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AGGREGATE IMPLICATIONS OF BARRIERS TO FEMALE ENTREPRENEURSHIP

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We develop a framework for quantifying barriers to labor force participation (LFP) and entrepreneurship faced by women in India. We find substantial barriers to LFP, and higher costs of expanding businesses through hiring workers for women entrepreneurs. However, there is one area where 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, policies promoting female entrepreneurship can significantly increase female LFP even without explicitly targeting 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 for the economy. 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.

KEYWORDS: Female entrepreneurship, gender discrimination, misallocation, economic development.

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 over 125,000 firms, surveyed under the Enterprise Surveys (World Bank (2020)), which covers 138 countries across 13 years (2006–2018).[1] The lack of business ownership by women is striking. On average, less than a fifth (17.8% to be exact) of businesses across the world are owned by women, with women's share of ownership ranging from around 7–8% in tobacco, basic metals, and petroleum to at most 25–30% in retail and hotel 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 23% of employees in male-owned firms are women, the share

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[1]The Enterprise Surveys are firm-level surveys that are nationally representative for the type of firms they seek to cover. The surveys do not cover very small (less than 5 employees), informal, or fully state-owned firms, and cover only the manufacturing and service sectors. More details on the methodology and data can be found at: https://www.enterprisesurveys.org/en/enterprisesurveys.

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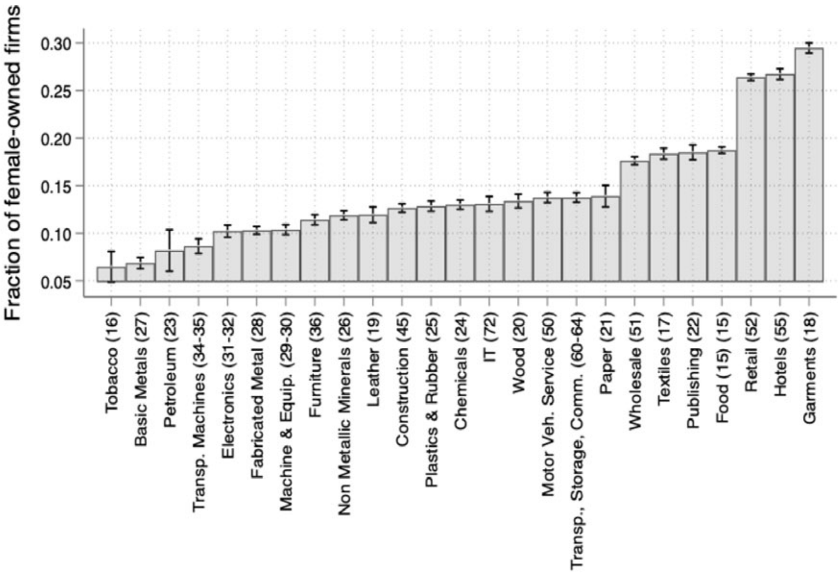
(a) Fraction of Female Entrepreneurs Across Industries



(b) Fraction of Women Employees and Managers

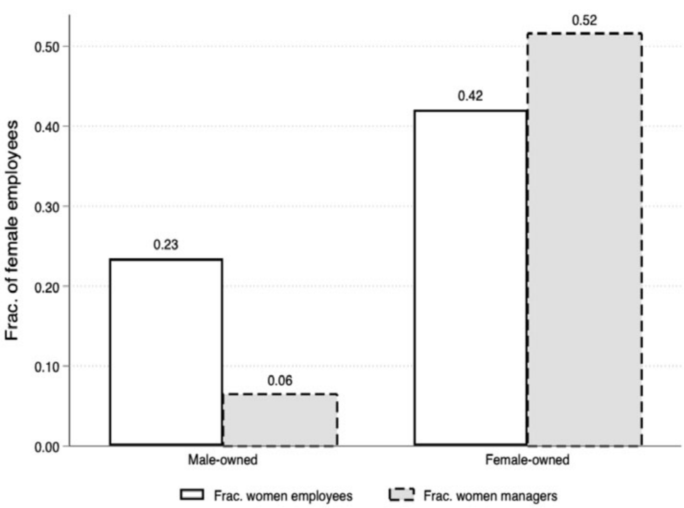


FIGURE 1.—Share of women entrepreneurs, employees, and managers. Both figures use the World Bank Enterprise Surveys. Figure 1(a) plots the average (unweighted) fraction of female-owned firms across 25 sectors. Figure 1(b) plots the fraction of women employees and the probability that the top manager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

of female employees is 42% in female-owned firms. More strikingly, while only 6.5% of male-owned firms have a woman as their top manager, over 50% of women-owned firms have a woman as their top manager. 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 as well as their aggregate implications in a large developing economy, India. 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 (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 likely to have important aggregate implications.

In the vein of this proposition, this paper aims to identify and analyze a particular type of distortions, namely gender-based distortions that affect female entrepreneurship. A rich literature has sought to identify constraints facing female entrepreneurs using randomized experiments (see Quinn and Woodruff (2019) and Jayachandran (2021) for reviews). The experimental variation allows for causal inference, but studies typically focus on one distortion at a time. Our approach differs from that literature in that we develop a unified framework that accounts for multiple gender-related distortions, modeled as "wedges," and quantified using micro data. This framework allows us to analyze how these constraints interact with each other. Among other things, it helps us understand why sometimes relaxing one constraint at a time may not be particularly effective when other constraints are binding. For instance, we show that policies promoting entry of female entrepreneurs have little effect given that female-owned businesses face important constraints to growth and expansion. Similarly, policies targeting female LFP may succeed in increasing it, but the increase in female labor supply could depress women's real wages in equilibrium, unless accompanied by a boost in labor demand for women.

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—a census of all non-farm establishments in India, which also include own-account enterprises, and firms in 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 either own-account enterprises, or informal firms.[4] Using these data and a model-based approach, we identify entry and operation frictions faced by female-owned firms relative to their male counterparts, and use counterfactual simulations to assess the productivity and welfare implications of various policy interventions.

[2] Hsieh, Hurst, Jones, and Klenow (2019) estimated large such gains for the United States between 1960 and 2010. Their study focuses on race- and gender-based distortions. Bento (2020) and Morazzoni and Sy (2022) focused on entrepreneurship in the U.S., and estimated large productivity and welfare gains associated with the elimination of gender-specific distortions.

[3] See Cuberes and Teignier (2014) and Ranasinghe (2024) for reviews.

[4] The Census data are better suited to our analysis than the Enterprise Surveys or other Indian firm data that either do not cover micro (less than 5 employees) or informal firms, or only cover specific sectors.

Our analysis is guided by a stylized model of occupational choice along the lines of Roy (1951) and Banerjee and Newman (1993). 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 be self-employed, earn wages as workers, or start a business as entrepreneurs. 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,[5] and employs a large fraction of women (World Development Report (2012)). Firms (entrepreneurs) need to pay an entry cost to operate in either sector and an additional registration cost to formalize.[6] 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.[7] There is only one input in production: labor. Entrepreneurs choose the sector (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, that is, 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).[8] While we do not measure these factors directly (but model them as "wedges"),[9] our estimated frictions are correlated with various indices of women empowerment across regions in India, constructed on the basis of comprehensive indicators (such as inputs in household decisions, patriarchal norms, asset ownership patterns, access to education and health, etc.). This increases our confidence that our estimates are meaningful in capturing various underlying barriers and frictions that women face in the labor force.

[5]See La Porta and Shleifer (2014), Ulyssea (2018), Dix-Carneiro, Goldberg, Meghir, and Ulyssea (2024), Chaurey, Chiplunkar, and Soundararajan (2024).

[6]The importance of these fixed entry and registration costs has been emphasized across many contexts. See comprehensive reviews by Jayachandran (2021) and Quinn and Woodruff (2019).

[7]See Beck and Hoseini (2014), Nikaido, Pais, and Sarma (2015), Chaudhuri, Sasidharan, and Raj (2020), Raj and Sasidharan (2020), and Morazzoni and Sy (2022).

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

[9]Some of the most important drivers of gender inequality in developing countries, that is, 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.

We have three key findings. First, the excess costs faced by women are substantial. Labor force participation costs are roughly twice as large for women than for men on average despite a significant decline over time. Similarly, women entrepreneurs face a 10–20% higher cost of expanding their business through hiring (both in the informal and formal sectors), compared to their male counterparts. Second, the only area where female entrepreneurs seem to have a significant advantage over their male counterparts is in the employment of 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), or by family-owned firms (i.e., it holds even when family-owned businesses or non-hired workers are excluded from the analysis). This comparative advantage of female entrepreneurs in employing females is especially important in a context like India, where female labor force participation is low and women workers are scarce. Third, *conditional on female labor force participation*, constraints on the intensive margin (i.e., expanding the business) are more severe than constraints on the extensive margin (i.e., fixed costs of entry into entrepreneurship). In fact, we find no evidence that (conditional on LFP) females face higher fixed costs of entry into informal entrepreneurship; however, we do find that they face significantly higher fixed costs of formalization.

