The Poverty Impact of Informal Sector Policies*

Elias Steiner†

— FIRST DRAFT —

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Abstract

This paper develops a general equilibrium model with heterogeneous agents to analyze the poverty impact of different policies aimed at reducing informality. The model features occupational choice with self-employment, minimum wages and a split labor market that are characteristic of developing countries. The counterfactual analyses using Madagascan data show that reducing entry costs into the formal sector or tightening enforcement of formality slightly increase the scope of the formal economy but fail to reduce poverty. Lowering the revenue tax rate or the minimum wage, in contrast, entail growth, a larger formal sector with more formal employment and lower poverty levels.

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†University of Lucerne, Department of Economics, Frohburgstrasse 3, 6002 Lucerne, Switzerland, e-mail: elias.steiner@unilu.ch, phone: +41 77 449 1989.

1 Introduction

Development policy has long grown into a multifaceted business. Experts throughout the world are working on various fronts to achieve a wide range of development targets, laid out by the 17 Sustainable Development Goals (SDG). The first of these SDG is to eradicate extreme poverty for all people everywhere by 2030. Extreme poverty is defined as living on below I$ 1.90 per day.[1] While this target is straightforward, the means to achieve it are not. In this article, I focus on a feature of developing economies that is closely related to poverty: the informal sector. The informal sector comprises firms that are not registered, do not pay taxes, and disregard regulations such as labor laws. This sector is extremely large in developing countries. Hassan and Schneider (2016) estimate the share of the informal sector in GDP to exceed 30% for most poor countries. The International Labor Organization (ILO) estimate for informal employment is often higher than three quarters of total occupation. The relation to poverty arises along two dimensions. First, the informal sector is negatively related to total factor productivity (see, e.g., D'Erasmo et al., 2014). La Porta and Shleifer (2014) find that informal entrepreneurs have lower education, are less productive and run smaller establishments. Further, informal employees are not guaranteed minimum wages, and their earnings may be far below the absolute poverty line (see, e.g., Amuedo-Dorantes, 2004). Thus, it is fair to say that the informal sector is the sector of the poor. Second, Page and Pande (2018) identify an increase in government capacity as the most effective way to eradicate poverty in functioning states. However, it lies in the nature of the informal sector that it undermines state capacity by operating beyond the grip of the government. Therefore, in order to increase total factor productivity and government capacity, getting informal firms to formalize is a key element in the fight against poverty.

Although the size of the informal sector is negatively correlated with income, the poverty impact of policies aimed at increasing the scope of the formal sector is not well understood. Due to the large number of impoverished people occupied in the informal sector, any policy targeting it has immediate effects on the livelihoods of the poor. However, policies designed to incentivize entrepreneurs to formalize are likely to work for larger, more productive informal establishments. While these entrepreneurs might indeed see their incomes rise as a result of formalization, there are a number of aggregate effects that affect those at the low end of the income distribution. A larger formal sector entails more formal employment at better wages. Higher tax revenues allow for more generous transfers to the poor or better provision

[1] Throughout the paper, I$ refers to international dollars at constant 2011 prices.

of public goods. To give an illustrating example, lowering revenue taxes leads to an increase in output of formal firms and to a move of some more productive informal entrepreneurs to the formal sector. To produce more output in this sector, additional formal labor is needed providing better-paying job opportunities for informal workers as well as low productivity informal entrepreneurs. The result is a reduction in poverty.

I develop a structural model that allows for the analysis of different policies and their effects on poverty. The model is based on the seminal contributions to the trade literature by Melitz (2003) and Chaney (2008) in that it features monopolistic competition with entrepreneurs that are heterogeneous in their productivity. I introduce occupational choice, where individuals can start an enterprise in the formal or the informal sector, or become workers. The formal sector firms face additional entry costs and revenue taxes, and must pay at least the minimum wage. In contrast, the informal sector wage is a market clearing wage. In this sense, the informal labor market is a residual that occupies all workers that do not find jobs in the formal sector. I further take into account the entrepreneurs' own labor in their establishments to explicitly allow for one-man enterprises. This captures well a choice faced by many in developing countries between laboring at a low wage for an informal firm—always in hope to find a better-paying formal job—or becoming self-employed. The importance of this margin is reflected by the fact that in 2017 the ILO classified about half of the labor force in Sub-Saharan Africa as own-account workers. This occupational decision is governed by the expected income when looking for a job. While potential workers hope to find a formal job, many end up working in the informal sector even though their income would be higher if they started their own enterprise. Additionally, the model allows for part-time self-employment, a situation that is common in developing countries given the large number of micro-enterprises.[2] These novel features are tailored to picture the reality of the low-income segment of developing economies and particularly allow to shed light on the effects of informal sector policies on the poor. Finally, since formal entrepreneurship would—given the additional cost of production—never be chosen voluntarily, the government enforces a firm size cap, above which entrepreneurs are forced to operate in the formal sector. This leads to a range of productivity in which it pays off to stay informal but reduce the operating size below the optimum. Hence, the informal sector is again divided into unconstrained and constrained informal entrepreneurs.

I use this model to analyze four different informal sector policies, of which some have been

[2]With the rise of the "gig economy," this employment status is likely to gain in importance (see, e.g., The Economist, October 4, 2018).

widely discussed in the literature. However, while this previous literature has almost exclusively focused on the effects of such policies on formality, I shed light on their effect on the bottom of the productivity distribution and therefore on the poor. The first policy is to lower entry costs into the formal sector. As was first argued by de Soto (1989, 2000), firms are excluded from the formal sector because of the high entry barriers commonly found in developing countries. Thus, removing these barriers should pull informal firms into formality. The second two policies—reducing taxes or the minimum wage—are two ways to lower the variable costs of being formal. The argument behind this approach is that informal entrepreneurs want to avoid costs by hiding from the government (see, e.g., Farrell, 2004; Levy, 2008). Finally, the fourth policy is to tighten enforcement. While formality is legally binding in most countries, developing countries often lack the means or the will to enforce formality upon entrepreneurs (see, e.g., Ordóñez, 2014). Whereas the previous literature finds that reducing entry costs or taxes, or implementing stricter enforcement, all lead to an increase in formality (see, e.g., Prado, 2011; Ulyssea, 2018), the general equilibrium effects on formal employment, real wages, poverty and welfare differ dramatically across these policies. The last policy—reducing the minimum wage—has so far received little attention in this context. In order to advise policy makers, it is important to understand the different impacts of different policies. Not least because how the large number of poor are affected is crucial to the democratic support for a policy.

The model is solved numerically and calibrated to household data from Madagascar. Madagascar, as one of the ten poorest countries in the world, is a particularly interesting case. Its informal sector contributes roughly 45% to GDP (Hassan and Schneider, 2016) and occupies over 90% of the population according to the ILO. When last published in the World Bank's World Development Indicators (WDI) in 2012, 78% of the population were living on below I$ 1.90 a day.[3] I use the *Enquête Périodique Auprès des Ménages* (EPAM) of 2010 which samples about 12'000 households across the country. My sample consists of 3'072 mostly small non-agricultural enterprises run by members of these households. Once I have calibrated my model to these data, I run counterfactual analyses for the four policies described above.

Consistent with the literature, I find that all four policies lead to an increase in the scope of the formal sector. However, the effects are larger for reductions in the revenue tax rate or the minimum wage. While reducing entry costs and tightening enforcement lead to the shift of some marginal entrepreneurs from the informal to the formal sector, these policies do not entail changes in the behavior of formal firms and the poverty impact is modest at best. In contrast,

[3] All data from the ILO and the World Bank were retrieved in April, 2019.

reducing the variable costs of production (revenue tax, minimum wage) entails an increase in output in the formal sector. In consequence, these firms demand more formal labor. It is this better-paying labor opportunity that achieves to pull many people out of poverty. This result is in line with previous findings (see, e.g., World Bank, 2013; Canelas, 2018) Additionally, higher output by formal firms generates more tax revenue allowing for more generous transfers or the provision of public goods that contribute to poverty reduction.[4]

This paper is related to a number of others. To my knowledge, Prado (2011) is the first to analyze informal sector policies in a general equilibrium model with monopolistic competition and two sectors. I add to this research by introducing a split labor market with a minimum wage in the formal sector. Ulyssea (2018), who uses a structural model with perfect competition and heterogeneous workers, analyzes the extensive as well as the intensive margin of formality in the case of Brazil. The key difference to his model is that I introduce a complete set of occupational choice such that labor supply is endogenized. I further take into account that entrepreneurs have a labor endowment themselves. These novel features make my model better suited to analyze the equilibrium effects at the low end of the productivity distribution. Allen et al. (2018), in a similar model to the two above, show how different productivity thresholds across industries lead to overlaps in the firm size and productivity distributions. Since I focus on the poor, I content with perfect duality of the two sectors, which greatly simplifies my model. Finally, Ordóñez (2014) develops a Lucas type model to analyze the effect of full enforcement of formality in Mexico. However, to the best of my knowledge, there are no studies addressing the impact of informal sector policies on the poor through general equilibrium effects. And to date, I am not aware of any articles on the informal sector where a structural model is calibrated to data from a least developed country where poverty is still an acute issue. The simplicity of my model allows for calibration using only a small number of variables, which are commonly available for these countries. In addition to the above-mentioned papers, there is a large empirical literature on the informal sector (e.g., Jaramillo, 2009; Almeida and Carneiro, 2012; Günther and Launov, 2012; de Mel et al., 2013; de Andrade et al., 2014; Demenet et al., 2016; De Giorgi et al., 2018; Rocha et al., 2018; Benhassine et al., 2018). More remotely, this paper relates to studies on the informal labor market (e.g., Bosch and Esteban-Pretel, 2012; Charlot et al., 2015), and to the broad literature on structural models with heterogeneous firms (e.g., Hopenhayn, 1992; Melitz, 2003; Restuccia and Rogerson, 2008; Chaney, 2008). Finally, the article contributes to the vast literature on poverty (e.g. Banerjee and Duflo, 2011; Young,

[4] In developing countries, an important part of these transfers comes in the form of subsidies for food or fuel.

