

Aggregate Effects of Gender Gaps in the Labor Market: A Quantitative Estimate*

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Abstract

This paper examines the quantitative effects of gender gaps in entrepreneurship and workforce participation. We simulate an occupational choice model with heterogeneous agents in entrepreneurial ability. Gender gaps in entrepreneurship affect negatively both income and aggregate productivity, since they reduce the entrepreneurs' average talent. Specifically, the expected income loss from excluding 5% of women is 2.5%, while the loss is 10% if they are all employers. We find that gender gaps cause an average income loss of 15% in the OECD, 40% of which is due to entrepreneurship gaps. Extending the model to developing countries, we obtain substantially higher losses, with significant variation across regions.

JEL classification numbers: E2, J21, J24, O40.

Keywords: gender inequality, entrepreneurship talent, factor allocation, aggregate productivity, span of control, out-of-necessity self-employment.

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1 Introduction

Although recent decades have witnessed a significant drop in gender gaps in many countries, the prevalence of gender inequality is still high, especially in the developing world. These gaps are apparent in several dimensions, including education, political representation, and bargaining inside the household. In the labor market, women typically receive lower wages, are underrepresented in most occupations, work fewer hours than men and have less access to productive inputs.¹

One important aspect of gender inequality in the labor market that has not been much studied in the literature is the low presence of women in entrepreneurial activities. The World Bank (2001) estimates that, in developed countries, the average incidence of females among employers is less than 30%. According to OECD (2014), across the 27 European Union countries, only 25% of business owners with employees are women, only 3% of CEOs are women, and the percentage of females in boards is only 18%.² In OECD countries, the proportion of sole-proprietors enterprises owned by women is between 20% and 40%. Studies looking at developing countries find much larger gender gaps. Macchiavello et al. (2014), for example, analyze the garment industry in Bangladesh and find that four of every five production workers in this industry are women, while just over one in 20 supervisors is a woman. In their experiment, they show that, after receiving adequate training, women are as likely as men to keep their job but less likely to be tried out or promoted. Everything else equal, a better use of women's potential in the labor market is likely to result in greater macroeconomic efficiency. When there are no friction to agents' labor choices, for example, the most talented people typically organize production carried out by others and, as a result, they can spread their ability advantage over a larger scale. From this point of view, obstacles to women's access to entrepreneurship reduce the average ability of a country's entrepreneurs, affecting negatively the way production is organized in the economy and, hence, reducing its market output.³

The objective of this article is to examine the quantitative effects of gender gaps in entrepreneurship and labor force participation on aggregate productivity and income per capita. We first develop an occupational choice model that illustrates the negative impact of gender inequality on resource allocation and, as a result, on aggregate productivity and income

¹See, for instance, Klasen and Lamanna (2009), Olivetti and Petrongolo (2008, 2014), and Blau and Kahn (2007, 2013).

²A report by Cranfield University (2014) states that the United Kingdom has made more progress in reducing these gaps than other EU countries: in 2014, 20% of all directors of UK companies in the FTSE 100 were females, up from 12.5% in 2010. The proportion of executive directors in these companies was 7% up from 5.5% in 2010.

³Elborgh-Weitek et al. (2013) also argue that gender inequality may have negative macroeconomic effects. Barsh and Yee (2012) claim that the employment of women on an equal basis would allow companies to make a better use of talent.

per capita. Our theoretical framework is an extension of the span-of-control model of Lucas (1978). We add two new elements to his model. First, we consider a third occupation, namely self-employment, on top of employers and workers, as in Gollin (2008). Secondly, we introduce several exogenous frictions that only affect women. In the model, agents are endowed with entrepreneurial talent drawn from a random distribution and choose their occupation based on this talent. While men are unrestricted in their labor market choices, women’s choices are limited, which leads of an inefficient allocation of talent across occupations and reduces aggregate productivity as well as income per capita.

Quantitatively, the model predicts that if all women were excluded from entrepreneurship, income per capita would fall by 10% in the short run, due to the fall in the average talent of entrepreneurs. In the long run, when the capital stock is adjusted to the new productivity level, income per capita would fall by 11%. If all women were excluded from the labor force, on the other hand, output per capita would fall by almost 47% in the short run, when the capital stock is fixed, and by 50% in the long run, when capital per worker is readjusted. It is worth noting that in the model we abstract from the decision to participate in the labor market, i.e. we assume that all agents work in some occupation unless they are not “allowed” to do so. Henceforth, our exercise only calculates *market* output losses, since in reality women not participating in the labor market are likely to generate some production in the household sector. We omit household production in the model to keep the analysis as simple as possible, but also because of the lack of data.⁴

In the cross-country analysis, we use the model to quantify the effects of the existing labor market gender gaps in a large sample of both developed and developing economies. The benchmark model prediction for the sample of OECD countries is an average income loss of 15% due to entrepreneurship and participation gender gaps, almost 40% of which is due to gender gaps in entrepreneurship. The model is then extended to incorporate *out-of-necessity* entrepreneurs, i.e. agents who choose self-employment as their occupation because they have no better job choices. We use this extended version of the model to quantify the effects of the gender gaps in a sample of developing countries, for which it has been documented that self-employment (and out-of-necessity self-employment) is much more prevalent than in rich countries.⁵ The model with *out-of-necessity* self-employed predicts larger average income losses for the sample of developing countries, with significant variation across geographical regions. In the Middle East and North Africa, the average income loss due to gender gaps is almost 38%, about a fifth of which is due to the occupational gender gaps, while in Central Asia the average income loss is about 10%, with 70% of the loss generated

⁴In what follows we will refer to “restrictions” to women in the labor market, although, once again, we do not know with certainty to what extent these restrictions reflect women’s optimal choices.

⁵See the Global Entrepreneurship Monitor survey (Brush et al. (2011), www.gemconsortium.org, and Poschke (2013) for a detailed characterization of this type of entrepreneurs.

by the occupational gender gaps. Merging the two samples, we find that there is an inverse-U relationship between the level of development of a country and its income losses caused by all the gender gaps —entrepreneurship and labor force participation—, while there is a negative relationship between the development level and the income losses caused only by gender gaps in entrepreneurship. These results are consistent with the observed U-shaped relationship between development and female labor force participation.⁶

The origins of these labor market frictions could be very diverse and, in this paper, we do not aim at identifying whether they are due to pure discrimination or they reflect women’s optimal choices taking into account their alternatives. In 2010, the OECD launched its Gender Initiative to analyze specific barriers that women face in the labor market, as well as to implement policies that promote gender equality in OECD countries and beyond (OECD 2012, 2014).⁷ The barriers identified in their study can broadly be classified in different categories. First, women are often less likely than men to borrow money in order to finance a business (Eurostat, 2008).⁸ Second, informational or cultural factors may also create barriers for women who wish to become entrepreneurs. For example, shareholders are less likely to appoint women as managers due to lack of data on women’s performance as entrepreneurs. Similarly, young women and women out of the labor force often lack accurate information about entrepreneurship as a viable and attractive career for them. Third, women’s preferences for part-time work and a better work-life balance, in combination with an inflexible labor market, lead women to run smaller firms and earn less than their male counterparts, which could partly explain why the labor force participation of women is below that of men in most countries.⁹ Fourth, women often seem to lack the necessary confidence in their skills to become entrepreneurs.¹⁰ Moreover, as a result of all the previous barriers, women tend to have less experience than men when they start up a business, which may explain their lower earnings as entrepreneurs. One additional natural reason why women may be underrepresented in the labor market is the existence of gender gaps in education for young women. In recent decades, however, education gender gaps have substantially shrunk in most countries, as shown in Becker et al. (2010), which documents an unprecedented increase in higher education in the last 40 years all over the world, especially for women. Their study shows that, nowadays,

⁶See, for instance, Goldin (1995).

⁷See also www.oecd.org/gender/data.

⁸According to Cole and Mehran (2009), women in the United States are more likely to be discouraged to apply for loans for fear of rejection, although there is some evidence showing that, once they do so, they do not have a higher rejection rate than their men counterpart.

⁹A related issue is that, in many countries, government policies tend to focus on helping start-ups and small firms. While this may indeed help women to run their own firms, it makes them less likely to create relatively large firms.

¹⁰Coleman and Robb (2012) claim that this may in part be explained by women’s lack of familiarity with finance and accounting practices.

in most high-income countries and in many lower-income ones, there are indeed more women than men that complete tertiary education. Parro (2012) examines the evolution of the gender gap in education in a large sample of developed and developing countries between 1950 and 2005. He finds that gender inequality in education increased between 1950 and 1975 and decreased between 1975 and 2005. Using long-run data (1800-2010), Morrison and Murin (2009) construct a new database on historical educational attainment with a sample of 74 countries for the period 1870-2010 and concludes that educational attainment accelerated in the second half of the twentieth century and that there has been some convergence in educational attainment in a sample of developed countries. In terms of gender, they find that in most Asian and African countries, the educational takeoff has closed the gender gap. Only sub-Saharan Africa and India currently lag behind other countries in terms of gender gaps between female and male education. In view of our analysis, one would expect that these improvements should have translated into less gender gaps in the labor market.¹¹

The remainder of the article is organized as follows. In Section 2, we briefly discuss the existing literature linking labor gender inequality and economic growth, with an emphasis on papers most closely related to our work. The benchmark theoretical model is presented in Section 3. The numerical simulations and the cross-country results for the OECD sample are described in Section 4. Section 5 presents the extended model for the developing countries and shows the simulation results for the non-OECD sample. Finally, Section 6 concludes.

