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Talent Allocation and Post-Reform Growth in Central America

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Abstract

This paper examines the post-reform economic growth in three Central American economies—Costa Rica, El Salvador, and Panama. From 1995 to 2015, each economy witnessed phenomenal shifts in labor market participation and occupational distribution of women. If the innate talent for a job did not change differently across genders, the occupational changes suggest that many talented women in the mid-1990s were in professions that did not conform to their comparative advantage. The paper studies the evolution of the occupational distribution using a model of occupational choice in which three forces create frictions to efficient allocation—discrimination in labor markets, obstacles to human capital accumulation, and preferences (or social norms). The analysis shows that the underlying improvement in talent allocation over the past two decades had a quantitative impact on growth in Costa Rica and Panama. Decomposing the aggregate effects reveals that the gains were driven by declines in obstacles to human capital accumulation. In contrast, shifts in labor market discrimination created headwinds for expansion. The aggregate effects in El Salvador are relatively mild and noisy to the extent that the qualitative effect is difficult to pin down. Nonetheless, the analysis finds that the preference for market work has increased sharply in El Salvador for both genders and has proved to be a drag on growth.

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1 Introduction

Guided by the principles of the Washington Consensus, many Central American (CENAM) countries started on a path of structural reforms beginning in the late 1980s.[1] Since then, the region has recorded considerable gains in multiple dimensions of reforms outpacing those of many fast-growing economies during the period (Swiston and Barrot, 2011). The growth experiences of regional economies in the pre- and post-reform periods varies markedly (Figure 1(a)). At one extreme the growth took off after 1990 in El Salvador and Panama while remaining near trend in Costa Rica, Honduras, and Guatemala. Nicaragua stands out as the outlier where the real GDP per capita dropped drastically during the 1980s following the Sandinistas' ascension to power. The country has been on a path of slow recovery since then.

Given their unique experience, the discussion of growth in CENAMs since 1990 has primarily concentrated on the role of reforms in delivering it. Yet, there is a lack of consensus on whether reforms promote growth. Instead, the reform-growth link is found to be highly context-specific (Easterly and Levine, 2003; Rodrik, 2005; Prati *et al.*, 2013).[2,3] Moreover, studies concentrating on CENAMs have not found definite evidence of reform-led growth in the region (Ferreira and Harrison, 2012; Caceres, 2017; Roquez-Diaz and Escot, 2018). At the same time, some CENAMs have experienced healthy economic growth over the last few decades. Figure 1(b) highlights the relative performance of three CENAMs – Costa Rica, El Salvador, and Panama, that are the focus of this paper.[4] In terms of real GDP per capita expansion, Costa Rica and El Salvador lie above the 60th and 70th percentiles of the global distribution. Their relative standing is robust to the exclusion of high-income economies.[5] Panama lies above the 90th percentile of the global sample and 80th percentile of the sample that excludes high-income countries.

If reforms were not effective, what other factors can explain the immense gains observed over this period? In this paper, I turn the lens towards the phenomenal changes in the labor markets in the last two decades. Specifically, I investigate the shifts in the participation and occupational decisions of men and women. Table 1 provides a snapshot of these changes.

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[1] Williamson (1990, 2000) lists the set of reforms that constitute the development policies prescribed by the Washington Consensus.

[2] Studies that concentrate on specific reforms have also not yielded a consistent takeaway. For example, see Sachs *et al.* (1995), Dollar and Kraay (2004) and Berg and Krueger (2003) for evidence on trade liberalization. Also see Juhn *et al.* (2014) and Gaddis and Pieters (2017) who report differential impact of trade liberalization on labor market outcomes of men and women in Brazil and Mexico.

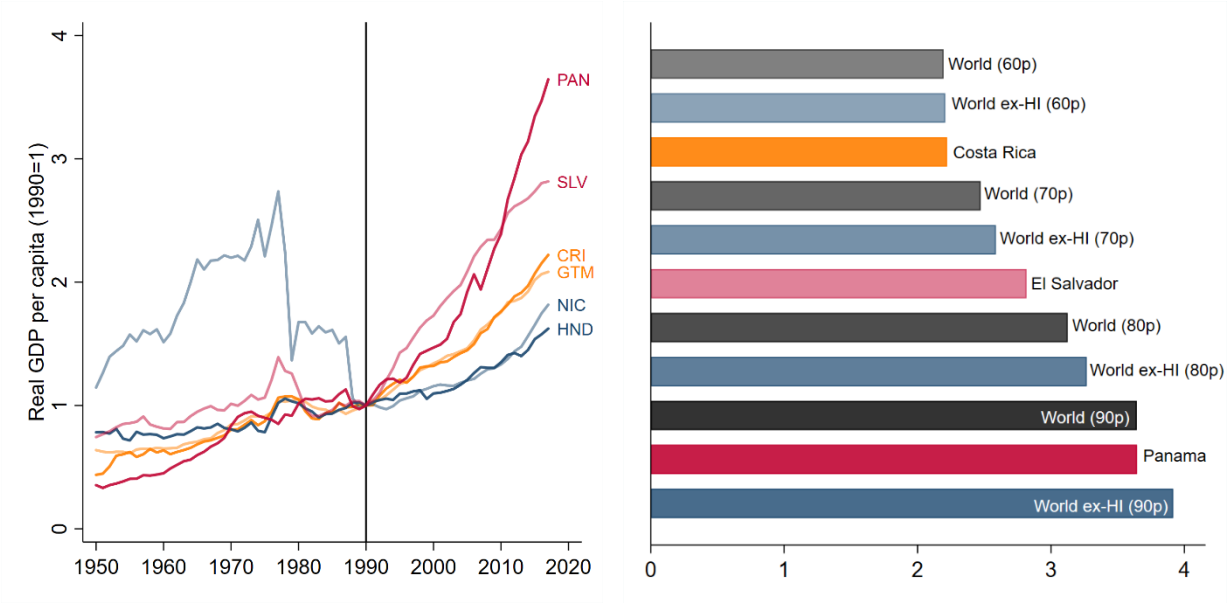
[3] Reform literature often exploits cross-country variation to investigate the reform-growth link. This leaves little room for the individual country analysis. In the context of CENAMs, Ferreira and Harrison (2012) and Roquez-Diaz and Escot (2018) are notable exceptions. The former finds that export diversification policies that replaced import substitution regime did not deliver long-run growth in Costa Rica. The latter considers the effects of trade liberalization in four CENAMs and finds no evidence of reform-led growth in any except Nicaragua.

[4] The exclusion of other CENAMs is not because of their growth performance. Instead, the unavailability of data restricts their inclusion.

[5] I follow the World Bank's income definitions (The World Bank, 2020). For the fiscal year 2020, the World Bank classifies countries with GNI per capita of USD 12,376 or more in 2018 (as per the World Bank Atlas method) as high-income.

Figure 1: Real GDP per capita (1990=1)[1]

(a) Growth in CENAM **(b) Real GDP per capita in 2017**



[1]Real GDP per capita in 1990 is normalized to 1 in each country. The left panel shows the evolution of real GDP per capita across the six CENAMs. The right panel shows the real GDP per capita in 2017 relative to 1990 for three leading CENAMs together with that of the world and the world excluding high-income economies at various percentiles. The figures use data from the Penn World Tables 9.1 (Feenstra *et al.*, 2015) and the World Bank's income-based country classification taxonomy.

Table 1: Labor market changes: 1995-2015 (aged 25-54)[1]

	Costa Rica		El Salvador		Panama	
	1995	2015	1995	2015	1995	2015
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Labor force participation (%)						
Women	36.3	55.6	51.4	57.7	46.4	63.3
Men	94.8	94.2	95.0	92.2	95.6	96.8
Panel B: Share in high-income occupations (%)						
Women	8.8	15.8	6.9	7.7	12.0	20.1
Men	17.4	19.9	11.7	9.6	13.5	17.2

[1]Section 3 provides details on the sample selection of workers corresponding to the above statistics.

