)), and real profits of women entrepreneurs increase by over 60 percent (Figure 5(d)). Lastly, similar to the previous scenario, average productivity of a female-owned firm decreases by 3.7 percent (Figure 6(a)) as the ability threshold for the marginal female entrepreneur to enter decreases (Figure 6(b)). Note however that the marginal female entrepreneur is still 7 percentage points more productive than her male counterpart. Lastly, this translates into median aggregate productivity gains of 0.59 percent across Indian states (with a 25th-75th percentile increase of 0.42-0.89 percent) and median real income gains of 6.3 percent (with a 25th-75th percentile gains of 2.64-16.25 percent).

Removing excess LFP costs: All our previous counterfactuals considered removing barriers faced by women entrepreneurs. However, from Section 5.2, we know that LFP costs are substantial and around 2.5 times for women as compared to men. We therefore consider a counterfactual policy that sets the entrepreneurial costs and hiring barriers to their baseline values, but removes excess LFP costs for women, i.e., we set $\overline{u}_f = \min\{\overline{u}_m, \overline{u}_f\}$.

The fraction of women in the labor force almost doubles in this scenario (Figure 5(a)). The fraction of women who are entrepreneurs increases five times to 6 percent, as compared to 1.2 percent at baseline. There are no substantial changes in the allocation of men in the economy (Figure 5(b)), but there is still a modest increase of 3 percentage points in the fraction of men who participate in the labor force, and an equally large increase in the fraction of men who are wage earners. This increase is due to the 5.5 percent increase in the earnings of male workers (Figure 5(c)). On the other hand, real wages for female workers *decrease* by 11.5 percent. This decrease is due to the fact that we do not change the entrepreneurial barriers faced by women and therefore, while this counterfactual increases female labor supply, it does not adequately stimulate labor demand through the creation of new female-owned firms. Similarly, the average profits of male-owned firms increase by 6 percent, while the profits of female-owned firms do not change much (Figure 5(d)). Turning to productivity (Figures 6(a) and 6(b)), while the average and marginal ability of the male entrepreneurs do not change much relative to the baseline, the average productivity of female entrepreneurs decreases by 5 percent, and the threshold productivity of the marginal woman entrepreneur also decreases by 6 percentage points. These changes translate into median aggregate productivity gains of 0.68 percent across Indian states (with a 25th-75th percentile increase of 0.55-1.14 percent) and median real income gains of 26.40 percent (with a 25th-75th percentile gains of 16.21-37.3 percent). The effects on productivity are similar to the previous counterfactual that removed all excess entrepreneurial barriers faced by women. However, the effects on income are larger, despite the fall in real wages and profits, because now there are more women who choose to participate in the labor force and earn income.

Removing all excess barriers: The last counterfactual we consider is the removal of all excess barriers faced by women. This includes not only the labor force participation barriers, but also the excess barriers to entrepreneurship and hiring. As a result, labor force participation of women more than doubles (to around 60 percent), and the fraction of women who are entrepreneurs increases to 8.2 percent (Figure 5(a)). Interestingly, for men (Figure 5(b)), there is a small increase (3 percentage points) in labor force participation, a 2.2 percentage points *decrease* in the fraction of male entrepreneurs and consequently, a 6 percentage point increase in the fraction of men who are workers.

These patterns can be rationalized by examining the changes in real wages (Figure 5(c)) and profits (Figure 5(d)). Male workers experience a 6.5 percent increase in real wages and a small 3 percent increase in real profits, which explains the reallocation of men into wage employment discussed previously. For women on the other hand, it is interesting to note that in the present scenario that reduces both labor supply and labor demand constraints, real wages and profits for female workers and female entrepreneurs increase by 1.7 percent and 26 percent respectively. These effects contrast sharply with the previous scenario that reduced only labor supply barriers and which resulted in a large decrease of real wages and profits for women.

Lastly, regarding the average and marginal ability of men and women entrepreneurs (Figures 6(a) and 6(b)), we observe that the average ability of male (female) entrepreneurs increases (decreases) relative to the baseline by 2.2 (6.3) percent, which is rationalized by the increase (decrease) in the ability of the marginal male (female) entrepreneur. In particular, this scenario nearly equalizes the ability of the marginal male and female entrepreneur (Figure 6(b)). However, the less productive male entrepreneurs (who exit) are now replaced by more productive female entrepreneurs (who enter). This reallocation channel improves the aggregate productivity in the economy by 1.5 percent across Indian states (with a 25th-75th percentile increase of 0.98-2.50 percent) and results in median real income gains of 37.8 percent (with a 25th-75th percentile gains of 30.2-48.9 percent).

Discussion: The counterfactual scenarios considered above lead to several policy-relevant insights. First, the barriers faced by women are substantial, both with respect to entrepreneurship and with respect to their participation in the labor force. Their removal has quantitatively meaningful impacts on aggregate productivity and welfare.

Second, policies targeting the intensive margin of growing a business through the hiring of workers have far greater impact than those targeting the fixed costs of entry and formalization. Intuitively, interventions that lower the costs of entry will have minimal impact on women's labor allocation decisions if distortions preventing them from succeeding post-entry remain in place.

Third, removing the barriers to operating businesses not only helps female entrepreneurs, it also benefits female workers relative to male workers in the form of higher real wages.

Fourth, policies that target women entrepreneurship, also improve female labor force participation, which is particularly important in the Indian setting where female labor force participation is low. This is both because more women become entrepreneurs and because, with more female entrepreneurs, more women are willing to enter the labor force as wage earners given that female entrepreneurs hire more female workers.

Fifth, policies that mitigate the excess costs to labor force participation alone significantly boost the labor supply of women. However, they do not boost the creation of female-owned businesses as much, thus depressing real wages and profits of women in equilibrium. Nevertheless, despite these lower wages, since more women are now wage earners, and the marginal women entrepreneurs who start firms replace less-productive male entrepreneurs, there are aggregate productivity and welfare gains in the economy.

Sixth, our results highlight the importance of addressing both labor supply and labor demand distortions. The elimination of barriers to female labor force participation increases (as expected) female labor force participation and boosts productivity and average real income. But the larger supply of women results in substantially lower real wages for them, while average profits in female-owned firms are stagnant. In contrast, boosting labor demand (in addition to labor supply) for women results in higher real wages and profits for them and larger aggregate productivity and real income gains.

Lastly, all our counterfactual scenarios highlight the presence of low productivity male-owned firms, who operate in the economy only because they do not face competition from female-owned firms. The latter cannot enter or grow post-entry because they face excessive barriers. Removing these barriers results in the marginal (low-productivity) male entrepreneurs exiting the market, allowing for the marginal (higher-productivity) female entrepreneurs to enter. In conclusion, affirmative action policies that can effectively target both the constraints to labor force participation as well as barriers to entrepreneurship are highly effective in boosting productivity and welfare, both for women and the economy as a whole.

7 Conclusion

Our analysis demonstrates that eliminating excess barriers to entrepreneurship facing women is beneficial not only to women, but to the entire economy. But it does not speak to the question of which specific policies would lead to elimination of such barriers. Barriers at both the extensive and intensive margins are modeled as "wedges" in our framework, and identified based on the data patterns in the Census data related to entrepreneurship. Further research needs to relate the estimated wedges to actual policies to assess which interventions are most effective. The main challenge is that several of these barriers are not due to legal constraints, but to norms and attitudes, which are more difficult to measure. This challenge notwithstanding, our work has two main policy-relevant messages: First, absent a comprehensive approach towards eliminating *all* gender distortions in the labor market, policies focused exclusively on increasing female LFP may have unintended adverse effects on female wages and profits of female entrepreneurs; complementing such policies with measures supporting female entrepreneurship ensures that the additional supply of women on the labor market is met with additional demand, and results in larger benefits for women. Second, interventions aimed at supporting female entrepreneurship will be more effective if they target the intensive margin (i.e., support existing female-owned enterprises) than the extensive margin (i.e., encourage new entry of female entrepreneurs).

Testing and implementing policy interventions at scale requires not only studying their implications for the labor force participation and entrepreneurial decisions of the women they directly target, but also assessing their impact on the labor supply decisions of all men and women, along with the resulting changes in wages and prices in equilibrium. In this regard, our analysis can prove helpful. Combining case studies of specific interventions to empower women with our framework can be a fruitful approach towards identifying the most promising policies in equilibrium.

References

Acemoglu, D., D. H. Autor, and D. Lyle (2004): "Women, War, and Wages: The Effect of Female Labor Supply on the Wage Structure at Mid-century," *Journal of Political Economy*, 112, 497–551.

Altonji, J. G. and R. M. Blank (1999): "Race and Gender in the Labor Market," *Handbook of Labor Economics*, 3, 3143–3259.

Ashraf, N., N. Bau, N. Nunn, and A. Voena (2020): "Bride Price and Female Education," *Journal of Political Economy*, 128, 591–641.

Banerjee, A. V. and A. F. Newman (1993): "Occupational Choice and The Process of Development," *Journal of Political Economy*, 101, 274–298.

Bansal, S. (2017): "Indian States and Women: Where are They Empowered, Where are They Not," *Hindustan Times. https://www. hindustantimes. com/interactives/women-empowerment-index.*

Bardasi, E., C. M. Blackden, and J. C. Guzman (2007): "Gender, Entrepreneurship, and Competitiveness in Africa," *Africa Competitiveness Report*, 1, 69–85.

Basu, R. and M. D. Thomas (2009): "Exploring Women's Daily Lives and Participation in the Informal Labour Market in Mumbai, India," *Gender & Development*, 17, 231–242.

Beck, T. and M. Hoseini (2014): "Informality and Access to Finance: Evidence from India," *Center Discussion Paper Series.*

Bento, P. (2020): "Female Entrepreneurship in the US 1982-2012: Implications for Welfare and Aggregate Output," Tech. rep.

Bertrand, M. (2011): "New Perspectives on Gender," *Handbook of Labor Economics*, 4, 1543–1590.

Bick, A., N. Fuchs-Schündeln, D. Lagakos, and H. Tsujiyama (2021): "Structural Change in Labor Supply and Cross-Country Differences in Hours Worked," Tech. rep., National Bureau of Economic Research.

Blau, F. D., M. A. Ferber, and A. E. Winkler (2014): "The Economics of Women, Men and Work," *Upper Saddle River, New Jersey: Pearson, 7th Edition*.