2 Literature review

The empirical literature on the relationship between economic growth and gender inequality is quite extensive.¹² This literature has reached some consensus on the fact that there is a positive effect of increases in income per capita on gender equality and, more relevant to our paper, a negative effect of gender inequality on economic growth. Some studies show a negative effect of gaps in the labor force participation on a country's economic performance (Klasen and Lamanna, 2009; Thévenon et al., 2012, ILO, 2014). More commonly, though, gender gaps in education have been emphasized as a growth deterrent (Barro and Lee, 1993; Tzannatos, 1999; Dollar and Gatti, 1999; Klasen, 2002; Barro and Sala-i-Martin, 2003; Abu-Ghaida and Klasen, 2004; Klasen and Lamanna, 2009; Thévenon et al., 2012). These gaps may have a direct effect on growth but they also operate through the labor market channels

¹¹In spite of the fact that gender differences in education have narrowed substantially in recent decades, girls are still often subject to education biases that make them less inclined to study fields in which individuals are more likely to eventually become entrepreneurs. The OECD (2013), for instance, reports that women have a higher probability to obtain degrees in health and humanities, but they are underrepresented in the so-called STEM fields of study (Science, Technology, Engineering, and Mathematics).

¹² See, for instance, Goldin (1990), Dollar and Gatti (1999), Tzannatos (1999), or Klasen (2002). Cuberes and Teignier (2014) provide a comprehensive review of the empirical and theoretical literature on this topic.

that we study in this paper. In particular, as explained above, less educated women, or biases in women’s education, can lead to lower female labor force participation and women being underrepresented in entrepreneurship.

In the theoretical literature, several studies focus on explaining the effects of economic growth on different gender gaps, for example, Becker and Lewis (1973), Galor and Weil (1996), Greenwood et al. (2005), Doepke and Tertilt (2009), Fernandez (2009) and Ngai and Petrongolo (2013). Other papers have focused on the reverse effect, i.e. the impact of gender inequality on growth. These theories are, in most cases, based on the fertility and children’s human capital channels, as in Galor and Weil (1996), and Lagerlöf (2003).¹³ Galor and Weil (1996), for example, argue that an increase in women’s relative wage increases the cost of raising children, which lowers population growth, increases children’s education levels and leads to higher labor productivity and growth. Our paper differentiates from these theoretical articles in two directions: first, we calibrate and simulate our theoretical framework in order to be able to produce reasonable estimates of the costs associated to specific gender gaps. Second, we focus on a relatively ignored mechanism through which gender inequality reduces aggregate productivity, namely, the *talent pool* channel.

With respect to the first point, Cavalcanti and Tavares (2011) construct a growth model based on Galor and Weil (1996) in which there is exogenous wage discrimination against women. When they calibrate their model using U.S. data, they find very large effects associated with these wage gaps: a 50 percent increase in the gender wage gap in their model leads to a decrease in income per capita of a quarter of the original output. Their results also suggest that a large fraction of the actual difference in output per capita between the U.S. and other countries is indeed generated by the presence of gender inequality in wages. We depart from this paper in that our focus is on the misallocation of talent and resources caused by gender inequality.

With respect to the second point, Esteve-Volart (2009) also develops a model of occupational choice and talent heterogeneity. Her paper finds that labor market discrimination leads to lower average entrepreneurial talent and slower female human capital accumulation which, in turn, has a negative impact on technology adoption, innovation and economic growth. The model, however, is used to derive qualitative results but not to carry out numerical exercises.

To our knowledge, the only existing paper that incorporates a quantitative analysis and considers the *talent pool* channel is Hsieh et al. (2013). Their paper uses a Roy model to estimate the effect of the changing occupational allocation of white women, black men, and black women between 1960 and 2008 on U.S. economic growth and finds that the improved allocation of talent during this period accounts for 17 to 20 percent of growth. Our paper

¹³Lagerlöf (2006) calibrates the Galor-Weil model but does not provide a quantitative estimate of the productivity costs associated with a decrease in gender inequality.

differs from theirs in several dimensions. First, we explicitly add self-employment as a possible occupation in the model, which is particularly important to model the behavior of developing countries. Second, we study the effects of gender inequality in the labor market in a large sample of countries, rather than just focusing in the U.S economy. Finally, our theoretical framework is substantially different from theirs in that we emphasize, although, in a static framework, the span-of-control element of agents who run firms.¹⁴

3 Benchmark model

In this section, we present a general equilibrium occupational choice model where agents are endowed with a random entrepreneurship skill that determines their optimal occupation. The model is based on the span-of-control framework in Lucas (1978), with the extension of self-employment as a possible occupational choice. In the benchmark model, agents choose to work as either employers, self-employed, or workers, while in the extended model presented in Section 5 we introduce the possibility of having the so-called *out-of-necessity self-employed*, in line with the literature claiming that in developing countries self-employment is the only possible alternative for some agents.

3.1 Model setup

The economy we consider has a continuum of agents indexed by their entrepreneurial talent x , drawn from a cumulative distribution Γ that takes values between B and ∞ . We assume the economy is closed and that it has a workforce of size N and K units of capital. Labor and capital are inelastically supplied in the market by consumers, in exchange for a wage rate w and a capital rental rate r respectively. These inputs are then combined by firms to produce an homogeneous good. Agents decide to become either firm workers, who earn the equilibrium wage rate w —which we assume to be independent of their entrepreneurial talent—, or entrepreneurs, who earn the profits generated by the firm they manage.¹⁵

An agent with entrepreneurial talent or productivity level x who chooses to become an employer and hires $n(x)$ units of labor and $k(x)$ units of capital produces $y(x)$ units of output and earns profits $\pi(x) = y(x) - rk(x) - wn(x)$, where the price of the homogeneous good is

¹⁴Our paper also relates to several recent papers that use the span-of-control model of Lucas (1978) to study the effects of financial frictions and other cross-country differences on the misallocation of resources and productivity. See, for example, Amaral and Quintin (2010), Antunes et al. (2008), Bhattacharya et al. (2013), Buera et al. (2011), Buera and Shin (2013) and Erosa et al. (2010).

¹⁵In what follows we will refer to an entrepreneur as someone who works as either an employer or a self-employed.

normalized to one. As in Lucas (1978) and Buera and Shin (2011), the production function is given by

$$y(x) = x \left(k(x)^\alpha n(x)^{1-\alpha} \right)^\eta, \quad (1)$$

where $\alpha \in (0, 1)$ and $\eta \in (0, 1)$. The parameter η measures the *span of control* of entrepreneurs and, since it is smaller than one, the entrepreneurial technology involves an element of diminishing returns. On the other hand, an agent with talent x who chooses to become self-employed uses the amount of capital $\tilde{k}(x)$, produces $\tilde{y}(x)$ units of output and earns profits $\tilde{\pi}(x) = \tilde{y}(x) - r\tilde{k}(x)$. The technology he or she operates is

$$\tilde{y}(x) = \tau x \tilde{k}(x)^{\alpha\eta}, \quad (2)$$

where τ is the self-employed productivity parameter.¹⁶ One interpretation of this parameter is that self-employed workers have to spend a fraction of their time on management tasks, which would imply that τ is equal to the fraction of time available for work to the power $(1 - \alpha)\eta$. As explained below, we estimate this parameter to match the average fraction of self-employed in the data.

3.2 Agents' optimization

3.2.1 Employers

Employers choose the units of labor and capital they hire in order to maximize their current profits π . The optimal number of workers and capital stock, $n(x)$ and $k(x)$ respectively, depend positively on the productivity level x , as equations (3) and (4) show:

$$n(x) = \left[x\eta(1 - \alpha) \left(\frac{\alpha}{1 - \alpha} \right)^{\alpha\eta} \frac{w^{\alpha\eta-1}}{r^{\alpha\eta}} \right]^{1/(1-\eta)}, \quad (3)$$

$$k(x) = \left[x\eta\alpha \left(\frac{1 - \alpha}{\alpha} \right)^{\eta(1-\alpha)} \frac{r^{\eta(1-\alpha)-1}}{w^{\eta(1-\alpha)}} \right]^{1/(1-\eta)}. \quad (4)$$

¹⁶The consumption good produced by the self-employed and the capital they use is the same as the one in the employers' problem. However, it is convenient to denote them \tilde{y} and \tilde{k} to clarify the exposition.

3.2.2 Self-employed

When we solve for the problem of a self-employed agent with talent x who wishes to maximize his or her profits, we find

$$\tilde{k}(x) = \left(\frac{\tau x \alpha \eta}{r} \right)^{\frac{1}{1-\alpha\eta}}. \quad (5)$$

3.2.3 Occupational choice

Figure (1) displays the shape of the profit functions of employers ($\pi_e(x)$) and self-employed ($\pi_s(x)$) along with wage earned by workers as a function of talent x .¹⁷ The figure also shows the relevant talent cutoffs for the occupational choices. Here we present the equations that define these thresholds: the first one, z_1 , defines the earnings such that agents are indifferent between becoming workers or self-employed and it is given by

$$w = \tau z_1 \tilde{k}(z_1)^{\alpha\eta} - r \tilde{k}(z_1). \quad (6)$$

If $x \leq z_1$ agents choose to become workers, while if $x > z_1$ they become self-employed or employers. The second cutoff, z_2 , determines the choice between being a self-employed or an employer and it is given by

$$\tau z_2 \tilde{k}(z_2)^{\alpha\eta} - r \tilde{k}(z_2) = z_2 x \left(k(z_2)^\alpha n(z_2)^{1-\alpha} \right)^\eta - r k(z_2) - w n(z_2) \quad (7)$$

so that if $x > z_2$ an agent wants to become an employer.