Panel A reports the labor force participation rate (LFPR) of prime-aged (25-54) women and men in 1995 and 2015. While the LFPR of men has been relatively stable (ranging from 3 pp decline in El Salvador to 1 pp rise in Panama), women's participation has expanded considerably. The rate increased by 17-19 pp in Costa Rica and Panama, and by 6 pp in El Salvador. Women also narrowed the gap with men regarding their representation in high-income occupations (Panel B). The share of women working in high-income occupations grew by 7-8 pp in Costa Rica and Panama that is orders of magnitude higher

than of men. Though the extension realized by women in El Salvador was muted (80 bp), it is noteworthy given that men's representation shrunk by 2 pp.

How can these changes bear an effect on the aggregate economic performance? What links occupational convergence to aggregate gains is the notion that innate talent in an occupation within a group is likely to be time invariant. A recent study analyzes the occupational convergence in the United States (between race and gender groups) and finds that 20-40 percent of the growth in market output per capita during 1960-2010 can be attributed to the underlying improved allocation of talent (Hsieh *et al.*, 2019). Likewise, the occupational distribution of 1995 in CENAMs suggests that many talented women with a comparative advantage in high-income jobs – or in the labor market in general, were engaged elsewhere. A better allocation of talent over the decades could have potentially boosted growth in CENAMs too.

To analyze the labor market changes and their aggregate consequences, I employ the occupational choice model in Hsieh *et al.* (2019). The model extends the classic Roy (1951) model in which a worker chooses an occupation to maximize her utility. Three forces in the model can lead to workers choosing occupations that do not correspond to their comparative advantage. First, discrimination in the labor markets arises in the form of occupation-specific wedges between wages and marginal products (Altonji and Blank, 1999). Second, workers face barriers to human capital accumulation that raise the costs of acquiring occupation-specific education and training.[6] Finally, preferences and social norms can drive workers away from their most suited occupations. For instance, rigid social norms can deter women from entering the workforce or from pursuing high-skilled occupations (Altonji and Blank, 1999; Bertrand, 2011). The channel is broad enough to encompass shifts in preferences for children or the ability to alter fertility decisions that are closely tied to market work (Costa, 2000; Blau *et al.*, 2013).[7]

Besides evaluating the aggregate effects, the analysis sheds light on how the three forces have evolved over the years. I find that it became easier for women to attain human capital in most occupations. More importantly, these gains are also evident in high-income occupations. However, there is considerable heterogeneity across CENAMs when it comes to labor market discrimination. In Costa Rica and Panama, discrimination became more severe in all occupations barring a couple. The trend extends to high-income jobs. As such, the two forces acted counter to each other in many cases. In contrast, discrimination declined more broadly in El Salvador.

The intertemporal trends in preferences offer valuable insights. Departing from Hsieh *et al.* (2019), I use a less restrictive identifying assumption that allows men's preferences to vary across occupations and time. Women's and men's preferences have shifted away from home-based work to market occupations in Costa Rica and Panama. However, changes in preferences and norms have veered towards working at home in El Salvador. The heterogeneity across CENAMs has implications that are

[6] These barriers include bias in the allocation of household resources in favor of boys. Acosta (2011) shows that increases in remittances in El Salvador led to an uptick in the school attendance of girls but not of boys. This suggests that financial constraints concerning educational investments are more binding for girls. Similarly, highlighting the importance of intra-household allocation, Li *et al.* (2017) find that an additional sibling reduces the likelihood of secondary education of girls relatively more in the country.

[7] In the context of CENAMs, Kasy and Ramos-Chaves (2014) conclude that child support legislation and mandatory DNA testing led to changes in the family structure, creating opportunities for women to enter the labor market in Costa Rica.

critical from a policy standpoint. Reforms need to focus more on the labor market discrimination in Costa Rica and Panama. On the other hand, El Salvador will benefit from human capital interventions and policies that affect preferences and social norms.

The model shows that the changes in the occupational distribution had a substantial impact on aggregate output. Market output per capita in 2015 drops by 23-40 percent in Costa Rica and by 75-94 percent in Panama when I replace the present level of barriers and preferences with those from 1995. For the former, the lower bound translates to roughly half of the actual change in real GDP per capita. For Panama, the conservative estimate surpasses the actual growth by 16 percent.[8] The aggregate implications are milder in El Salvador. Additionally, it is difficult to determine whether the shifts in barriers and preferences aid or constrict growth. Depending on the choice of parameters, market output per capita in 2015 could have been either 13 percent lower or 6 percent higher if past levels persisted.

Decomposition reveals that gains in Costa Rica and Panama are driven by changes in obstacles to human capital accumulation. Shifts in labor market discrimination created headwinds in both countries. Though less powerful than the human capital channel, declines in discrimination support growth in the United States (Hsieh *et al.*, 2019). The exercise contributes to the literature by showing that the aggregate effects of shifts in preferences can be quantitatively significant. Unlike the US study, my identification strategy allows men's preferences to change over time. Over the decades, both women's and men's preferences in El Salvador have shifted away from market work. Market output per capita in 2015 would have been 5-16 percent higher if the country had the preference profile as in 1995. This indicates 10-34 percent of the actual growth over the period. In contrast, preferences do not exert any meaningful impact on growth in the United States.

Finally, the paper complements the literature that has investigated the barriers to occupational decisions in CENAMs by comparing how the situation has evolved over the last two decades.[9] A novelty of the approach here is that the occupational choice model adjusts for the fact that workers self-select into occupations based on their idiosyncratic occupation-specific innate talent. Under self-selection, occupational frictions are more robustly associated with occupational shares than with wage gaps (Hsieh *et al.*, 2019). The average talent of women will be higher in an occupation in which they are not well represented as only the most talented can pursue it. In the absence of the above three forces, women earn more than men to compensate for talent differences. Davila and Pagan (1999) make a similar point while comparing gender wage gaps in Costa Rica and El Salvador. In the presence of selection effects, the analysis of frictions should jointly consider the occupational distribution and wage gaps.

Following the identification strategy in Hsieh *et al.*, (2019), I measure occupational frictions faced by women relative to men. This amounts to assuming that men do not face discrimination in the labor markets, nor do they encounter obstacles to human capital formation. The assumption is restrictive as barriers can arise for both genders. Indeed, Dahbura (2018) and Kalsi (2018) find that boys are more prone to criminal victimization in El Salvador which affects their schooling. The identification, however, does not

[8] In the results section, I explain why real labor earnings match more transparently to data relative to GDP per capita. Though quantitatively different, the significance of the three forces remains substantial when using labor earnings as a yardstick. At a minimum, the three channels jointly account for 25 percent of the actual gain in real earnings per capita in Costa Rica. For Panama, their contribution ranges between 147-185 percent of the actual change.

[9] Some of the earlier studies include Arends (1992a; 1992b), Winter and Gindling (1992), Gindling (1993) and Funkhouser (1997).

constrain women to always remain at a disadvantage. In case women are favored, it will amount to them receiving *subsidies* as wages or in acquiring human capital. The baseline estimates rule out this possibility in all three CENAMs when both barriers are considered jointly. There is some evidence that suggests that women receive *subsidies* in human capital formation in Costa Rica and Panama in certain occupations. However, they are dwarfed by labor market discrimination.

The rest of the paper is organized as follows. The next section lays out the occupational choice model. Following, I discuss the details of the data used in the quantitative analysis. Section 4 covers the country-wise calibration of the model. Section 5 describes how the barriers and preferences have evolved over the last two decades, and section 6 reports the aggregate implications of the changes.

2 Model

To analyze the occupational choices of workers, I employ the occupational choice model developed in Hsieh *et al.* (2019). The model extends the set-up of a standard Roy (1951) model in which workers are endowed with idiosyncratic innate talent in each occupation. More importantly, the model introduces three forces that are critical in choosing occupations. First, workers face idiosyncratic discrimination in the labor market. Second, the cost of acquiring human capital varies across workers effectively creating obstacles to human capital accumulation. Third, workers prefer some occupations over others. In what follows, I often refer to the first two forces together as barriers to occupational choice.