2012; Page and Pande, 2018).

The article proceeds as follows. The next section introduces the model. Section 3 describes the data and performs the calibration. In Section 4, I conduct the counterfactual analyses and present the results. Section 5 concludes.

2 The Model

2.1 Set-Up

Production

I consider an economy that is populated by $N > 0$ individuals.[5] Individuals are heterogeneous in their entrepreneurial productivity, $\varphi \in (0, \infty)$. Entrepreneurial productivity is drawn from a distribution with a probability density function (pdf) $g(\varphi)$. Each individual is endowed with one unit of labor. Depending on their productivity, individuals choose one out of a set of three occupations: entrepreneurship in the formal sector, entrepreneurship in the informal sector, or worker. I assume entrepreneurial productivity not to matter once an individual chose to become a worker, i.e., labor productivity is the same for all individuals.

The market structure is monopolistic competition, where each entrepreneur supplies a variety of a single final good. The production function uses only labor as input and depends on productivity

$$q(\varphi) = [1 + l]\varphi, \tag{1}$$

where $q(\varphi)$ denotes output and l is hired labor input.[6] As is standard in the heterogeneous firms literature, a higher productivity implies production of a variety of the final good at lower cost. The cost of production is the labor cost, i.e., hired labor times the sectoral wage, w_k, with $k \in \{i, f\}$ for the informal and the formal sector respectively. I add one to the hired labor in the production function to take into account the entrepreneur's own-labor. This implies that each entrepreneur can produce φ units of output even without hiring any additional workers. To account for the large number of micro-enterprises in developing countries, I explicitly allow for the hired labor demand to be negative, i.e. the special case where $l \in (-1, 0)$. This means that the total labor requirement to operate such an enterprise is smaller than one and the

[5] I abstain from using a continuum of individuals as is often found in the literature. This is to facilitate the translation to numerical computer code.

[6] Since productivity is the only source of ex ante heterogeneity, it is sufficient to index individuals by φ. The probability that two random draws yield the same value for φ is zero.

entrepreneur is under-employed in her own establishment. Such an entrepreneur would offer part of her time in the labor market.[7] I assume that these entrepreneurs will find work in the sector they produce in at this sector's wage. This assumption greatly simplifies the analysis.[8]

Labor Market

The labor market is split into a formal and an informal segment that both draw from the same labor supply. This labor supply is the pool of all the individuals that choose to be workers. The additional labor supply by part-time entrepreneurs (for those with $l \in (-1, 0)$) is directly subtracted from total sectoral labor demand. Individuals who work for a formal firm—henceforth the formal workers—earn a formal wage, which is constrained below by a minimum wage, $w_f \geq w_{min}$. The informal wage, w_i, is—by nature—not constrained by any regulation and is determined by labor market clearing. Given that the minimum wage is binding, all workers would prefer to work in the formal sector.[9] However, the number of jobs at formal establishments is limited. I assume that formal jobs are assigned to individuals randomly and that those who do not find a formal job will find work in the informal labor market. In this sense, the informal labor market is a residual occupation that absorbs all labor not employed in the formal sector.[10] Random assignment of individuals to formal and informal jobs is governed by the probability of finding a job in the formal sector, which I denote by γ.[11] This probability is endogenously determined by the ratio of formal labor demand to total labor demand. The expected wage, when choosing to be a worker, is thus given by

$$E[w] = (1 - \gamma)w_i + \gamma w_f. \tag{2}$$

Consumption

Individuals generate an income that is either comprised of a wage, of profits from entrepreneurship, or of both. Entrepreneurs who are underemployed in their own establishments, and therefore offer some of their labor in the labor market, are counted as entrepreneurs. Their wage

[7] This implies that total labor used in production is equal to N in equilibrium.

[8] Technically, this simplifying assumption works as long as aggregate demand for informal and formal labor are both non-negative. Intuitively, this assumption could mean that entrepreneurs are more visible by and better connected to other firms in their sector. Thus they are the first to get a job by their fellow entrepreneurs.

[9] I only look at equilibria where $w_i \leq w_f = w_{min}$. Equilibria with $w_i = w_f > w_{min}$ are thinkable.

[10] Official unemployment rates in developing countries are often rather low (e.g., 1,8% for Madagascar, ILO). Since there are hardly any unemployment benefits, individuals prefer work at very low wages to being unemployed.

[11] This leads to symmetry breaking whereby two individuals with ex ante almost the same productivity draw may ex post end up earning very different incomes.

income will be regarded as part of their profits as is described further below. Total income is used to buy varieties of the final good for consumption. The consumption basket is chosen to maximize the Constany Elasticity of Substitution (CES) utility function

$$U = \left[\sum_{\varphi \in \Phi_e} q(\varphi)^{\rho} \right]^{\frac{1}{\rho}}, \tag{3}$$

where $0 < \rho < 1$, and Φ_e denotes the set of all realized productivity draws that result in entrepreneurship. Since each entrepreneur produces a different variety and each productivity draw is realized only once, the number of productivity draws in this set equals the number of varieties in the economy. Throughout the model, I assume that N is large such that each individual's decision does not affect any aggregate outcomes.

A standard result of the monopolistic competition literature is that the individual utility maximization problem leads to aggregate demand for each variety of

$$q(\varphi) = \frac{R}{P} \left[\frac{p(\varphi)}{P} \right]^{-\sigma}, \tag{4}$$

where $\sigma = 1/(1-\rho)$ is the elasticity of substitution, R is aggregate revenue,[12] and P is the CES price aggregator. Later on, I will use P as the numeraire and set it equal to one such that nominal variables equal real variables.

Government

The government is raising revenues from the formal entrepreneurs by levying a fixed entry fee, $T \geq 0$, and a variable revenue tax at rate $\tau \in (0, 1)$. To avoid these additional costs, entrepreneurs can choose to produce in the informal sector. These entrepreneurs, however, need to hide from the government who is trying to enforce formality. I assume that the the government is only able (or willing) to discover entrepreneurs that reach a critical size and strictly enforces formality on all entrepreneurs producing more output than a threshold, $\hat{q}$.[13] To achieve this, it penalizes informal firms producing output larger than $\hat{q}$ with a fine, which is assumed to be large enough that in equilibrium no informal entrepreneur would choose this

[12] Note that in equilibrium aggregate income must equal aggregate revenue.

[13] Since all entrepreneurs producing exactly $\hat{q}$ will charge the same price, setting the threshold on quantity is identical to capping firm revenue. This is the simplest way to model enforcement. It is possible to model a probability of enforcement conditional on firm size. The qualitative results remain similar (see, e.g., Ordóñez, 2014, Appendix C).

option.

Total tax revenue is given by

$$\mathcal{T} = \tau R_f + N_f T, \tag{5}$$

where R_f denotes the aggregate revenue of the formal sector and N_f is the number of formal entrepreneurs. Total tax revenue is redistributed lump-sum to all individuals.[14] Thus, each individual receives

$$t = \frac{\mathcal{T}}{N}. \tag{6}$$

2.2 Individual Optimization

Entrepreneurs' Optimization Problem

Each entrepreneur—whether formal or informal—produces a variety of a single final good under monopolistic competition. Profits of informal entrepreneurs are given by

$$\pi(\varphi) = p(\varphi)q(\varphi) - w_i \left[\frac{q(\varphi)}{\varphi} - 1\right]. \tag{7}$$

Subject to the demand function (4), the price that maximizes profits is

$$p(\varphi) = \frac{w_i}{\rho\varphi}, \tag{8}$$

i.e, marginal cost times a markup, $1/\rho$. Given this price, the demand function (4) determines optimal output, $q(\varphi)$, and the production function (1) pins down the profit-maximizing hired labor input $l(\varphi)$. In equilibrium, revenue is

$$r(\varphi) = R\left[\frac{\rho\varphi P}{w_i}\right]^{\sigma-1} \tag{9}$$

and profits are given by

$$\pi(\varphi) = \frac{R}{\sigma}\left[\frac{\rho\varphi P}{w_i}\right]^{\sigma-1} + w_i. \tag{10}$$

Profits are thus a fraction $1/\sigma$ of revenue. The w_i on the right-hand side of equation (10) reflects the fact that entrepreneurs are working themselves. Thus, adding the wage either takes into account the cost saved from own-labor, or the actual labor income from working for

[14] Lump-sum transfers are a very convenient modeling device. In principle, it is possible to implement any progressive transfer scheme in the model. Additionally, transfers can be understood to include the provision of public goods that benefit all individuals.

another entrepreneur (for those with $l(\varphi) \in (-1, 0)$).