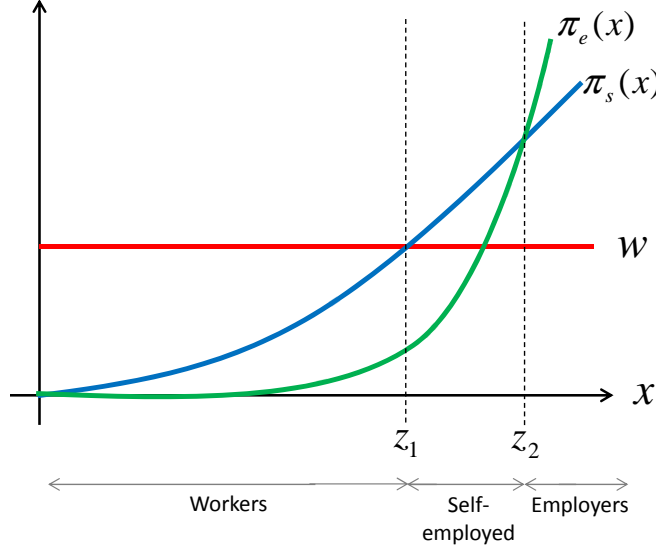
3.3 Female labor market frictions

Our model assumes that men and women are identical in all dimensions except that women face several exogenous restrictions on their occupational choices. The first constraint we impose is that only a fraction μ of them can freely choose their occupation, while a fraction $1 - \mu$ are excluded from employership. Out of the latter group of women, a fraction μ_o have the possibility of becoming self-employed, while a fraction $1 - \mu_o$ are also excluded from self-employment. As a result, a fraction $(1 - \mu)(1 - \mu_o)$ of women are shut out from entrepreneurship, i.e. both employership and self-employment, and can only become workers.¹⁸

¹⁷In order to construct this figure we are implicitly using values for the parameters τ, α , and η , such that the three occupations are chosen in equilibrium.

¹⁸Figure (5) in Appendix A shows the optimal occupation choices of women given the frictions they face.

Figure 1: The occupational map



Note that, in this setup, we are not allowing for the possibility of women being excluded from self-employment but not from employership, since we think that whichever are the barriers women face to become self-employed, they should apply even more strongly to become an employer.¹⁹

Finally, the third friction we introduce is that only a fraction λ of women are allowed to participate in the labor market, while a fraction $(1 - \lambda)$ of randomly selected women are excluded from all the possible occupations in the labor market.²⁰ Again, this friction may reflect discrimination, or other *supply factors*, but it might also reflect differences in optimal choices of women, or other *demand factors*. Since our model does not incorporate a household sector, women who do not participate in the labor market produce zero output. Because of this, the income loss due to the λ gender gap estimated by our model is actually a *market output* loss, which is likely to be larger than the *total output* loss because of the potential production taking place inside the household when women do not participate in the labor market.²¹

Because of the way we introduced these gender gaps into model, all women face the same probability of being excluded from participation and entrepreneurship. This would be the right modeling choice if some women were banned from entrepreneurship or work due to pure

¹⁹In terms of the parameters of the model, if $\mu = 1$, then the value of μ_o does not affect the occupational choices of women.

²⁰We say that women excluded from the labor force are randomly selected because their talent is drawn from the same distribution as the rest of the population.

²¹To the extent that entrepreneurship gaps affect negatively the labor market participation return of women, a model with household production and endogenous female participation is likely to predict larger output losses due to the introduction of μ and μ_o gender gaps.

discrimination, if some of them did not have access to education or credit, if some of them had a strong preference for childcare or other forms of home production, or if some lacked the accurate information about entrepreneurship options. Admittedly, the aggregate impact would be larger if more talented women were less likely to be excluded, which would be the case if these distortions affected women's earnings in the form of a fixed cost or a wedge. It could also be the case, however, that more talented women were more likely to get excluded, which would be the case if, for example, they had a higher propensity to marry richer men and, as a result, they were also more likely not to participate in the labor market or to choose part-time work.²²

3.4 Competitive Equilibrium

We assume that women represent half of the population in the economy and that there is no unemployment. Moreover, any agent in the economy can potentially participate in the labor market, except for the restrictions on women described above. Under these assumptions, in equilibrium, the total demand of capital by employers and self-employed must be equal to the aggregate capital endowment (in per capita terms) k :

$$k = \frac{1}{2} \left[\int_{z_2}^{\infty} k(x) d\Gamma(x) + \int_{z_1}^{z_2} \tilde{k}(x) d\Gamma(x) \right] + \frac{\lambda}{2} \left[\mu \int_{z_2}^{\infty} k(x) d\Gamma(x) + (\mu + (1 - \mu)\mu_0) \int_{z_1}^{z_2} \tilde{k}(x) d\Gamma(x) + (1 - \mu)\mu_0 \int_{z_2}^{\infty} \tilde{k}(x) d\Gamma(x) \right], \quad (8)$$

where the first bracket represents the demand for capital by male entrepreneurs and the second one is the demand for capital by female entrepreneurs, which has three components, each of them multiplied by the fraction of women in the labor force, $\frac{\lambda}{2}$. The first one represents the capital demand by female employers, i.e. those with enough ability to be employers and who are allowed to be so, while the second and third terms represent the demand by female self-employed; the second term shows the demand for capital by women who have the right ability to be self-employed and are allowed to work as such, and the third term shows the demand from women who become self-employed because they are excluded from employership.²³

Similarly, in the labor market, the total demand of workers must also be equal to its total

²²Note, however, that by assuming perfect substitution between male and female labor and management we could be biasing downwards the estimated effects of gender gaps if women had comparative advantage in different sectors than men or if they provided a different type of labor.

²³The functions $k(\cdot)$ and $\tilde{k}(\cdot)$ are defined in equations (4) and (5).

supply:

$$\begin{aligned} & \frac{1}{2} \left[\int_{z_2}^{\infty} n(x) d\Gamma(x) \right] + \frac{\lambda}{2} \mu \left[\int_{z_2}^{\infty} n(x) d\Gamma(x) \right] = \\ & \frac{1}{2} \Gamma(z_1) + \frac{\lambda}{2} [\Gamma(z_1) + (1 - \mu)(1 - \mu_0)(1 - \Gamma(z_1))], \end{aligned} \quad (9)$$

where the upper terms represent the total labor demand and the lower ones the total labor supply. The first term is the labor demand by male employers and the second one corresponds to the labor demand by female employers, i.e. those women with enough ability to be employers who are allowed to participate in the labor market and to choose their occupation freely. The first term of the labor supply shows the fraction of men who choose to become workers, while the second one shows the fraction of female workers. The latter is composed by the fraction of females who want to be workers as well as the fraction of females who have enough ability to be employers or self-employed but are excluded from both occupations. For these group of women, the only option is to become workers.²⁴

In this economy, aggregate production per capita, which is the sum of output by male employers and self-employed, as well as output by female employers and female self-employed:

$$\begin{aligned} y \equiv \frac{Y}{N} = & \frac{1}{2} \left[\int_{z_2}^{\infty} y(x) d\Gamma(x) + \int_{z_1}^{z_2} \tilde{y}(x) d\Gamma(x) \right] + \\ & \frac{\lambda}{2} \left[\mu \int_{z_2}^{\infty} y(x) d\Gamma(x) + \mu \int_{z_1}^{z_2} \tilde{y}(x) d\Gamma(x) + (1 - \mu)\mu_0 \int_{z_1}^{\infty} \tilde{y}(x) d\Gamma(x) \right] \end{aligned} \quad (10)$$

where $y(x)$ and $\tilde{y}(x)$ are defined in equations (1) and (2), respectively.

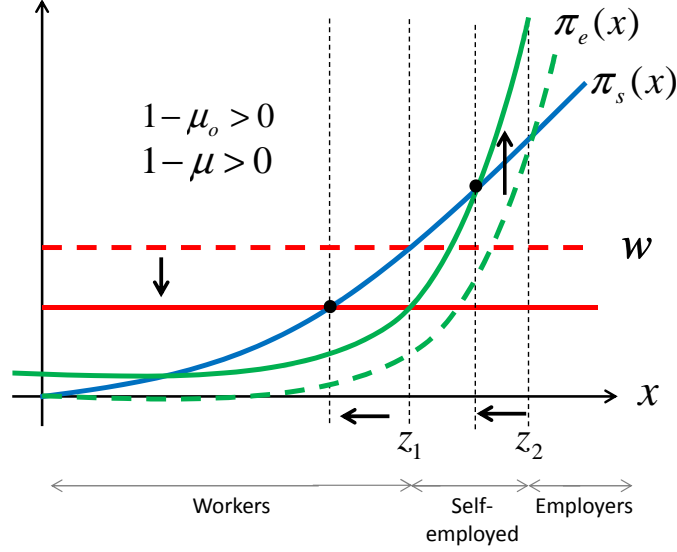
A competitive equilibrium in this economy is a pair of cutoff levels (z_1, z_2) , a set of quantities $[n(x), k(x), \tilde{k}(x)]$, $\forall x$, and prices (w, r) such that equations (3) - (9) are satisfied; that is agents choose their occupation optimally, entrepreneurs choose the amount of capital and labor to maximize their profits, and all markets clear.

3.5 Comparative statics

In this subsection we show qualitatively how the agents' occupational choice are affected by exogenous changes in the two entrepreneurship gender gaps, namely the fraction of women who are excluded from employership $(1 - \mu)$ and the fraction of those women who are also

²⁴The function $n(\cdot)$ is defined in equation (3).

Figure 2: Qualitative effects of μ and μ_o – gaps



“excluded” from self-employment ($1 - \mu_o$). Figure (2) shows the change in the talent thresholds (z_1, z_2) when $(1 - \mu)$ and $(1 - \mu_o)$ become positive.