2.1 Workers

Each worker's lifetime consists of three periods – young, middle and old, during which she works. This implies that in each period there are three cohorts of workers. The worker chooses her occupation and human capital investment in an initial pre-period which remains fixed throughout the three working periods. There is a total of I occupations, one of which involves working in the home sector. In addition, each worker belongs to a group g which influences occupational preferences and barriers. The groups correspond to the gender of the workers. In any period t, the lifetime utility U_{igt}^{y} of a young worker from group g who decides to work in occupation i follows the following specification

$$\log U_{igt}^{y} = \beta \sum_{t}^{t+2} \log C_t + \log(1-s) + \log z_{igt}^{y} \tag{1}$$

where C_t is the consumption in period t and s is the time spent on accumulating human capital in the pre-period. The total time endowment in the pre-period is set to 1. Hence, β captures the trade-off between lifetime consumption and leisure in the pre-period.

Preferences can drive workers away from their comparative advantage. The parameter z_{igt}^{y} is the utility that a young worker in period t derives from working in occupation i. There are various reasons why preferences may change over time and across groups. For instance, they may be shifts in preferences towards fertility and marriage which might shift preferences for working in the home sector for women but not men. In general, evolving social norms can also alter preferences of men and women in complex fashion.

The human capital of a worker h_{it}^{c} of cohort c who works in occupation i is given by

$$h_{it}^{c} = \gamma_c s^{\phi_{it}} e^{\eta} \tag{2}$$

Apart from time resource s, the production of human capital requires goods e and η is the elasticity of human capital with respect to such expenditures. The elasticity of time spent in school ϕ_{it} varies across occupations making schooling time more rewarding in some occupations. Moreover, the time elasticities evolve over time guided by any general rise in schooling. The human capital also responds to experience and the parameter γ_c governs the returns to experience.

Workers work in each period and use the earned wage income for consumption and repaying the education expenditures incurred in the pre-period. The period budget constraint satisfies

$$C_t = \left(1 - \tau_{igt(w)}^{c}\right) w_{it} \epsilon h_{it}^{c} - e_t\left(1 + \tau_{igt(h)}^{c}\right) \tag{3}$$

where C_t is the period consumption and w_{it} is the efficiency wage in the chosen occupation i. Income of a worker depends on the efficiency units of labor supplied which depends on the human capital h_{it}^{c} and the level of the worker's innate talent ϵ.

Labor market discrimination is another force that distorts occupational choice. These arise in the form of *taxes* on labor earnings $\tau_{igt(w)}^{c}$. These taxes vary across occupations and groups but are assumed to be the same across cohorts, i.e., $\tau_{igt(w)}^{y} = \tau_{igt(w)}^{m} = \tau_{igt(w)}^{o}$ $\forall\, i, g, t$. This implies that all workers from a group face the same level of discrimination in labor markets independent of their cohort in any given period. The assumption is critical in separating labor market discrimination from obstacles to human capital formation. Still, this does not mean that lifetime realization of discrimination is the same across cohorts as different cohorts live in different periods over their lifetime.

Finally, obstacles to human capital accumulation feature as increased cost of education goods. A young worker in period t borrows $e\left(1 + \tau_{igt(h)}^{y}\right)$ in the pre-period to obtain an amount e of goods and repays e_t over the lifetime such that $\sum_{t}^{t+2} e_t = e$. The human capital barriers $\tau_{igt(h)}^{y}$ raise the cost of education which varies across occupations, groups, cohorts and time. However, as the workers take these expenditures in the pre-period, they neither gain nor lose from any future changes in human capital barriers. In other words, there is no renegotiation of the education repayment loan $\left(\tau_{igt(h)}^{y} = \tau_{ig,t+1(h)}^{m} = \tau_{ig,t+2(h)}^{o}\right)$. The workers maximize their life utility in equation (1) given the budget constraint (3) and can observe the present levels of efficiency wage w_{it}, and barriers. To keep the computation simple, the model assumes that young workers expect the current efficiency wages and labor market barriers to hold in the future when they are making their education and occupational decisions.

To make analytical progress with workers' decisions, the model follows McFadden (1974) and Eaton and Kortum (2002) and parameterizes the talent by assuming it to follow the multivariate Fréchet distribution

$$F(\epsilon_i, \ldots, \epsilon_I) = \exp\left(-\sum_i \epsilon_i^{-\theta}\right) \tag{4}$$

The above specification implies that workers have different levels of innate talent across occupations, and it is possible for a worker to have a much higher talent in one occupation but not the others.

The above set-up implies that the amount of time spent in school by young workers in period t depends on the elasticity of human capital to education expenditures η, consumption-leisure trade-off parameter β, and the occupation-specific elasticity to schooling ϕ_{it}

$$s_{it}^{y*} = \frac{1}{1 + \frac{1-\eta}{3\beta\phi_{it}}} \tag{5}$$

The above expression indicates that all variation in schooling time across time and occupations is driven by ϕ_{it}. More importantly, the choice of s is independent of a worker's group g. At this point, it is also useful to introduce a notation for *composite* barrier τ_{igt}^{c} which combines $\tau_{igt(h)}^{c}$ and $\tau_{igt(w)}^{c}$ and is given by $\frac{\left(1+\tau_{igt(h)}^{c}\right)^{\eta}}{1-\tau_{igt(w)}^{c}}$. The composite barriers will feature repeatedly in aspects related to the optimization problem of the workers.

Occupational choice: A worker chooses an occupation that provides her with the highest utility U_{igt}^{y}. As the talent is drawn from the Fréchet distribution, it follows that the utility from choosing an occupation also follows the same distribution. Thus, it is possible to analytically solve for the occupational propensities at the group level.

Proposition 1: The propensity of a young worker from group g to choose an occupation i in any period t is given by

$$p_{igt}^{y} = \frac{\widetilde{w}_{jgt}^{\theta}}{\sum_{j}\left(\widetilde{w}_{jgt}^{y}\right)^{\theta}} \tag{6}$$

where $\widetilde{w}_{igt}^{y} = \frac{w_{it}\left(s_{it}^{y}\right)^{\phi_{it}}\left[\left(1-s_{it}^{y}\right)z_{igt}^{y}\right]^{\frac{1-\eta}{3\beta}}}{\tau_{igt}^{c}}$.

Note that the occupational choices made when young follow throughout the lifetime of workers, i.e., $p_{igt}^{y} = p_{ig,t+1}^{m} = p_{ig,t+2}^{o}$. The above proposition illustrates the forces that govern the occupational sorting. Equation (5) shows that the choice of schooling time s_{it}^{y} is invariant across groups. Given this, the parameters that vary across groups and lead to variations in occupational distribution across groups are preferences z_{igt}^{y} and the composite frictions τ_{igt}^{y}. The latter increases with a rise in barriers in either the labor market or in human capital accumulation. Hence, if a group has a higher fraction of workers in some occupation relative to some other group, then either that group has a higher preference or faces steeper barriers in that occupation, or both. The above equation also pins down the labor force participation rate as home-sector is one of the occupations. An interesting feature of the model is that it allows preferences to change in groups who otherwise may or may not face any significant barriers. For example, to use the exposition in Hsieh et al. (2019), the LFPR could have declined for men in the United States because of the

preference for the home-sector going up as a result of availability of better video games. Of course, the other reason could be the shrinking of efficiency wage w_{it} in certain blue-collar occupations.

Worker quality: Nonetheless, it is not only the number of workers that determines the supply of labor inputs. The human capital of workers which depends on schooling time, education goods and innate ability affect the effective labor supply. The following proposition isolates the average quality κ_{igt}^{c} of a worker from group g working in occupation i in any period t.