Given these results, we investigate, in a series of counterfactual scenarios, the potential gains to the economy of eliminating gender-related barriers. We first examine the impact of policies that sequentially reduce the various excess costs faced by women entrepreneurs. Specifically, in all industry-regions where women entrepreneurs face higher costs than men, we equalize costs across the two genders; however, in cases where women appear to have an advantage over men (e.g., in attracting female workers), we do not eliminate this advantage. Next, we repeat this exercise by imposing complete gender parity, that is, also eliminating the advantage that women have in hiring other women. The reason we proceed in this fashion is that we cannot tell, based on our data, whether the "women working for other women" pattern reflects preferences or is itself the result of distortions—if, for instance, women feel harassed or discriminated against by male employers and hence opt to work for females. The first interpretation (i.e., preferences) calls for keeping the revealed "advantage" fixed in the counterfactual scenarios; the latter (i.e., distortions at the workplace) calls for eliminating all gender-related distortions.

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 entry and formalization costs) of entrepreneurship. Intuitively, eliminating excess fixed 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 profits of women entrepreneurs and only marginally decreasing real wages of women. 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. This more efficient reallocation results in substantial gains in aggregate productivity and welfare (as measured by real income). Removing all types of barriers facing women while preserving their comparative advantage in the employment of female workers boosts labor force participation in the economy with female LFP doubling, and raises aggregate productivity by 3% and welfare (real income) by 43%. These gains are large and suggest that promoting gender equality in entrepreneurship can contribute meaningfully to economic development.

Importantly, all these effects are also present in the case where all gender-related frictions are eliminated, so that women no longer have an advantage in the employment of females. The effects remain large and positive, and generate around 70–80% of the increase in female LFP, aggregate productivity, and real income from the previous case (where women entrepreneurs retain their advantage). This suggests that even without letting women retain an advantage in some areas, policies targeted at achieving gender-parity can generate substantial benefits not only for women, but for the economy as a whole.

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 et al. (2019) and Bento (2020), and cross-country analyses of Cuberes and Teignier (2016) and Ranasinghe (2024). However, our model differs from the models used in the aforementioned papers in several respects as it is geared towards capturing key features of our setting, India, 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 and reduced-form 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 policies that eliminate various excess barriers including a scenario where all gender-related frictions are removed. Section 7 concludes.

2. THEORY

2.1. *Conceptual Issues*

Before presenting the model, we provide a brief overview of our treatment of gender in order to make explicit which primitives in the model are assumed to be the same and which are allowed to differ across genders. A framework in which men and women are allowed to differ in every possible dimension will attribute all differences in economic outcomes to differences in primitives by construction.

We assume that men and women are the same in the following respects: First, they have the same preferences for work. Accordingly, we interpret differences in the estimated "disutility" of work as capturing distortions preventing women from participating in the labor force rather than innate stronger dislike for work. The reason for this assumption is that we have no way of identifying preferences versus distortions in our setting. Fundamentally, it is very difficult to separate the two as preferences are themselves endogenous: in the presence of distortions, for example, norms discouraging female LFP, lack of child care, etc., women may find employment outside the home less appealing, even though they are not innately different from men.[10] Second, we assume that male and female entrepreneurs active in the same industry employ the same production technology. This assumption is necessitated by data constraints as well as the desire to keep the framework tractable. While our primary data source does not allow us to directly test this assumption, we use additional data that cover a subset of firms (NSS) to provide corroborative evidence in Supplemental Appendix E.2 (Chiplunkar and Goldberg (2024)). Third, we assume that men and women do not differ in their innate entrepreneurial ability, though their ex post realization of productivity, which is industry-specific, may be different. We discuss this assumption extensively when we introduce it in the model as well as in Supplemental Appendix F, where we also partially relax it.

On the other hand, we allow men and women to differ in all those dimensions that can be identified based on the information available in our data. Specifically, we allow male and female workers to be imperfect substitutes in the production function. We also allow the productivity of male and female workers to differ, with these differences being sector-specific; this treatment accounts for the brawn versus brain hypothesis and its implications for comparative advantage. Given these differences, male and female wages are not equalized. However, the wage differences are attributed to the imperfect substitutability of male and female workers and their differential productivity by sector as opposed to wage discrimination. We abstract from wage discrimination because we cannot identify it in our setting. By doing so, we ignore an additional, potentially important source of misallocation, and bias our results towards underestimating gender-related distortions. However, given that the rest of our findings suggest large distortions, this limitation makes our conclusions even stronger. Finally, we allow for men and women to face differential fixed costs of entry in all employment choices as well as differential distortions in expanding their businesses.

2.2. *Setup*

The economy consists of a mass of N_g individuals of gender g (male or 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. Thus, we do not allow for product differentiation across the formal and informal sectors.[11] The only difference between firms in the formal and informal sectors is in their compliance with regulations, and the potential distortions they face in expanding via hiring workers (discussed below).

2.3. *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

[10]In principle, one could try to infer differences in preferences through a series of experiments in which gender-specific constraints to LFP are successively relaxed. For instance, one could offer child-care subsidies as in the work of Bjorvatn, Ferris, Gulesci, Nasgowitz, Somville, and Vandewalle (2022) on Uganda, and examine if these have a positive effect on female labor force participation. To our knowledge, the evidence from developing countries on such issues is scant to date.

[11]Using additional survey data, we examine in Supplemental Appendix F.2 whether there are gender differences in perceived characteristics of firms or products. We find no gender differences in how entrepreneurs report the innovation/quality of their product or the competition they face by other businesses offering similar products or services.

for notational convenience) is indexed by her/his individual entrepreneurial productivity $z \sim H(z)$. Labor is the only input in production. This assumption implies that any potential distortions affecting other inputs (e.g., capital) will be loaded onto labor in our framework, so that it is more appropriate to interpret distortions in hiring as distortions in expanding the business more generally. Supplemental Appendix E discusses the implications of this modeling in detail and shows that it does not affect our main conclusions (at least not for the subset of firms considered in that appendix).[12] Entrepreneurs hire male and female workers to produce output that is sold in a competitive market. We allow for male and female workers to be imperfect substitutes in production with differential productivity A^g across industry sectors. For example, we allow for the productivity of a female worker (relative to male) to be different in formal agriculture as compared to informal agriculture, formal manufacturing, etc. 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.

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' (i.e., 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

$$y = zl^{\rho}, \tag{1}$$

$$l = \left[\sum_g (A^g)^{\frac{1}{\gamma}} (l^g)^{\frac{\gamma-1}{\gamma}}\right]^{\frac{\gamma}{\gamma-1}}, \tag{2}$$

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 a size-dependent penalty of being informal.[13]

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

$$\max_{\{l^m, l^f\}} \pi_{gI}(z) = pzl_{gI}^{\rho_I} - w_{gI}^m l_{gI}^m - w_{gI}^f l_{gI}^f, \tag{3}$$

[12]The Census data we use to estimate the model do not provide information on other inputs, and hence we are not able to estimate a more general model that includes multiple inputs. In Supplemental Appendix E.2, we consider such a model and estimate it using the 62nd Round of the National Sample Survey data (NSS) in 2005. The NSS provides information only on a subset of firms, namely those operating in informal manufacturing. The results obtained using the NSS and a model with multiple inputs are very similar to the ones obtained in our baseline model for the corresponding sector, that is, informal manufacturing. For a detailed discussion, see Supplemental Appendix E.2.

[13]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.

where $\rho_I = \lambda\rho < \rho$ captures a size-based penalty faced by firms operating in the informal sector.[14] 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.[15]

The terms w_{gI}^m and w_{gI}^f denote the *effective* wages facing entrepreneurs in the informal sector. Entrepreneurs differentiated by gender may face frictions in growing their businesses. We capture these in a reduced-form way, as "wedges," that is, 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.[16] For example, cultural norms may make it hard for some men to work for women, so that women entrepreneurs may have a harder time 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 using the shorthand described above as distortions that increase the effective cost of labor. 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 $\boldsymbol{w_{gI}} \equiv \{w_{gI}^m, w_{gI}^f\} = (1+\tau_{gI})\{\widetilde{w}^m, (1+\tau_{gI}^f)\widetilde{w}^f\}$. 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

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

$$l_{gI}(z) = \left[\rho_I \frac{z}{w_{gI}/p}\right]^{\frac{1}{1-\rho_I}}, \tag{5}$$

$$\pi_{gI}(z) = \frac{1-\rho_I}{\rho_I} \times w_{gI} l_{gI}(z), \tag{6}$$

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

[15] We later show in Supplemental Appendix B.2 that this size-based penalty can be rewritten 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.