3.5.1 An increase in the employership gender gap ($\downarrow \mu$)

A decrease in μ initially generates a decline in the number of employers and hence a decrease in the labor demand and the equilibrium wage, which decreases the cutoff z_1 . Everything else equal, this results in an increase in profits for the remaining employers, which reduces also the cutoff z_2 . The effect on the demand for capital is ambiguous since the demand from employers declines but that of the self-employed increases. If the demand for capital actually decreases, the cost of renting capital goes down, so both self-employed and employers’ profits increase and, hence, both cutoffs z_1 and z_2 decrease further.

3.5.2 An increase in self-employment gender gaps ($\downarrow \mu_o$)

A decrease in μ_o (given $\mu < 1$) generates a decline in the number of self-employed and hence an increase in the labor supply, which in turn drives wages down. As in the previous case, this has a direct negative effect on the cutoff z_1 as well as an indirect negative effect on the cutoff z_2 , through its effect on the employers’ profit function. As before, whether the demand for capital increases or decreases is a quantitative question since there is a negative effect from the drop in self-employed and a positive one from the rise in employers.

4 Benchmark model numerical results

In this section, we simulate the benchmark model to calculate the income effects of the gender gaps in the labor market discussed in the previous section. We first describe the

Table 1: Parameter values

Parameter	Value	Explanation
B	1	Normalization
η	0.79	From Buera and Shin (2011)
α	0.114	To match capital share: $\alpha\eta + (1 - \eta) = 0.3$
ρ	6.5	To match employers' share OECD countries
τ	0.7	To match self-employed share OECD countries

parametrization of the model and calculate the maximum possible effects of these gaps. Then we estimate the gender gaps and quantify their effects using data from OECD countries. In Section 5 we extend the model to make it more suitable for developing countries, and we then use data from non-OECD countries to quantify effects of the gender gaps on these countries.

4.1 Skill distribution

To simulate the model, we use a Pareto function for the talent distribution, as in Lucas (1978) and Buera et al. (2011). In particular, the cumulative distribution of talent is given by

$$\Gamma(x) = 1 - B^\rho x^{-\rho}, \quad x \geq 0, \quad (11)$$

where $\rho, B > 0$.

4.2 Model Parametrization

Table 1 shows the parameter values used in the model simulations. The parameter B of the talent distribution is normalized to 1, while the parameter η is taken from Buera and Shin (2011).²⁵ The capital-output elasticity parameter α is set to 0.114 in order to match the 30% capital income share observed in the U.S. data. Since entrepreneurs' profits are considered capital income, we set $\alpha\eta + (1 - \eta)$ equal to 30% as in Buera and Shin (2011). The parameter ρ of the talent distribution is set to 6.5 to minimize the distance between the actual and the predicted fraction of employers in the OECD countries, which is 4.5% on average. Similarly, the self-employed relative productivity parameter τ is chosen to match the fraction of self-employed workers in the OECD countries, which is 10.8% on average.

The cross-country dispersion in the share of employers and self-employed workers is not negligible, with 10th-to-90th interpercentile ranges of 2.3 and 3.17 respectively. This dispersion can obviously not be generated by the parametrization of ρ and τ . As explained in subsection 4.4, however, the gender gaps (μ, μ_o, λ) are country specific and they do generate

²⁵Buera and Shin (2011) choose η to match the top five percent income share in the U.S., which is 30%. This is a reasonable approximation given that the top earners are entrepreneurs both in the model and the U.S. data.

some variation across countries in the predicted entrepreneurship rates. These gaps partly explain the dispersion in entrepreneurship across countries, with a correlation between actual and predicted shares of 10% in the case of employers and 6.7% in the self-employed workers case. To give an idea of the model goodness of fit for the OECD sample, the average absolute deviation of the model is 44% for the share of employers and 61% for the self-employed share.

When computing the numerical results in the next two subsections, we distinguish between the short run and the long run. In the short run, capital is taken as constant and, therefore, not affected by the introduction of the gender gaps (μ, μ_o, λ) ; in the long run, on the other hand, the capital stock takes its steady-state value and, therefore, is negatively affected by the introduction of the gender gaps.²⁶ To compute the steady-state capital stock, we assume a gross interest rate of 0.125, which is consistent with a depreciation rate of 0.075 and an intertemporal discount factor of 0.05 in a continuous-time model.²⁷ Given that the output elasticity to the capital stock is only $\alpha\eta = 0.09$, the long-run results do not differ much to the short-run ones.

4.3 Income effects from gender gaps

Table 2 shows the effect on (market) income per worker caused by the introduction of the different gender gaps considered in this paper. As stated above, women are assumed to be identical to men in all dimensions, so in the absence of gender gaps, their occupational choices would be the same as those of males. When the gender gaps (μ, μ_o, λ) are introduced, however, the efficient allocation is distorted and, as a result, there is a decline in aggregate income per worker and per capita.

The first row shows that if all women were excluded from employership ($\mu = 0$) but not from self-employment ($\mu_o = 1$) the income per capita loss would be 7.1% in the short run and 8.62 in the long run. In the second row we see that if all women were excluded from becoming entrepreneurs ($\mu = 0$ and $\mu_o = 0$), i.e. both employers and self-employed, income per worker would fall by 10.1% in the short run and 11% in the long run. Naturally, the largest effect on (market) income per capita occurs when all women are excluded from the labor market $\lambda = 0$, which, given our assumptions, is equivalent to reducing the labor force by 50%. As we can see in the third row of the table, in this case, income per capita falls by almost 47% in the short run and 50% in the long run.

²⁶The value for the stock of capital used in the short run is irrelevant, since the income loss predicted by the model due to the introduction of gender gaps is not affected by its value.

²⁷The intertemporal discount factor we use is similar to the one proposed by Cooley and Prescott (1995), while the value for the depreciation rate is roughly an average of values found in the literature; for example, 0.048 in Cooley and Prescott (1995) and 0.1 in Christiano et al. (2005).

Table 2: Potential income losses from gender gaps

	Short Run	Long Run
Due to highest possible <i>employership</i>-gap ($\mu = 1, \rightarrow \mu = 0; \mu_0 = 1, \lambda = 1$)	7.1%	8.6%
Due to highest possible <i>entrepreneurship</i>-gap ($\mu = 1, \mu_0 = 1 \rightarrow \mu = 0, \mu_0 = 0; \lambda = 1$)	10.1%	11%
Due to highest possible <i>lfp</i>-gap ($\lambda = 1 \rightarrow \lambda = 0; \mu = 1, \mu_o = 1$)	46.8%	50%

4.4 Cross-country results: OECD sample

In this section, we use labor market data for 33 OECD countries for the year 2010 to quantify the income effects of the observed gender gaps.²⁸ The variables used are: labor force participation by gender, fraction of employers (or self-employed with employees) by gender and fraction of own-account workers (or self-employed without employees) by gender, which we denote as self-employed in our paper. Although, in line with the theoretical literature, one could have expected low gender gaps in the labor market in OECD countries compared to the rest of the world, these gaps are still sizable in many cases, as we will see in the next subsection.

4.4.1 Country-specific gender gaps

For each country in our sample, we compute the parameters associated with the gender gaps (μ, μ_o, λ) comparing the male and female data on labor force participation, share of employers and share of self-employed. The numerical results for each OECD country are presented in Appendix B.

The parameter λ , which denotes the fraction of women not excluded from the labor force, is computed as the ratio of female labor force relative to the male labor force. The average *labor force participation*-gender gap, defined as $1 - \lambda$ is 0.22, i.e. out of every hundred men who participate in the labor market there are only 78 women doing so. This gap ranges from 0.61 in Turkey to 0.08 in Iceland, Finland and Norway. Similarly, the parameter μ is computed as the share of female employers —defined as female employers over female employment— over the share of male employers. The average gap in employers ($1 - \mu$) is 0.62, varying from a value of 0.81 in Turkey to 0.38 in Australia. Finally, the parameter μ_o is inferred from the

²⁸OECD (2014), "Gender Equality: Gender equality in entrepreneurship", OECD Social and Welfare Statistics (database).

Table 3: Average income losses from gender gaps - OECD sample

%	Short-run income loss		Long-run income loss	
	Due to (μ, μ_o)	Due to (μ, μ_o, λ)	Due to (μ, μ_o)	Due to (μ, μ_o, λ)
Top 25%	5.06	19.7	5.72	21.5
50 to 75 percentile	4.88	13.8	5.47	15.1
25 to 50 percentile	5.20	12.5	5.80	13.7
Bottom 25%	5.17	9.61	5.77	10.6

data to match the female share of self-employment relative to the male one, given the value of μ . The *entrepreneurship*-gender gap, defined as the fraction of “women” excluded from both employership and self-employment, is calculated as $(1 - \mu)(1 - \mu_o)$ and it is equal to 0.43 on average, ranging from 0.69 in Ireland to 0 in Chile.²⁹ The *employership*-gender gap, defined as the fraction of women excluded from employership but not from self-employment, is calculated as $(1 - \mu)\mu_o$, is equal to 0.18 on average, ranging from 0.53 in Turkey to 0 in Ireland and Poland.

4.4.2 Cross-country results

The cross-country results for the OECD sample are summarized in Table 3, which shows the effects of introducing all the gender gaps analyzed—the (μ, μ_o, λ) gaps—and the effects of introducing the occupational gender gaps to employership and self-employment—the (μ, μ_o) gaps—both in the short run, when the capital stock is fixed, and the long run, when the capital stock takes its steady-state value. Countries are classified in four groups depending on their total income loss: countries above the 75th percentile, countries between the 50th and 75th percentile, countries between the 25th and 50th percentile and those below the 25th percentile. As it is apparent from the table, not surprisingly, the long run costs for each group are substantially larger than the short run ones. The table also reveals that the fraction of the total income losses represented by the restrictions on entrepreneurship represent about 40% of the total income loss, with the reminding loss being generated by the gaps in labor force participation.