Proposition 2: The average quality κ_{igt}^{c} of a worker from group g and cohort c working in occupation i in any period t is given by

$$\kappa_{igt}^{c} = \begin{cases} \left(s_{it}^{y}\right)^{\phi_{it}} \gamma_0 \left[\eta \dfrac{1-\tau_{igt}^{y(w)}}{1+\tau_{igt}^{y(h)}}\, w_{it}\ \bar{\gamma}\, \left(s_{it}^{y}\right)^{\phi_{it}}\right]^{\bar{\eta}} \Gamma \left(\dfrac{1}{p_{igt}^{y}}\right)^{\frac{1}{\theta(1-\eta)}}, c = y \\ \left(s_{it}^{m}\right)^{\phi_{it}} \gamma_1 \left[\eta \dfrac{1-\tau_{ig,t-1}^{y(w)}}{1+\tau_{ig,t-1}^{y(h)}}\, w_{i,t-1}\ \bar{\gamma}\, \left(s_{it}^{m}\right)^{\phi_{i,t-1}}\right]^{\bar{\eta}} \Gamma \left(\dfrac{1}{p_{igt}^{m}}\right)^{\frac{1}{\theta(1-\eta)}}, c = m \\ \left(s_{it}^{o}\right)^{\phi_{it}} \gamma_2 \left[\eta \dfrac{1-\tau_{ig,t-2}^{y(w)}}{1+\tau_{ig,t-2}^{y(h)}}\, w_{i,t-2}\ \bar{\gamma}\, \left(s_{it}^{o}\right)^{\phi_{i,t-2}}\right]^{\bar{\eta}} \Gamma \left(\dfrac{1}{p_{igt}^{o}}\right)^{\frac{1}{\theta(1-\eta)}}, c = o \end{cases} \tag{7}$$

where $\Gamma = \Gamma\left(1 - \frac{1}{\theta}\frac{1}{1-\eta}\right)$ is the constant corresponding to the gamma function on account of using the Fréchet distribution.

Like the occupational choices of workers, the schooling s_{it}^{c} of middle- and old-aged workers is a function of conditions prevailing when they were young. For this reason, the market variables inside the square brackets reflect the position in the prior two periods for the non-young cohorts. Moreover, the model does not allow for more schooling to be obtained later which implies that $s_{it}^{y} = s_{i,t+1}^{m} = s_{i,t+2}^{o}$. Still, the human capital technology which governs the creation of effective units of labor in any period t applies to all cohorts. For example, an increase in the time-elasticity ϕ_{it} in some occupation i, raises the effective labor units of middle- and old-aged workers in period t. The only difference is that they are not able to alter their schooling decisions because of such technology shocks. The proposition captures this effect and the returns to schooling in shaping worker quality outside the square bracket is invariant across cohorts.

Average wages: The model also allows to see which forces determine the variation in average occupational wages across groups. The principal takeaway is that in the presence of the selection effect due to variations in innate ability across occupations, the wage gaps across groups are a biased measure of barriers faced. The following proposition gives the analytical expression for the average wages earned by workers from different groups in any occupation.

Proposition 3: The average wage $\overline{wage}_{igt}^{c}$ in any occupation i earned by workers from any group g and cohort c in any period t is given by

$$\overline{wage}^{c}_{igt} = \Gamma\,\bar{\eta}\left(\sum_{j}\left(\widetilde{w}^{c}_{jgt}\right)^{\theta}\right)^{\frac{1}{\theta}\frac{1}{1-\eta}}\left((1-s^{c}_{it})z^{y}_{igt'}\right)^{-\frac{1}{3\beta}}\frac{1-\tau^{c}_{igt(w)}}{1-\tau^{c}_{igt'(w)}}\frac{w_{it}}{w_{it'}}\frac{\gamma_c}{\bar{\gamma}}\,(s^{c}_{it})^{\phi_{it}-\phi_{it'}} \tag{8}$$

where t' equals $t, t-1$ and $t-2$ for young, middle and old cohorts respectively and $\bar{\eta} = \eta^{\frac{\eta}{1-\eta}}$.

First, consider the average wages of young workers from some group g. The term that drives variation in average wages across occupation is $\left((1-s^{y}_{it})z^{y}_{igt}\right)^{-\frac{1}{3\beta}}$. If schooling returns to human capital ϕ_{it} is higher for some occupation i, then workers in the occupation spend more time in school which leads to higher relative wages. Additionally, if workers have lower relative preference z^{y}_{igt} for an occupation i, they need to be compensated by higher wages. The above equation shows that the average wages are not higher in occupations in which workers face larger barriers. This happens because of the selection effect which works in the opposite direction. Equation (6) shows that an increase in labor market barriers reduced the share of workers choosing that occupation. Equation (7) links this reduction in share to a rise in the average quality of the remaining workers. The self-selection mechanism implies that only the very talented workers remain with less talented workers exiting to other occupations. There is no reason why the selection effects will exactly wash-off the direct effect of the barriers. Instead, the finding is a by-product of employing the Fréchet distribution. Nonetheless, the essential point to note is that the average earnings do not capture the effect of labor market barriers when workers self-select in occupations based on their comparative advantage.

The above proposition also highlights what drives variation in growth of mean wage across groups of a cohort working in any given occupation. The returns to schooling, experience and skills have identical effect and do not matter. The only force that drives this variation is the labor market barrier $\tau^{c}_{igt(w)}$. This crucial insight assists the separation of the two barriers from the composite barrier τ^{y}_{igt}.

Finally, the propensity of women to work in any occupation $\frac{p^{y}_{iwt}}{p^{y}_{imt}}$ relative to men is obtained using the propositions above

$$\frac{p^{y}_{iwt}}{p^{y}_{imt}} = \left(\frac{\tau^{y}_{iwt}}{\tau^{y}_{imt}}\right)^{-\theta}\left(\frac{\overline{wage}^{y}_{iwt}}{\overline{wage}^{y}_{imt}}\right)^{-\theta(1-\eta)} \tag{9}$$

The above equation provides a simple mapping from two easily available moments in the data – average wages $\overline{wage}^{y}_{igt}$ and occupational propensity p^{y}_{igt}, to composite barriers. It is difficult to identify barriers for men and women separately without any normalization. Therefore, to recover barriers arising for women, I assume that men face no barriers in labor markets and in human capital accumulation, i.e., $\tau^{c}_{imt(w)} = \tau^{c}_{imt(h)} = 0 \Rightarrow \tau^{c}_{imt} = 1\ \forall\ i, t, c$. Equation (9) does not explicitly contain workers' preferences z^{y}_{igt} but implicitly through their effect on average wages. Finally, the normalization entails interpreting barriers associated with women as being relative to that faced by men. Still, this does not necessarily mean that women are always discriminated in favor of men. There is no restriction on the value of composite barriers τ^{c}_{iwt} other than it being positive which means that the composite barriers can be less

than unity. It is possible that either $\tau^{c}_{iwt(w)} < 0$ or $\tau^{c}_{iwt(h)} < 0$ (or both) which connotes a favorable situation for women at the expense of men. In the later sections, I show that in all three Central American economies women face relatively lower barriers in accumulating human capital in many occupations.

2.2 Firms and barriers in labor markets and in accumulating human capital

The final output Y is produced using efficiency labor units H_i from each occupation according to a CES technology

$$Y = \left[\left(\sum_{i=1}^{I} A_i H_i\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{10}$$

where A_i is the occupation-specific productivity and σ is the elasticity of substitution across the various occupation-specific efficiency labor units. The occupation-specific efficiency labor units H_i is an aggregate of efficiency units across all groups and cohorts $\left(H_i = \sum_g \sum_c H^c_{ig}\right)$.