For formal firms, the optimization problem is very similar. They obtain profits of

$$\pi_f(\varphi) = (1-\tau)p(\varphi)q(\varphi) - w_f\left[\frac{q(\varphi)}{\varphi} - 1\right] - T. \tag{11}$$

Thus, formal entrepreneurs optimally charge a price,

$$p_f(\varphi) = \frac{w_f}{(1-\tau)\rho\varphi}, \tag{12}$$

generate revenues

$$r_f(\varphi) = R\left[\frac{(1-\tau)\rho\varphi P}{w_f}\right]^{\sigma-1}, \tag{13}$$

and profits

$$\pi_f(\varphi) = (1-\tau)\frac{R}{\sigma}\left[\frac{(1-\tau)\rho\varphi P}{w_f}\right]^{\sigma-1} + w_f - T. \tag{14}$$

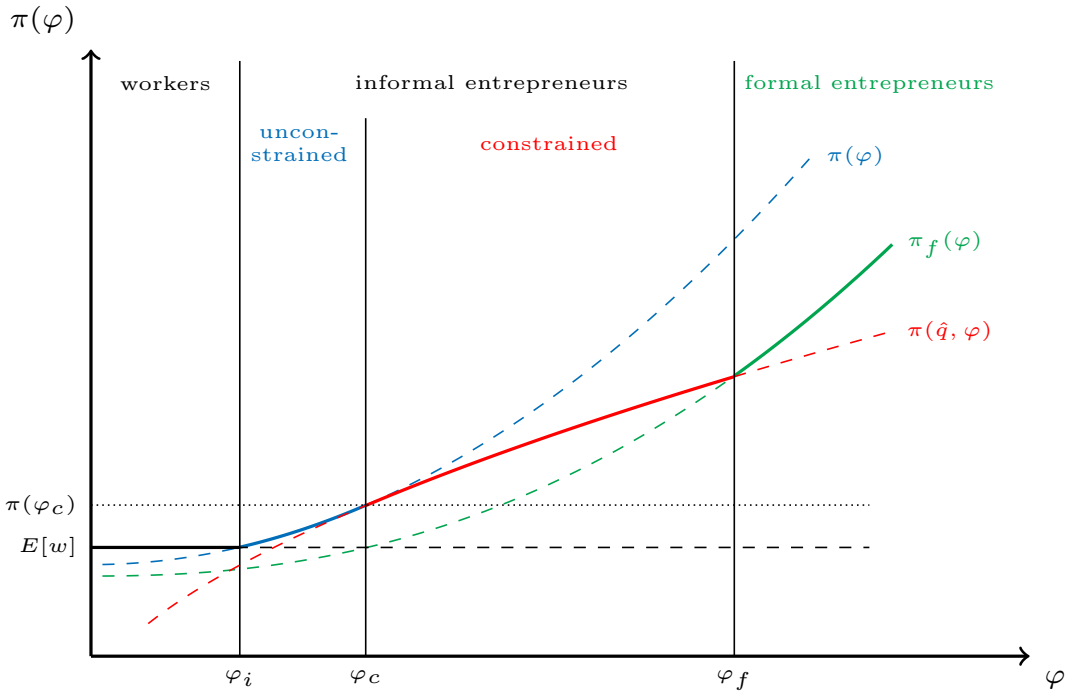
Occupational Choice

In equilibrium, there will be four groups of individuals: workers, unconstrained informal entrepreneurs, constrained informal entrepreneurs, and formal entrepreneurs. The constrained informal entrepreneurs are those who—in absence of formality costs—would optimally choose to produce a quantity higher than $\hat{q}$. However, in order to avoid these costs, they reduce their output to $\hat{q}$ to "fly below the radar." I denote the size of each group by L, N_i, N_c, and N_f, respectively. Note that $L+N_i+N_c+N_f = N$. The group of workers are randomly divided into two subgroups: informal and formal employees. But, since the assignment to these subgroups is random, an individual simply chooses to become a worker. To which group an individual belongs depends on its productivity, φ, and there will be three thresholds dividing the individuals into the four segments. I denote these thresholds by φ_i, φ_c, and φ_f.[15]

Figure 1 graphically illustrates the occupational choice problem. To the left of φ_i, the expected wage, $E[w]$, is higher than profits that could be obtained in any sector. Individuals with draws of φ in this range choose to become workers. Between φ_i and φ_f individuals become informal entrepreneurs. The first group of informal entrepreneurs—those between φ_i and φ_c—optimally choose prices and quantities without worrying about the government. They are therefore unconstrained. An entrepreneur with productivity φ_c optimally produces exactly $\hat{q}$ units of output. This is the maximum quantity that can be produced in the informal sector

[15]The subscript denotes the segment of the economy of which the threshold is the lower bound.

Figure 1: Occupational Choice



without detection by the government. Hence, individuals with productivity draws between φ_c and φ_f are constrained informal entrepreneurs. For constrained entrepreneurs, profits still increase with φ—even though output remains constant—because a higher φ implies lower labor input for the same output. Finally, beyond φ_f, profits in the formal sector exceed what is obtained restraining output to $\hat{q}$. Thus, individuals with $\varphi \geq \varphi_f$ choose to become formal entrepreneurs. The solid line connects the relevant segments of each profit curve.

Formally, the thresholds can be found by comparing incomes of each two neighboring groups at the margin. In that way, the first threshold can be found by comparing the expected income of workers to informal profits[16]

$$\pi(\varphi_i) = E[w]. \tag{15}$$

Using equations (2) and (10), I obtain

$$\varphi_i = \left[\frac{\sigma(E[w] - w_i)}{R}\right]^{\frac{1}{\sigma-1}} \frac{w_i}{\rho P}. \tag{16}$$

[16] A special case is where $\varphi_i > \varphi_c$, i.e., all informal entrepreneurs are constrained. In this case we must have that $\pi(\hat{q}, \varphi_i) = E[w]$.

The second threshold, φ_c, is the productivity level at which an entrepreneur optimally chooses to produce exactly $\hat{q}$ in the informal sector, i.e., it describes the productivity draw at which an entrepreneur generates the same profit being unconstrained or constrained informal,

$$\pi(\varphi_c) = \pi(\hat{q}, \varphi_c), \tag{17}$$

where[17]

$$\pi(\hat{q}, \varphi) = r(\varphi_c)\left[1 - \frac{\varphi_c}{\varphi}\rho\right] + w_i. \tag{18}$$

The threshold φ_c is pinned down by $\hat{q} = q(\varphi_c)$, which can be solved using the demand function (4) to get

$$\varphi_c = \left[\frac{\hat{q}P}{R}\right]^{\frac{1}{\sigma}} \frac{w_i}{\rho P}. \tag{19}$$

Finally, the decision to formalize is based on the comparison of the profits as a constrained informal entrepreneur to those obtained in the formal sector

$$\pi(\hat{q}, \varphi_f) = \pi_f(\varphi_f). \tag{20}$$

I solve this using equations (14) and (18) to get the equation

$$-\frac{1-\tau}{\sigma}\left[\frac{1-\tau}{1+\delta}\right]^{\sigma-1}\varphi_f^{\sigma} + \left[\varphi_c^{\sigma-1} + \frac{(T-\delta w_i)\bar{\varphi}^{\sigma-1}}{R}\right]\varphi_f - \varphi_c^{\sigma}\rho = 0. \tag{21}$$

This term can be solved for its root to get φ_f.

To rule out the case where low-productivity individuals have an incentive to set up a formal business only to take advantage of the formal wage they can earn in this sector, i.e., setting up a business without producing anything and offering their total labor endowment in the market, I make the assumption that T is sufficiently large. Formally, I impose the condition that, in equilibrium,

$$T \geq w_f - E[w]. \tag{22}$$

In this way, there will be clean sorting of entrepreneurs into sectors according to their productivity.[18]

[17] Note that if $\varphi = \varphi_c$, the term in brackets in equation (18) equals $1 - \rho = 1/\sigma$ and, hence, the whole term is equal to $\pi(\varphi_c)$.

[18] Depending on parameterization, equation (21) has multiple roots. However, imposing condition (22), I can rule out that more than one root lies within the domain of φ.

Income

Workers' income is homogeneous and depends only on the type of employment (informal or formal). It is given by the wage plus the lump-sum transfer

$$y_k = w_k + t, \tag{23}$$

where $k \in \{i, f\}$. Entrepreneurs' income is simply

$$y_s(\varphi) = \pi_s(\varphi) + t, \tag{24}$$

where $s \in \{i, c, f\}$. Since I will set $P = 1$, these are nominal as well as real incomes.

To make statements about poverty, I denote the real poverty line by μ. Individuals with real incomes below this threshold are counted as poor.