[16] In theory, instead of assuming potential wedges on inputs (labor), we could put them on output. However, they would be isomorphic in our context. Given that we have data on firm size, but not output, we put these potential barriers on labor.

where

$$w_{gI} = \left[\sum_{g'} A^{g'} \left(w_{gI}^{g'}\right)^{1-\gamma}\right]^{\frac{1}{1-\gamma}}.$$

Mathematical proofs are provided in Supplemental Appendix B.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

$$\max_{\{l^m, l^f\}} \pi_{gF} = (1-t) p l_{gF}^{\rho} - w_{gF}^m l_{gF}^m - w_{gF}^f l_{gF}^f. \tag{7}$$

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

$$l_{gF}^{g'}(z) = A_F^{g'} \left(\frac{w_{gF}^{g'}}{w_{gF}}\right)^{-\gamma} \times l_{gF}(z), \tag{8}$$

$$l_{gF}(z) = \left[\rho(1-t)\frac{z}{w_{gF}/p}\right]^{\frac{1}{1-\rho}}, \tag{9}$$

$$\pi_{gF}(z) = \frac{1-\rho}{\rho} \times w_{gF} l_{gF}(z), \tag{10}$$

where

$$w_{gF} = \left[\sum_{g'} A^{g'} \left(w_{gF}^{g'}\right)^{1-\gamma}\right]^{\frac{1}{1-\gamma}}.$$

Mathematical proofs are provided in Supplemental Appendix B.1.

2.4. *Labor Supply Decisions*

Individuals decide whether and how to participate in the labor force. Conditional on working, an individual can be self-employed (i.e., operate an owner-only firm), work as a worker, or be an entrepreneur. To model the decision to participate in the labor force, we adopt a structure similar to Bick, Fuchs-Schündeln, Lagakos, and Tsujiyama (2022), 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

$$U(x, \eta) = \max_C C - \mathbf{1}_{LFP} \times \eta \overline{u}_g \tag{11}$$

$$\text{s.t. } \sum_j p_j c_j \le I(x) + b,$$

where $I(x)$ is the income earned by an individual if (s)he participates in the labor force as self-employed, a worker, or an entrepreneur. The term 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. We use the term "disutility" to capture all costs associated with work outside the home, and not just dislike of work (in that sense, the term may be misleading, but we nevertheless use it for convenience as it is standard in the literature). As noted earlier in Section 2.1, an important premise of this work is that men and women do not differ in their innate dislike of work, so that differences in "disutility" reflect gender barriers to LFP.

Let $P = \prod(p_j/\alpha_j)^{\alpha_j}$ be the price index of the economy, which we normalize to 1. We assume that individuals cannot save, that is, they consume their entire income. An individual will participate in the labor force as long as the real income from working is greater than the disutility of participating in the labor force, that is, $\eta\overline{u}_g < \frac{I(x)}{P}$. 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, Self-, and Wage-Employment. Conditional on participating in the labor force, individuals choose between being entrepreneurs, self-employed, or wage workers. 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.

Note that this specification does not allow for innate entrepreneurial ability to vary across genders (though, as will become clear shortly, we do allow the realization of entrepreneurial productivity to vary across genders in an industry-sector-specific way). A potential caveat is that even if men and women may not have innate differences in their suitability to entrepreneurship, they may differ in other characteristics, for example, education, that affect their entrepreneurial performance. We examine this possibility in Supplemental Appendix F. A comparison of educational attainment of men versus women in India does not allow for clear conclusions. While men have more years of schooling and higher literacy rates on average than women, adjusting for their learning gives a different picture: quality-adjusted years of schooling tend to be higher for women (consistent with Angrist, Djankov, Goldberg, and Patrinos (2021)). Along the same lines, surveys investigating perceptions about the entrepreneurial ability of men versus women in India do not reveal that women perceive themselves as inferior entrepreneurs (though, of course, these perception could reflect selection bias).

An entrepreneur of gender 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.[17] Alternatively, an individual can pay a fixed cost E_{gW} and work for a (gender-specific) wage $\tilde{w}^g$. Lastly, an individual could pay a fixed cost E_{gO} to enter self-employment, in which case, s/he earns a stochastic income $\Pi_{gO} = \zeta\tilde{w}^g$, where $\zeta \sim H(\zeta)$, $H(0) = 0$, and $H(1) = 1$.[18] As with entrepreneurship, we assume that the fixed costs of entering wage- and self-employment are gender-specific. We do not make any a priori assumptions about the relative magnitudes of the fixed costs of the various options (so the fixed costs of entering wage employment, for instance, could be lower or higher than the fixed costs of entering entrepreneurship), but let the data determine these magnitudes. Section 4.3 discusses how they are identified.

To summarize, the expected income for an individual with entrepreneurial ability x, who chooses to participate in the labor force, is given by[19]

$$I(x) = \begin{cases} b + \zeta\widetilde{w}^g - PE_{gO} & \text{(Self employment)}, \\ b + \widetilde{w}^g - PE_{gW} & \text{(Wage employment)}, \\ b + E\big(\Pi_{gI}(x)\big) - PE_{gI} & \text{(Informal entrepreneurship)}, \\ b + E\big(\Pi_{gF}(x)\big) - PE_{gF} & \text{(Formal entrepreneurship)}. \end{cases} \tag{12}$$

An individual will choose the occupation that maximizes her/his expected income. They will work in wage employment as long as $\zeta \leq \zeta^*$, where $\zeta^* = 1 - \frac{E_{gW}-E_{gO}}{\tilde{w}^g/P}$ and the fraction of individuals in wage employment will be given by $H(\zeta^*)$. Since we observe non-zero entry in both the formal and informal sectors, there is a (gender-specific) threshold level of entrepreneurial ability in each sector x^*_{gs}, such that an individual with ability x^*_{gI} is indifferent between informal entrepreneurship and non-entrepreneurship (wage- or self-employment); and with ability x^*_{gF} is indifferent between informal and formal entrepreneurship. Lastly, from the LFP indifference condition discussed above, the threshold disutility that determines participation in the labor force is given by $\eta^*_g = E(I(x))/(\overline{u}_g P)$, 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 her/his ex post industry-specific productivity $z_{sj} = x\varepsilon_{sj}$, where ε_{sj} is drawn from a gender-specific Fréchet distribution, that is, $\varepsilon_{sj} \sim \text{Fréchet}(T_{sj}, \theta_g)$ with a CDF given by $F(\varepsilon) = e^{-(\varepsilon/T_{sj})^{-\theta_g}}$.

[17]See reviews by Jayachandran (2021) and Quinn and Woodruff (2019).

[18]The above assumption implies that the variable returns (i.e., excluding the fixed costs) of wage employment are higher than the returns of self-employment. Since we only observe the number of wage-earners and self-employed in the Economic Census (and not their wages or profits), this assumption helps us incorporate the self-employed in the analysis while keeping the model tractable. From the 62nd Round (in 2005) of the National Sample Survey, a nationally representative survey of individuals, earnings of men and women in self-employment are 42.1% and 50.1% of those in wage employment on average.

[19]The fixed costs are measured in units of output, which implies that their expenditure is given by $PE_{(.)}$.

THEOREM 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*

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

$$(b) \quad E\big[l_{gsj}(x)\big] = \varphi_{gsj}^{-1/\widetilde{\theta}_s} \Gamma_{\widetilde{\theta}_s} \left[\rho_s \frac{T_{sj} x}{w_{gsj}/p_{sj}}\right]^{\frac{1}{1-\rho_s}} \quad [\textit{ Avg. Firm Size }], \tag{13}$$

$$(c) \quad E\big[\pi_{gsj}(x)\big] = \frac{1-\rho_s}{\rho_s} \times w_{gsj} E\big[l_{gsj}(x)\big] \quad [\textit{ Avg. Profits }],$$

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 Supplemental Appendix B.3. To summarize the above discussion, each individual in this economy is indexed by $\{g, x, \zeta, \eta\}$, that is, gender g, entrepreneurial ability x, stochastic profit in self-employment ζ, 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 $\zeta > \zeta^*$ will be self-employed, while those with $\zeta < \zeta^*$ will either become entrepreneurs or wage workers. Among those, individuals with $x < x_{gI}^*$ will enter wage employment, $x \in [x_{gI}^*, x_{gF}^*]$ will enter the informal sector as entrepreneurs, and those with $x > x_{gF}^*$ will enter the formal sector as entrepreneurs. Conditional on sector choice s, entrepreneurs draw an ex post productivity signal z_{sj} that determines the industry j in which they operate.

2.5. *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 $\sum_g \widetilde{w}^g L_{\text{supply}}^g$, where $L_{\text{supply}}^g = F(\eta_g^*)H(\zeta^*)G(x_{gI}^*)N^g$. The second term, Π, denotes the total profits of the firms in the economy net of their entry costs, that is, it consists of (i) earnings of the self-employed, given by $\Pi_O = \sum_g N^g F(\eta_g^*) \int_{\zeta_g^*}^1 (\zeta\tilde{w}^g - PE_{gO})\, dH(\zeta)$; (ii) profits of the firms in the informal sector $\Pi_I = \sum_g \sum_j N^g F(\eta_g^*) H(\zeta_g^*) \times \int_{x_{gI}^*}^{x_{gF}^*} \varphi_{gIj}(E\Pi_{gIj}(x) - PE_{gI})$ and profits of the firms in the formal sector $\Pi_F = \sum_g \sum_j N^g F(\eta_g^*) H(\zeta_g^*) \times \int_{x_{gF}^*} \varphi_{gFj}(E\Pi_{gFj}(x) - PE_{gF})$. 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_{demand}^g, is given by $L_{\text{demand}}^g = \sum_{g'} \sum_j \sum_s L_{g'sj}^g$, where $L_{g'sj}^g$ is the total labor of gender g, demanded by entrepreneurs of gender g' in sector s and industry j given by Equations (4), (8), and (13). The equilibrium in this economy is defined by the following conditions:

(i) the labor markets clear for both genders; the goods market clears for each industry.
(ii) the zero-profit conditions for the formal and informal sectors, and the indifference conditions for LFP and self-employment, hold with equality for both genders.
(iii) the total benefits received by individuals are equal to the taxes collected.