The modeling of discrimination follows from Becker (1957). The utility of the final output producer U_F depends on the profits net of any disutility from employing workers from certain groups

$$U^F_t = \left(Y_t - \sum_i \sum_g \sum_c \left(1 - \tau^c_{igt(w)}\right) w_{it} H^c_{igt}\right) - \left(\sum_i \sum_g \sum_c d_{igt(w)} H^c_{igt}\right) \tag{11}$$

where $d_{igt(w)}$ is the disutility from using a unit of efficiency labor unit from group g in an occupation i. The first term within the parentheses denotes the profits and the second term relates to the utility loss from discriminatory preference of the owner. All producers are assumed to be discriminatory and under perfect competition the labor market barriers $\tau^c_{igt(w)}$equals the ratio of producer's disutility $d_{igt(w)}$ and the efficiency wage rate w_{it}. The only possibility under which a producer hires a worker from a group against which she discriminates is by offering the worker a lower wage to offset marginal disutility $d_{igt(w)}$.

Similarly, a school acts as an intermediary and sells the educational goods e used for human capital accumulation. Like the final output producer, the school discriminates against certain groups and maximizes profits net of any such disutility U^S_t

$$U^S_t = \sum_i \sum_g \left(R_{it} - \left(1 - \tau^y_{igt(h)}\right)\right) e^y_{igt} - \sum_i \sum_g d_{igt(h)} e^y_{igt} \tag{12}$$

where R_{it} denotes the price of the educational good e^y_{igt} which the school faces and equals unity as the exchange between the school and the final output producer occurs under perfect competition. The disutility that the school derives from supplying a unit of educational good to a worker from group g pursuing an occupation i is represented by $d_{igt(h)}$. As all schools are discriminatory and operate under perfect competition, the barriers to human capital accumulation $\tau^y_{igt(h)}$ equal $d_{igt(h)}$. Thus, a school charges a premium from workers in groups against which it discriminates to offset the marginal disutility.

This concludes the discussion of the theory of occupational choice which I use to study the evolution of occupational change during the last two decades in Costa Rica, El Salvador and Panama. In the next section, I provide details on the data that I use to perform the quantitative analysis for the three Central American economies.

3 Data

The main source of data is the country household surveys. The Socio-Economic Database for Latin America and the Caribbean (SEDLAC) (CEDLAS and the World Bank, 2019) is a repository of the major household surveys conducted in the Latin American and Caribbean countries. For most countries, the available surveys start appearing since the late 1980s. Given that the focus of the analysis is on prime-aged workers (25-54 years), the SEDLAC potentially offers lifetime information of the oldest cohort (45-54 years) in the present decade. For example, it is possible to know the occupational distribution of this cohort in the 1990s when it was classified as young. Thus, the availability of data over last two decades or so allows me to extract comprehensive information on all current cohorts. The three years that serve as reference points are 1995, 2005 and 2015 because the latter is the latest year for which data are available. The surveys do not correspond to actual panel. Rather, I construct a synthetic panel for each cohort to foster analysis.

The repository harmonizes the data at the country level to make them comparable across years. Still, due to several reasons many surveys remain non-comparable. To fulfill the basic requirement of having data on at least three years separated by a decade, I try bringing non-comparable surveys under analysis subject to them passing quality checks so that they are suitable for use in the study. This effort helps extend coverage to Costa Rica and Panama, as comparable surveys spanning a 20-year span are only available for El Salvador. Furthermore, to add power to the analysis, I pool data from the adjacent year surveys to the reference years whenever possible.[10] More details are listed in the data appendix.

The sample restrictions follow the procedure adopted by Hsieh *et al.* (2019). The model assumes that the workers make their occupational decisions after completing their school. Thus, considering only workers within the ages of 25-54 keeps focus on post-schooling choices. Moreover, the model does not feature the transitory state of unemployment. Hence, I drop those individuals from the analysis who report being unemployed. Finally, I exclude all individuals in the armed forces. Gender lines partition the workers into two groups.

In addition to cohort and gender classification, I need information on three important worker characteristics – occupational choice, level of schooling and income. The occupational classification of workers follows the structure of International Standard Classification of Occupations (ISCO-88) (International Labor Organization, 2012) at the 1-digit (major group) level. There are nine occupations at this level which vary considerably in terms of skills requirements and educational intensity. Apart from the standard market occupations, the set of possible occupations includes the home sector. I assume

[10] Table A1 in the appendix lists the survey years associated with each reference year for each country.

individuals not in the labor force work to be engaged in the home sector. Table 2 lists the 1-digit occupations together with some examples of narrower sub-groups that constitute them.[11]

I make two more adjustments to the data. First, I classify the bottom five percentile of workers in terms of their hours worked in the market occupations to be engaged in the home sector. Depending on the country and the year, the cut-off for being classified in the marker occupations ranges from 21–24 hours. Second, I drop the bottom five percentile of workers in terms of their incomes when using such data. The income of a worker includes earnings from supplying labor in market occupations together with business and farm income in the previous year. A useful feature of the SEDLAC data is that the data on income are converted to real income in local currency with base year in 2011. Finally, I use sampling weights provided by the surveys to aggregate variables at the group-occupation-cohort level, or any combination thereof.

The next section explains how I calibrate the model using the survey data to recover the parameters of the model including the barriers operating in the labor markets and in the accumulation of human capital. Obtaining the estimates of barriers allows me to conduct counterfactual experiments that quantify their aggregate impact.

Table 2: Occupational classification

Occupation	Sub-groups
Managers (MNG)	Chief executives, senior officials and legislators; Administrative and commercial managers; Production and specialized services managers etc.
Professionals (PRF)	Science and engineering professionals; Health professionals; Teaching professionals etc.
Technicians (TCH)	Science and engineering associate professionals; Health associate professionals; Business and administration associate professionals etc.
Clerks (CLR)	General and keyboard clerks; Customer services clerks; Numerical and material recording clerks etc.
Sales and personal services workers (SSR)	Personal services workers; Sales workers; Personal care workers etc.
Skilled agricultural workers (AGR)	Market-oriented skilled agricultural workers; Market-oriented skilled forestry, fishery and hunting workers; Subsistence farmers, fishers, hunters and gatherers
Craft workers (CRF)	Building and related trade workers; Metal, machinery and related trade workers; Handicraft and printing workers etc.
Machine operators (MOP)	Stationary plant and machine operators; Assemblers; Drivers and mobile plant operators etc.
Elementary workers (ELM)	Cleaners and helpers; Agricultural, forestry and fishery laborers; Laborers in mining, construction, manufacturing and transport etc.
Home sector workers (HSW)	*Not in labor force*[1]

[1]Individuals not in any occupation and not looking for work. For more information on the ISCO-88, see ILO (2012).

[11] The 1-digit occupations (major groups) in ISCO-88 are comparable to those in ISCO-88. New occupations are introduced in the latter, together with some merging and splitting of older categories. Yet, the changes are restricted at the sub-group or finer levels (ILO, 2012).

4 Calibration

I now move on to the quantitative analysis and begin by discussing the calibration of the model.

4.1 Calibration of time-invariant parameters

First, let me consider the parameters of the model that remain invariant over the decades. There are seven such parameters. Barring the elasticity of substitution across occupation-specific labor inputs σ, all time-invariant parameters are calibrated at the country level. For the baseline results, I assume $\sigma = 4$ and report the responsiveness of the results by considering other values of σ in the appendix.

The preference parameter β captures the trade-off between consumption and time dedicated in accumulating human capital. I calibrate β to match the Mincerian returns to schooling at the occupation-group level after adding gender controls.

To calibrate the elasticity of human capital η with respect to associated expenditures, I use the share of GDP (adjusted for the share attributed to labor) spent on education. The education expenditure share includes both private and public spending. The World Development Indicators database (World Bank, 2019) contains annual series on the government expenditure on education as a share of GDP for many years since 1970. The average of this series serves as one component of the total education expenditure.[12] The OECD Indicators database (OECD, 2019) comprises some information on the private education spending across countries. However, the data are sparse both in terms of country and time coverage. The only CENAM for which the private education expenditures are available is Costa Rica. Moreover, this data is available only for 2013. The private education spending as a share of GDP stood at 2 percent in 2013 and I use this as a baseline for all countries.[13] Nonetheless, I note that this value is higher relative to many countries in the OECD database and it is likely that the actual values are lower. Finally, I use a labor income share of 0.65 to adjust the education expenditure share for all countries. There is a wide range of estimates of this parameter with many well-known measurement concerns. The chosen value lies within the range of the estimates and near the median and the average across countries and years (Gollin (2002), Guerriero (2019)).