2.3 Aggregation and Equilibrium

Aggregation

In this section, I will discuss the number of entrepreneurs in each sector and find expressions for the aggregate price level and revenue. I denote by Φ the set of all productivity draws in the economy. I write the number of individuals in this set as $|\Phi| = N$. The thresholds φ_i, φ_c, and φ_f divide this set into four subsets. These subsets are represented by Φ_l for the workers, and Φ_i, Φ_c, and Φ_f for the informal, constrained informal, and formal entrepreneurs respectively. To give an example, Φ_l is the set of all individuals with a productivity draw $\varphi < \varphi_i$.[19] The size of each group is thus given by

$$L = |\Phi_l|, \quad N_i = |\Phi_i|, \quad N_c = |\Phi_c|, \quad \text{and} \quad N_f = |\Phi_f|. \tag{25}$$

Further, I denote the total number of entrepreneurs by $N_e = |\Phi_e|$.

Regarding the price level, I write the CES price aggregator as

$$P = \left[\sum_{\varphi \in \Phi_i} p(\varphi)^{1-\sigma} + N_c p(\varphi_c)^{1-\sigma} + \sum_{\varphi \in \Phi_f} p_f(\varphi)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}. \tag{26}$$

[19] At each threshold, an individual with a productivity draw equal to the threshold is indifferent between the two occupations the thresholds separates. I assume that such individuals would choose the "higher" sector.

The middle term on the right-hand side arises from the fact that all constrained entrepreneurs produce the same quantity and, hence, also obtain the same price. Defining δ as the wage differential such that $w_f = (1+\delta)w_i$, I can use expressions (8) and (12) for informal and formal prices to write

$$P = \frac{w_i}{\rho\bar{\varphi}} = p(\bar{\varphi}), \tag{27}$$

where

$$\bar{\varphi} \equiv \left[\sum_{\varphi \in \Phi_i} \varphi^{\sigma-1} + N_c \varphi_c^{\sigma-1} + \left[\frac{1-\tau}{1+\delta}\right]^{\sigma-1} \sum_{\varphi \in \Phi_f} \varphi^{\sigma-1} \right]^{\frac{1}{\sigma-1}} \tag{28}$$

is aggregate productivity.[20]

Using equation (27) to substitute for P in the expression for revenue (9) and summing up over all individual revenues, I obtain

$$R = r(\bar{\varphi}). \tag{29}$$

Finally, aggregate output is given by $Q = R/P$. With $P = 1$, real output equals nominal output, i.e., $Q = R$.

Employment

In this section, I will show how many workers are hired in each sector in equilibrium. Total labor supply is given by L as defined above. In equilibrium, aggregate wage income of workers in unconstrained informal firms must be $R_i - \Pi_i$, where R_i and Π_i denote total informal revenue and profits respectively. Hence, informal labor demand is given by

$$L_i = \frac{R_i - \Pi_i}{w_i}. \tag{30}$$

Using equation (27) to substitute for P in individual profits (10) and summing up over all unconstrained informal entrepreneurs, I get aggregate informal profits of

$$\Pi_i = \frac{R_i}{\sigma} + N_i w_i. \tag{31}$$

[20] From equation (4) and the expression for the prices it follows that $\frac{q(\varphi)}{q(\bar{\varphi})} = \left(\frac{\varphi}{\bar{\varphi}}\right)^{\sigma}$. Hence, $\bar{\varphi}$ is a harmonic mean of φ weighted by $\frac{q(\varphi)}{q(\bar{\varphi})}$.

Thus, I write informal labor demand as

$$L_i = \frac{\rho R_i}{w_i} - N_i. \tag{32}$$

This is the share of informal revenue going to labor, divided by the informal wage, minus the own-labor of informal entrepreneurs.

In an analog fashion, total income of formal workers must be $R_f - \Pi_f - \mathcal{T}$. Therefore, formal labor demand can be written as

$$L_f = \frac{\rho(1-\tau)R_f}{w_f} - N_f. \tag{33}$$

While all constrained informal entrepreneurs turn the same revenue, their productivity differs. A higher productivity implies lower labor input to produce the same quantity and, hence, higher profits. Thus, the expression for constrained informal labor demand is

$$L_c = \frac{\rho \frac{R_c}{N_c} \sum_{\varphi \in \Phi_c} \frac{\varphi_c}{\varphi}}{w_i} - N_c. \tag{34}$$

Equilibrium

For any set of productivity draws, Φ, the equilibrium is characterized by the set of five endogenous variables, $\{\Phi_i, \Phi_c, \Phi_f, w_i, R\}$. Given w_i and R, conditions (15), (19) and (20)—which pin down the thresholds φ_i, φ_c and φ_f—determine the three sets of productivity draws of the entrepreneurs. From equation (25), I can find the numbers of individuals in each of these sets. L follows immediately from $L = N - N_e$. To find w_i and R, two more equations are needed. Using the labor demand equations (32), (33) and (34), together with the labor market clearing condition $L = L_i + L_c + L_f$, it is possible to determine R. Finally, setting $P = 1$, the goods market clearing condition

$$R = \left[\sum_{\varphi \in \Phi_i} q(\varphi)^\rho + N_c q(\varphi_c)^\rho + \sum_{\varphi \in \Phi_f} q_f(\varphi)^\rho \right]^{\frac{1}{\rho}} \tag{35}$$

can be used to find w_i.

Numerical Solution

The model is solved numerically in three steps. The basic principle is to search through the set $\{\varphi_i, \varphi_c, \varphi_f, \delta\}$ until the equilibrium is found.[21] I restrict the search to equilibria with $\delta > 0$, i.e., the exogenous minimum wage is assumed to be binding for the formal sector. In a first step, given an initial guess for the values of the above set, I calculate L, N_i, N_c, and N_f, as well as $w_i = w_f/(1+\delta)$. The value for $\bar{\varphi}$ follows immediately from equation (28).

In a second step, I find total revenue, R, using the labor market clearing condition. This is done by writing the share of each sector in revenue as

$$S_s = \frac{R_s}{R}, \tag{36}$$

where $s \in \{i, c, f\}$. For example, the share of the formal sector is given by

$$S_f = \frac{\sum_{\varphi \in \Phi_f} R \left[\frac{(1-\tau)\rho\varphi P}{(1+\delta)w_i}\right]^{\sigma-1}}{\sum_{\varphi \in \Phi_i} R \left[\frac{\rho\varphi P}{w_i}\right]^{\sigma-1} + N_c R \left[\frac{(\rho\varphi_c P}{w_i}\right]^{\sigma-1} + \sum_{\varphi \in \Phi_f} R \left[\frac{(1-\tau)\rho\varphi P}{w_f}\right]^{\sigma-1}}, \tag{37}$$

which simplifies to

$$S_f = \sum_{\varphi \in \Phi_f} \left(\frac{1-\tau}{1+\delta}\frac{\varphi}{\bar{\varphi}}\right)^{\sigma-1}. \tag{38}$$

This expression is independent of aggregate revenues and can be found solely from the initial guess of the thresholds and δ. From the labor demand functions (32), (33) and (34), and the labor market clearing condition, $L = L_i + L_c + L_f$, I can solve for aggregate revenue

$$R = \frac{N w_i}{\rho\left(S_i + S_c \frac{1}{N_c}\sum_{\varphi \in \Phi_c} \frac{\varphi_c}{\varphi} + \frac{1-\tau}{1+\delta} S_f\right)}. \tag{39}$$

In a third step, I use the goods market clearing condition, which, with $P = 1$ and equation (4) or (27), allows to solve for the informal wage

$$w_i = \rho\bar{\varphi}. \tag{40}$$

Having determined w_i, R, and thus γ and $E[w]$, I can check whether the initial guess leads to an equilibrium by using conditions (15), (19) and (20) for the thresholds. The initial guess for δ is verified using the condition $\delta = w_f/w_i - 1$. If the results equal the initial guess up to a

[21] I use four bisect search loops nested within each other.

certain tolerance, the equilibrium is found and the search stops. Otherwise, the initial guess is adjusted and all the steps are repeated. Once the thresholds, aggregate revenue and the wage differential are determined, it is straightforward to solve the whole model for all aggregate and individual variables.

3 Data and Calibration

3.1 Data and Facts

To make quantitative statements, I calibrate the model to household data from Madagascar. The *Enquête Périodique Auprès des Ménages* (EPAM) of 2010 contains data of 12'640 households across the country. Members of these households run 3'072 non-agricultural enterprises that had positive revenue and were active during the whole year. I use these enterprises as observations. The data contain information on revenues, profits, employees, wages, as well as on taxes and whether a firm is registered with the national statistics office.[22] The latter two indicate the formality status of enterprises. While these data serve well the purpose of this paper—to analyze the effects of policies at the low end of the productivity distribution—they are not fully representative of all firms in the country. Since the data are based on households, they do not contain any very large or multinational enterprises. Thus, the formal sector is underrepresented in the data at hand. However, the data give a good impression of small-scale entrepreneurs for which the model should make predictions. I further augment these data with information from previous literature, ILOSTAT and WDI. In the following, I provide descriptive statistics for the key variables.