3. DATA AND REDUCED-FORM EVIDENCE

Our primary data come from two rounds of the Economic Census of India (EC) for 1998 and 2005.[20] 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 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, which cover 95–97% of male- and female-owned firms in both rounds of the EC.[21] Lastly, we define a "firm" as an establishment that hires at least one worker, while those that do not hire any workers are classified as "self-employed." Our final sample consists of 26.23 million firms in 1998 and 40.86 million firms in 2005.

Table I 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. Five stylized facts stand out. First, over half of Indian establishments correspond to self-employed individuals, and the overwhelming majority of them are male. Second, excluding the self-employed, the majority of all other firms in India are male-owned as well, and more than 99% of them (both male and female) operate in the informal sector. Firms in the formal sector are, however, significantly bigger. Third, female-owned firms (excluding self-employed) account for only 3% of the total establishments in the country. Fourth, as reported in columns (3) and (4), female-owned firms are smaller (larger) than male-owned firms in the informal (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.

[20]We do not use the 2013 round of the Economic Census since it does not report whether a firm is 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 (La Porta and Shleifer (2014), Ulyssea (2018)).

[21]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.

TABLE I

SUMMARY STATISTICS.

Firm Type	Total Firms		Firm Size		Frac. Female Emp.	
	1998 (1)	2005 (2)	1998 (3)	2005 (4)	1998 (5)	2005 (6)
Male, Self-Employed	12.68	21.14				
	(48.35%)	(51.74%)				
Male, Informal	11.58	15.83	3.29	3.02	0.10	0.10
	(44.13%)	(38.74%)	(2.83)	(2.12)	(0.21)	(0.22)
Male, Formal	0.08	0.14	77.31	67.54	0.21	0.25
	(0.31%)	(0.34%)	(440.9)	(166.58)	(0.25)	(0.30)
Female, Self-Employed	1.07	2.50				
	(4.07%)	(6.12%)				
Female, Informal	0.82	1.24	3.01	2.81	0.70	0.76
	(3.13%)	(3.04%)	(2.61)	(1.86)	(0.39)	(0.37)
Female, Formal	0.00	0.01	97.59	76.53	0.37	0.48
	(0.01%)	(0.02%)	(1197.03)	(130.34)	(0.33)	(0.40)
Total	26.23	40.86				

Note: 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) and (2) are reported in millions. Percentage of the total is 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) is the fraction of female employees within a firm. Standard deviations are reported in parentheses below.

A comparison between 1998 and 2005 reveals further interesting patterns. The average number of workers (columns (3) and (4)) has decreased for all categories between 1998 and 2005. At the same time, the number of self-employed individuals as well as firms (both male and female) have significantly increased in this period. The combination of these two patterns suggests a decline in entry costs into both labor force and entrepreneurship. The decline in firm size is particularly pronounced for formal firms (both male- and female-owned), suggesting a decline in the costs of formalization, especially for women.[22] The fraction of female employees (columns (5) and (6)) across firms in both sectors has remained relatively stable in male-owned firms, but increased in female-owned firms.

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

$$\begin{aligned} y_{fjd} = \alpha_d + \alpha_j + \beta_1 \text{Female}_f + \beta_2 \text{Formal}_f + \beta_3 \text{Female}_f \times \text{Formal}_f \\ + \delta X_{fjd} + \varepsilon_{fjd}, \end{aligned} \tag{14}$$

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.), and a dummy for whether the firm operates in a rural or urban area. We cluster standard errors at the district level.

[22]This is also consistent with a package of policy reforms (fiscal, financial, technology, and infrastructural support) implemented in the early 2000s primarily for the micro, small, and medium firms (MSMEs).

TABLE II

TOTAL FIRM SIZE AND COMPOSITION ACROSS GENDER AND SECTORS.

	Log(L)		Frac. Female Emp.	
	1998 (1)	2005 (2)	1998 (3)	2005 (4)
Panel A: Without Industry Fixed Effects				
Female	−0.0167	−0.0346	0.304	0.298
	(0.0175)	(0.00485)	(0.0126)	(0.0111)
Formal	2.348	2.536	0.0904	0.0970
	(0.0364)	(0.0332)	(0.00951)	(0.00990)
Female × Formal	0.135	0.196	−0.180	−0.111
	(0.0689)	(0.0452)	(0.0231)	(0.0176)
R^2	0.212	0.280	0.328	0.301
Panel B: With Industry Fixed Effects				
Female	−0.00962	−0.0435	0.232	0.235
	(0.0135)	(0.00642)	(0.00953)	(0.00786)
Formal	2.079	2.385	0.0520	0.0692
	(0.0347)	(0.0361)	(0.00831)	(0.00885)
Female × Formal	0.170	0.184	−0.120	−0.0676
	(0.0672)	(0.0480)	(0.0191)	(0.0164)
R^2	0.338	0.344	0.472	0.404
N	12.48 m	17.22 m	12.48 m	17.22 m
Male, Informal	1.007	0.970	0.190	0.205
Firm controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes

Note: 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. All regressions control for district fixed effects, along with whether the firm has access to power, dummy variables for different forms of financial access, 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 II reports the results. Panel A 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 4.35 log-points (or 4.4%) smaller in size than male-owned informal firms, but 14.05 log-points (or 15%) 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 23.5 p.p. in the informal sector, and 16.74 p.p. 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 not significantly 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.[23]

[23]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 A1.

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 III lists the model parameters. Given data limitations, we use a combination of calibration and estimation to set their values.

4.1. *Parameterization*

We treat every state in India as a separate closed economy (or region r) and aggregate all 4-digit industries into three broad industries (denoted by j), namely (i) agriculture and mining; (ii) manufacturing, and (iii) services.[24] 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:

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

(b) "Barriers" faced by individuals and entrepreneurs, including the fixed costs of entry into the various employment options $\Upsilon = \{\overline{u}, E_O, E_w, E_I, E_R\}_{\forall g,r}$ 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. Note that conditional on the expected profits in each occupation (self-employment, workers, entrepreneurship, etc.), the occupational choice depends on the differences in the fixed costs as opposed to their levels, that is, they are invariant to an additive scale. Moreover, from the expression for η^*, we can only identify either $\overline{u}_g$ or E_O. We therefore normalize $E_O = 0$ for both genders, so that all other fixed costs are interpreted *relative to* the fixed costs of entering self-employment.

Similarly to Bick et al. (2022), we assume the individual disutility of work follows a uniform distribution, that is, $\eta \sim U(0, 1)$. 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 also assume $\zeta \sim U(0, 1)$ and entrepreneurial ability for an entrepreneur g follows a log-normal distribution with mean 0 and variance σ_x^2, that is, $x \sim \log N(0, \sigma_x^2)$. Further, we assume the realized industry-sector-specific productivity $z_{sj} = x\varepsilon_{sj}$, where $\varepsilon \sim$ Fréchet(T_{sj}, θ_g).[25]

[24] In principle, our data allow 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. The key challenge, however, is that there are very few female firms (especially formal female firms) in several of these industries; accordingly, the disaggregate analysis is not particularly meaningful as we cannot recover the entry costs, hiring frictions, etc., in these NIC industries that have very few or no female entrepreneurs. We discuss this in Supplemental Appendix C.1. However, the reduced-form results of Table II suggest that the estimates are not severely 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 in our baseline model. However, in Supplemental Appendix C.1, we estimate the model for nine 1-digit industries (rather than the three aggregate industries described above), as the 1-digit level is the most disaggregate level at which we can meaningfully estimate fixed costs of entry into entrepreneurship. The results are similar to those obtained when the model is estimated at the more aggregate level. Importantly, our finding that female entrepreneurs hire more female workers is robust to the estimation at the more disaggregate level.

[25] As discussed earlier, our baseline specification does not allow for the distribution of innate entrepreneurial ability to vary by gender. However, note that the ex post realizations of productivity can be gender-specific across industries and sectors. Supplemental Appendix F provides a detailed discussion of these assumptions. Moreover, in Supplemental Appendix F.3, we allow the variance σ_x to vary by gender, and show that it does not affect our results in a meaningful way. If anything, the results become quantitatively stronger.

TABLE III

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_{sjr}	Aggregate production technology	Share of male-owned formal firms across industries in each sector
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
$\{E_w, E_I, E_R\}$	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

We normalize the productivity of male workers A^m to be 1, and the hiring barriers faced by male entrepreneurs to be zero, that is, $\tau_{mI} = \tau_{mF} = 0$ 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. Finally, the relative worker productivities (A^g) are identified from the ratio of female to male workers in male-owned firms across industries (within a sector). However, the levels for A^g cannot be separately identified from gender-specific wages. We can only identify the relative productivity across industries and hence have to assume that the productivity of male and female workers is equal to 1 in one industry (services in our case).[26]

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, that is, $\{\alpha_j\}_{\forall j}$, 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.