The Fréchet shape parameter governs the skill dispersion and an increase in its value reduces the variability of innate talent. To estimate this parameter, I fit the residuals obtained after regressing the log of hourly wages on occupation-group-dummies to estimate $\theta(1-\eta)$ in an intermediate step. The value of θ is recovered given the estimate of η via the process discussed previously.

The only time-invariant parameters that need calibration are the experience-related returns to human capital γ_c. The parameters γ_0, γ_1, γ_2 relate to the young, middle and old cohorts and I normalize γ_0 to 1. To isolate the experience-related human capital gain for the other cohorts, I target the wage growth of young men over their lifetime after controlling for occupational choices. The average across all occupations serve as the baseline for each country. Table 3 reports the time-invariant parameters for each country. The calibrated values of El Salvador are close to that of Panama. The preferences structure of

[12] Another strategy is to use a long-term average considering data from the mid-1990s onward only. However, this truncated average is very close to the baseline considered here for each country.

[13] The private education share consists of early childhood spending which is approximately 0.2 percent of GDP.

Costa Rica reveals that households in the country put a lower weight on consumption relative to time in school compared to the other two countries. Moreover, the country allocates a higher share of its income on education and realizes lower variability of workers' income together with a higher return to experience.

Table 3: Calibration of time-invariant parameters

		Country		
Parameters	Target	Costa Rica	El Salvador	Panama
β	Mincerian returns	0.175	0.218	0.234
η	Expenditure share of education	0.117	0.085	0.089
θ	Dispersion of hourly wages	6.46	4.71	4.99
$\gamma_y, \gamma_m, \gamma_o$	Wage growth of young men	1, 1.40, 1.90	1, 1.24, 1.42	1, 1.28, 1.33
σ	Arbitrary	3	3	3

4.2 Parameters that vary over time

Remaining parameters of the model vary over time. These parameters also vary across occupations, and often also across gender groups and cohorts. I discuss each set of parameters separately following closely the chronology of actual steps undertaken.

Occupation-specific time elasticity of human capital $\boldsymbol{\phi_{it}}$: The parameter captures the fact that time allotted to human capital accumulation varies across occupations and time. The calibration focuses on the young men who by assumption do not face any obstacles. Using the worker optimization condition, the elasticity is estimated using equation (5) given estimates of η and β from before. The schooling s_{it}^{y} relates to the mean schooling of young men in occupation i in period t.

Taste parameters $\boldsymbol{z_{igt}^{c}}$: The parameters capture preference and social norms that apply to women and men individually. I normalize the parameters so that the preferences for occupations are measured relative to the home sector ($z_{home,gt}^{c} = 1 \; \forall \; g, c, t$). Next, in contrast to Hsieh *et al.* (2019), I assume the preference for only agricultural work, and not every occupation, equals unity for men ($z_{agr,men,t}^{y} = 1$). Note that preferences of a worker are invariant over time.[14] The first step is to impute average wages in the home sector for young men given average wages in other market occupations. I also assume that women do not face barriers of either sort in the home sector. This allows inferring average wages in home sector for women given data on occupational propensity of both groups. Next, I apply wage equation (8) to back out taste parameters of both groups.

Labor market frictions $\boldsymbol{\tau_{igt(w)}^{c}}$ and barriers to human capital accumulation $\boldsymbol{\tau_{igt(h)}^{y}}$: As stated before, I assume that men do not face any barriers $\left(\tau_{i,men,t(w)}^{c} = \tau_{imen,t(h)}^{c} = 0\right)$. The barriers are estimated in two steps. In the first step, the composite barriers are identified using propensity and wage data according to equation (9). Following, the composite is decomposed into the two constituent barriers based on the variation in timing and impact across cohorts which varies for the two barriers. Barriers to human capital accumulation are only faced by young cohorts when they are choosing occupations and the level of

[14] $z_{igt}^{y} = z_{ig,t+1}^{m} = z_{ig,t+2}^{o} \; \forall \; i, g, t.$

schooling. Thus, any variation in wage growth of a cohort across men and women controlling for occupation and human capital differences when young is entirely due to changes in labor marker barriers. Finally, the difference in the timing- and cohort-impact allows for disentangling the change in the two barriers over time. To obtain the levels, I assume an initial split with Cobb-Douglas share of 0.5 on either barrier.[15] As this split is arbitrary, I consider alternative initial splits by loading nearly all composite effect on either barrier in turn to check the sensitivity of the results.

Occupation-specific productivity A_{it}: The only parameters left to be calibrated are the productivity parameters and equilibrium conditions are used to pin them down. For a given set of efficiency wages w_{it} and productivity A_{it}, the labor supply LS_{it} can be computed given the parameters of the model.[16] The following first-order condition from the worker's optimization then yields new set of productivity A_{it}

$$A_{it} = \left(\frac{LS_{it}}{Y_t}\, w_{it}^{\sigma}\right)^{\frac{1}{\sigma-1}}$$

which are used to update labor supply till convergence is achieved.

This concludes the discussion of the calibration strategy. Table 4 summarizes the identifying assumptions and normalization employed in the model calibration. Further details are provided in the appendix.

Table 4: Identifying assumptions and normalizations

Parameter	Definition	Nature of identification	Value
$\tau^{c}_{i,men,t(h)}$	Human capital barriers: men	Assumption	0
$\tau^{c}_{i,men,t(w)}$	Labor market barriers: men	Assumption	0
$\tau^{c}_{home,g,t(h)}$	Human capital barriers: home-sector, men and women	Assumption	0
$\tau^{c}_{home,g,t(w)}$	Labor market barriers: home-sector, men and women	Assumption	0
$z^{y}_{home,g,t}$	Preferences: home-sector, men and women	Normalization	1
$z^{y}_{agr,men,t}$	Preferences: agriculture, men	Assumption	1
α	Initial CD split across barriers, α on labor markets	Assumption	0.5

5 Barriers and preferences

The calibrated model allows for making counterfactual changes on barriers and preferences, and quantitatively evaluate their aggregate impact. However, the analysis also yields a rich set of estimates on barriers and preference which offers insights for policy action. I discuss them before moving on to the counterfactual exercises in the next section.

[15] Specifically, $\left(\tau^{c}_{igt}\right)^{\alpha} = \frac{1}{1-\tau^{c}_{igh(w)}}$ and $\left(\tau^{c}_{igt}\right)^{1-\alpha} = \left(1+\tau^{c}_{igt(h)}\right)^{\eta}$ at $t = 1995$.

[16] The calibration procedure outlined till now also allows for backing out w_{it} from the data. The only set of unknowns are the productivity terms for which a starting guess is required. See further details of the calibration exercise in the appendix.

5.1 Changes in barriers over the last two decades

Recall that there are nine market occupations in addition to the home-sector. Neither men nor women face any barriers in the home-sector. The calibration identifies the levels of two barriers for young cohorts in each occupation across all periods. Thus, it is possible to analyze whether it has become easier for women to participate in the market work because of declining barriers. Specifically, I can check in which of the nine market occupations have these gains been realized and if there are any in which the barriers have increased over time. The model puts no restriction on the barriers other than the assumptions and normalizations pertaining to the home-sector. Therefore, it is possible that the estimated barriers faced by women are negative (or gross barriers being lower than unity). A negative value in an occupation will indicate that instead of being at a disadvantage, women hold an edge over men in that occupation. Figure 2 plots the barriers faced by young women in the labor market (panel (a)) and human capital accumulation (panel (b)). The figures correspond to the gross levels: $\left(\frac{1}{1-\tau^{y}_{ight(w)}}\right)$ and $\left(1+\tau^{y}_{igt(h)}\right)^{\eta}$ for labor market and human capital barriers respectively. The 1995 values of both barriers are normalized to unity for each occupation to facilitate inter-temporal comparison.