In Madagascar, the informal sector contributes roughly 45% to GDP (Hassan and Schneider, 2016) and in 2012 occupied about 84% of non-agricultural labor according to the ILO. In the dataset at hand, I find that 27.4% of firms pay taxes and 10.6% are registered with the statistical office. 9.7% fulfill both criteria. These 9.7% contribute 35.2% of total revenue in the sample and employ 13.2% of the workforce. This is still roughly consistent with the country-wide estimates if we take into account that large capital intensive enterprises, e.g., in the mining sector, would contribute a lot to GDP but employ relatively few workers. Most firms in the sample are small with over half having only one worker and another quarter employing two

[22] Many small entrepreneurs in the data are traders. They have high revenue but vary low profits because they need to buy the goods they are trading. Since my model abstracts form intermediate inputs, I calculate revenues as profits + wages + taxes.

workers. Only 2.6% have five or more workers. This indicates a large share of self-employment as one would expect.

Madagascar has a relatively high minimum wage at I$ 1'455 for 2010, according to the ILO.[23] For those firms who employ hired labor, the average wage paid in the sample is only I$ 662—far below the minimum wage. This is suggestive of low compliance, which is what we expect if the informal sector is large. The WDI estimate for GDP per capita is I$ 1'386 for 2010. Average income in the data is I$ 1'749. However, the two are not comparable since the data does not include non-working individuals.

A key issue is to get a sensible measure for poverty. I start by using the UN extreme poverty line of I$ 1.90 per person per day. The poverty rate at this threshold obtained from the WDI is 0.79 for 2010. However, to translate this into a yearly wage is not straightforward. There is an ongoing discussion on how to define a living wage.[24] I do the least by adjusting the poverty rate for the number of people that depend on each income earner. Hence, I take the total population in 2010 of 21'151'640 and divide it by the ILO estimate of the number of workers, which is 9'239'000. Thus, I get a dependency ratio of 2.28 and a yearly poverty line for wages of I$ 1'580.[25] A problem for my analysis is that the minimum wage is usually set with this poverty line in mind. Here, the minimum wage is below the poverty line. However, taking into account the lump-sum transfers, my calibration results in formal incomes that are just a few dollars apart from the poverty line. Therefore, small changes in income can drastically change the poverty headcount. One way around this is to use the poverty gap as a measure for poverty besides the poverty rate. The poverty gap is the average shortfall of the poverty line for all poor individuals as a share of the poverty line. It is estimated to be 0.38 for Madagascar, i.e., the average poor person has an income that is 38% lower than the poverty line.

Finally, I look at the GINI coefficient of the income distribution. The GINI Index for Madagascar was estimated to be 0.42 in 2010. This value is relatively high in international comparison. However, since the really rich are not represented in my data, I expect the GINI coefficient resulting from my calibration to be somewhat lower.

[23] I use the Madagascan minimum wage of 2010, which was set at 77'062 Madagascan Ariary per month. Applying the PPP conversion factor obtained from the WDI for 2010 of 635.35, I obtain a yearly minimum wage of I$ 1'455.

[24] See, e.g., https://www.globallivingwage.org for techniques to estimate living wages per country and per sector.

[25] Bacause of a lack of data, this ratio is calculated neglecting that a share of these workers only work part-time. The dependency ratio to full-time equivalents is probably higher.

3.2 Calibration

Exogenous Parameters

In the last section, I gave numbers for the poverty line and the minimum wage of $\mu = 1'580$ and $w_{min} = 1'455$. In addition to these, there are three exogenous parameters that need to be set: τ, T and σ. Since τ conceptually is a VAT, I set it to the Madagascan rate of 20%, as reported by Ernst & Young.[26] T is the cost of setting up business, which is estimated by the World Bank in the *Doing Business* indicators. The estimate for Madagascar in 2010 is a cost of 54.3% of GNI p.c. From the WDI, I find that GNI per capita in 2010 was I$ 1'371, and 54.3% of this is I$ 744. Hence, I set T to I$ 744.

There are basically no estimates of the elasticity of substitution for developing countries. I follow Caliendo and Rossi-Hansberg (2012) and set $\sigma = 3.8$. This estimate was obtained by Bernard et al. (2003) for U.S. manufacturing plants. Table 1 summarizes the exogenous parameters.

Table 1: Exogenous Parameters

Parameter	Value	Source
w_{min}	1'455	ILO / WDI
μ	1'580	UN / ILO
τ	0.20	Ernst & Young
T	774	WDI / *Doing Business Indicators*
σ	3.8	Caliendo and Rossi-Hansberg (2012)

Calibration Strategy

To make quantitatively realistic statements about different policies, I calibrate my model to the EPAM data. I assume that φ follows a Pareto Type-II distribution with pdf[27]

$$f(\varphi) = \left[1 + \frac{\varphi}{\lambda_\varphi}\right]^{-\alpha_\varphi}, \tag{41}$$

where α_φ and λ_φ are shape and scale parameters respectively. I use unweighted minimum distance estimation to find values for $\hat{q}$, α_φ and λ_φ that lead to a good fit to a set of targets from the data. I proceed by feeding a range of different values for $\{\hat{q}, \alpha_\varphi, \lambda_\varphi\}$ into the model and

[26] Data from Ernst & Young retrieved in July, 2019 from www.ey.com.

[27] The Pareto distribution is standard in the literature to approximate productivity distributions (see, e.g., Chaney, 2008)

compare the outcome to moments in the data.[28] More formally, I find the input combination that minimizes the sum of squared standardized residuals (SSR) given by

$$SSR = \sum_{i=1}^{k} \left(\frac{x_{km} - x_{kd}}{x_{kd}} \right)^2, \tag{42}$$

where x_{km} are the moments generated by the model and x_{kd} are the target moments from the data. Further, I consider only calibrations that satisfy condition (22) and have $L_i + L_c \geq 0$ in the baseline specification as well as in all counterfactual analyses.

Assuming that revenue follows a Pareto distribution as well,[29] I choose five calibration targets. These are the distribution parameters of revenue, α_r and λ_r, the share of formal firms in the economy, N_f/N, the share of formal revenue in GDP, S_f, and the share of formal employment, γ.

I am using three input parameters to fit the model to five target outcomes. Hence, there are many input combination that lead to similar SSR. Which one turns out to be the lowest depends partly on the predetermined precision of the search loop. Therefore, I present a preferred calibration along with three alternative specification that can be found in Tables 4 to 6 in Appendix A. The results turn out to be very robust.

Baseline Estimation

Table 2 presents the preferred baseline calibration. The share of formal firms is 6%. These firms employ 47% of the labor force and generate 51% of revenue. The obtained SSR is 5.69. This fit is not particularly precise. The reason is that to satisfy condition (22), I need a sufficiently high expected wage, which can only be obtained with a large share of workers being employed in the formal sector. However, the lower part of Table 2 shows that the fit to the poverty measures and the average wage is very accurate. The first column of Table 3 contains additional information on occupation. Total formal occupation, i.e., the share of all individuals occupied in the formal sector, is 25%. In total, 46% of the individuals become workers. Thus, 54% choose to be entrepreneurs—at least part-time. Further, in any scenario, there are no unconstrained informal firms. This finding is consistent with the calibration of a

[28] This is done using nested loops for the three input parameters. The steps are set to 0.2.

[29] The pdf of the revenue distribution is assumed to be

$$f(r) = \left[1 + \frac{r}{\lambda_r} \right]^{-\alpha_r}. \tag{43}$$

Table 2: Calibration Outcome

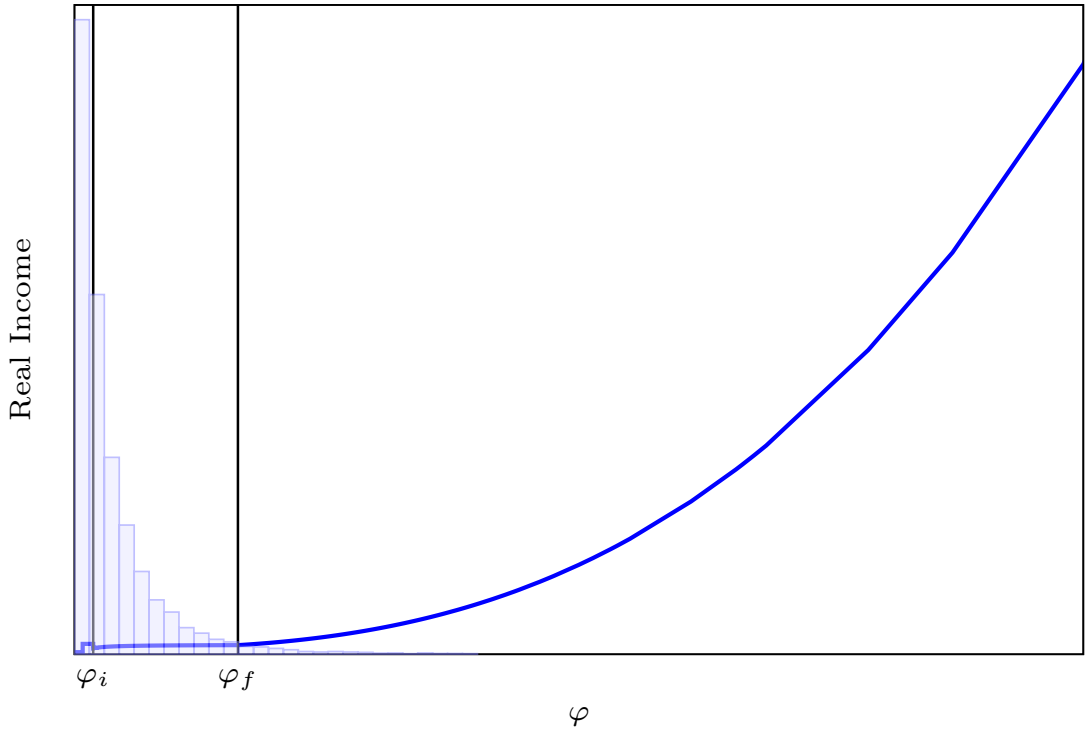
	EPAM	WDI/ILO/H&S	Model
Target variables:			
α_r	2.33	-	5.49
λ_r	3'470	-	7'430
γ	0.19	0.27	0.47
N_f/N_e	0.10	-	0.06
S_f	0.35	0.47	0.51
Additional variables:			
Poverty rate	-	0.79	0.76
Poverty gap	-	0.38	0.31
GINI Index	-	0.42	0.30
$E[w]$	662	-	784

Notes: $\alpha_\varphi = 3.6$, $\lambda_\varphi = 75.0$ and $\hat{q} = 42.0$. SSR of this fit is 5.69. EPAM data is used for all target variables. The countrywide poverty data, GDP p.c. and the GINI Index are obtained from the WDI. γ is obtained from the ILO. H&S refers to Hassan and Schneider (2016) who provide data on S_f.

different model by Ordóñez (2014).