Chaudhuri, K., S. Sasidharan, and R. S. N. Raj (2020): "Gender, small firm ownership, and credit access: some insights from India," *Small Business Economics*, 54, 1165–1181.

Cuberes, D. and M. Teignier (2014): "Gender Inequality and Economic Growth: A Critical Review," *Journal of International Development*, 26, 260–276.

——— (2016): "Aggregate Effects of Gender Gaps in the Labor Market: A Quantitative Estimate," *Journal of Human Capital*, 10, 1–32.

De Giorgi, G., M. Paccagnella, and M. Pellizzari (2013): "Gender Complementarities in the Labor Market," *Bank of Italy Occasional Paper*.

Deshpande, A. and N. Kabeer (2019): "(In) Visibility, Care and Cultural Barriers: The Size and Shape of Women's Work in India," .

Deshpande, A. and S. Sharma (2013): "Entrepreneurship or Survival? Caste and Gender of Small Business in India," *Economic and Political Weekly*, 38–49.

Dix-Carneiro, R., P. K. Goldberg, C. Meghir, and G. Ulyssea (2021): "Trade and Informality in the Presence of Labor Market Frictions and Regulations," Tech. rep., National Bureau of Economic Research.

Evans, A. (2020): "Why are North and South India so Different on Gender?" https://www.draliceevans.com/post/why-are-southern-north-eastern-indian-states-more-gender-equal.

Fernández, R. (2013): "Cultural Change as Learning: The Evolution of Female Labor Force Participation over a Century," *American Economic Review*, 103, 472–500.

Fernández, R. and A. Fogli (2009): "Culture: An Empirical Investigation of Beliefs, Work, and Fertility," *American Economic Journal: Macroeconomics*, 1, 146–77.

Fernández, R., A. Fogli, and C. Olivetti (2004): "Mothers and Sons: Preference Formation and Female Labor Force Dynamics," *The Quarterly Journal of Economics*, 119, 1249–1299.

Fletcher, E., R. Pande, and C. M. T. Moore (2019): "Women and Work in India: Descriptive Evidence and a Review of Potential Policies," .

Ghani, E., W. R. Kerr, and S. D. O'Connell (2013): "Promoting Women's Economic Participation in India," .

——— (2014): "Political Reservations and Women's Entrepreneurship in India," *Journal of Development Economics*, 108, 138–153.

Ghosh, P. K. (2018): "A Study of the Long-run Substitutability Between Men and Women," IZA Conference Mimeo.

Govt. of India (2000): "Comprehensive Policy Package for Small Scale Industries," http://www.dcmsme.gov.in/MSME-DO/policypkg.htm.

Gruber, S. and M. Szołtysek (2016): "The Patriarchy Index: A Comparative Study of Power Relations Across Historical Europe," *The History of the Family*, 21, 133–174.

Hamermesh, D. S. (1996): *Labor Demand*, Princeton University Press.

Hsieh, C.-T., E. Hurst, C. I. Jones, and P. J. Klenow (2019): "The Allocation of Talent and US Economic Growth," *Econometrica*, 87, 1439–1474.

Hsieh, C.-T. and P. J. Klenow (2009): "Misallocation and Manufacturing TFP in China and India," *The Quarterly Journal of Economics*, 124, 1403–1448.

Hyland, M., S. Djankov, and P. K. Goldberg (2020): "Gendered Laws and Women in the Workforce," *American Economic Review: Insights*.

Jayachandran, S. (2020): "Microentrepreneurship in Developing Countries," .

Johnson, M. and M. P. Keane (2013): "A Dynamic Equilibrium Model of the US Wage Structure, 1968–1996," *Journal of Labor Economics*, 31, 1–49.

Kaboski, J. P. and R. M. Townsend (2011): "A structural evaluation of a large-scale quasi-experimental microfinance initiative," *Econometrica*, 79, 1357–1406.

Lahoti, R. and H. Swaminathan (2016): "Economic Development and Women's Labor Force Participation in India," *Feminist Economics*, 22, 168–195.

LaPorta, R. and A. Shleifer (2014): "Informality and Development," *Journal of Economic Perspectives*, 28, 109–126.

Morazzoni, M. and A. Sy (2021): "Female Entrepreneurship and Financial Frictions," .

Ngai, L. R. and B. Petrongolo (2017): "Gender Gaps and the Rise of the Service Economy," *American Economic Journal: Macroeconomics*, 9, 1–44.

Nikaido, Y., J. Pais, and M. Sarma (2015): "What Hinders and What Enhances Small Enterprises' Access to Formal Credit in India?" *Review of Development Finance*, 5, 43–52.

Olivetti, C. and B. Petrongolo (2014): "Gender Gaps Across Countries and Skills: Demand, Supply and the Industry Structure," *Review of Economic Dynamics*, 17, 842–859.

——— (2016): "The Evolution of Gender Gaps in Industrialized Countries," *Annual Review of Economics*, 8, 405–434.

Pitt, M. M., M. R. Rosenzweig, and M. N. Hassan (2012): "Human Capital Investment and the Gender Division of Labor in a Brawn-based Economy," *American Economic Review*, 102, 3531–60.

Plan International (2017): "Plan for Every Child Gender Vulnerability Index Report-1," https://smartnet.niua.org/sites/default/files/resources/gender-vulnerability-index.pdf.

Quinn, S. and C. Woodruff (2019): "Experiments and Entrepreneurship in Developing Countries," *Annual Review of Economics*, 11, 225–248.

Raj, R. S. and S. Sasidharan (2020): *Small Firm Ownership and Credit Constraints in India*, Routledge India.

Rao, N., A. Verschoor, A. Deshpande, and A. Dubey (2008): "Gender Caste and Growth Assessment–India," *Report submitted to DFID. http://www.uea.ac.uk/dev/publications/RPP8*.

Rendall, M. (2013): "Structural Change in Developing Countries: Has it Decreased Gender Inequality?" *World Development*, 45, 1–16.

Restuccia, D. and R. Rogerson (2017): "The Causes and Costs of Misallocation," *Journal of Economic Perspectives*, 31, 151–74.

Roy, A. D. (1951): "Some Thoughts on the Distribution of Earnings," *Oxford Economic Papers*, 3, 135–146.

Singh, A., P. Chokhandre, A. K. Singh, K. M. Barker, K. Kumar, L. McDougal, K. James, and A. Raj (2021): "Development of the India Patriarchy Index: Validation and Testing of Temporal and Spatial Patterning," *Social Indicators Research*, 1–27.

Udry, C. (1996): "Gender, Agricultural Production, and the Theory of the Household," *Journal of Political Economy*, 104, 1010–1046.

Ulyssea, G. (2018): "Firms, Informality, and Development: Theory and Evidence from Brazil," *American Economic Review*, 108, 2015–47.

——— (2020): "Informality: Causes and Consequences for Development," *Annual Review of Economics*, 12, 525–546.

Weinberg, B. A. (2000): "Computer Use and the Demand for Female Workers," *ILR Review*, 53, 290–308.

World Bank (2012): *World Development Report 2012 : Gender Equality and Development*, washington, DC.

World Bank (2020): "World Bank Enterprise Surveys," Data from http://www.enterprisesurveys.org.

Tables

Table 1: Summary Statistics

Firm type	Total firms		Firm size		Frac. Female Emp.	
	1998	2005	1998	2005	1998	2005
	(1)	(2)	(3)	(4)	(5)	(6)
Male, Informal	11.58	15.83	3.29	3.01	0.19	0.21
	(92.75%)	(91.93%)	(3.68)	(2.79)	(0.25)	(0.25)
Male, Formal	0.08	0.14	77.47	67.69	0.21	0.25
	(0.65%)	(0.82%)	(438.82)	(166.19)	(0.25)	(0.30)
Female, Informal	0.82	1.24	2.96	2.81	0.57	0.58
	(6.57%)	(7.21%)	(2.98)	(2.82)	(0.33)	(0.31)
Female, Formal	0.00	0.01	97.87	76.63	0.45	0.48
	(0.02%)	(0.04%)	(1118.20)	(130.07)	(0.37)	(0.40)
Total	12.48	17.22				

Notes: A firm is classified as "informal" if it is either not registered with the govt. or does not have to pay taxes (fewer than 10 workers or fewer than 20 workers without electricity), and "formal" otherwise. Numbers in columns (1)-(2) are reported in millions. Percentage of the total are reported in parentheses below. Firm size in columns (3) and (4) report the average employees within a firm. Frac. of Female Emp. in columns (5) and (6) are the fraction of female employees within a firm. Standard deviations are reported in parentheses below.

Table 2: List of Parameters

Parameter	Details	Targeted Moments
α	Share of each industry in consumer demand	Share of firm sales in industry j as a frac. of the economy
ρ	Returns to scale in production	Avg. labor share in sales
γ	EoS b/w male and female workers	Set to 2.1 from the literature
t_{jr}	Tax in formal sector	Avg. sales tax in ASI
λ_j	Size-based penalty of operating in the informal sector	Ratio of avg. firm size of informal and formal male-owned firms
T_{jr}	Aggregate production technology	Ratio of avg. firm size of male-owned formal firms across industries
A_{sjr}	Female (relative to male) worker productivity	Ratio of female-male workers in male-owned firms across industries
$\{\sigma_x^2, \theta_g\}$	Variance of the productivity distribution	Variance of male & female firm size in the formal sector
$\overline{u}_g$	Disutility of LFP	Gender-specific LFP rate
$\{E_I, E_R\}$	Fixed costs of entrepreneurship and formalization	No. of entrepreneurs in the formal & informal sector as a frac. of the labor force
τ_{gs}	Hiring barriers	Ratio of avg. firm size of female-owned to male-owned firms
τ_{gs}^f	Hiring barriers	Ratio of avg. female-male workers in female-owned to male-owned firms

Table 3: Parameter Values

	1998 Agri.	1998 Manf.	1998 Services	2005 Agri.	2005 Manf.	2005 Services
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Parameter values that vary by industry						
A_I	0.65	0.66	1.00	0.64	0.67	1.00
A_F	0.16	0.33	1.00	0.42	0.29	1.00
T	0.54	1.90	1.00	0.46	2.12	1.00
λ	0.84	0.81	0.78	0.85	0.85	0.85
	(0.005)	(0.002)	(0.003)	(0.007)	(0.003)	(0.004)
Panel B: Ability distribution parameters						
$\widetilde{\theta}_m$	2.66			2.74		
	(0.21)			(0.04)		
$\widetilde{\theta}_f$	2.64			2.61		
	(0.09)			(0.03)		
σ_x	0.13			0.11		
	(.002)			(0.004)		

Notes: Each of the first three rows in Panel A reports the average values for the parameter across regions. Columns (1)-(3) report the parameter values for each industry in 1998 while columns (4)-(6) report the parameter values for each industry in 2005. The parameter λ varies only by industry (standard errors in parentheses). Parameters in Panel B do not vary by industry or regions, and hence only the values for each year are reported in columns (1) and (4) for 1998 and 2005 respectively. Bootstrapped standard errors are reported in parentheses.