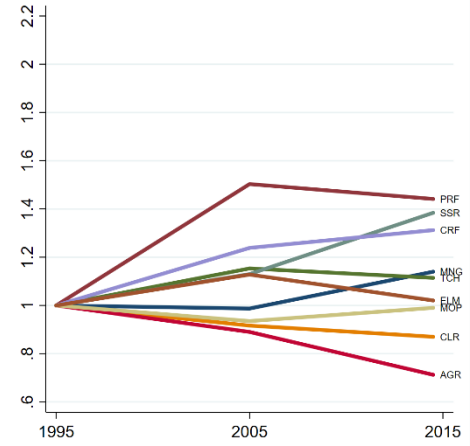
El Salvador is the only economy in which there has been a general decline in labor market discrimination faced by women (figure 2.2(a)). Only three occupations in Costa Rica (figure 2.1(a)) and two in Panama (figure 2.3(a)) recorded a decline in barriers. While none of the education-intensive occupations see a decline in the two countries, two such occupations undergo a weakening of obstacles in El Salvador. Still, the median decline in labor market barriers for the country stands at a meager 2 percent. In contrast, the median occupation in the other two countries register a growth of 12-21 percent.

Unlike barriers in labor markets, the barriers affecting human capital accumulation have gone down more generally across occupations in each of the three countries. Six of the nine occupations in Costa Rica (figure 2.1(b)) and El Salvador (figure 2.2(b)) have undergone a contraction whereas in Panama (figure 2.3(b)) this trend is visible in seven. The decline has also been quantitatively meaningful in many cases. The median occupation in Costa Rica and Panama has seen its gross barrier shrink by 18 and 26 percent respectively. For El Salvador, the median drop in the human capital barrier is close to that in the labor market.

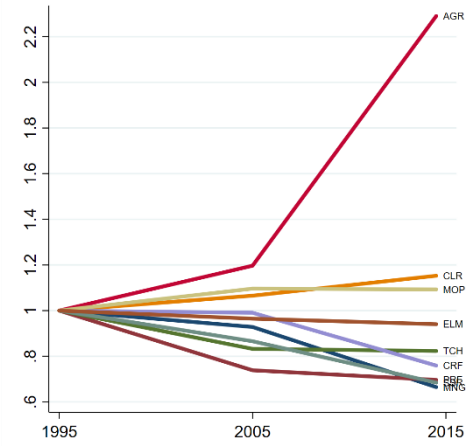
Considering the joint effect of the two barriers reveals that the changes over time have benefitted women in most occupations in each of the three Central American economies. While the composite barriers declined in five occupations in Costa Rica, all but two recorded a drop in the other two countries. All three education-intensive occupations followed the general trend in El Salvador and Panama. The median fall in composite barriers for both countries is close and ranges between 10-12 percent. In contrast, the quantitative joint impact is much lower in Costa Rica where the median contraction was just 0.4 percent.

Figure 2: Gross barriers over time, women (1995=1)[1,2]

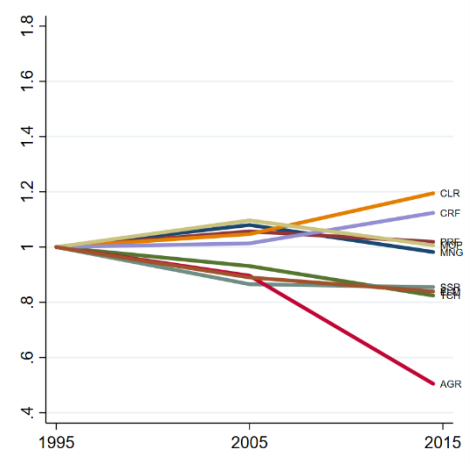
2.1 (a) Labor market: Costa Rica



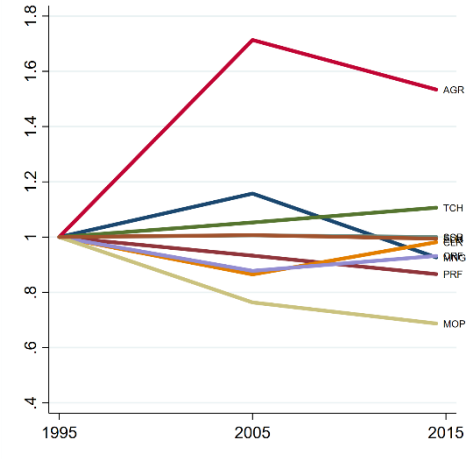
2.1 (b) Human capital accumulation: Costa Rica



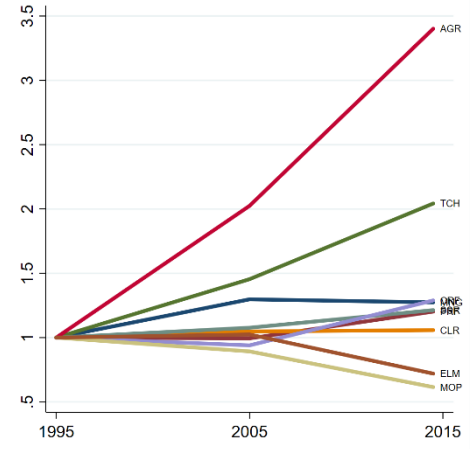
2.2 (a) Labor market: El Salvador



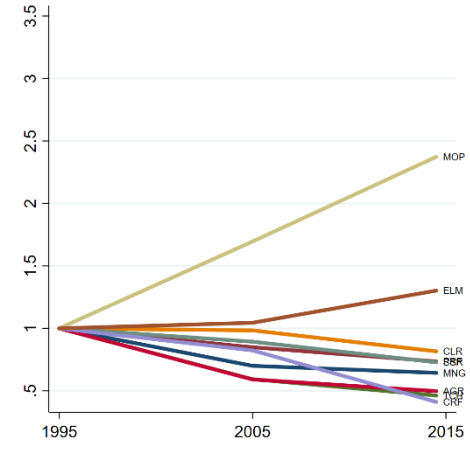
2.2 (b) Human capital accumulation: El Salvador



2.3 (a) Labor market: Panama



2.3 (b) Human capital accumulation: Panama



[1]The above figures show the changes in the gross barriers over the two decades for Costa Rica. Panels (a) and (b) corresponds to the barriers in the labor market $\left(\frac{1}{1-\tau^{c}_{igt(w)}}\right)$ and human capital accumulation $\left(\left(1+\tau^{c}_{igt(h)}\right)^{\eta}\right)$ respectively, with 1995 values normalized to unity. Values above one in 2005 and 2015 imply an increase in barriers faced by women.

[2]MNG: managers, PRF: professionals, TCH: technicians, CLR: clerks, SSR: sales & personal services, AGR: skilled agricultural workers, CRF: craft workers, MOP: machine operators, ELM: elementary occupations.

In summary, women in all three countries are finding it easier to accumulate human capital. Nonetheless, the trends in the labor markets are not as encouraging. The labor market barriers have risen in all three education-intensive occupations in Costa Rica and Panama. Thus, the findings call for reforms that correct for barriers women face post their educational attainment in the market for jobs. The discussion until now focused on the changes in barriers over the last two decades. Moving on, I show where the occupations stand with respect to the level of barriers in 2015.