[26]The industry we base the normalization on does not affect our results. Services is a natural choice given that the literature documents the lowest gender productivity gaps in services, compared to agriculture and manufacturing (Pitt, Rosenzweig, and Hassan (2012), Rendall (2013), Olivetti and Petrongolo (2014)).

A rich literature estimates this elasticity, and the estimates typically range from 1.7 to 2.3 across studies and contexts.[27] We set $\gamma = 2.1$, which is 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 data set for formal firms in India. The tax rates are between 5% and 8% 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).[28] 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 III provides a list of all the parameters along with the moments we target 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 (relative to male) workers in services to equal 1 in both the formal and informal sectors, that is, we set $A_{s,\text{Services},r} = 1$. From Equations (4) and (8), 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 $T_{\text{Services},r} = 1$ in both the formal and informal sectors, and identify $\{T_{sjr}\}_{\forall j,r}$ for agriculture and manufacturing using the share of male-owned firms in each sector in these industries (Equation (13)), 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 male-owned firms in the informal to formal sector (Equations (5) and (9)) for each industry separately (3 moments). Lastly, we use the variance of firm size for male-owned and female-owned firms in the formal and informal sector (4 moments) to estimate $\{\sigma^2_x, \theta_{gs}\}_{\forall g}$.

Regarding the parameters in Υ, we identify the fixed costs of labor force participation, wage work, and informal and formal entrepreneurship, that is, $\{\overline{u}_{gr}, E_{W,gr}, E_{I,gr}, E_{R,gr}\}_{\forall g,r}$, using the labor force participation rate for men and women ($2 \times R$ moments), number of men and women in wage work ($2 \times R$ 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). As noted earlier, we can only identify these fixed costs of wage work and entrepreneurship relative to self-employment, which also cannot be separately identified from a (gender-specific) LFP cost. Accordingly, we normalize $E_{O,gr}$, that is, the fixed cost of self-employment conditional on participating in the labor force, to be equal to 0.

Turning to 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

[27]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).

[28]We discuss identification more systematically in Section 5.4 where we employ an approach similar to Kaboski and Townsend (2011) and Bick et al. (2022) to establish identification.

TABLE IV

PARAMETER VALUES.

	1998			2005		
	Agri. (1)	Manf. (2)	Services (3)	Agri. (4)	Manf. (5)	Services (6)
Panel A: Parameter values that vary by industry						
T_I	0.52	0.72	1.00	0.51	0.62	1.00
T_F	0.43	1.06	1.00	0.44	0.74	1.00
A_I	1.03	1.03	1.00	1.04	1.03	1.00
A_F	1.01	0.94	1.00	0.94	0.88	1.00
λ	0.97	0.97	0.92	0.89	0.92	0.93
Panel B: Ability distribution parameters						
$\widetilde{\theta}_{mI}$	2.19			2.44		
$\widetilde{\theta}_{fI}$	2.22			2.73		
$\widetilde{\theta}_{mF}$	2.02			2.14		
$\widetilde{\theta}_{fF}$	2.04			2.15		
σ_m	0.30			0.31		

Note: Each of the first three rows in Panel A reports the average values for the parameter across regions. The parameter λ varies only by industry. 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.

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 $g(X) = (M(X) - M_{\text{data}})/M_{\text{data}}$.

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 and Section 5.5, we discuss identification and model fit. In Supplemental Appendix D, we correlate our estimates with existing measures of women empowerment and gender-specific policies and show that they are consistent with common wisdom.

5.1. *Comparative Advantage, Technology, Informality, and Entrepreneurial Ability*

Table IV 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 $\{\sigma_x^2, \theta\}$.

The estimates for A_I show that women working in the informal sector do not have a significant comparative (dis)advantage relative to men in either agriculture or manufacturing (relative to services). In the formal sector (A_F), women have a disadvantage of working in agriculture (especially in 2005) and manufacturing relative to services.[29] Relative to services, the technology parameter (T) is around half in agriculture (in both sectors) and about 0.60–0.70 in manufacturing. The size-based penalty of operating in the informal sector (λ) is 0.97 in agriculture and manufacturing, and 0.92 in services in 1998. In 2005, it is 0.89, 0.92, and 0.93 in agriculture, manufacturing, and services, respectively. In Supplemental Appendix B.2, we discuss how these estimates relate to size-based penalties (such as the probability of detection, for example).

Despite allowing for the ability distribution to vary across years, the parameter estimates are remarkably similar between 1998 and 2005 ($\sigma_x \approx 0.30$). In our baseline estimation, we restrict σ_x to be the same across genders, so that the ex ante entrepreneurial ability distribution is the same for men and women. In Supplemental Appendix F, we provide an extensive discussion of this assumption by relating it to data on education as well as to responses on surveys of women's aptitude for entrepreneurship. In the same appendix (Section F.3), we also examine the ramifications of relaxing this assumption by allowing the shape parameter σ_x to vary by gender, and obtain very similar results to the baseline specification. The parameter $\tilde{\theta}_{gs} \equiv \theta_{gs}(1-\rho)$ is 2.19 (2.22) in the informal sector, and 2.02 (2.04) in the formal sector for men (women) in 1998. It is 2.44 (2.74) in the informal sector, and 2.14 (2.15) in the formal sector for men (women) in 2005. These values are consistent with estimates from Hsieh et al. (2019), who used a similar modeling structure for the United States, and estimated a value of 2.57. Note that our parameter estimates imply that ex post, women are slightly more productive than men (though their ex ante ability is assumed to be the same). These results are in line with those of Ashraf, Bandiera, Minni, and Quintas-Martınez (2022), who also found that women are more productive than men using an entirely different methodology and data from a large multinational firm covering 101 countries.

5.2. *Fixed Costs of Entrepreneurship and LFP*

The fixed costs include those for entry and formalization in the informal and formal sector, entry into wage work, and the disutility of participating in the labor force (which we shall call LFP costs). We estimate these costs separately for male and female entrepreneurs, region (r), and year (t). Figure 2 reports the average (across regions) values for men and women using blue triangles and red circles, respectively. The dash (solid) lines show a one standard error band around the averages in 1998 (2005). Several interesting patterns emerge.

First, women faced around 2.4 times the cost of entering the labor force compared to men in 1998. While LFP costs have declined for both men and women over time, women still face around twice the cost of participating in the labor force in 2005. Second, conditional on entering the labor force, the fixed costs of working in wage work or starting informal entrepreneurship (relative to self-employment) are quite low—both for men and women, and over time. In contrast, there is a stark gender-difference in the costs of formalizing informal businesses. Compared to men, women faced around twice the cost to formalize their business in 1998. Despite a reduction in these costs over time, for both men and women, they remained around 25% higher for women than men in 2005.

The low fixed costs of wage work and informal entrepreneurship (relative to self-employment), for both men and women, may seem surprising at first, given that wage

[29]This is consistent with a literature on 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)).

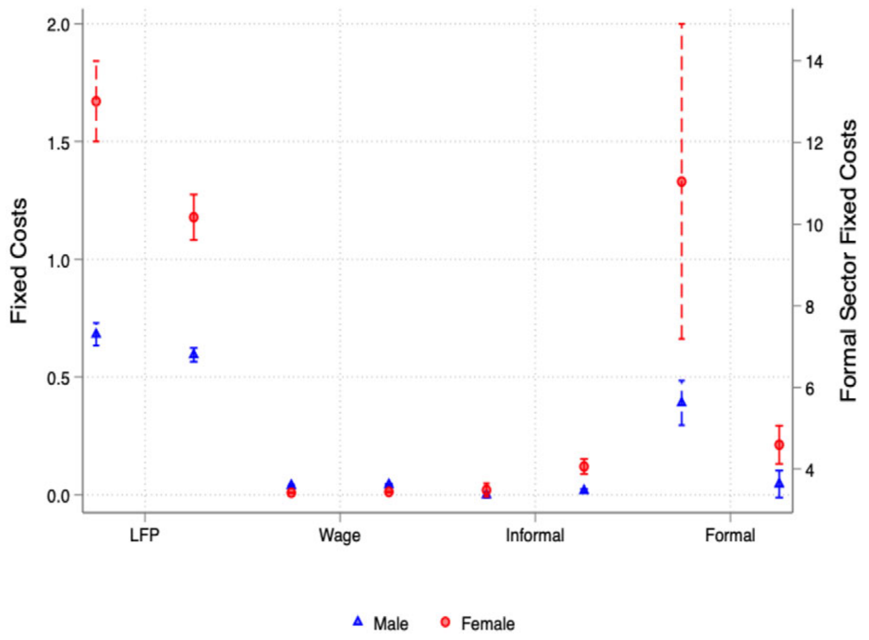


FIGURE 2.—Fixed costs of LFP, wage employment, and entrepreneurship. The above figure shows the estimates for the fixed costs to participate in the labor force (LFP), wage employment, informal and formal entrepreneurship. For each parameter, the estimates for 1998 (2005) are reported by the dash (solid) lines, with a 1 standard error range around the mean. Blue triangles and red circles are the estimates for men and women, respectively.

work is considered highly desirable in many low-income countries, and women have been shown to be reluctant entrepreneurs (Jensen (2022), Schoar (2010)). The low estimates likely reflect the heterogeneity of wage employment and informal entrepreneurship. Many wage jobs are low-paying and provide no benefits. Similarly, some informal enterprises barely differ from self-employment (in the sense that they may employ two, instead of just one, people, but are otherwise of similar size and productivity as the self-employed). Such options may not entail the high fixed costs of entry one typically associates with "good" wage jobs or successful enterprises.