Table 4: Estimates for Fixed Costs and Hiring Distortions

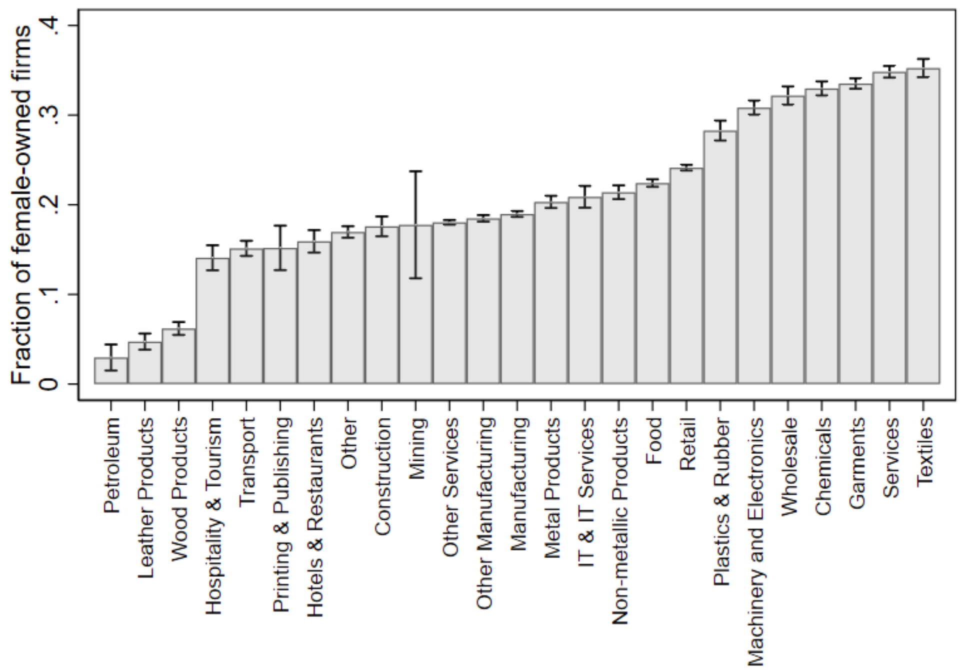
	1998	2005	(2)-(1)
	(1)	(2)	(3)
Panel A: Normalized LFP costs ($\overline{u}$):			
Male	1.00	0.84	-0.16
	[0.62]	[0.23]	
Female	3.16	2.03	-1.12
	[1.86]	[1.16]	
Panel B: Normalized Entry Costs (E_I):			
Male	1.00	0.58	-0.42
	[0.50]	[0.38]	
Female	0.31	0.47	0.16
	[0.41]	[0.36]	
Panel C: Normalized Formalization Costs (E_I):			
Male	1.00	1.03	0.03
	[0.94]	[0.94]	
Female	0.94	1.55	0.62
	[0.97]	[1.88]	
Panel D: Hiring distortions $\{\tau_{fs}, \tau_{fs}^{f}\}$:			
$1 + \tau_{fI}$	1.11	1.09	-0.02
	[0.08]	[0.08]	
$1 + \tau_{fF}$	1.16	1.18	0.02
	[0.37]	[0.28]	
$1 + \tau_{fI}^{f}$	0.95	0.94	-0.01
	[0.05]	[0.03]	
$1 + \tau_{fF}^{f}$	2.04	1.13	-0.91
	[2.78]	[0.76]	

Notes: Each row reports the average (across industries and regions) value of each parameter with standard deviations in parentheses below. LFP, Entry and Formalization costs across all firms have been normalized so that male-owned firms in 1998 have mean 1. Columns (1) and (2) report the value for 1998 and 2005 respectively. Column (3) reports the difference between columns (2) and (1).

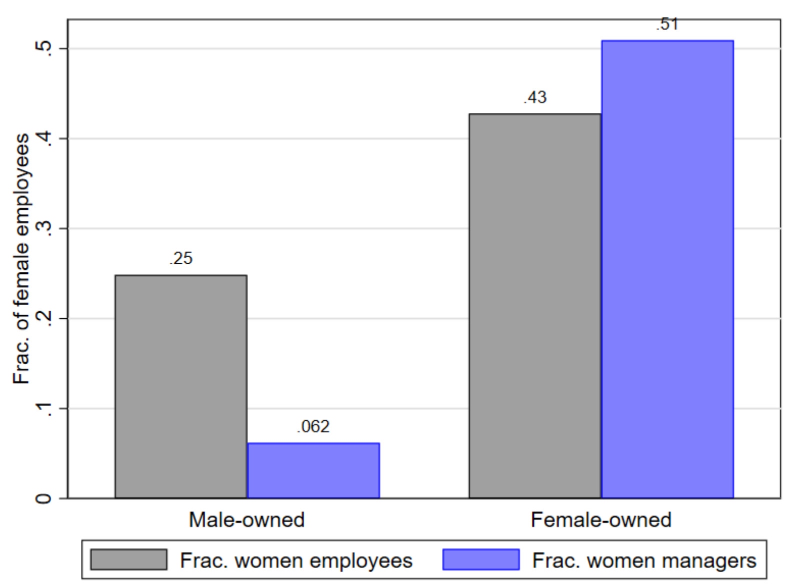
Figures

Figure 1: Share of Women Entrepreneurs, Employees and Managers

(a) Fraction of female entrepreneurs across industries

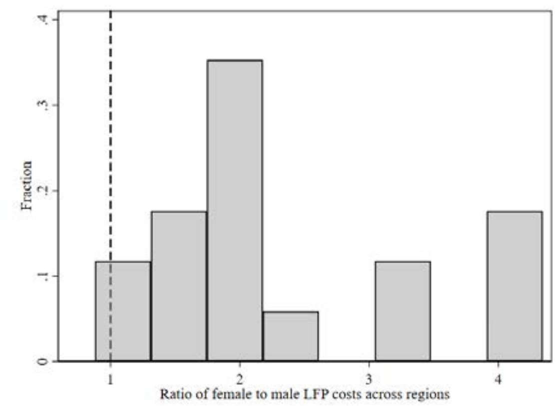


(b) Fraction of women employees and managers

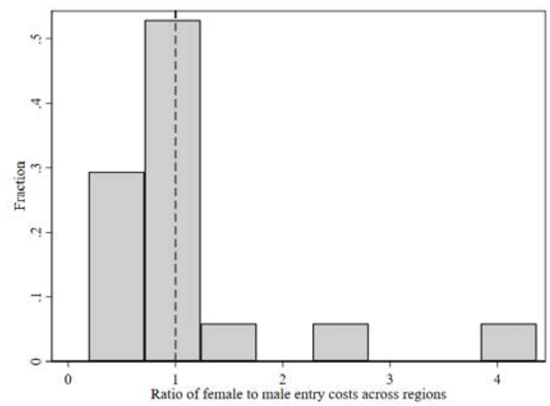


Notes: Both figures use the World Bank Enterprise Surveys. Figure 1(a) plots the average fraction of female-owned firms across 25 sectors. Figure 1(b) plots the fraction of women employees and the probability that the top manager in a firm is a female.

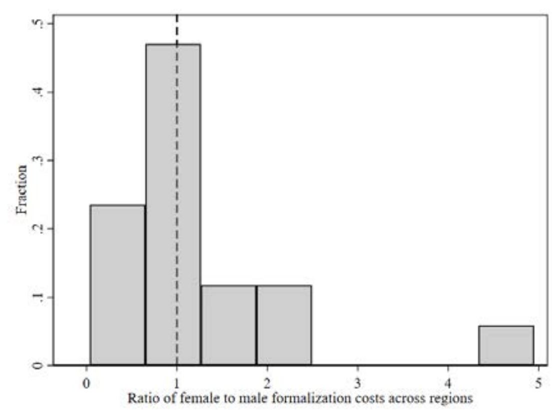
Figure 2: Excess Entry Barriers for Female Entrepreneurs across Industries



(a) Ratio of female-male LFP costs



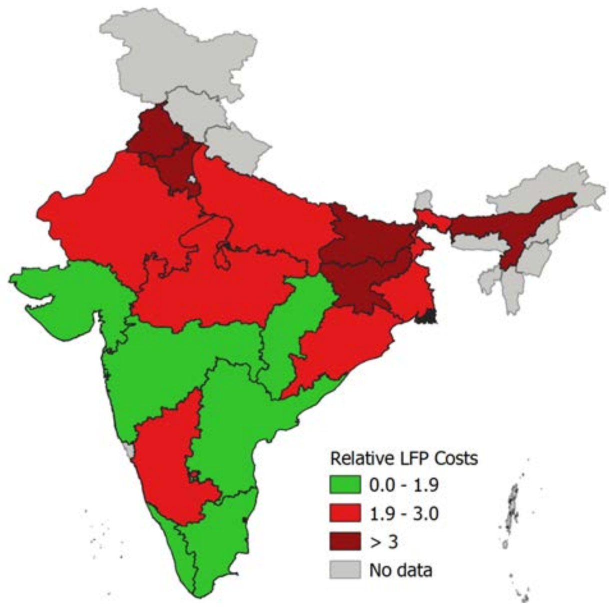
(b) Ratio of female-male entry costs



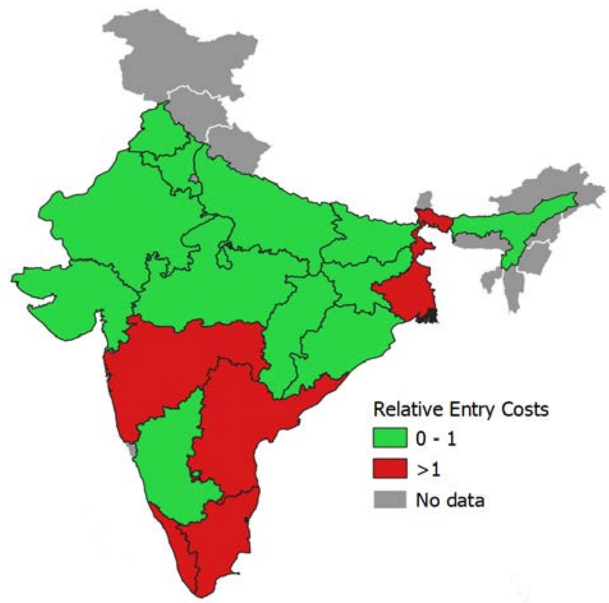
(c) Ratio of female-male formalization costs

Notes: Figures (a), (b) and (c) plots the distribution of the ratio of female to male LFP, entry and formalization costs i.e., $\overline{u}_f/\overline{u}_m$, E_{fI}/E_{mI} and E_{fR}/E_{mR} across regions in 2005.