Most relevant for this paper is the resulting income distribution. Figure 2 shows real income including transfers as a function of φ in equilibrium. The underlying histogram shows the distribution of φ. As can be seen, most individuals concentrate in the low-income segment. Figure 3 zooms in on this low-productivity segment.[30] The workers are ordered such that informal workers come first and formal workers second. The figure also includes the poverty line, μ and the expected income of workers that governs the decision between looking for a job or becoming an entrepreneur. As can be seen, informal employees, all informal and even the lowest productivity formal entrepreneurs do not reach the poverty line. Formal workers earn incomes including transfers just above the poverty line. This results in a poverty rate of 76%. The poverty gap can be interpreted as the area below the poverty line and above the income curve, weighted with the underlying distribution. It is 0.31. In the next section, I will present four counterfactual analyses where I reduce each of the four policy parameters—T, $\hat{q}$, τ, and w_{min}—by 10% in turn.

Figure 2: Real Incomes by Productivity: All Individuals



Note: The right tail is cut off for visibility. I do not mark the threshold φ_c since it is lower than φ_i and therefore irrelevant. All informal entrepreneurs are constrained.

4 Counterfactual Analyses

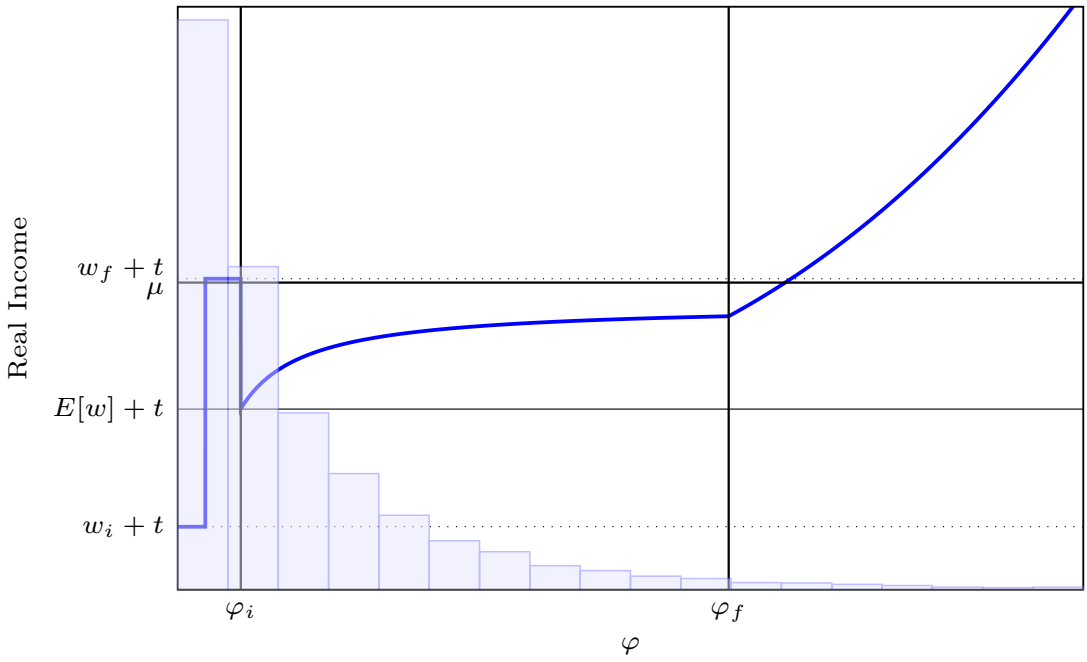
4.1 Lowering Entry Costs

The expensive procedure of starting a business is often seen as a key obstacle to formalization. Reducing these costs is on the top of the agenda in many developing countries. De Giorgi et al. (2018) document how, in the last two decades, the cost of setting up a business have drastically decreased throughout the world. I use my model to conduct a counterfactual analysis where I reduce the entry cost into the formal sector, T, by 10%.

As can be seen in Figure 4, this indeed leads to a small increase in the share of formal entrepreneurs, i.e., the threshold φ_f shifts to the left. The formal entrepreneurs see their incomes rise slightly since they save on entry costs. However, as is shown in Column 2 of Table 3, there is hardly any increase in output (R/N). Thus, the share of formal labor, γ,

[30]The transformation is approximately equal to dropping the top one percent income earners.

Figure 3: Real Incomes by Productivity: Low Productivity Individuals



remains basically constant—not least because the new formal enterprises are relatively small with little labor requirement. Some formal entrepreneurs that were just below the poverty line escape poverty but since these were already relatively well off before, the poverty gap remains unaffected. Thus, I can safely conclude that reducing the entry cost—while having a marginal effect on the scope of the formal sector—is ineffective in reducing poverty or raising incomes for the broader population.

4.2 Stricter Enforcement

The second policy experiment is to increase enforcement, i.e., reducing $\hat{q}$ by 10%. The results of this policy are shown in Figure 5 and in the third column of Table 3. Unsurprisingly, the constrained informal entrepreneurs see their incomes fall because their output has to decrease. Some of these entrepreneur now see it profitable to switch to the formal sector where they can produce more than the new output cap. However, they are still worse off than before the policy change. Due to the fall in output, less informal labor is required, which leads to lower real incomes in the informal sector and a fall in aggregate demand. This, in turn, negatively affects formal output and labor demand. Deteriorating labor market conditions induce some workers to set up business in the informal sector. In the new equilibrium almost everyone is worse off and the poverty gap increases slightly. Given that the rise in tax revenue—the primary reason

Table 3: Counterfactual Analyses

	Baseline	$T * 0.9$	$\hat{q} * 0.9$	$\tau * 0.9$	$w_{min} * 0.9$
γ	0.47	0.48	0.49	0.56	0.87
N_f/N_e	0.06	0.06	0.06	0.07	0.09
Formal occupation	0.25	0.25	0.25	0.30	0.54
S_f	0.51	0.52	0.52	0.56	0.71
N_c/N_e	0.94	0.94	0.94	0.93	0.91
L/N	0.46	0.46	0.43	0.47	0.57
Poverty rate	0.76	0.75	0.76	0.71	0.96
Poverty gap	0.31	0.31	0.32	0.27	0.07
R/N	1'197	1'208	1'178	1'296	1'686
GINI Index	0.30	0.30	0.30	0.29	0.19
t	145	149	151	156	269
w_i	179	179	136	156	83
$E[w]$	784	788	789	881	1156

Note: $\alpha_\varphi = 3.6$, $\lambda_\varphi = 75.0$, $\hat{q} = 42.0$, $SSR = 5.69$

for stricter enforcement—is negligible, I conclude that this policy type is not recommendable.