The costs for each OECD country are presented in Appendix B. The average income loss due to the gender gaps in this sample of countries is 15.4% in the long run and 14.1% in the short run, while the income loss due to gender gaps in employership and self-employment are 5.7% in the long run and 5% in the short run. The countries with the largest average total losses in the long run are Turkey (33.1%), Mexico (25.5%), and Italy (21.2%), while

²⁹A zero gap in Chile reflects the fact that, according to our calculations, in this country no women is excluded from both employership and self-employment.

Iceland (9.2%), Norway (9.7%), and Finland (9.7%) display the smallest losses. The countries with the largest average losses generated by distortions in entrepreneurship in the long run are Israel (7.4%), Turkey (7.3%), and Estonia (7.2%). Chile (2.7%), Australia (3.5%), and Poland (4.7%) display the smallest losses associated with distortions in entrepreneurship.

5 Extension: out-of-necessity self-employment

5.1 Model with out-of-necessity self-employment

In this section, we present and simulate an extended version the model to make it more suitable for developing countries, which display a much larger fraction of self-employed workers than developed countries.³⁰ One possible explanation for this difference is the existence of the so-called *out-of-necessity* entrepreneurs, who choose this occupation because they had no other occupational choices apart from taking advantage of a business opportunity.³¹ To capture this phenomenon, in the extended model, a fraction $1 - \theta$ of both males and females are not allowed to become workers and, as we can see in Figure (6) in Appendix A, they choose to become self-employed.

The agents' optimization problem and occupation map in this version of the model is exactly the same as the one discussed in Section 3. However, the market-clearing conditions are now different to reflect the new restrictions in the labor market. The capital market clearing can be written as

$$\begin{aligned}
k = & \frac{1}{2} \left[\int_{z_2}^{\infty} k(x) d\Gamma(x) + \int_{z_1}^{z_2} \tilde{k}(x) d\Gamma(x) + (1 - \theta) \int_B^{z_1} \tilde{k}(x) d\Gamma(x) \right] \\
& + \frac{\lambda}{2} \left[\mu \int_{z_2}^{\infty} k(x) d\Gamma(x) + (\mu + (1 - \mu)\mu_0) \int_{z_1}^{z_2} \tilde{k}(x) d\Gamma(x) \right] \\
& + \frac{\lambda}{2} \left[(1 - \mu)\mu_0 \int_{z_2}^{\infty} \tilde{k}(x) d\Gamma(x) + (1 - \theta)(\mu + (1 - \mu)\mu_0) \int_B^{z_1} \tilde{k}(x) d\Gamma(x) \right]
\end{aligned}$$

where the upper term is the demand for capital by men and the lower term is the women's demand for capital. Compared to equation (8), the demand for capital has now two new components: the last terms in the first and second lines, which correspond to the capital demand of male and female *out-of-necessity* self-employed. A fraction $(1 - \theta)$ of males with

³⁰According to the data, the overall fraction of self-employed (own-account workers in the ILO dataset) is less than 11% in OECD countries and almost 35% in developing countries.

³¹Using data from the Global Entrepreneurship Monitor survey, Poschke (2013) finds that necessity entrepreneurs represent almost 50% of all entrepreneurs in non-OECD countries.

ability below z_1 become self-employed since they would like to be workers but are not allowed to do so and choose their second-best option. Moreover, a fraction $(1 - \theta)$ of females with ability below z_1 would like to be workers but, since they are “excluded” from this occupation, they choose to become *out-of-necessity* self-employed if they are eligible to do so, i.e. if they are not excluded from entrepreneurship³² These *out-of-necessity* self-employed demand the optimal amount of capital given their talent or ability. Similarly, the labor market-clearing condition is given by

$$\frac{1}{2} \left[\int_{z_2}^{\infty} n(x) d\Gamma(x) \right] + \frac{\lambda}{2} \mu \left[\int_{z_2}^{\infty} n(x) d\Gamma(x) \right] = \frac{1}{2} \theta \Gamma(z_1) + \frac{\lambda}{2} \theta [\Gamma(z_1) + (1 - \mu)(1 - \mu_0)(1 - \Gamma(z_1))],$$

where the first line represents the aggregate labor demand and the second line represents the aggregate labor supply. Compared to equation (9), the only difference here is that the labor supply terms are multiplied by the parameter θ , given that a fraction $(1 - \theta)$ of both males and females are not allowed to become workers.

5.2 Extended model numerical results

To simulate the extended model, we use the talent distribution function described in equation (11) and the parameter values of Table 1 used in the simulations of the benchmark model. Table 4 shows the effects of the occupational gaps on income per capita when the parameter θ is smaller than 1, i.e. when at least a fraction of agents who want to be workers are not allowed to do so. Interestingly, the effect of the *employership* gap decreases with the θ -friction, since a fall in θ reduces the general equilibrium effect of the μ -gap on the wage rate and, hence, reduces the negative effect on the aggregate productivity of entrepreneurs.³³ The effect of the *entrepreneurship* gap, however, increases with θ , given that excluding females from employership and self-employment implies excluding from the labor force a fraction $(1 - \theta)(1 - \mu)(1 - \mu_o)$, as we can see in Figure (6) in Appendix A.

³²Note that since the entrepreneurship friction is $(1 - \mu)(1 - \mu_o)$, a fraction $1 - (1 - \mu)(1 - \mu_o) = \mu + (1 - \mu)\mu_o$ are not excluded from self-employment.

³³Intuitively, a fall in θ reduces the supply of workers and, as a result, the introduction of the μ -gap creates a smaller fall in the equilibrium wage. This limits the incorporation of less talented employers and, hence, limits the fall in aggregate productivity.

Table 4: Potential income losses from gender gaps

	Short Run		Long Run	
	$\theta = .75$	$\theta = .25$	$\theta = .75$	$\theta = .25$
Due to highest possible <i>employership</i>-gap ($\mu = 1, \rightarrow \mu = 0; \mu_0 = 1, \lambda = 1$)	6.1%	3%	7.4%	3.7
Due to highest possible <i>entrepreneurship</i>-gap ($\mu = 1, \mu_0 = 1 \rightarrow \mu = 0, \mu_0 = 0; \lambda = 1$)	17%	33.5%	18.6%	36.1

5.3 Cross-country results: non-OECD sample

In this section, we use labor market data for 106 non-OECD countries from the International Labor Organization (KILM, 8th Edition) for the latest available year. As in section 4.4, the variables used are the country’s labor force participation, fraction of employers (or self-employed with employees) and fraction of own-account workers (self-employed without employees) by gender, which we denote as self-employed in our paper.³⁴ As before, for each country, we then compute the gender gap parameters (μ, μ_o, λ) comparing the male and female data on labor force participation, share of employers and share of self-employed. The parameter θ is jointly estimated with the other parameters to match the fraction of self-employed in each country. The numerical results for non-OECD countries are presented in Appendix C.

The average cross-country results obtained are summarized in Table (5), where the countries are split in 7 geographic regions, *Central Asia* (6), *East Asia and the Pacific* (13), *Europe* (13), *Latin America and the Caribbean* (26), *Middle East and North Africa* (13), *South Asia* (7), and *Sub-Saharan Africa* (28).³⁵ For each region, columns (2) and (4) show the average income loss (in the short and long run, respectively) due to the occupational gender gaps. (μ, μ_o) , while columns (3) and (5) show the average income loss due to all the gender gaps (μ, μ_o, λ) . Our results suggest the existence of remarkable differences across regions in income losses due to gender gaps, especially in those generated by the female labor participation gap. The region with the largest income loss is the *Middle East and North Africa* where, according to our estimates, the total income loss is 35% in the short run and 38% in the long run, a fifth

³⁴In KILM, the category “self-employed” is subdivided in four groups: employers, own-account workers, members of producers’ cooperatives, and contributing family workers. Given the definition of each of these groups, we have decided that the most sensible choice was to use own-account workers to represent the self-employed in our model, and assume that members of producers’ cooperatives, and contributing family workers are workers.

³⁵We follow the World Bank to assign each country to a region, with the exception of countries that belong in the Europe and Central Asia group, which we split in two geographical regions, Europe and Central Asia, since we believe the labor markets in these two regions are very different. The numbers in parentheses indicate the number of countries assigned to each region.