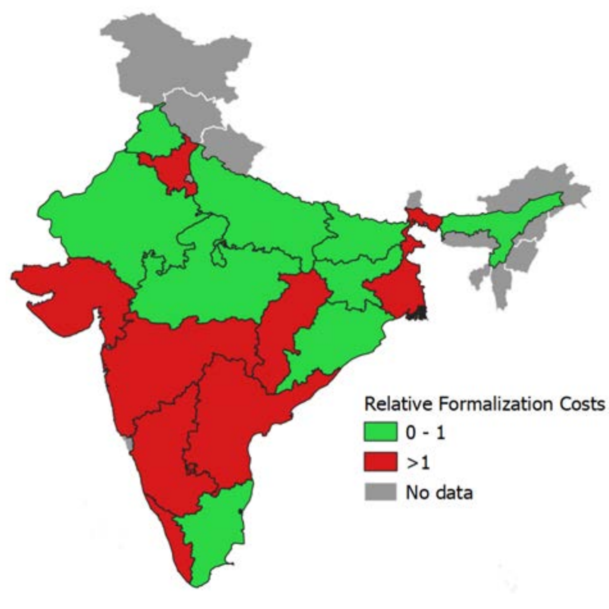
Figure 3: Excessive Entry Barriers for Women Entrepreneurs across States



(a) Relative LFP costs



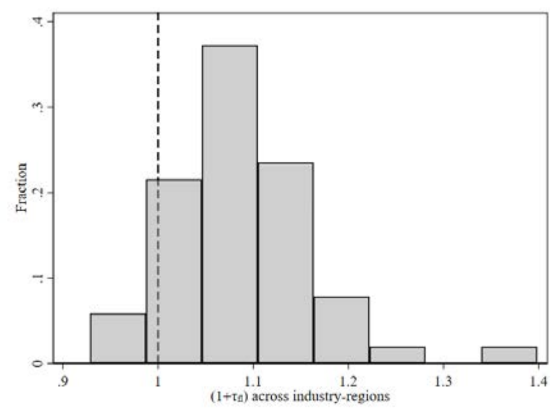
(b) Relative entry costs



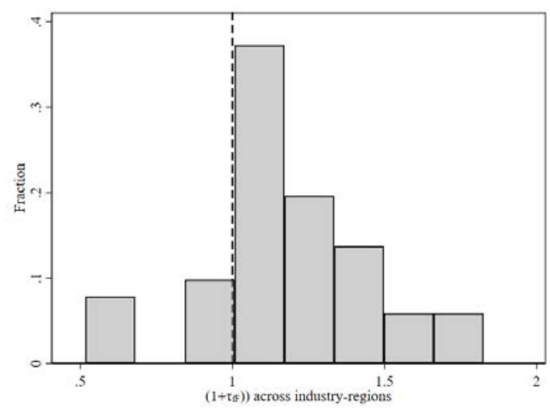
(c) Relative formalization costs

Notes: Maps (a), (b) and (c) plot the the ratio of female to male LFP, entry and formalization costs i.e., $\overline{u}_f/\overline{u}_m$, E_{fI}/E_{mI} and E_{fR}/E_{mR} across Indian states in 2005.

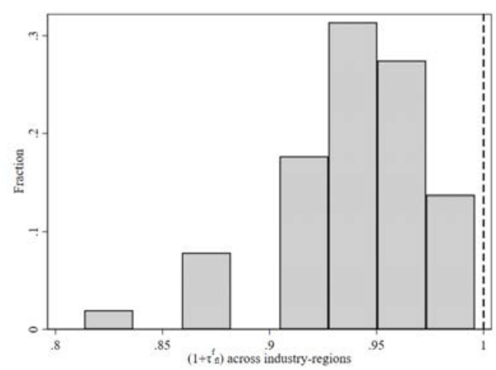
Figure 4: Hiring Barriers in the Formal and Informal Sectors



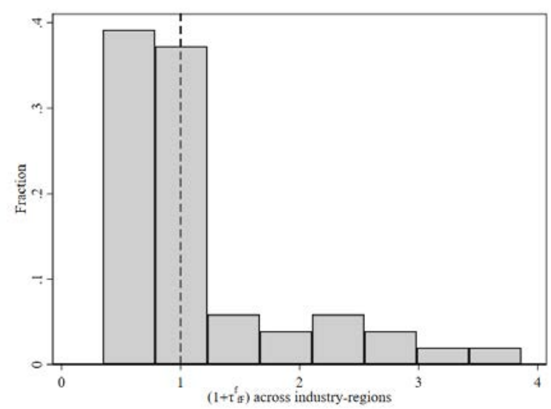
(a) $1 + \tau_{fI}$



(b) $1 + \tau_{fF}$



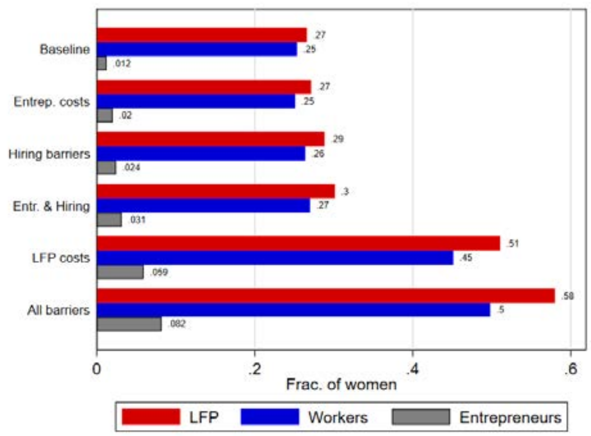
(c) $1 + \tau^f_{fI}$



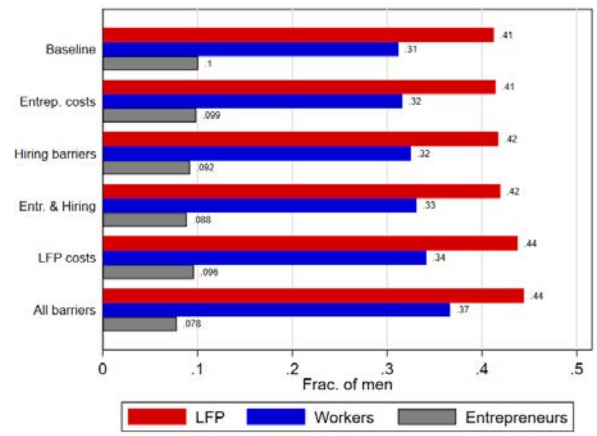
(d) $1 + \tau^f_{fF}$

Notes: Figures (a)-(b) plot the distribution of hiring barriers faced by women entrepreneurs (relative to men) across regions and industries in the informal and formal sectors in 2005 i.e., $1_{\tau fs}$. Figures (c)-(d) plot the distribution of barriers faced by women entrepreneurs (relative to male entrepreneurs) in hirng female workers (relative to male workers) i.e., i.e., $1_{\tau^f_{fs}}$.

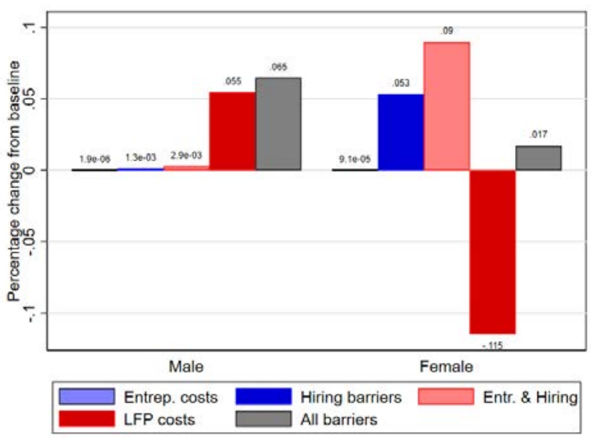
Figure 5: Impact of Affirmative Action Policies on Female LFP, Entrepreneurship and Earnings