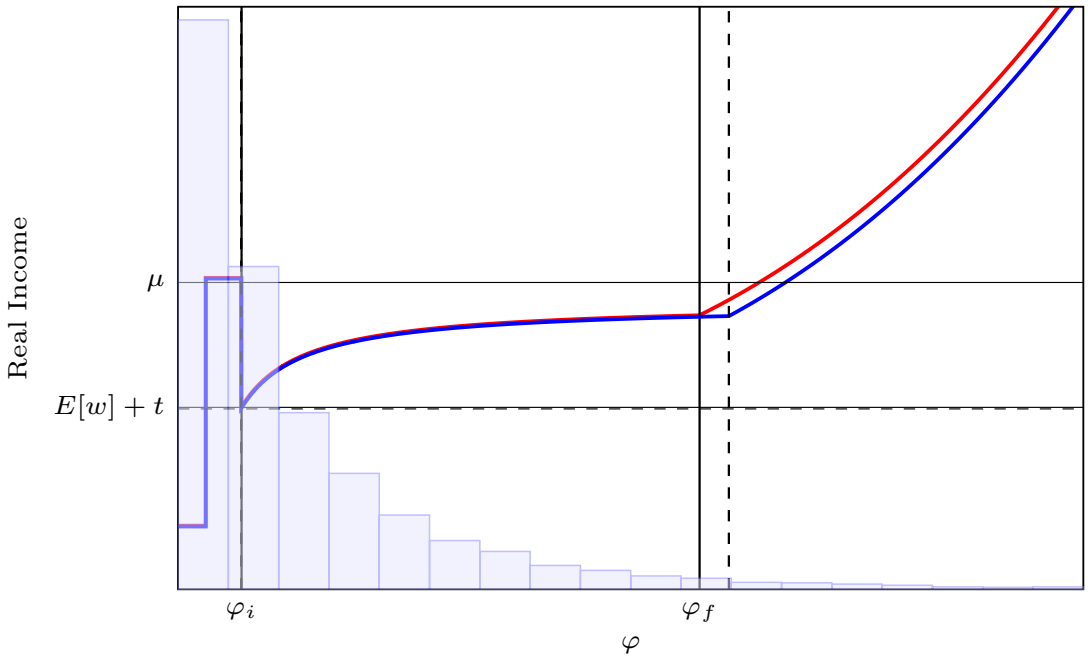
4.3 Reducing the Revenue Tax Rate

Another obstacle to formalization, besides the entry costs, are the higher variable costs of production in the formal sector. In my model, these additional costs are comprised of higher wages and the revenue tax. If these costs were lowered, we would expect more entrepreneurs to choose to become formal. Figure 6 depicts what happens when the revenue tax rate, τ, is lowered by 10%.

The first obvious finding is that formal entrepreneurs are much better off. They produce more, hire more labor, and turn higher profits. Higher incomes in the formal sector increase aggregate demand and, thus, GDP. The increase in incomes of informal entrepreneurs that can be seen in Figure 6, however, is to a large extent due to the higher transfers. With lower production costs, the formal outcompete informal firms. Exit and formalization lead to a fall in informal output and labor demand. Informal workers, i.e., the poorest individuals, earn even lower wages than before. However, there are fewer of them and transfers are higher—indeed, lowering the tax rate leads to an increase in tax revenue for this calibration.

This policy—while having a large positive effect on the already well off formal entrepreneurs—is also quite effective in reducing poverty through formal employment. The reduction in the informal wage is partly offset by higher tax transfers. Finally, aggregate welfare, as measured by R/N, increases considerably.

Figure 4: Lowering Entry Costs



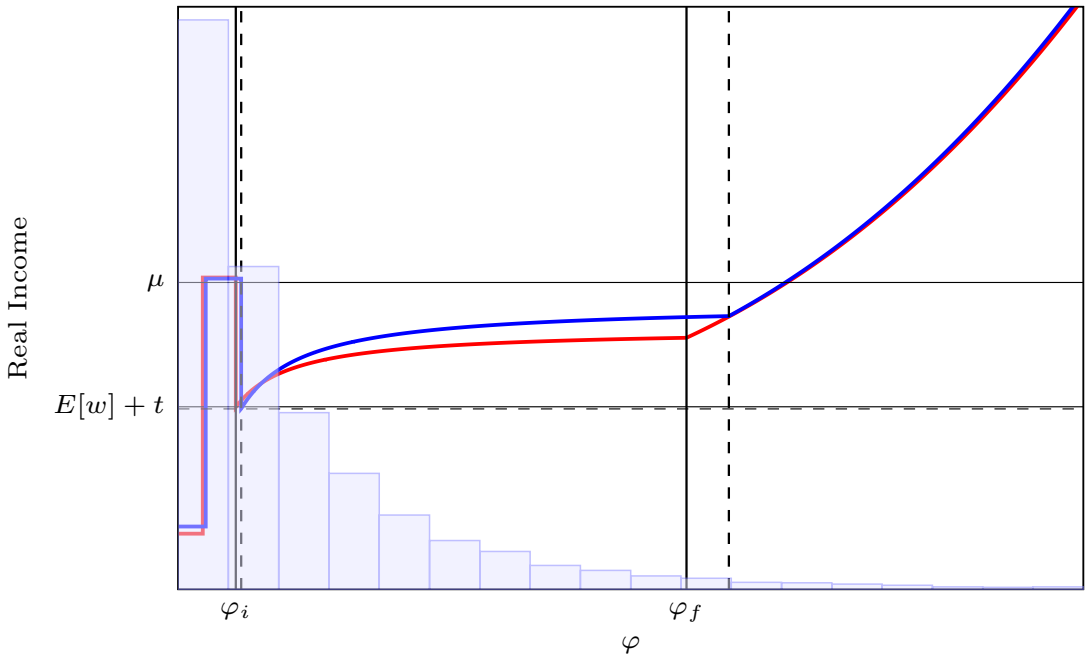
Note: The blue line depicts the baseline scenario, and the red line shows the case with lower entry costs.

4.4 Lowering the Minimum Wage

As shown in Figure 7, reducing the minimum wage by 10% has a surprisingly large impact. Similarly to reducing taxes, the first effect is an increase in output, labor demand, and profits in the formal sector. From equation (12) it follows immediately that a decrease in the minimum wage depresses the formal prices more than a decrease in the tax rate. Thus, the effect is a magnitude stronger. The increase in formal labor demand additionally increases income and aggregate demand. Even though the formal wage is lower, the labor demand effect on the expected wage is so strong that total labor supply in the economy increases by almost one quarter.

Since many informal entrepreneurs become workers or move to the formal sector, the total informal output decreases; the demand for informal labor and the informal wage fall. However, since tax revenue almost doubles, the effect on incomes of informal workers is even slightly positive. The remaining informal entrepreneurs, too, see their incomes rise because higher demand pushes up the price given the fixed quantity, $\hat{q}$, and because they receive higher transfers. Since many of these entrepreneurs are partly self-employed, the lower informal wage, in contrast, has a slightly negative impact on their incomes.

Figure 5: Stricter Enforcement



Note: The blue line depicts the baseline scenario, and the red line shows the case with a lower $\hat{q}$.

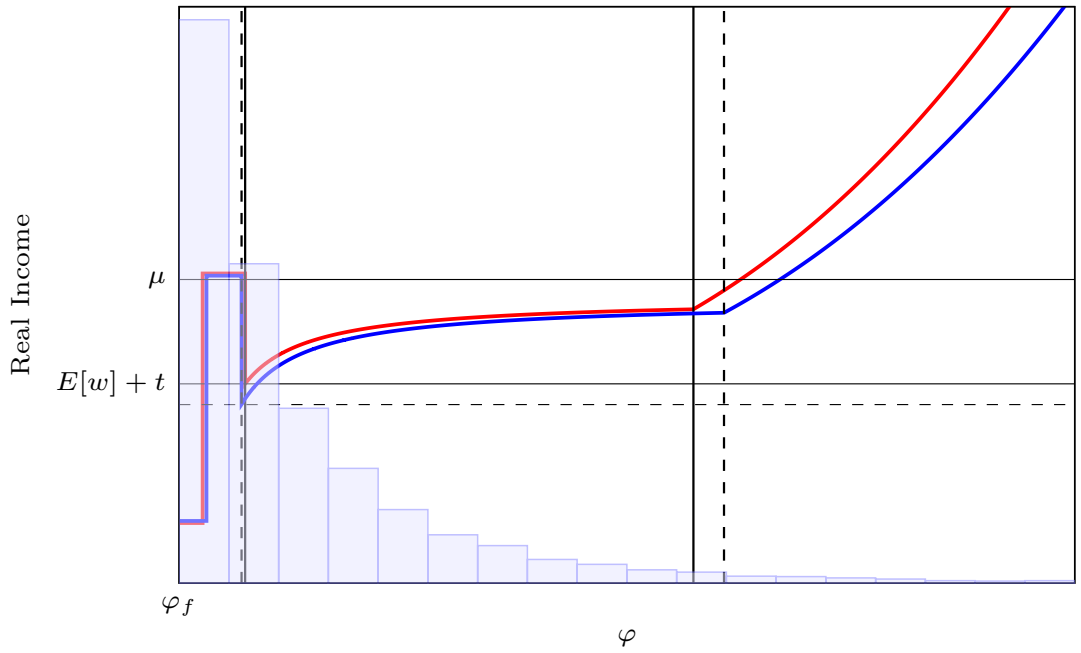
Regarding poverty, the analysis becomes slightly more complicated. As can be seen in Figure 7, the income of formal workers is now pushed below the poverty line.[31] The gap, however, is very narrow and if the poverty line was defined to be just slightly lower, the poverty rate would decrease instead of increase. If one looks at the poverty gap, this becomes clearly apparent: it is reduced by three quarters.[32] Hence, reducing the minimum wage—while increasing the number of poor individuals—has a strong equalizing effect among the poor. This materializes in a lower GINI Index and a reduced poverty gap. GDP per capita increases drastically. This analysis shows well a difficulty faced by policy makers. A government eager to report a low poverty rate would be hesitant to lower the minimum wage. However, if the focus is to improve welfare for as many people as possible while imposing low costs on the others, this policy is very effective.

One caveat should not be neglected. Madagascar has a relatively high minimum wage and reducing it by 10% does not change that. Per contra, many developing countries, especially

[31] Formal workers represent roughly 20% of the population in the baseline scenario.

[32] This result is in line with empirical evidence found by Ham (2018) for Honduras, where an increase in the minimum wage lead to a reduction in the share of the formal labor force and, thus, to an increase in poverty.