Supplemental Appendix C.2 examines one particular source of heterogeneity related to the employment of "non-hired" workers.[30] Non-hired labor is pervasive in the informal sector, in both male- and female-owned firms. Non-hired workers are treated as "wage workers" in our framework. But given that they do not go through a formal hiring process, they presumably face lower fixed costs of entering wage employment. To understand the role of non-hired labor in the fixed cost estimation, we classify non-hired workers as self-employed, and then re-estimate the model to obtain new fixed cost estimates. This scenario, though extreme, is useful as a benchmark because classifying non-hired workers as self-employed implies that their income is lower in expectation than that of hired wage employees. As Figure C3(b) demonstrates, treating non-hired workers as self-employed substantially increases the fixed costs of wage employment relative to the baseline, for both genders, but especially for women (by more than six times). These results are reassuring, in the sense that they rationalize our baseline estimates. The effects on the other

[30]Non-hired workers are typically household members working in smaller firms and/or apprentices.

TABLE V

ESTIMATES FOR HIRING DISTORTIONS.

	1998 (1)	2005 (2)	(2)–(1) (3)
$1+\tau_{fI}$	1.24	1.18	-0.06
	[0.12]	[0.08]	
$1+\tau_{fF}$	1.07	1.14	0.07
	[0.38]	[0.19]	
$1+\tau_{fI}^{f}$	0.96	0.95	-0.01
	[0.04]	[0.03]	
$1+\tau_{fF}^{f}$	0.99	1.00	0.01
	[0.20]	[0.25]	

Note: Each row reports the average (across industries and regions) value of each parameter with standard deviations in parentheses below. Columns (1) and (2) report the value for 1998 and 2005, respectively. Column (3) reports the difference between columns (2) and (1).

types of fixed costs are very small. Given that our focus is on entrepreneurship, and not on wage work, we proceed with our baseline classification.

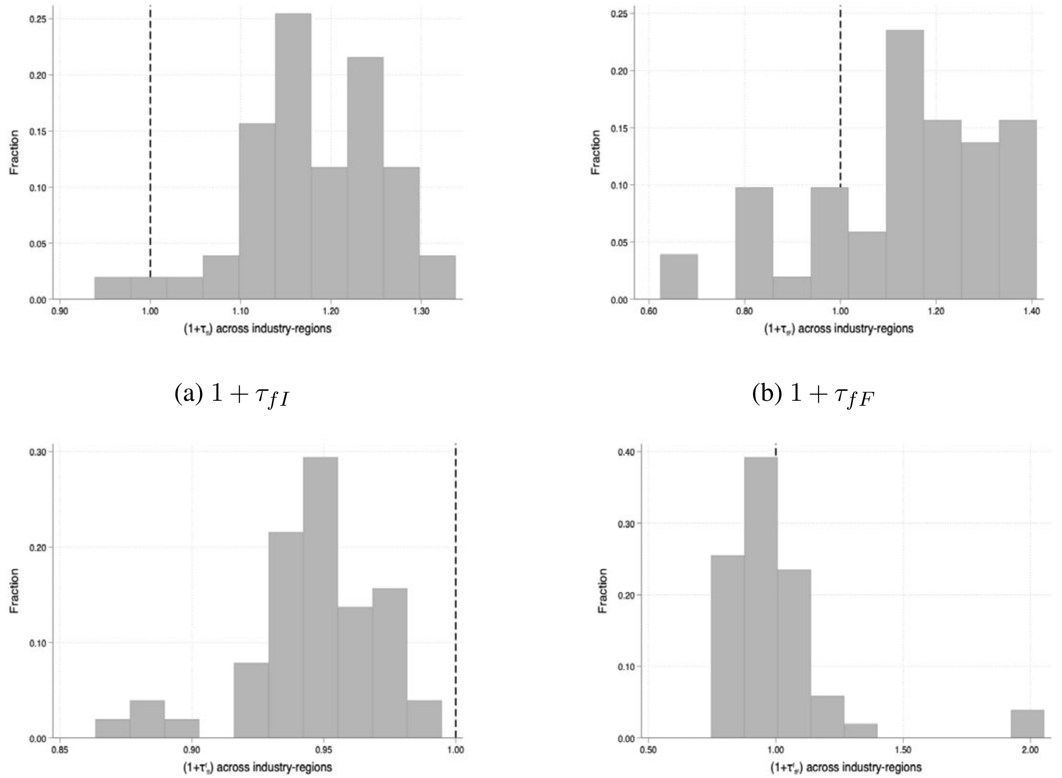
In Supplemental Appendix D, we use region-specific measures of women empowerment from various sources in the literature to examine whether our implied measures of gender-related barriers correlate with the documented level of women empowerment in these regions. We find that states with more conservative gender norms do have higher relative LFP costs for women as compared to men. There is no statistical association between gender empowerment and formalization costs, though the estimated coefficients have the expected signs.

5.3. *Distortions in Hiring Workers*

For each industry j, region r, and year t, we quantify two types of barriers that may distort the expansion/hiring of female-owned firms. First, τ_{fsj} is the additional cost of employing 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, $1+\tau_{fsj}^{f}$ is the additional marginal cost incurred by women entrepreneurs relative to male entrepreneurs, in employing female workers relative to male workers, in sector s and industry j (again, we remind the reader that we have normalized $\tau_{msj}^{f}=0$).

As shown in Table V, the cost of employing a worker is on average around 20–25% (10–15%) higher for women entrepreneurs in the informal (formal) sector compared to men. Figures 3(a) and 3(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 than male-owned firms. $1+\tau_{fI}$ ranges from approximately 1.10 to 1.30, while $1+\tau_{fF}$ ranges from 1.00 to 1.40 across most industries and states. These results indicate that women-owned businesses (both formal and informal) face substantial barriers in employing workers, across both industries and states. In Supplemental Appendix D, we show that these barriers are lower in states with more progressive gender norms.

Turning to the gender composition of workers, that is, $1+\tau_{fs}^{f}$, the estimates indicate that this is the only area in which female entrepreneurs have an advantage, and more so



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

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

FIGURE 3.—Hiring barriers in the formal and informal sectors. 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, that is, $1+\tau_{fs}$. Figures (c)–(d) plot the distribution of barriers faced by women entrepreneurs (relative to male entrepreneurs) in hiring female workers (relative to male workers), that is, $1+\tau^f_{fs}$.

in the informal sector. From Table V, female entrepreneurs in the informal sector incur 5–6% lower costs to hire a female (relative to male) worker, relative to male entrepreneurs. This advantage is still present, but muted, in the formal sector, where despite the average being equal to 1, the median is 0.93 in 1998 and 0.95 in 2005. Figures 3(c) and 3(d) display the heterogeneity across industries and states. The advantage for female entrepreneurs in employing women (relative to men) in the informal sector is quite substantial, over 10% in some industry-regions. It is also present in most cases in the formal sector.

Note that Figures 3(c) and 3(d), as well as the reduced-form results of Table II, show that this pattern is not driven by selection of female workers and entrepreneurs into a few industries, as it is present in every industry, even at a highly disaggregate level as in Table II.[31] Furthermore, in Supplemental Appendix C.1, we estimate the model at a more disaggregate level: the NIC 1-digit industry level instead of the level of three aggregate

[31]As reported in Table A1, these patterns are robust even when we exclude "family-owned" firms.

industries (agriculture, manufacturing, and services).[32] We find that the estimates of the hiring frictions are very similar to those in our baseline estimation, and that the distributions of these frictions (especially τ_{fsj}^{f}) overlap greatly.

The comparative advantage of female entrepreneurs in employing female workers may itself 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 households if they seek work outside the home, such resistance may be less pronounced in cases where they work for other women. Rigorously examining the sources of the pattern we document using micro-economic data and surveys is an interesting question for future research.

To summarize, the estimates suggest that while the excess barriers female entrepreneurs face have been reduced over time, there nevertheless remains a substantial gender gap across industries and regions. On the extensive margin, the excess barriers women face affect primarily their labor force participation decisions and entry into formal entrepreneurship. In contrast, the fixed costs of entering wage work or starting an informal enterprise, *conditional on LFP*, are not excessive. On the intensive margin, female entrepreneurs face additional costs of expanding their businesses, so even though entry into the informal sector may not be particularly costly, growth still is. The only exception is in the employment of female workers, where female entrepreneurs appear to have an advantage.