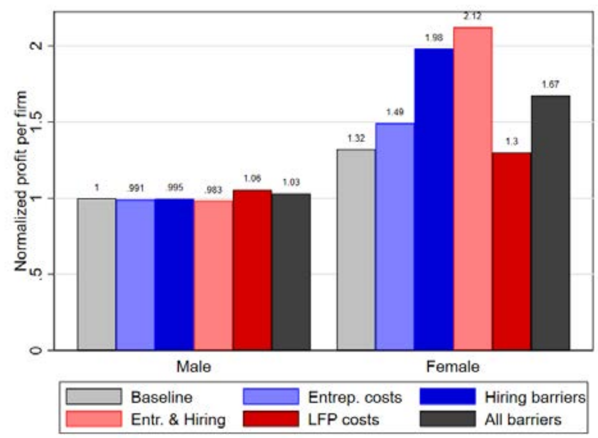
(a) Distribution of females



(b) Distribution of males



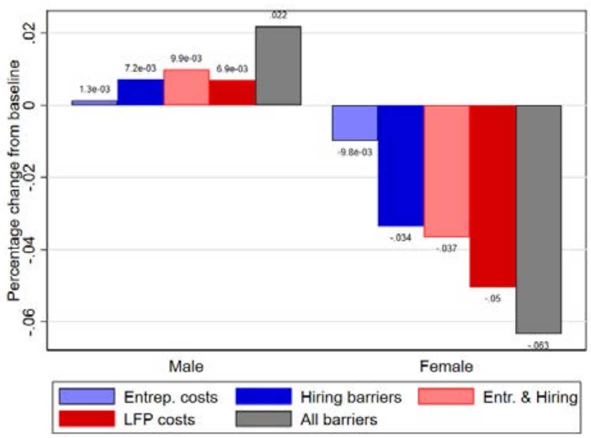
(c) Real wages



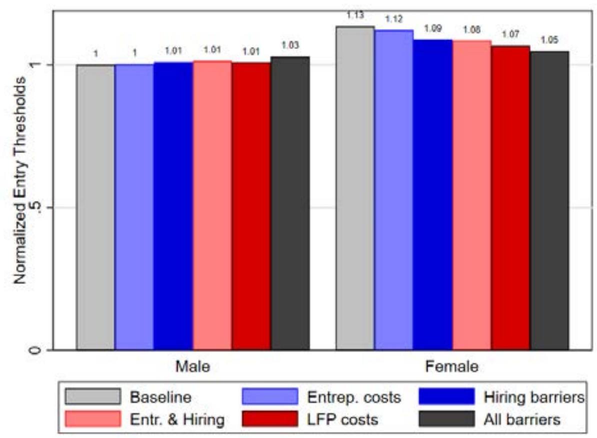
(d) Real profits per firm

Notes: The above figures report the impact of five affirmative action policies: (i) Entrep. costs removes the excess fixed costs (E_I and E_R) faced by women entrepreneurs; (ii) Hiring barriers sets $\tau_f > 0$ and $\tau_f^f > 0$ to 0; (iii) removed all excess fixed costs and hiring barriers in (i) and (ii) above; (iv) sets the entrepreneurial costs and hiring barriers to their baseline, but only removes excess LFP costs i.e., sets $\overline{u}_f = \min\{\overline{u}_m, \overline{u}_f\}$; (v) removes all excess barriers in (iii) and (iv). For each policy, Figures (a) and (b) show the distribution of women and men in the economy in the labor force and between wage and self-employment. Figures (c) and (d) show the effect of each policy on real wages and real average profits for male and female workers and entrepreneurs respectively.

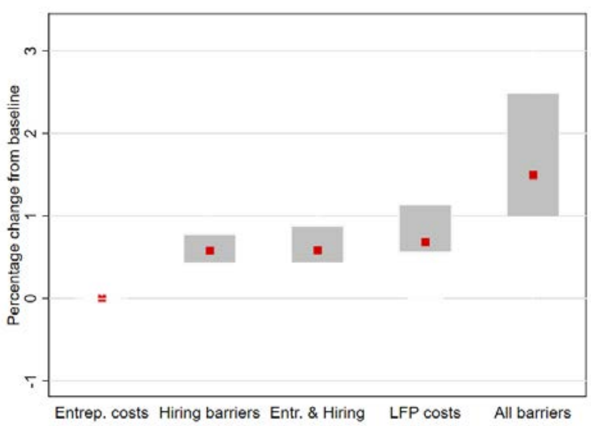
Figure 6: Impact of Affirmative Action Policies on Productivity and Welfare



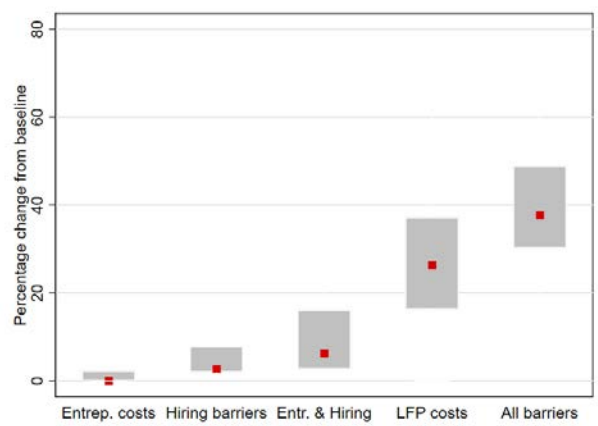
(a) Average ability of entrepreneurs



(b) Ability of the marginal entrepreneur



(c) Change in Aggregate Productivity



(d) Change in Real Income

Notes: The above figures report the impact of five affirmative action policies: (i) Entrep. costs removes the excess fixed costs (E_I and E_R) faced by women entrepreneurs; (ii) Hiring barriers sets $\tau_f > 0$ and $\tau_f^f > 0$ to 0; (iii) removed all excess fixed costs and hiring barriers in (i) and (ii) above; (iv) sets the entrepreneurial costs and hiring barriers to their baseline, but only removes excess LFP costs i.e., sets $\overline{u}_f = \min\{\overline{u}_m, \overline{u}_f\}$; (v) removes all excess barriers in (iii) and (iv). For each policy, Figures (a) and (b) show the ability of the average and marginal entrepreneur respectively. Figures (c)-(d) show the changes in aggregate productivity and real income across the economy as compared to the baseline.

ONLINE APPENDIX

A Additional Tables and Figures

Table A1: Total Firm size and Composition Across Gender and Sectors

	Log(L) 1998	Log(L) 2005	Frac. female emp. 1998	Frac. female emp. 2005
	(1)	(2)	(3)	(4)
Panel A: Without industry fixed effects				
Female	-0.0162	-0.0297	0.298	0.288
	(0.0176)	(0.00466)	(0.0138)	(0.0130)
Formal	2.448	2.575	0.0647	0.0792
	(0.0328)	(0.0309)	(0.00941)	(0.0103)
Female × Formal	0.234	0.171	-0.122	-0.0910
	(0.141)	(0.0441)	(0.0401)	(0.0198)
R^2	0.210	0.283	0.341	0.316
Panel B: With industry fixed effects				
Female	-0.0123	-0.0451	0.233	0.236
	(0.0135)	(0.00612)	(0.00956)	(0.00781)
Formal	2.132	2.417	0.0428	0.0562
	(0.0340)	(0.0353)	(0.00818)	(0.00915)
Female × Formal	0.329	0.173	-0.0920	-0.0632
	(0.166)	(0.0473)	(0.0282)	(0.0166)
N	12.48m	17.22m	12.48m	17.22m
R^2	0.338	0.345	0.472	0.402
Male, Informal	1.007	0.970	0.189	0.205
Firm controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes

Notes: Female and Formal are dummy variables that take the value 1 if the firm is female-owned or if it is in the formal sector and 0 otherwise. Firm controls used are: whether the firm has access to power; dummy variables for different forms of financial access; whether the firm is primarily agriculture-based; and whether the firm is in the rural or urban area. Industry fixed effects are at the four-digit level using the NIC98 for 1998 and NIC04 for 2005. Standard errors are clustered at the district level.

Table A2: Total Firm Size and Composition across Gender and Sectors, Excluding Family-owned Firms

	Log(L)		Frac. female emp.	
	1998	2005	1998	2005
	(1)	(2)	(3)	(4)
Panel A: Without industry fixed effects				
Female	0.0489	-0.0439	0.326	0.322
	(0.0471)	(0.00716)	(0.0227)	(0.0127)
Formal	2.290	2.510	0.115	0.114
	(0.0318)	(0.0310)	(0.00897)	(0.0102)
Female × Formal	-0.0160	0.209	-0.180	-0.139
	(0.0815)	(0.0431)	(0.0293)	(0.0174)
R^2	0.227	0.308	0.233	0.216
Panel B: With industry fixed effects				
Female	-0.00768	-0.0782	0.264	0.267
	(0.0285)	(0.00776)	(0.0169)	(0.00806)
Formal	1.933	2.333	0.0747	0.0875
	(0.0302)	(0.0357)	(0.00749)	(0.00865)
Female × Formal	0.0742	0.241	-0.145	-0.113
	(0.0613)	(0.0473)	(0.0231)	(0.0141)
N	5.23m	9.88m	5.23m	9.88m
R^2	0.378	0.380	0.368	0.293
Male, Informal	1.192	1.059	0.0855	0.126
Firm controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes

Notes: The sample is restricted to firms that are not "family-owned". Family-owned firms are defined as those firms where more than half the employees are not hired on wage contracts. Female and Formal are dummy variables that take the value 1 if the firm is female-owned or if it is in the formal sector and 0 otherwise. Firm controls used are: whether the firm has access to power; dummy variables for different forms of financial access; whether the firm is primarily agriculture-based; and whether the firm is in the rural or urban area. Industry fixed effects are at the four-digit level using the NIC98 for 1998 and NIC04 for 2005. Standard errors are clustered at the district level.

Table A3: Derivatives of Moments to Parameters

Moment	A_I	A_F	τ_I^f	τ_F^f	τ_I	τ_F	λ	T
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Sample from the 1998 Round of the Economic Census								
$R_{mI,j}/R_{mI,Serv.}$	**0.67**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$R_{mF,j}/R_{mF,Serv.}$	0.00	**0.65**	0.00	0.00	0.00	0.00	0.00	0.00
$R_{fI,j}/R_{mI,j}$	0.00	0.00	**-2.20**	0.00	0.00	0.00	0.00	0.00
$R_{fF,j}/R_{mF,j}$	0.00	0.00	0.00	**-8.80**	0.00	0.00	0.00	0.00
$\bar{l}_{fI,j}/\bar{l}_{mI,j}$	0.15	0.05	-0.48	0.04	**-1.28**	0.21	-0.37	0.04
$\bar{l}_{fF,j}/\bar{l}_{mF,j}$	0.09	0.07	-0.17	-0.44	-0.41	**-0.81**	-0.11	0.02
$\bar{l}_{mF,j}/\bar{l}_{mI,j}$	-0.15	0.22	0.02	0.01	0.02	0.01	**-1.99**	-0.01
$\bar{l}_{mF,j}/\bar{l}_{mF,Serv.}$	0.01	0.20	0.00	-0.03	0.00	0.03	0.01	**0.47**
Panel B: Sample from the 2005 Round of the Economic Census								
$R_{mI,j}/R_{mI,Serv.}$	**0.67**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$R_{mF,j}/R_{mF,Serv.}$	0.00	**0.75**	0.00	0.00	0.00	0.00	0.00	0.00
$R_{fI,j}/R_{mI,j}$	0.00	0.00	**-2.21**	0.00	0.00	0.00	0.00	0.00
$R_{fF,j}/R_{mF,j}$	0.00	0.00	0.00	**-3.56**	0.00	0.00	0.00	0.00
$\bar{l}_{fI,j}/\bar{l}_{mI,j}$	0.11	0.09	-0.43	0.19	**-1.41**	0.22	-0.66	0.09
$\bar{l}_{fF,j}/\bar{l}_{mF,j}$	0.08	0.12	-0.17	-0.56	-0.51	**-0.61**	-0.18	0.10
$\bar{l}_{mF,j}/\bar{l}_{mI,j}$	-0.15	0.33	0.01	0.04	0.02	0.03	**-2.12**	-0.07
$\bar{l}_{mF,j}/\bar{l}_{mF,Serv.}$	0.01	0.21	0.00	0.00	0.00	0.00	-0.02	**0.71**

Notes: This table reports the derivatives of each moment with respect to each parameter. Each row is a moment calculated from the model simulation. Each number in the table indexed by row R and column C, is the percent change in the moment in row R, when a parameter in column C is increased by 1 percentage point. The largest value in each column is bold faced and underlined. Panel A (B) reports the results from the 1998 (2005) Round of the Economic Census. R_{gsj} and $\bar{l}_{gsj}$ are the ratio of female-male workers and the average size of a firm owned by an entrepreneur of gender g in sector s and industry j.