Table 5: Average income losses from labor market gender gaps- non-OECD sample (by World Bank region)

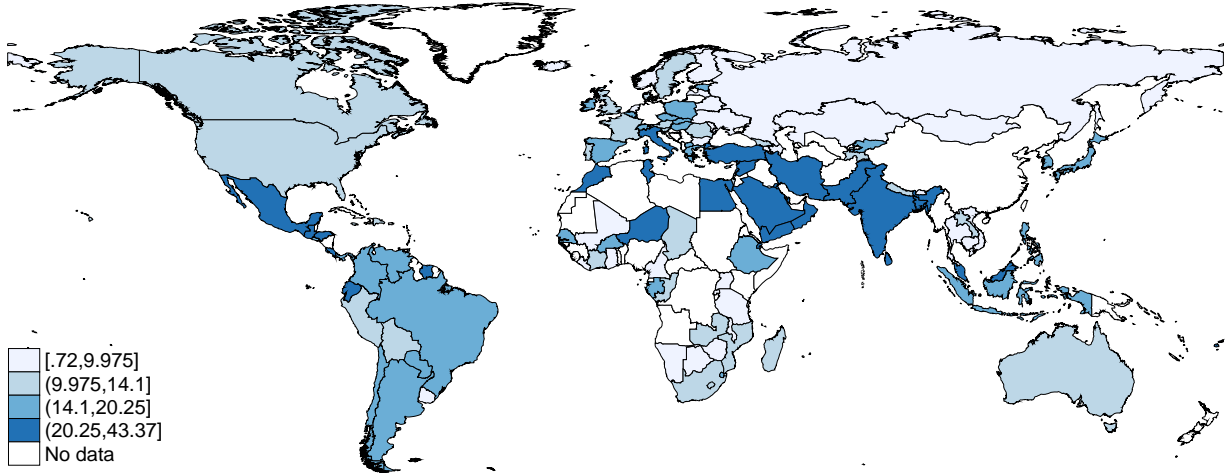
%	Short-run income loss		Long-run income loss	
	Due to (μ, μ_o)	Due to (μ, μ_o, λ)	Due to (μ, μ_o)	Due to (μ, μ_o, λ)
Central Asia	6.22	9.04	7.06	10.12
East Asia and Pacific	7.09	14.60	7.84	15.95
Europe	4.86	9.83	5.43	10.82
Latin America & C.	4.67	15.76	5.29	17.28
Middle East & N. Africa	6.90	35.11	7.72	37.83
South Asia	8.79	22.94	9.75	24.91
Sub-Saharan Africa	5.29	10.82	5.96	11.95

of which is due to the occupational choice gaps. *South Asia* has the second largest income losses due to gender gaps, 23% in the short run and 25% in the long run, almost 40% of which is due to occupational gaps. *Central Asia*, on the other hand, is the region with the lowest total income loss due to gender gaps, 9% in the short run and 10.1 in the long run, almost 70% of which is due to occupational gaps.

Appendix C contains the results for all countries in the non-OECD sample, together with the country-specific parameter estimates. The average θ is 0.75, indicating that only 25% of agents who want to be workers end up being self-employed instead. The average μ is 0.44, the average μ_o is 0.54 and the average λ is 0.74. The average income loss from all gender gaps is 16.05% in the short run and 17.53% in the long run, while the average income loss due to occupational gaps is 5.8% in the short run and 6.5% in the long run. These figures are higher than for the sample of OECD countries, although the fact that we use different versions of the models to calculate the costs in each group suggests that this comparison should be taken cautiously. With respect to the long-run total income losses from gender gaps, Yemen, Saudi Arabia, Syria, Qatar and Iran are the countries with the largest ones, all of them over 40%, while Ghana, Liberia and Rwanda are the countries with the smallest figures, all of them around 1%. With respect to the long-run income losses due to occupational gender gaps, Bangladesh, Burkina Faso and Pakistan are the countries with the largest ones, all of them above 17%, while Lesotho, Nepal, Rwanda and Bhutan are the countries with the smallest ones, in all cases below 1%.

After merging the OECD and the non-OECD, we summarize the results in Figures (3) and (4). Figure (3) shows the long-run total income loss due to gender gaps of each country in a world map, where we can see the largest losses are in Middle East and Northern Africa, South Asia and Latin America. Figure (4), on the other hand, plots the income losses against GDP per capita in 2010. The first plot shows that there is an inverse-U relationship between the level of development of a country and the total income loss caused by the gender gaps, while

Figure 3: World map of total income losses due to gender gaps



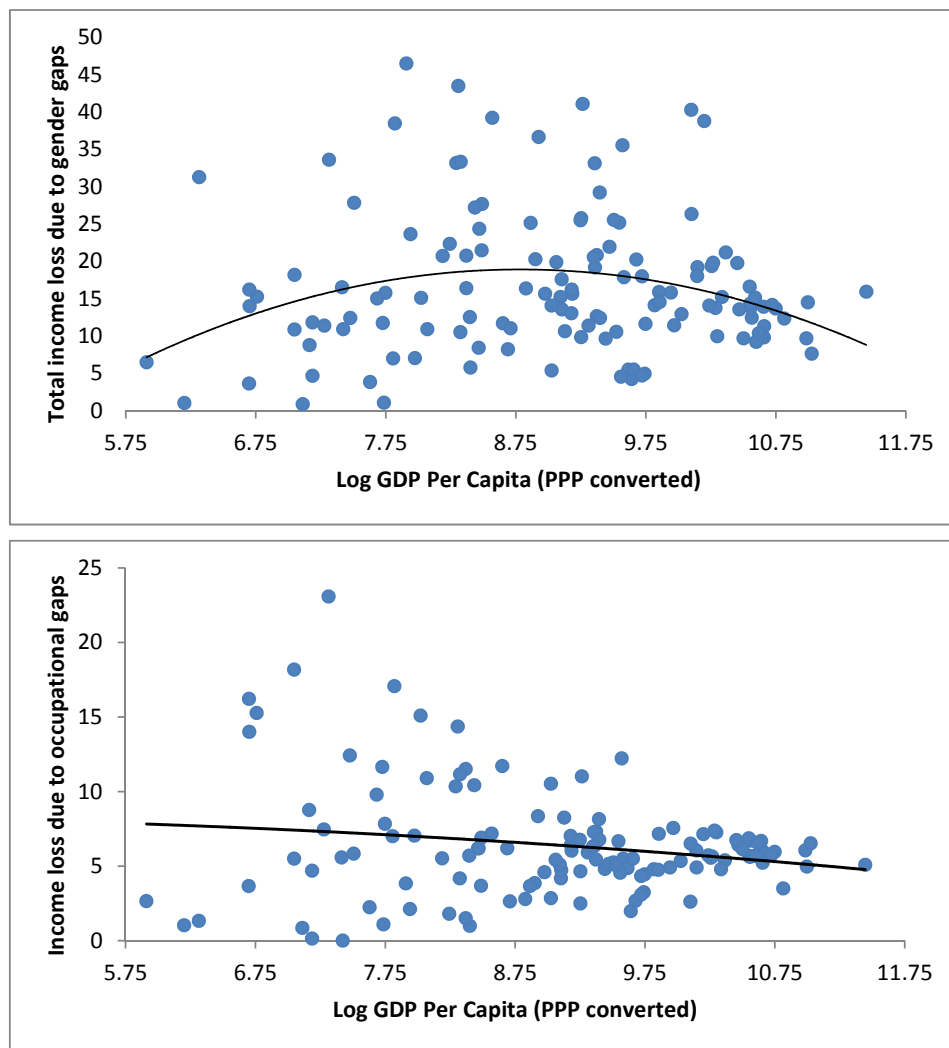
the second plot shows a negative relationship between the development level and the income losses caused by the gender gaps in entrepreneurship. This suggests that the inverse-U in the first plot is mostly driven by the U-shaped relationship between development and female labor force participation discussed, for example, in Goldin (1995).³⁶

6 Conclusion

This paper presents an occupational choice model and uses it to quantify the effects of gender gaps in the labor market on aggregate productivity and income per capita. Our numerical results show that gender gaps in entrepreneurship have significant effects on the allocation of resources and thus on aggregate productivity, while the gap from labor force participation has a large effect on income per capita. Specifically, if no women worked as an employer or a self-employed, our benchmark model predicts that income per worker would drop by around 10% in the short run and 11% in the long run, while if the labor force participation of women was zero, income per capita would decrease by almost 47% in the short run and 50% in the long run. When we carry out the country-by-country analysis, we find that there are important differences across countries and geographical regions. Gender inequality creates an average income loss of 14% in the short run and 15.4% in the long run for the OECD

³⁶Countries at different stages of their development process differ in many aspects, including the optimal choices of women in the labor market. In this sense, the interpretation of our gender gaps may not be the same across countries in different income groups and, as a result, the comparison between OECD and non-OECD should be taken with caution. An alternative to comparing gender gaps in a cross-section of countries at different stages of development, would be to use time series or panel data to compare these gaps - and their costs for one or several countries over time. An endogenous growth model where we introduce gender gaps in the labor market would be the appropriate conceptual tool in that case since it would allow use to analyze the two-directional link between gender inequality and economic growth. We leave this for future research.

Figure 4: Income losses and development level



sample, and an average income loss of 16% in the short run and 17.5% in the long run for the sample of developing countries. On average, 44% of those losses are due to gender gaps in occupational choices. The region with the largest income loss due to gender inequality is Middle East and North Africa, with an average income loss of 38% in the long run, followed by South Asia and Latin America and the Caribbean, with long-run income losses of 25% and 17.3%, respectively.

Our results suggest that the costs associated with gender gaps in the labor markets are substantial. As explained in OECD (2014), there are several public policies that can increase gender equality in the labor market: fostering a gender neutral legal framework for business, reducing administrative burdens on firms and excessive regulatory restrictions, ensuring equal access to finance for female and male entrepreneurs, and pair relevant financing schemes with support measures such as financial literacy, training, mentoring, coaching and consultancy services, and increasing access to support networks, including professional advice on legal and fiscal matters. A recent example of a country that has implemented some of these policies is Norway, where in 2006, its government established a quota system that made it mandatory for companies to have at least 40% of women in their boards (Bertrand et al., 2014). Other countries have now implemented regulations that force companies listed in the stock exchange to comply with Corporate Governance Codes (CDC's). In view of our findings, public policies along these lines may increase efficiency in the labor market and result in substantial gains in productivity and, potentially, women's welfare.