5.4. *Identification*

Section 4.3 provided 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 et al. (2022). Specifically, for each of the seven sets of key model parameters, namely: hiring distortions faced by women entrepreneurs ($\{\tau_{fIj}, \tau_{fFj}\}$ and $\{\tau_{fIj}^{f}, \tau_{fFj}^{f}\}$), 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.[33] To do so, we re-solve the model each time by increasing one parameter by 1 p.p. 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 A2. Each number in a row r and column c is the percentage change in the moment in row r (averaged across regions, industries, and gender) when the parameter in column c is increased by 1 p.p. (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 A2 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

[32]As discussed earlier, in principle, our data allow for a more disaggregate analysis, and we have in fact attempted estimation based on more disaggregate industry definitions. The key challenge, however, is that there are very few female firms in several disaggregate industry-region pairs. As a result, with highly disaggregate data, we cannot recover the entry costs in those NIC industries that have very few or no female entrepreneurs. We discuss this issue in detail in Supplemental Appendix C.1.

[33]Note that the fixed costs of entry and formalization are not identified based on data moments, but are computed based on the the zero-profit conditions. Accordingly, we do not discuss them in this subsection.

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).

5.5. *Model Fit*

Tables A3–A5 in the Supplemental Appendix show the fit of the model for the 2005 data.[34] In Panel A of Table A3, 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 five moments, the fraction of men and women in: (a) the labor force; (b) self-employment; (c) wage employment; (d) informal entrepreneurship; and (e) 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.

In Table A4, 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 A4, 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. Despite this, the model does a decent job at fitting the levels as well.[35] Lastly, Panel C shows that the model also fits the standard deviation of firm size in the formal and informal sectors.

Lastly, in Table A5, we examine moments related to the share of male-owned and female-owned firms across sectors and regions. Panel A reports the average (and standard deviations) across states for the three industries in the informal sector, while Panel B reports the same for the formal sector. As we can see, the model is able to replicate the sorting of male-owned (columns 1–2) and female-owned firms (columns 3–4) across industries and both sectors. Note that we only target the relative shares for male-owned firms in both sectors and yet, the model is able to match their levels for both men and women (who we do not target at all). Figure A2 then shows the distribution across all regions and industries. Each dot on the figure is the share of male-owned (blue triangles) and female-owned firms (red circles) in each industry and region in the data (horizontal axis) and model counterpart (vertical axis). The solid line is the 45 degree line. As we can see, the model does a good job at matching these moments well in both sectors.

6. IMPACT OF POLICIES ELIMINATING BARRIERS FACING WOMEN

Apart from quantifying the various types of barriers faced by female entrepreneurs, the advantage of our framework is that it allows us to evaluate the aggregate effects of

[34] We show the fit only for 2005 since these are the data that we use to evaluate counterfactual policies.

[35] In Figure A1, we show the model fit in firm size across all industries and regions for both male and female firms in the formal and informal sectors.

counterfactual policies in general equilibrium. In particular, we evaluate the impact of six scenarios that sequentially eliminate the barriers faced by females in the economy on both the extensive margin (i.e., participation in the labor force, wage work, self-employment, and informal/formal entrepreneurship) and the 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 successively eliminate:

(i) *Excess fixed costs*: We eliminate the excess fixed costs faced by women in both wage work and entrepreneurship (informal and formal), that is, we set $E_{fW} = \min\{E_{mW}, E_{fW}\}$, $E_{fI} = \min\{E_{mI}, E_{fI}\}$, and $E_{fR} = \min\{E_{mR}, E_{fR}\}$.

(ii) *Excess hiring barriers*: We set $\{E_{gW}, E_{gI}, E_{gR}\}$ 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 fixed 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 III 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, that is, set $\overline{u}_f = \min\{\overline{u}_f, \overline{u}_m\}$.

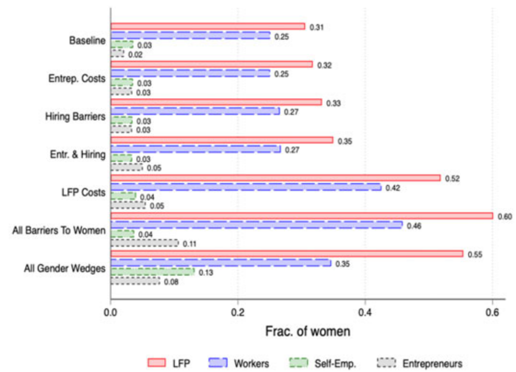
(v) *All excess barriers facing women*: In a fifth counterfactual, we remove all excess barriers faced by women on labor force participation, fixed costs of informal and formal entrepreneurship, and intensive margin hiring barriers.

(vi) *All gender-related wedges*: The counterfactual exercises (i) to (v) study the implications of removing excess costs women face, either in entering entrepreneurship or in expanding their businesses, while keeping the "advantage" they have in hiring female workers intact. In a final scenario, we examine the implications of eliminating all gender-related wedges. That is, we set: $E_{fA} = E_{mA}$, $\{\tau_{fs}; \tau^f_{fs}\} = \{0; 0\}$, and $\overline{u}_f = \overline{u}_m$.

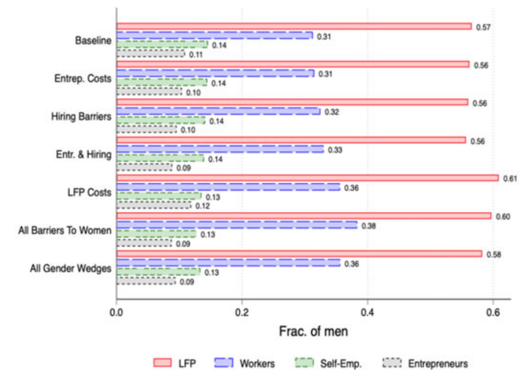
The reason we analyze scenarios (v) and (vi) separately is because it is not a priori clear that the "advantage" of female entrepreneurs in attracting female workers reflects preferences (in which case it should be left intact in the counterfactuals), or is itself a result of gender-based frictions (in which case it should be eliminated in a counterfactual considering complete gender parity). As discussed earlier, it is possible that gender norms or discrimination make women more likely to work for other women. On the other hand, the cross-country evidence presented in Section 1 suggests that the positive association between female business ownership and female employment is present in all countries, including ones with higher female labor force participation and gender norms more favorable to women than our Indian context. Distinguishing between these two interpretations is an exciting question for future research. By comparing scenarios (v) and (vi), we consider the aggregate implications of both interpretations.

We examine the effects of the above policy scenarios on 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 real profits). The results are displayed graphically in Figure 6. 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. Figures 6 and 6 display results for all six scenarios.

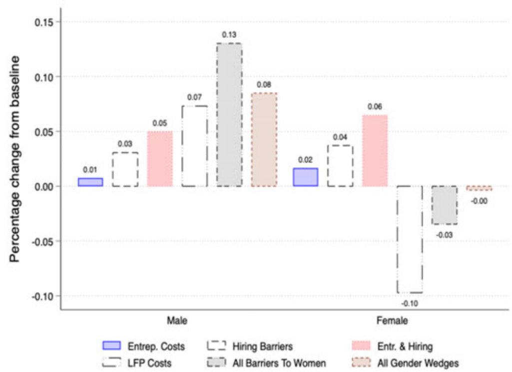
We focus our discussion on the main lessons learnt from a comparison across the counterfactual exercises. By sequentially eliminating the constraints facing female en-



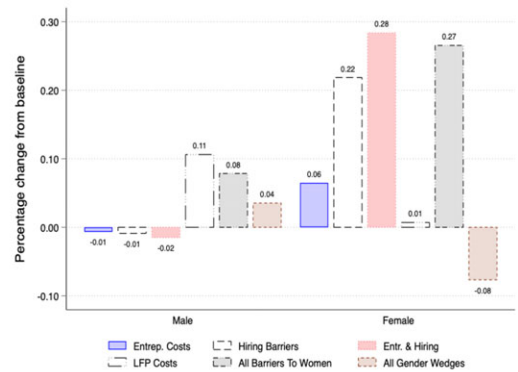
(a) Distribution of Women in the Economy



(b) Distribution of Men in the Economy

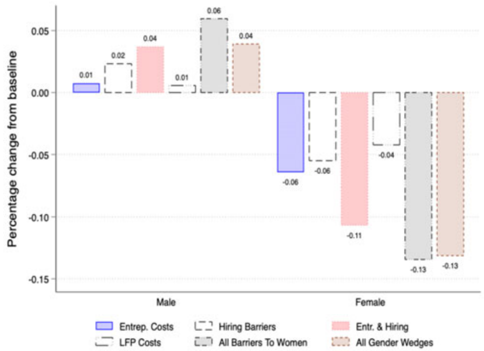


(c) Real Wages

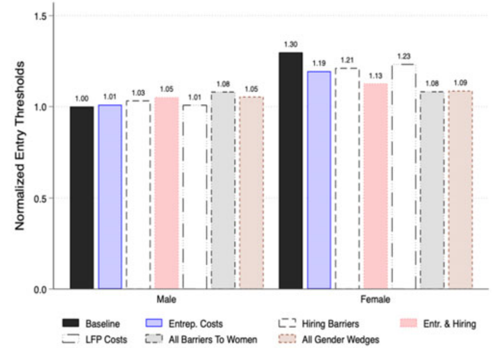


(d) Real Profits per Firm

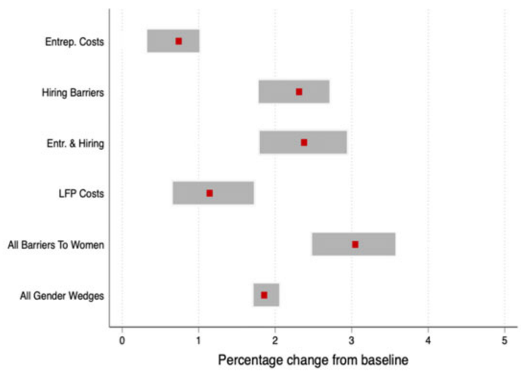
FIGURE 4.—Impact of policy scenarios on FLFP, entrepreneurship, and earnings. The above figures report the impact of six policies that eliminate barriers facing women, as described in Section 6 of the paper. For each policy, Figures (a) and (b) show the distribution of women and men in the labor force, wage- and self-employment, and entrepreneurship. Figures (c) and (d) show the percentage change in gender-specific real wages and real average profits for workers and entrepreneurs, respectively, under each policy as compared to the baseline.