Table A4: Model Fit I

	Male		Female	
	Data	Model	Data	Model
	(1)	(2)	(3)	(4)
Panel A: Occupational choice of individuals				
1-LFP	0.58	0.59	0.73	0.73
	(0.04)	(0.04)	(0.07)	(0.07)
Frac. Wage Emp.	0.31	0.31	0.25	0.25
	(0.04)	(0.04)	(0.07)	(0.07)
Frac. Inf. Entrp.	0.11	0.10	0.02	0.01
	(0.01)	(0.03)	(0.01)	(0.01)
Frac. Formal Entrp.	0.001	0.001	0.0001	0.0002
	(0.0005)	(0.0001)	(0.0001)	(0.0001)
Panel B: Ratio of female-male workers in a firm				
Informal	0.98	0.99	1.11	1.11
	(0.09)	(0.11)	(0.15)	(0.16)
Formal	1.65	1.64	2.17	2.17
	(2.69)	(2.65)	(6.54)	(6.47)

Notes: Each row reports the average value across regions with the standard deviation in parentheses. Columns (1)-(2) report the moments for men, while (3)-(4) report those for women. Columns (1) and (3) report the moments in the Data, while (2) and (4) report their simulated counterparts from the Model. Panel A reports the allocation of men/women in the economy with the fraction of individuals who are (a) not in the labor force; (ii) in wage employment; (iii) informal entrepreneurship and (iv) formal entrepreneurship. Panel B reports the ratio of female to male workers in an informal and formal male-owned (Coumns 1-2) and female-owned firm (Columns 3-4).

Table A5: Model Fit II

	Male		Female	
	Data	Model	Data	Model
	(1)	(2)	(3)	(4)
Panel A: Ratio of average firm size				
$\bar{l}_{gI}/\bar{l}_{mI}$	1	1	1.01	1.09
	(0)	(0)	(0.18)	(0.24)
$\bar{l}_{gF}/\bar{l}_{mF}$	1	1	0.97	1.25
	(0)	(0)	(0.71)	(0.85)
$\bar{l}_{gF}/\bar{l}_{gI}$	21.57	18.36	18.32	19.05
	(5.89)	(24.54)	(15.20)	(42.11)
Panel B: Average firm size				
Informal	4.21	4.28	4.37	4.92
	(0.70)	(3.05)	(0.40)	(3.73)
Formal	95.09	93.99	113.05	126.77
	(43.61)	(80.24)	(93.83)	(116.71)
Panel C: Std. Deviation of firm size				
Informal	3.60	1.49	3.58	1.77
	(1.34)	(1.16)	(1.16)	(1.40)
Formal	184.70	42.85	156.75	59.15
	(108.7)	(38.12)	(175.14)	(63.99)

Notes: Each row reports the average value across regions with the standard deviation in parentheses. Columns (1)-(2) report the moments for men, while (3)-(4) report those for women. Columns (1) and (3) report the moments in the Data, while (2) and (4) report their simulated counterparts from the Model. Panel A reports the ratio of the average firm size for: (i) firms of gender g relative to male-owned firms in the informal sector; (ii) firms of gender g relative to male-owned firms in the formal sector and (iii) firms of gender g in the formal relative to the informal sector. Panel B reports the average firm-size in the informal and formal sector and Panel C reports the standard deviation for those firms.

Table A6: Correlations of Cost Estimates and Measures of Women Empowerment

	WEI	GVI	PI	Pol. Res.
	(1)	(2)	(3)	(4)
Panel A: Relative LFP Costs				
Index	-0.188	-0.285	0.245	0.0235
	(0.104)	(0.148)	(0.0702)	(0.336)
R^2	0.304	0.351	0.445	0.247
Panel B: Relative Entrepreneurial Entry Costs				
Index	0.324	0.487	-0.574	0.329
	(0.295)	(0.323)	(0.193)	(0.524)
R^2	0.542	0.563	0.689	0.521
Panel C: Relative Formalization Costs				
Index	0.0162	0.245	-0.119	-0.827
	(0.248)	(0.221)	(0.131)	(0.526)
R^2	0.259	0.281	0.272	0.335
N	34	34	34	34

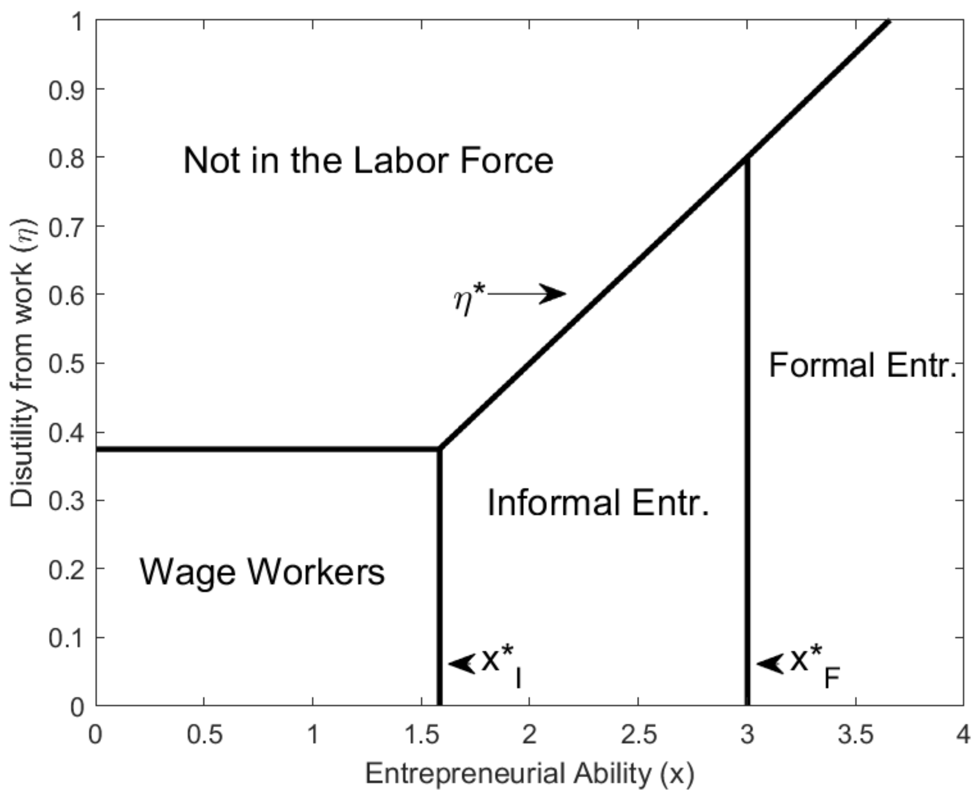
Notes: The dependent variables in Columns (1)-(3) are the LFP costs, Entry Costs in Columns (4)-(6) and Formalization costs in Columns (7)-(9). The Index variable is three measures of social norms and women empowerment, namely: Women Empowerment Index or WEI (Bansal, 2017), Gender Vulnerability Index or GVI (Plan International, 2017), and Patriarchal Index or PI (Singh et al., 2021). Each index is normalized to have mean 0 and standard deviation 1. Res. Yrs. in Panel B are the years since the first time electoral quotas were instituted in a state for women. All regressions control for the GDP of the state, fraction of population in urban areas and fraction of population comprising of SC/ST castes along with year fixed effects. Bootstrapped standard errors are reported in parantheses.

Table A7: Correlations of Hiring Barriers and Measures of Women Empowerment

	Informal			Formal		
	WEI	GVI	PI	WEI	GVI	PI
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Hiring barriers $(1+\tau_{fsj})$						
Index	-0.0189	-0.0202	-0.00472	0.0612	-0.0555	-0.0332
	(0.0106)	(0.0185)	(0.00765)	(0.0753)	(0.0949)	(0.0338)
R^2	0.317	0.314	0.307	0.109	0.105	0.107
Panel B: Hiring barriers for female relative to male workers $(1+\tau^f_{fsj})$						
Index	0.0145	0.00895	-0.00461	0.0483	0.124	-0.194
	(0.00536)	(0.00674)	(0.00242)	(0.458)	(0.266)	(0.178)
R^2	0.237	0.215	0.216	0.272	0.273	0.277
N	102	102	102	102	102	102

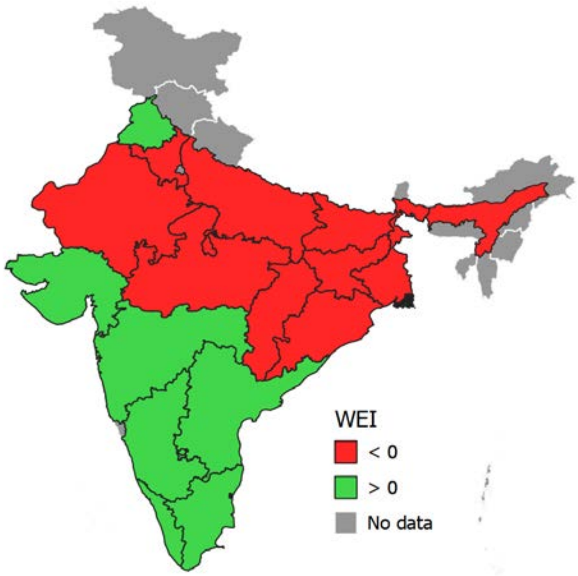
Notes: The dependent variable in Panel A is $1+\tau_{fsj}$ and $1+\tau^f_{fsj}$ in Panel B. Columns (1)-(3) use the dependent variable for the informal sector, while Columns (4)-(6) use the barriers in the formal sector. The Index variable is three measures of social norms and women empowerment, namely: Women Empowerment Index or WEI (Bansal, 2017), Gender Vulnerability Index or GVI (Plan International, 2017), and Patriarchal Index or PI (Singh et al., 2021). Each index is normalized to have mean 0 and standard deviation 1. Res. Yrs. All regressions control for the GDP of the state, fraction of population in urban areas, fraction of population comprising of SC/ST castes, labor force participation rate, along with fixed effects for year and industry. Bootstrapped standard errors stratified by states are reported in parantheses.