As discussed before, in this paper, we abstract from modeling the decision of agents to participate in the labor force, as well as any differential aspect in the occupational choices of women. An interesting extension would be to introduce a household production sector in the model, which is likely to lead to a division of labor between husbands and wives, as in Becker (1981). This would obviously reduce the welfare effects of the labor force participation gender gap, although it would also reduce the female value of participating in the labor market and, hence, the optimal female labor supply. Similarly, we also abstract from sectoral differences in terms of female labor intensity, which seem to exist in the real world. Taking into account the imperfect substitution of male and female labor, together with the differences in female labor intensity by sector, would probably raise the losses predicted by the model. On the other hand, if one assumed that women have less entrepreneurial talent than men —perhaps due to gender gaps in education— then our framework is likely to overestimate the negative impact of gender gaps in entrepreneurship on aggregate income.

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A Occupational choice maps of women

The two figures below illustrate how women's constraints are linked to their talent draw and what they imply in terms of their occupational choice. The first figure shows the occupational choice map of women in the benchmark model, while the second figure shows the one in the extended model with *necessity* entrepreneurs.

Figure 5: Occupational choice map of women - benchmark model

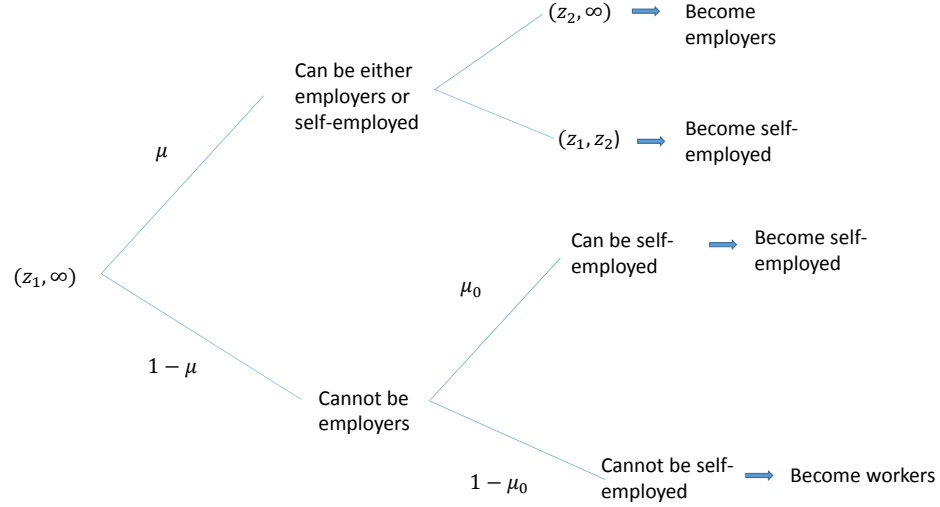
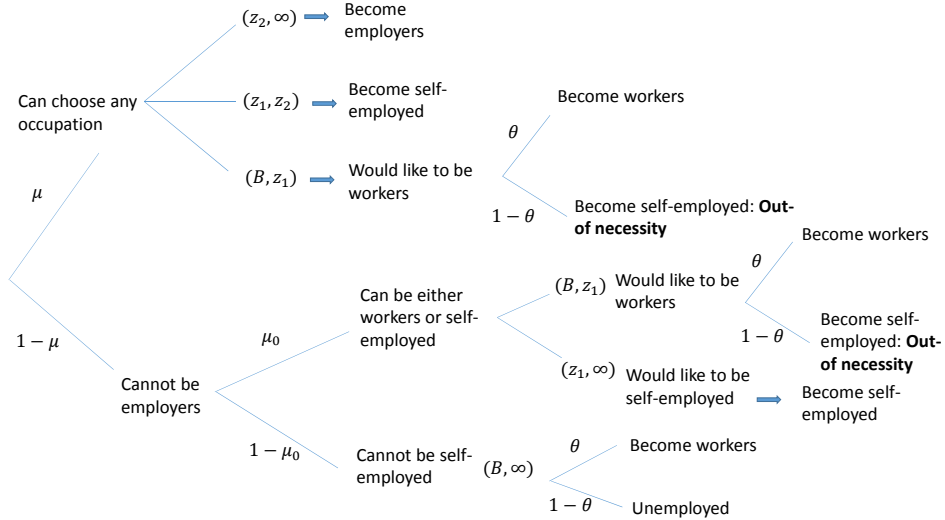


Figure 6: Occupational choice map of women - extended model



B Cross-country results: OECD sample³⁷

(Year 2010)	μ	μ_o	λ	1	2	3	4
Australia	0.62	0.02	0.81	3.18	11.27	3.50	12.32
Austria	0.40	0.50	0.80	4.57	12.61	5.22	13.92
Belgium	0.39	0.24	0.78	5.08	13.81	5.67	15.14
Canada	0.38	0.35	0.87	4.98	10.23	5.61	11.31
Chile	0.64	1.00	0.63	2.25	18.48	2.68	20.24
Czech Republic	0.36	0.22	0.73	5.44	16.48	6.06	18.02
Denmark	0.30	0.21	0.87	6.02	11.31	6.70	12.45
Estonia	0.24	0.39	0.83	6.34	13.15	7.16	14.53
Finland	0.35	0.25	0.92	5.49	8.77	6.14	9.70
France	0.32	0.25	0.83	5.74	12.32	6.41	13.55
Germany	0.38	0.34	0.80	5.03	12.99	5.66	14.29
Greece	0.39	0.36	0.69	4.93	17.69	5.55	19.36
Hungary	0.48	0.20	0.79	4.31	12.89	4.79	14.12
Iceland	0.39	0.20	0.92	5.10	8.35	5.68	9.21
Ireland	0.31	0.00	0.77	6.27	15.24	6.86	16.61
Israel	0.23	0.32	0.85	6.56	12.48	7.37	13.77
Italy	0.41	0.26	0.64	4.81	19.43	5.38	21.20
Japan	0.29	0.23	0.70	6.06	18.09	6.75	19.76
Korea	0.39	0.27	0.68	5.04	18.13	5.64	19.81
Luxembourg	0.41	0.57	0.76	4.42	14.45	5.07	15.93
Mexico	0.38	0.70	0.54	4.51	23.39	5.25	25.53
Netherlands	0.35	0.36	0.91	5.31	8.84	5.99	9.81
Norway	0.36	0.23	0.92	5.42	8.78	6.05	9.70
Poland	0.50	0.00	0.75	4.33	14.59	4.75	15.91
Portugal	0.41	0.31	0.83	4.77	11.74	5.35	12.92
Slovak Republic	0.43	0.59	0.76	4.26	14.36	4.90	15.83
Slovenia	0.41	0.03	0.81	5.20	12.88	5.71	14.08
Spain	0.49	0.04	0.77	4.36	13.94	4.79	15.22
Sweden	0.30	0.32	0.91	5.82	9.35	6.54	10.37
Switzerland	0.40	0.12	0.81	5.19	12.91	5.74	14.13

³⁷Variable 1: Short-run income loss due to occupational gender gaps (%); variable 2: short-run total income loss due to gender gaps (%); variable 3: long-run income loss due to occupational gender gaps (%); variable 4: long-run total income loss due to gender gaps (%).

(Year 2010)	μ	μ_o	λ	1	2	3	4
Turkey	0.19	0.65	0.39	6.28	30.53	7.29	33.11
United Kingdom	0.40	0.17	0.81	5.05	12.61	5.61	13.83
United States	0.38	0.14	0.82	5.37	12.47	5.95	13.66

C Cross-country results: non-OECD sample³⁸

Country	Year	Region	θ	μ	μ_o	λ	1	2	3	4
ATG	2001	LAC	1.00	0.51	0.34	0.99	3.86	4.18	4.34	4.69
ARG	2011	LAC	0.92	0.46	0.40	0.72	4.89	16.30	5.49	17.85
ARM	2011	CA	0.79	0.31	0.78	0.95	5.35	7.24	6.20	8.24
AZE	2008	CA	0.57	0.19	1.00	0.98	3.99	4.81	4.82	5.71
BHR	2010	MENA	1.00	0.29	0.00	0.26	6.51	36.00	7.14	38.76
BGD	2005	SA	0.25	0.36	0.00	0.61	21.25	31.10	23.09	33.60
BRB	2004	LAC	1.00	0.25	0.27	0.94	6.49	8.99	7.26	9.98
BLR	2009	EU	1.00	0.46	0.27	0.99	4.35	4.91	4.87	5.48
BLZ	2005	LAC	0.90	0.53	0.48	0.53	4.11	23.69	4.64	25.77
BTN	2011	SA	0.69	0.83	1.00	0.90	0.82	5.20	0.98	5.76
BOL	2009	LAC	0.72	0.41	0.74	0.85	4.98	11.28	5.70	12.53
BWA	2010	SSA	1.00	0.66	1.00	0.85	2.09	8.83	2.49	9.83
BRA	2009	LAC	0.87	0.48	0.30	0.78	5.42	14.30	6.04	15.67
BRN	1991	EAP	1.00	0.38	0.34	0.48	5.02	26.50	5.65	28.76
BGR	2011	EU	1.00	0.47	0.23	0.89	4.31	8.75	4.80	9.64
BFA	2006	SSA	0.41	0.32	0.10	1.00	16.66	16.66	18.17	18.17
KHM	2008	EAP	0.48	0.73	0.00	1.00	6.40	6.40	7.01	7.01
CMR	2001	SSA	0.47	0.53	1.00	0.97	1.88	3.33	2.24	3.83
CPV	2000	SSA	0.79	0.50	0.83	0.86	3.58	9.45	4.16	10.53
TCD	1993	SSA	0.23	0.33	0.54	1.00	11.27	11.27	12.42	12.42
COL	2011	LAC	0.59	0.48	0.86	0.71	3.61	16.00	4.17	17.58

³⁸1st column: country codes from Penn World Tables; 2nd column: latest year for which ILO data is available; 3rd column: World Bank region (EAP: East Asia and Pacific, EU: Europe, CA: Central Asia, LAC: Latin America and the Caribbean, MENA: Middle East and North Africa, SA: South Asia, SSA: Sub-Saharan Africa). Variable 1: Short-run income loss due to occupational gender gaps (%); variable 2: short-run total income loss due to gender gaps (%); variable 3: long-run income loss due to occupational gender gaps (%); variable 4: long-run total income loss due to gender gaps (%).