Figure 6: Reducing Taxes



Note: The blue line depicts the baseline scenario, and the red line shows the case with a lower revenue tax rate.

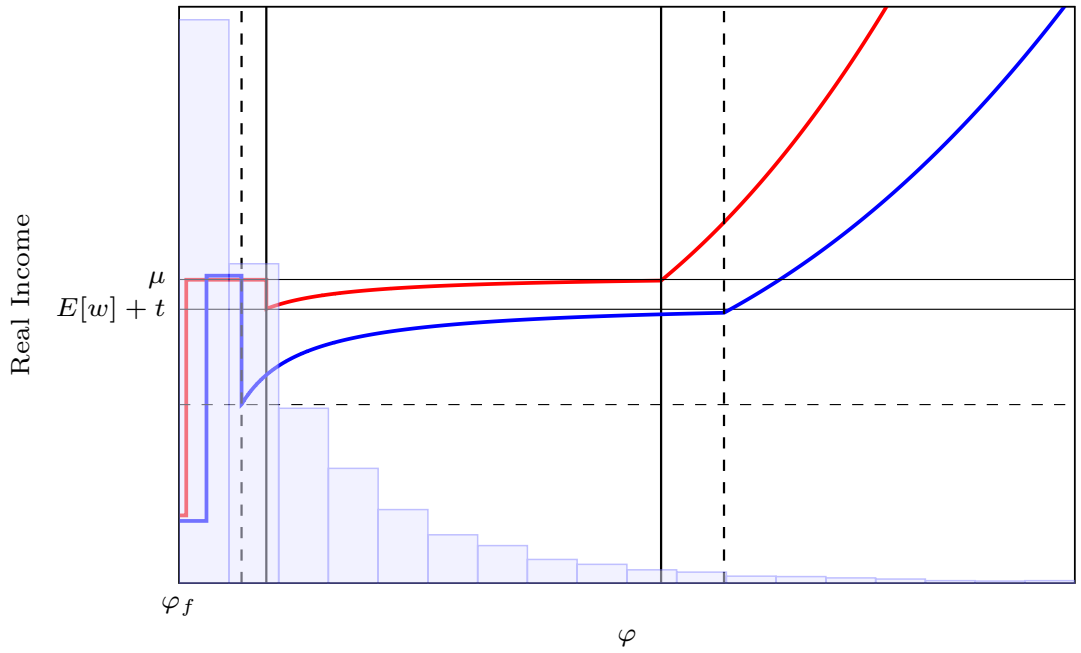
in Africa, set minimum wages quite far below the poverty line. In this case, reducing the minimum wage—while qualitatively having a similar effect to the one found here—would take income away from already very poor individuals. In this case, the effect on transfers is even more important. Further, it is crucial to note that it is the higher wages in the formal sector that are responsible for most of the poverty reduction independent of the chosen policy. These wages are only higher because there is a binding minimum wage. Thus, lowering the minimum wage too much would compromise this effect. However, the findings point in the direction that it might be effective to substitute higher government transfers for minimum wages.

5 Conclusion

There are many approaches to reducing extreme poverty. In this paper, I have looked into one top-down approach: inducing informal firms to formalize. Since the informal sector is characterized by low productivity and undermines the capacity of the state, reducing its size should go hand in hand with economic growth. What is less clear is whether the poorest segment of the population benefits from policies that increase the formal share of the economy.

Using a structural model that describes well a number of relevant features for those at

Figure 7: Lowering the Minimum Wage



Note: The blue line depicts the baseline scenario, and the red line shows the case with a lower minimum wage.

the bottom of the income distribution—such as self-employment or minimum wages—I show that increasing the share of the formal sector in the economy can indeed counteract poverty. However, whether this works depends crucially on the type of policy chosen to achieve this. The main channel through which poverty is reduced is by providing better-paying formal jobs for informal workers and micro-entrepreneurs locked in poverty. Additionally, higher tax revenue potentially allows for more generous transfers to the poor (or provision of public goods), which contributes to closing the poverty gap.

Comparing four different policies—reducing entry costs, increasing enforcement, reducing taxes, and lowering the minimum wage—I find that the effects of these policies differ drastically. Reducing the entry costs results primarily in the shift of a few informal entrepreneurs to the formal sector. These entrepreneurs, together with the existing formal entrepreneurs, see their incomes rise. For the rest of the economy, especially those at the lower end of the income distribution, the effects are negligible. Stricter enforcement—while marginally increasing the formal sector share of the economy and tax revenues—has a negative impact on the incomes of most individuals. Reducing the revenue tax rate is effective in both, increasing the formal sector share and tax revenue, as well as decreasing poverty. Finally, reducing the minimum wage has large positive effects on aggregate welfare and reduces the poverty gap. It is highly

effective in extending the scope of the formal sector. The poverty rate, however, increases if the income of formal workers is pushed from just above to just below the poverty line. While this impact might be important to policy makers keen on reporting low poverty rates, the effect on the actual lives of these workers are rather small. Not least because tax revenues increase by so much that most of the reduction in wages can be compensated through government transfers, e.g., in the form of food subsidies.

These results lead to a number of conclusions. First, it seems to be true that the informal sector is closely related to poverty and that reducing its size goes hand in hand with poverty reduction. Second, my results are supportive of the dual view on the informal sector dating back to Lewis (1954) and Harris and Todaro (1970). According to this theory, the informal sector is a collecting pond of those individuals that do not find work in the formal sector and therefore remain locked in poverty. Thus, the most effective way to eradicate poverty is by up-scaling output of the productive formal enterprises, which generates better-paying formal jobs. Third, this expansion of formal production is best achieved by improving the business environment of formal firms, i.e., by reducing taxes and regulatory costs (minimum wages). Fourth, this extension of the formal sector generates higher tax revenues, which, in turn, allow for more generous transfers and public goods provision to those that still remain locked in poverty.

Thus, while complicated and expensive registration procedures and a lack of enforcement capacity are often seen as key obstacles to formalization, improvements along these dimensions may not have the expected effect—neither on formalization nor on poverty reduction. Policy makers should put much more focus on making operating in the formal sector more profitable, thereby attracting firms to this sector and letting existing formal firms increase their production output and hiring more labor.

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Appendix A: Alternative Specifications

Table 4: Alternative Calibration I

	Baseline	$T * 0.9$	$\hat{q} * 0.9$	$\tau * 0.9$	$w_{min} * 0.9$
γ	0.47	0.47	0.48	0.55	0.88
N_f/N_e	0.04	0.04	0.04	0.05	0.08
S_f	0.57	0.57	0.58	0.62	0.78
N_c/N_e	0.96	0.96	0.96	0.95	0.92
L/N	0.58	0.58	0.56	0.60	0.71
Poverty rate	0.70	0.69	0.72	0.61	0.14
Poverty gap	0.31	0.30	0.32	0.26	0.06
R/N	1243	1247	1222	1359	1830
GINI Index	0.33	0.33	0.34	0.32	0.21
t	154	155	155	165	304
w_i	217	217	184	207	235
$E[w]$	795	797	792	895	1182

Note: $\alpha_\varphi = 2.8$, $\lambda_\varphi = 41.4$, $\hat{q} = 50.4$, $SSR = 6.43$

Table 5: Alternative Calibration II

	Baseline	$T * 0.9$	$\hat{q} * 0.9$	$\tau * 0.9$	$w_{min} * 0.9$
γ	0.46	0.46	0.48	0.53	0.83
N_f/N_e	0.06	0.06	0.06	0.07	0.09
S_f	0.47	0.48	0.49	0.52	0.66
N_c/N_e	0.94	0.94	0.94	0.93	0.91
L/N	0.44	0.45	0.42	0.46	0.54
Poverty rate	0.77	0.76	0.77	0.72	0.81
Poverty gap	0.29	0.29	0.30	0.25	0.09
R/N	1219	1229	1199	1305	1642
GINI Index	0.28	0.29	0.28	0.28	0.19
t	139	142	144	149	248
w_i	221	221	173	201	164
$E[w]$	785	787	785	870	1117

Note: $\alpha_\varphi = 4.2$, $\lambda_\varphi = 101.0$, $\hat{q} = 45.6$, $SSR = 6.16$

Table 6: Alternative Calibration III

	Baseline	$T * 0.9$	$\hat{q} * 0.9$	$\tau * 0.9$	$w_{min} * 0.9$
γ	0.48	0.49	0.51	0.56	0.87
N_f/N_e	0.07	0.08	0.08	0.08	0.11
S_f	0.45	0.46	0.46	0.49	0.63
N_c/N_e	0.93	0.92	0.92	0.92	0.89
L/N	0.38	0.39	0.36	0.40	0.48
Poverty rate	0.78	0.77	0.78	0.73	0.79
Poverty gap	0.26	0.26	0.28	0.23	0.07
R/N	1256	1266	1233	1339	1653
GINI Index	0.25	0.25	0.25	0.24	0.16
t	143	147	151	154	250
w_i	211	211	160	187	132
$E[w]$	810	815	819	901	1151

Note: $\alpha_\varphi = 6.0$, $\lambda_\varphi = 181.2$, $\hat{q} = 44.6$, $SSR = 7.08$