Figure A1: Graphical Representation of LFP Decisions

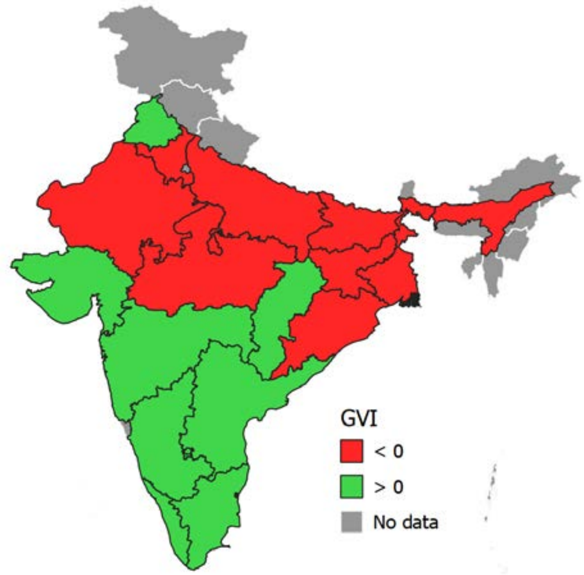


Notes: The above graph shows the relationship between how an individual's entrepreneurial ability (x) and disutility of work (η) affects his/her labor force participation decisions.

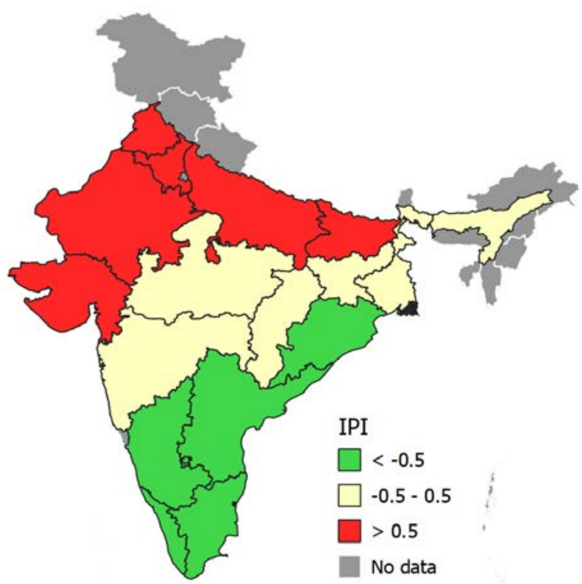
Figure A2: Women Empowerment, Gender Vulnerability and Patriarchy Index across States



(a) Women Empowerment Index



(b) Gender Vulnerability Index



(c) Patriarchy Index

Notes: The above maps show three indices that measure women empowerment in a state, namely: (a) Women Empowerment Index (Bansal, 2017); (b) Gender Vulnerability Index (Plan International, 2017) and (c) Patriarchy Index (Singh et al., 2021). Each index has been standardized to have mean 0 and standard deviation 1.

B Firm Ownership in the Enterprise Surveys

We use the World Bank's Enterprise Surveys World Bank (2020), henceforth WBES, to compare the characteristics of male-owned and female-owned firms. As discussed earlier, the WBES are detailed firm-level surveys of a representative sample of the economy's private sector. In particular, they have detailed questions with respect to the output and revenue of firms, along with the composition of their employment, interactions with the government (inspections, bribes, taxes, etc.) and lastly, the subjective evaluation of the respondent on the obstacles faced by the firm. We use a sample of around 140k firms across 141 countries and 13 years (2006-2018). We report the difference across male-owned and female-owned firms. We define a firm as female-owned if a majority of its owners are women.

To begin, in table B1, we report the characteristics of these firms and examine whether they differ based on the gender of the owner. For each charactersitic y, the average value for male and female-owned firms is reported in columns (2) and (3). Column (4) reports the raw difference between these means, while column (5) reports the coefficient β from the following regression:

$$y_{ict} = \alpha_c + \alpha_t + \alpha_s + \beta F_i + \gamma X_{ict} + \varepsilon_{ict} \tag{13}$$

where: y_i is the characteristic of interest for a firm i in country c in year t (such as sales, wage bill, etc.); α_c, α_t, α_s are country, year and sector fixed effects respectively; F_i is a dummy variable for whether the firm is female-owned or not; X_i are a set of firm-level controls (such as firm age). We cluster the standard errors at the country-level. β, our coefficient of interest is reported in column (5) or table B1. Lastly, for a better interpretation of the values in columns (5) and (6), we report them as a percent of the male-owned firm average (column (2)) in parentheses below.

We now turn to interpreting the results in table B1, where it is evident from column (4) that female-owned firms are smaller than male-owned firms along almost every dimension. First, they have around 5-8% lower sales and wages, 8% less number of establishments and 32% lesser workers. They are also around 30% less likely to take out formal loans, spend 11% more time on dealing with bureaucracies and 33% less likely to have secured a government contract in the last year. As reported in column (6), these results are robust after controlling unobservable differences across countries, sectors and over time, and the differences remain substantial in magnitude. One striking difference between these two types of firms however is the fraction of female workers is 17.9 pp (over 70%) higher in female-owned firms, while the probability that a firm with a top manager (not the owner) as a female is almost 45 pp (over 700%) more likely to be a female-owned firm.

Table B1: Differences in Male-owned and Female-owned Firms

	N	Male Mean/SE	Female Mean/SE	(3)-(2) Raw	 Coefficient
	(1)	(2)	(3)	(4)	(5)
Sales (USD millions)	101024	2.773	2.625	-0.147	-0.547
		[0.025]	[0.053]	[-5.3%]	[-13.44%]
Wage bill (USD millions)	98847	0.268	0.246	-0.022	-0.0498
		[0.002]	[0.005]	[-8.21%]	[-12.15%]
Number of Establishments	109490	1.685	1.551	-0.134	-0.135
		[0.014]	[0.026]	[-7.95%]	[-8.1%]
Total workers	118436	55.024	37.558	-17.466	-21.74
		[1.079]	[1.753]	[-31.74%]	[-22.95%]
Frac. Female workers	118392	0.249	0.428	0.179	0.124
		[0.001]	[0.002]	[71.89%]	[55.86%]
Frac. With top manager female	96373	0.062	0.509	0.447	0.455
		[0.001]	[0.004]	[720.97%]	[700%]
Frac. Formal loans	106579	0.112	0.079	-0.032	-0.00784
		[0.001]	[0.001]	[-28.57%]	[-6.17%]
Pct. Time spent on bureaucracy	110131	0.090	0.080	-0.010	0.0142
		[0.001]	[0.001]	[-11.11%]	[13.65%]
Secured govt. contract in last year?	101571	0.142	0.096	-0.046	-0.0397
		[0.001]	[0.002]	[-32.39%]	[-22.69%]

Notes: The mean for every variable is reported for male-owned firms in column (2) and female-owned firms in column (3). The standard errors are reported in parentheses for both these columns. Column (4) reports the raw difference between columns (3) and (2), while column (5) reports the regression coefficient for the regression. The coefficient as a percentage of the male-owned mean in column (2) are reported in parentheses below. All regressions have country, year and sector fixed effects. Standard errors are clustered at the country-level.

C Mathematical Proofs

C.1 Incumbent Firm Decisions

The problem of a firm with productivity z in a sector s (dropping gender and industry for notational ease) is given by:

$$\max \; p_s z l^{\rho_s} - \frac{1}{T}\left[w^m l^m + w^f l^f\right]$$

where $\{\rho_I, \rho_F\} = \{\lambda\rho, \rho\}$ and $\{p_I, p_F\} = \{p, (1-t)p\}$. Define:

$$w = \left[\sum_g A^g w^{g(1-\gamma)}\right]^{\frac{1}{1-\gamma}}$$

Then we can rewrite the maximization problem as a two-step problem where in the first step, the firm chooses labor l to maximize profits: $\max p_s z l^{\rho_s} - wl/T$ and then minimizes expenditure on male and female workers, given this choice of l. Taking the FOC and solving we get:

$$l_I^*(z) = \left[\rho_s \times \frac{Tz}{w/p_s}\right]^{\frac{1}{1-\rho_s}}$$
$$\pi_I^*(z) = \frac{1-\rho_s}{\rho_s} \times \frac{w l_I^*(z)}{T}$$

Cost minimization in the second stage implies:

$$\min \; w^m l^m + w^f l^f$$
$$\text{s.t.} \; \left[\sum_g A^g (l^g)^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}} = l_I^*$$

Taking the first order conditions and rearranging, we get:

$$w^g l^g(z) = A^g \left(\frac{w^g}{w}\right)^{1-\gamma} \times wl^*(z)$$

C.2 Penalty of Operating in the Informal Sector

An alternate way to present the model is to allow for a size-dependent penalty of operating in the informal sector. Let $\tau(l)$ be the penalty function such that $\tau(l) > 0$, $\tau'(l) < 0$ and $\tau(\infty) \to 0$. Alternately, one can think about $t_I(l)$ to be a per-unit size-dependent tax of operating in the informal sector, such that $\tau(l) = 1 - t_I(l)$. Therefore maximization problem of the firm can be written as:

$$\max_{l} \tau(l) pzl^\rho - wl$$

Taking the first order condition and rearranging:

$$\left[\rho\tau(l) + l\tau'(l)\right] pzl^\rho = wl \tag{14}$$

Comparing it to the baseline model, we have:

$$\left[\tilde{\rho} \times l^{\tilde{\rho}-\rho}\right] pzl^\rho = wl \tag{15}$$