Country	Year	Region	θ	μ	μ_o	λ	1	2	3	4
COG	2005	SSA	0.45	0.32	1.00	1.00	2.78	2.78	3.35	3.35
CRI	2011	LAC	0.92	0.45	0.56	0.62	4.52	20.08	5.14	21.94
CIV	2002	SSA	0.48	0.63	0.27	0.91	6.78	10.40	7.46	11.40
HRV	2011	EU	0.98	0.51	0.44	0.84	3.93	10.53	4.45	11.63
CYP	2011	EU	1.00	0.22	0.30	0.91	6.73	10.31	7.55	11.43
DJI	1996	MENA	0.81	0.68	1.00	0.55	1.78	21.67	2.12	23.63
DOM	2001	LAC	0.80	0.53	0.22	0.70	5.74	17.58	6.35	19.18
DMA	2010	LAC	0.56	0.55	0.00	0.91	9.63	12.88	10.53	14.06
ECU	2011	LAC	0.73	0.44	0.97	0.64	3.25	18.45	3.86	20.26
EGY	2011	MENA	1.00	0.17	0.83	0.25	6.06	36.34	7.17	39.22
SLV	2011	LAC	0.83	0.59	1.00	0.71	2.34	14.86	2.79	16.36
ETH	2005	SSA	0.47	0.25	0.25	1.00	14.79	14.79	16.21	16.21
FJI	2008	EAP	0.79	0.57	0.00	0.52	6.31	25.52	6.91	27.66
GAB	2005	SSA	0.61	0.55	1.00	0.72	2.14	14.30	2.56	15.75
GEO	2010	CA	0.60	0.26	0.40	1.00	10.57	10.57	11.72	11.72
GHA	2010	SSA	0.41	0.74	1.00	1.00	0.91	0.91	1.09	1.09
GRD	1998	LAC	0.94	0.62	0.74	0.68	2.66	16.41	3.08	17.98
GTM	2004	LAC	0.78	0.45	1.00	0.54	3.06	23.03	3.67	25.14
HND	2010	LAC	0.67	0.69	1.00	0.57	1.51	20.48	1.80	22.34
HKG	2011	EAP	1.00	0.32	0.06	0.92	6.08	9.20	6.68	10.08
IND	2010	SA	0.32	0.33	0.60	0.42	9.33	30.63	10.35	33.15
IDN	2009	EAP	0.48	0.34	0.43	0.76	10.42	18.99	11.52	20.75
IRN	2008	MENA	0.71	0.15	0.51	0.23	9.83	38.14	11.02	41.05
JAM	2011	LAC	0.63	0.62	0.16	0.86	6.38	11.92	7.02	13.04
KAZ	2011	CA	0.79	0.69	1.00	0.95	1.66	3.72	1.98	4.23
KWT	2011	MENA	1.00	0.81	0.00	0.50	1.55	23.95	1.71	25.99
KGZ	2006	CA	0.67	0.44	0.44	0.81	7.04	14.38	7.84	15.79
LAO	2005	EAP	0.44	0.44	0.04	1.00	13.83	13.83	15.10	15.10
LVA	2011	EU	1.00	0.49	0.32	1.00	4.05	4.05	4.55	4.55
LBN	2007	MENA	0.81	0.14	0.21	0.37	11.07	32.92	12.22	35.55
LSO	1999	SSA	0.27	1.00	0.78	0.78	0.00	9.97	0.00	10.90
LBR	2010	SSA	0.45	0.77	1.00	1.00	0.86	0.86	1.02	1.02
LTU	2011	EU	1.00	0.39	0.41	1.00	4.86	4.86	5.50	5.50
MAC	2011	EAP	1.00	0.33	0.06	0.97	5.94	6.93	6.53	7.62
MKD	2011	EU	0.95	0.50	0.00	0.67	4.95	18.26	5.43	19.87

Country	Year	Region	θ	μ	μ_o	λ	1	2	3	4
MDG	2010	SSA	0.48	0.32	0.28	1.00	12.75	12.75	14.00	14.00
MWI	1987	SSA	0.29	0.08	1.00	1.00	3.01	3.01	3.65	3.65
MYS	2011	EAP	0.95	0.35	0.30	0.57	5.96	23.13	6.67	25.18
MDV	2006	SA	1.00	0.24	1.00	0.58	5.14	22.17	6.19	24.37
MLI	2006	SSA	0.51	0.45	0.76	0.88	4.84	9.79	5.49	10.87
MLT	2011	EU	1.00	0.34	0.00	0.54	5.94	24.28	6.51	26.33
MUS	2011	SSA	0.99	0.29	0.27	0.56	6.05	23.44	6.76	25.50
MDA	2011	EU	0.77	0.50	0.25	1.00	6.37	6.37	7.05	7.05
MNG	2011	EAP	0.84	0.49	0.33	0.95	5.55	7.61	6.19	8.42
MAR	2008	MENA	0.75	0.24	0.29	0.42	10.08	30.80	11.16	33.33
MOZ	2003	SSA	0.35	0.18	0.49	1.00	13.84	13.84	15.27	15.27
NAM	2011	SSA	0.92	0.63	1.00	0.82	2.20	9.91	2.63	11.01
NPL	2001	SA	0.44	0.97	1.00	0.77	0.12	10.81	0.14	11.82
NER	2005	SSA	0.20	0.50	1.00	0.38	1.11	28.87	1.33	31.26
OMN	2010	MENA	1.00	0.59	1.71	0.20	1.99	37.37	2.61	40.27
PAK	2008	SA	0.66	0.02	0.28	0.34	15.49	35.68	17.07	38.48
PAN	2011	LAC	0.78	0.60	0.03	0.67	5.76	18.90	6.32	20.57
PRY	2010	LAC	0.77	0.45	1.00	0.61	3.07	19.58	3.68	21.47
PER	2011	LAC	0.72	0.39	0.90	0.80	4.03	12.20	4.73	13.56
PHL	2008	EAP	0.74	0.46	0.66	0.66	4.86	18.91	5.52	20.70
QAT	2004	MENA	1.00	0.12	0.00	0.17	8.50	39.77	9.30	42.72
ROM	2011	EU	0.87	0.43	0.11	0.87	6.64	11.53	7.32	12.63
RUS	2008	EU	1.00	0.61	0.55	0.96	2.84	4.39	3.25	4.94
RWA	1996	SSA	0.45	0.81	1.00	1.00	0.72	0.72	0.85	0.85
LCA	2000	LAC	0.77	0.42	0.51	0.87	6.03	11.24	6.77	12.43
STP	1991	SSA	0.85	0.24	0.97	0.50	4.86	25.46	5.83	27.81
SAU	1992	MENA	1.00	0.10	0.11	0.13	8.49	41.66	9.37	44.69
SEN	2011	SSA	0.76	0.20	1.00	0.75	4.62	14.83	5.58	16.53
SRB	2011	EU	0.87	0.52	0.00	0.77	5.85	14.85	6.41	16.20
SGP	2011	EAP	1.00	0.47	0.08	0.79	4.51	13.28	4.97	14.52
ZAF	2011	SSA	1.00	0.37	0.86	0.77	4.33	13.71	5.11	15.23
LKA	2011	SA	0.71	0.23	0.45	0.57	9.34	24.98	10.43	27.19
KNA	2001	LAC	1.00	0.36	0.30	0.87	5.27	10.33	5.91	11.40
VCT	2008	LAC	1.00	0.46	0.57	0.76	4.01	14.21	4.60	15.65
SUR	1998	LAC	0.95	0.25	0.24	0.49	7.33	26.91	8.16	29.20

Country	Year	Region	θ	μ	μ_o	λ	1	2	3	4
SWZ	1997	SSA	0.98	0.79	1.00	0.69	1.26	14.95	1.50	16.39
SYR	2011	MENA	0.73	0.21	0.03	0.18	13.13	40.49	14.35	43.47
TJK	2009	CA	0.52	0.18	0.69	0.87	8.68	13.55	9.80	15.04
TZA	2011	SSA	0.56	0.33	0.93	1.00	3.99	3.99	4.68	4.68
THA	2011	EAP	0.70	0.38	0.46	0.94	7.39	9.59	8.25	10.64
TTO	2005	LAC	0.96	0.50	0.24	0.68	4.40	17.61	4.90	19.22
TUN	1994	MENA	0.88	0.27	0.37	0.32	7.45	33.93	8.34	36.63
UGA	2003	SSA	0.33	0.49	0.53	1.00	7.92	7.92	8.76	8.76
UKR	2011	EU	0.96	0.62	0.96	0.95	2.41	4.70	2.86	5.36
URY	2010	LAC	0.89	0.47	0.58	0.88	4.45	9.52	5.06	10.57
VEN	2011	LAC	0.76	0.34	0.86	0.65	4.66	18.95	5.44	20.82
VNM	2004	EAP	0.52	0.43	0.30	1.00	9.90	9.90	10.90	10.90
YEM	2010	MENA	0.78	0.43	1.00	0.08	3.20	43.37	3.83	46.48
ZMB	2000	SSA	0.55	0.33	0.36	1.00	10.54	10.64	11.64	11.75
ZWE	2002	SSA	0.67	0.56	1.00	0.92	2.22	5.72	2.66	6.46