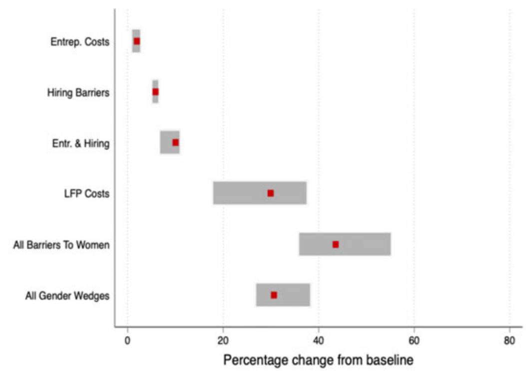
(a) Average Ability of Entrepreneurs Relative to Baseline



(b) Ability of the Marginal Entrepreneur



(c) Change in Aggregate Productivity



(d) Change in Real Income

FIGURE 5.—Impact of policy scenarios on aggregate productivity and welfare. The above figures report the impact of six policies that eliminate barriers facing women, as described in Section 6 of the paper. For each policy, Figure (a) reports the change in the average ability of an entrepreneur relative to the baseline scenario. Figure (b) reports the ability of the marginal entrepreneur. Figures (c)–(d) report the changes in aggregate productivity and real income as compared to the baseline.

trepreneurs, we gain insight as to which ones are most binding. Moreover, we demonstrate that when multiple barriers are present, eliminating just a subset of them may not be sufficient for substantively improving outcomes for women and the economy, as relaxing one constraint may make another constraint bind in equilibrium. The general message from our counterfactual analyses is that the barriers women face 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.

A further message of our analysis, however, is that 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 (see Figure 6). Intuitively, interventions that lower the costs of entry have limited impact on women's labor allocation decisions if distortions preventing them from succeeding post-entry remain in place. Therefore, policies encouraging the entry of women into formal businesses would need to be combined with measures promoting subsequent business growth. Such a combination (corresponding to scenario (iii) above) produces measurable gains for both female entrepreneurs and female workers and the economy as a whole. From Figure 6(a), the fraction of women who are entrepreneurs increases to 5% (from 2% at baseline), while the fraction of women in self-employment decreases by 0.2 p.p. (5.7%). Real wages for women increase by 6.5% (Figure 6(c)), and real profits of women entrepreneurs increase by around 25% (Figure 6(d)). Real wages and profits of men increase too, but in relative terms, both female workers and female entrepreneurs gain relative to male workers and male entrepreneurs.

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. From Figure 6(a), female labor force participation and the fraction of women workers increase by 4 p.p. and 2 p.p., respectively, as compared to the baseline.

It is interesting to compare interventions targeting female entrepreneurship to policies targeting general labor force participation of women (scenario (iv)). The latter significantly boost the labor supply of women. The fraction of women in the labor force increases by 21 p.p. (68%) in Figure 6(a). However, they do not boost the creation of female-owned businesses as much, thus depressing real wages and profits of women in equilibrium. Real wages for female workers *decrease* by around 10% (Figure 6(c)). This decrease is due to the fact that barriers facing female entrepreneurs are left intact 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, while the average profits of male-owned firms increase by 10%, the profits of female-owned firms do not change much (Figure 6(d)).

These 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. But the larger supply of women results in substantially lower real wages for them in equilibrium, while average profits in female-owned firms are not affected. In contrast, boosting labor demand by targeting barriers to entrepreneurship for women mitigates real wage declines stemming from the increase in labor supply, and results in additional profits for female-owned firms and real wage gains for female workers.

Finally, the implications of the various policy scenarios for aggregate productivity and welfare (measured by real income in our setting) are also of key interest. Eliminating all entry and expansion barriers to female entrepreneurship in scenario (iii) *depresses* the average productivity of female-owned firms by 10.7% (Figure 6(a)). This decline can be rationalized in Figure 6(b), which shows, for the baseline as well as for all counterfactual scenarios, the productivity of the marginal entrepreneur, that is, 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 30% more productive than her male counterpart. The removal of excess entrepreneurial costs allows more women to enter entrepreneurship, presenting male entrepreneurs with more competition. Accordingly, the productivity of the marginal female (male) entrepreneur decreases (increases), which results in a decrease (increase) in the productivity of the average female (male) entrepreneur. Nevertheless, the marginal female entrepreneur is still 5 p.p. more productive than her male counterpart, and this compositional shift translates into median aggregate productivity gains of 2.4% across Indian states (with a 25th–75th percentile increase of 1.78–2.95%) and median real income gains of 10% (with a 25th–75th percentile gain of 6.57–11.10%), as reported in Figures 6(c) and 6(d), respectively.

In comparison, targeting barriers to female LFP produces muted productivity gains but larger real income effects. The muted productivity gains are due to the fact that, from Figures 6(a) and 6(b), the average and marginal abilities of male entrepreneurs do not change much relative to the baseline, while the average productivity of female entrepreneurs decreases by 4.2%, and the threshold productivity of the marginal woman entrepreneur declines by 7 p.p. These changes translate into median aggregate productivity gains of 1.14% across Indian states (with a 25th–75th percentile increase of 0.64–1.74%) and median real income gains of 30% (with a 25th–75th percentile gain of 17.7–37.7%). The larger income effects that are observed despite the fall in female workers' real wages are a consequence of the substantially higher number of women in the labor force earning income.

Perhaps not surprisingly given the above insights, the most effective policy scenario combines measures targeting female entrepreneurship with measures aimed at increasing general female labor force participation (scenario (v)). In this case, labor force participation of women doubles to 60%, and the fraction of women who are entrepreneurs increases more than five-fold, to 11% (Figure 6(a)). The simultaneous increase of labor demand for women through the promotion of female entrepreneurship and labor supply through interventions targeting female LFP results in larger aggregate productivity and real income gains than any other policy in isolation.

Key in understanding these effects is the reallocation mechanism from male low-productivity entrepreneurs to female higher-productivity entrepreneurs. In the presence of gender-based barriers, low-productivity male-owned firms operate in the economy only because they do not face competition from more productive 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. The average ability of male (female) entrepreneurs increases (decreases) relative to the baseline by 6% (13.4%), which is rationalized by the increase (decrease) in the ability of the marginal male (female) entrepreneur (Figures 6(a) and 6(b), respectively). This scenario equalizes the ability of the marginal male and female entrepreneur (Figure 6(b)). This reallocation channel improves the aggregate productivity in the economy by 3% across Indian states (with a 25th–75th percentile increase of 2.5–3.6%) and results in median real income gains of 43.5% (with a 25th–75th percentile gain of 35.7–55.3%).

Lastly, we consider the implications of eliminating *all* gender-based frictions (scenario (vi)). The difference to the previous counterfactuals is that in this case, we shut down the indirect positive effects of an increase in female entrepreneurship on the employment and real wages of female workers. This scenario generates around 83% of the increase in female LFP, around two-thirds the change in aggregate productivity, and 70% of the gains in real income generated in the scenario in which female entrepreneurs retain the advantage they have in hiring female workers (scenario (v)). This suggests that this advantage is significant; when eliminated, the positive effects discussed in Section 6 are smaller.

Nevertheless, the effects remain large and positive, suggesting that even without policies that give women, or let them retain, an advantage in some areas, policies targeted at achieving gender-parity can generate substantial benefits for both women as well as the economy as a whole. Interestingly, however, in our case, the propensity of women to work for other women provides additional gains, not only to women, but also to the economy in the aggregate.

7. CONCLUSION

Our analysis demonstrates that eliminating 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. Furthermore, targeting specific constraints in the presence of multiple distortions may prove ineffective, as relaxing one constraint may make other constraints more binding. In this regard, our analysis of multiple distortions and their interactions 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.

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not have the right to republish them. Therefore, the replication package only includes the codes and the parts of the data that are not subject to the exemption. However, the authors provided the Journal with (or assisted the Journal to obtain) temporary access to the restricted data. The Journal checked the provided and restricted data and the codes for their ability to reproduce the results in the paper and approved online appendices.