Equations (14) and (15) are therefore connected through the $\tau(l)$ function such that:

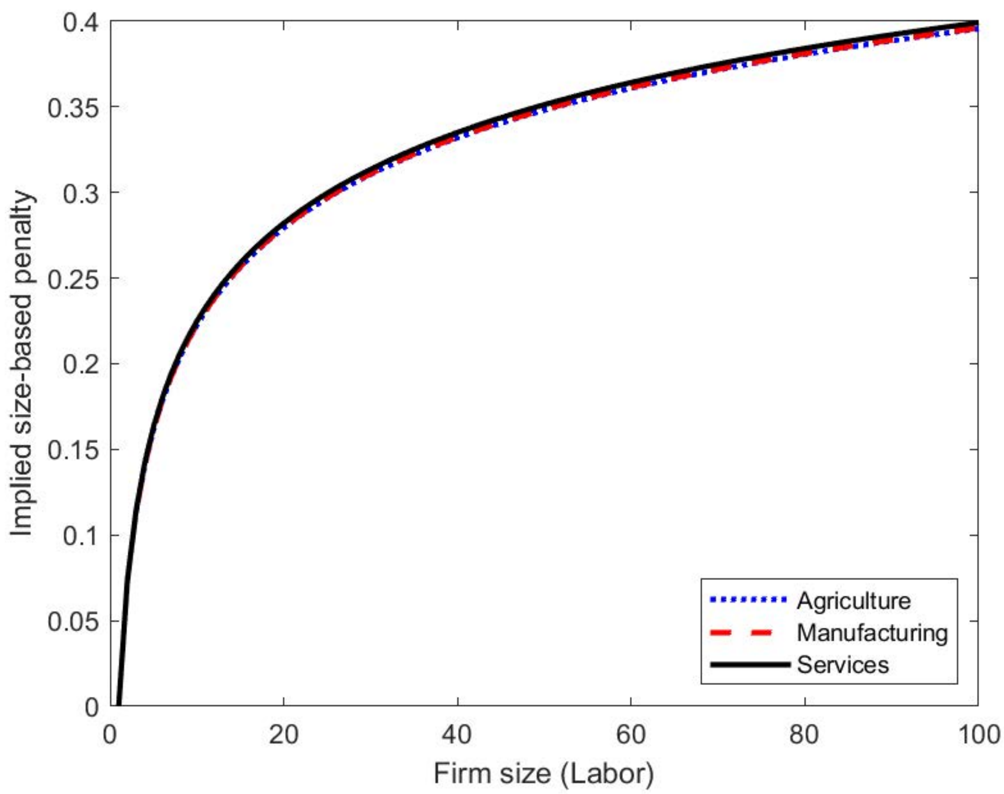
$$\rho\tau(l) + l\tau'(l) = \tilde{\rho} \times l^{\tilde{\rho}-\rho} \tag{16}$$

This is a differential equation of the form $ay + xdy/dx = bx^c$, where $y = f(x)$. This has a general solution of the form $y = \frac{bx^c}{a+c} + \frac{k}{x^a}$ where k is an integration constant. Therefore the general solution to $\tau(l)$ can be given by:

$$\tau(l) = \left[l^{\tilde{\rho}} + k \right] l^{-\rho} \tag{17}$$

To restrict $0 < \tau(l) < 1$, we assume $k = 0$ and plot $t_I(l) = 1 - \tau(l)$ in Figure C1.

Figure C1: Size-based Penalty Function



Notes: The above graph plots the size-based penalty function of operating in the informal sector as a function of firm size.

C.3 Allocation of entrepreneurs across industries

From Equations (2), (3), (5) and (6), the general form of the profit function and wage bill for a firm in sector s (dropping g for notational clarity) can be given by:

$$b_{sj} \equiv \frac{w_{sj} l_{sj}}{T_{sj}} = \eta_{L,sj} \times \varepsilon^{\frac{1}{1-\rho_s}}$$

$$\pi_{sj} = \eta_{\pi,sj} \times \varepsilon^{\frac{1}{1-\rho_s}}$$

where:

$$\eta_{L,sj} = \frac{w_{sj}}{T_j} \left[\rho_s \frac{T_j}{w_{sj}/p_{sj}} \times x \right]^{\frac{1}{1-\rho_s}}$$

$$\eta_{\pi,sj} = \frac{1-\rho_s}{\rho_s} \times \eta_{L,sj}$$

Let $\widetilde{\theta}_s = \theta(1-\rho_s)$. Dropping s for notational ease, the distribution of π_j within a sector s will follow a Frechet distribution given by $\pi_j \sim Frechet(\widetilde{\theta}, \eta_{\pi,j})$ with a CDF given by:

$$F(\pi) = exp\left[- \left(\frac{\pi}{\eta_\pi} \right)^{-\widetilde{\theta}} \right]$$

Note that the share of firms in an industry k will be the probability that the profits in industry k are more than all other industries. This implies that:

$$\begin{aligned}
\varphi_k &= Pr(\pi_k = \max\{\pi_j\}_{\forall j}) \\
&= \int \prod_{j \neq k} F(\pi_k) \times dF(\pi_k) d\pi_k \\
&= \int \prod_{j \neq k} e^{-(\pi_k/\eta_{\pi,j})^{-\widetilde{\theta}}} \times e^{-(\pi_k/\eta_{\pi,k})^{-\widetilde{\theta}}} \times \widetilde{\theta}\eta_{\pi,k}^{\widetilde{\theta}} \times \pi_k^{-\widetilde{\theta}-1} d\pi_k \\
&= \int e^{-(\sum_j \eta_{\pi,j}^{\widetilde{\theta}})\pi_k^{-\widetilde{\theta}}} \times \widetilde{\theta}\eta_{\pi,k}^{\widetilde{\theta}} \times \pi_k^{-\widetilde{\theta}-1} dx \\
&= \frac{\eta_{\pi,k}^{\widetilde{\theta}}}{\sum \eta_{\pi,j}^{\widetilde{\theta}}} \times \int \underbrace{e^{-\sum \eta_{\pi,j}^{\widetilde{\theta}} \pi_k^{-\widetilde{\theta}}} \times \widetilde{\theta}(\sum \eta_{\pi,k}^{\widetilde{\theta}})\pi_k^{-\widetilde{\theta}-1}}_{\text{Frechet distribution}} dx \\
&= \frac{\eta_{\pi,k}^{\widetilde{\theta}}}{\sum_j \eta_{\pi,j}^{\widetilde{\theta}}}
\end{aligned}$$

Substituting the values in the expression above, we have:

$$\begin{aligned}
\eta_{\pi,j} &= \frac{1-\rho_s}{\rho_s} \times \frac{w_{sj}}{T_j}\left[\rho_s \frac{p_{sj}}{w_{sj}/T_j} \times x\right]^{\frac{1}{1-\rho_s}} \\
&= \left\{\frac{1-\rho_s}{\rho_s} \times (\rho_s x)^{\frac{1}{1-\rho_s}}\right\} \times \left[\frac{p_{sj}}{(w_{sj}/T_j)^{\rho_s}}\right]^{\frac{1}{1-\rho_s}} \\
\Rightarrow \frac{\eta_{\pi,j}^{\widetilde{\theta}}}{\sum_j \eta_{\pi,k}^{\widetilde{\theta}}} &= \frac{\left[\frac{p_{sj}}{(w_{sj}/T_j)^{\rho_s}}\right]^{\theta}}{\sum_k \left[\frac{p_{sk}}{(w_{sk}/T_k)^{\rho_s}}\right]^{\theta}}
\end{aligned}$$

Note that since $\pi_k \sim Frechet(\widetilde{\theta}, \eta_{\pi,k})$, the distribution of maximum profits $\pi_j = \max\{\pi_k\}_j$ will also follow a Frechet distribution where $\pi_j \sim Frechet(\widetilde{\theta}, (\sum \eta_{\pi,k}^{\widetilde{\theta}})^{1/\widetilde{\theta}})$ so that:

$$\begin{aligned}
E(\pi_j | \pi_j = \max\{\pi_k\}_{\forall k}) &= (\sum \eta_{\pi,k}^{\widetilde{\theta}})^{1/\widetilde{\theta}} \Gamma_{\widetilde{\theta}} \\
&= \Gamma_{\widetilde{\theta}} \times \varphi_j^{-1/\widetilde{\theta}} \eta_{\pi,j}
\end{aligned}$$

where $\Gamma_{\widetilde{\theta}} = \Gamma(1 - 1/\widetilde{\theta})$. Lastly, turning to the wage bill (b_j), note that similar to profits,

$b_k \sim Frechet(\widetilde{\theta}, \eta_{L,k})$. Note that since $\pi_k = (\frac{1-\rho}{\rho})b_k$, $\pi_j = \max\{\pi_k\}_{\forall k}$ implies that $b_j = \max\{b_k\}_{\forall k}$. This implies that similar to the profits above,

$$E(b_j|\pi_j = \max\{\pi_k\}_{\forall k}) = \Gamma_{\widetilde{\theta}} \times \varphi_j^{-1/\widetilde{\theta}} \eta_{L,j}$$

Substituting in the values for η_π and η_L, we get:

$$(a)\varphi_{sj} = \frac{\left[\frac{p_{sj}}{(w_{sj}/T_j)^{\rho_s}}\right]^\theta}{\sum_k \left[\frac{p_{sk}}{(w_{sk}/T_k)^{\rho_s}}\right]^\theta}$$

$$(b)E[l_{sj}(x)] = \varphi_{sj}^{-1/\widetilde{\theta}_s} \Gamma_{\widetilde{\theta}_s} \left[\rho_s \frac{T_j p_j}{w_{sj}}\right]^{\frac{1}{1-\rho_s}} \times x^{\frac{1}{1-\rho_s}}$$

$$(c)E[\pi_{sj}(x)] = \frac{1-\rho_s}{\rho_s} \frac{w_{gsj}}{T_j} \times \left\{ \underbrace{\varphi_{gsj}^{-1/\widetilde{\theta}_s} \Gamma_{\widetilde{\theta}_s} \left[\rho_s \frac{T_j p_{sj}}{w_{gsj}}\right]^{\frac{1}{1-\rho_s}} \times x^{\frac{1}{1-\rho_s}}}_{=E[l_{sj}(x)]} \right\}$$