5.2 Current level of barriers

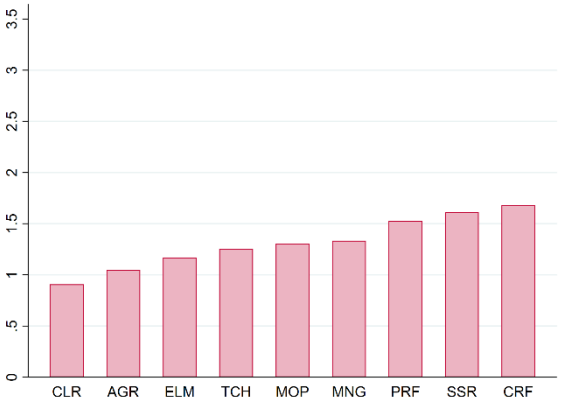
Figure 3 plots the occupation-wise distribution of the gross barriers for the three economies in 2015. Figures (a) and (b) correspond to the gross barriers in labor market $\left(\frac{1}{1-\tau^{y}_{i,women,2015(w)}}\right)$ and human capital accumulation $\left(\left(1+\tau^{y}_{i,women,2015(h)}\right)^{\eta}\right)$ respectively. Recall that the gross barriers are not bounded below by 1 in either case. Thus, an absolute value of less than unity implies that women receive a net subsidy and are an advantageous position relative to men. Like previously, I discuss the current standing of barriers in each country separately.

Wage discrimination against women is prevalent in Costa Rica (figure 3.1(a)) and Panama (figure 3.3(a)). Barring a couple of cases – none of which include any education-intensive professions, the gross labor market barriers are above unity in almost all occupations. El Salvador fares better in this regard (figure 3.2(a)). Women hold an edge over men in five occupations, including two education-intensive occupations of managerial and technical work. The situation reverses when it comes to human capital accumulation. Barring clerical jobs, women face obstacles in obtaining skills to pursue all other occupations in El Salvador (figure 3.2(b)). In contrast, women in Panama receive favorable treatment in all but two occupations (figure 3.3(b)). Costa Rica lies in between the two cases where the barriers act against women in four of the nine market occupations (figure 3.1(b)). Moreover, women hold an advantage over men in all three education-intensive professions in the latter two countries. Women encounter barriers acting against them in all occupations in each country with clerical jobs in Panama coming out as the only exception to this rule.

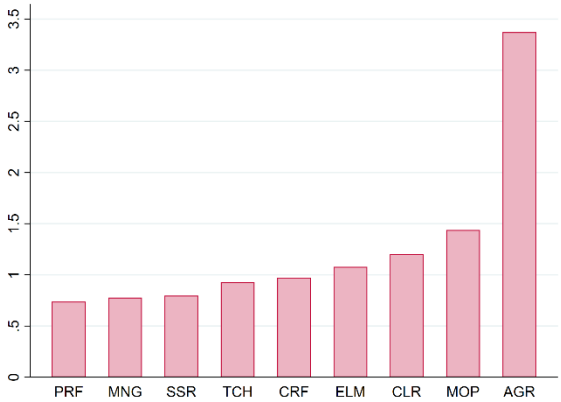
Comparing the prevalence of barriers across countries shows intriguing variations that are relevant for policy. Moving on, I now highlight the disparities in the magnitude of the barriers. Note that both Costa Rica and Panama appear close when considering the labor market barriers. Wage discrimination is prevalent in both countries. Nonetheless, the gross barrier for the median occupation in the latter (1.43) surpasses that of the former (1.30) by 10 percent. Furthermore, the median barrier among the education-intensive occupations transcends the overall median in both countries. Still, the extension is more notable in Panama. In contrast, parity holds across the gender line for the median occupation in El Salvador. Nonetheless, the level of barriers is relatively low even in professions in which women face discrimination with the median gross barrier standing at 1.10 for such occupations.

Figure 3: Current level of barriers[1,2]

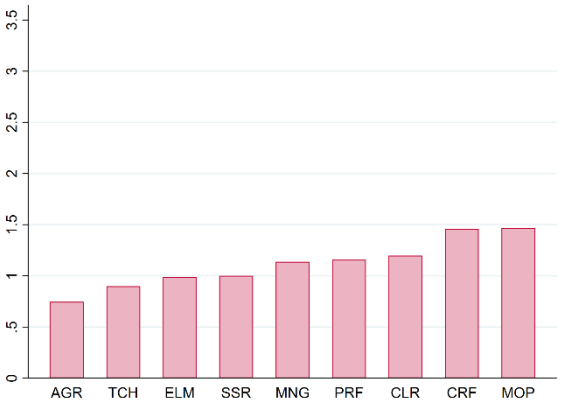
3.1 (a) Labor market: Costa Rica



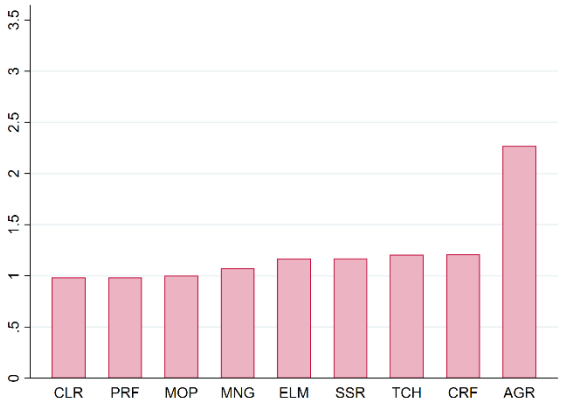
3.1 (b) Human capital accumulation: Costa Rica



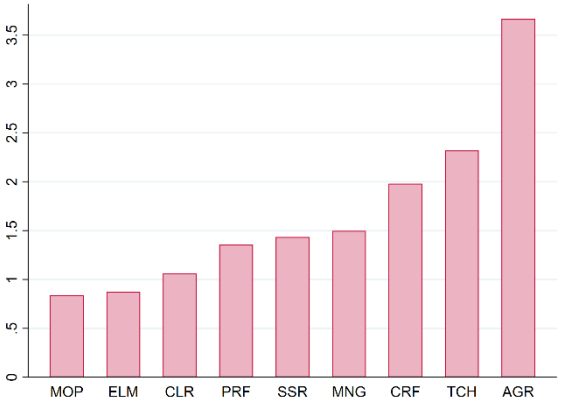
3.2 (a) Labor market: El Salvador



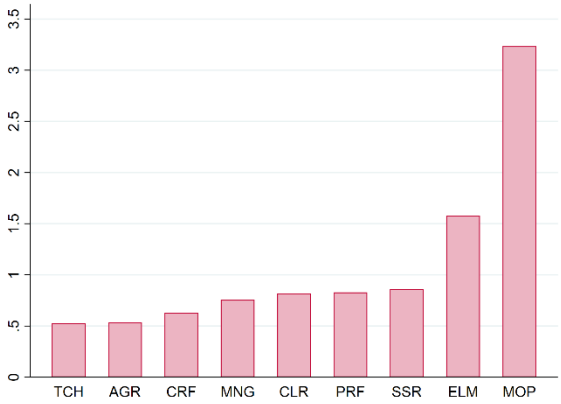
3.2 (b) Human capital accumulation: El Salvador



3.3 (a) Labor market: Panama



3.3 (b) Human capital accumulation: Panama



[1]The above figures show the decomposition of composite barriers faced by women into barriers which operate in the labor markets $\left(\frac{1}{1-\tau^{y}_{iwt(w)}}\right)$ and in the accumulation of human capital $\left(1+\tau^{y}_{iwt(h)}\right)^{\eta}$. Values above unity imply that women are at a disadvantage whereas values below unity indicate a relatively advantageous position for them.

[2]MNG: managers, PRF: professionals, TCH: technicians, CLR: clerks, SSR: sales & personal services, AGR: skilled agricultural workers, CRF: craft workers, MOP: machine operators, ELM: elementary occupations.

The challenges women face in human capital accumulation also vary across countries. In Costa Rica and Panama, an advantage in acquiring skills partially offsets the negative effects of wage discrimination in many occupations. However, the strength of support varies across the two countries. The median occupation lies very close to parity in the former while sitting firmly in favor of women in Panama. However, not only do women in both countries enjoy a favorable situation in all three education-intensive occupations, the variation in the median barrier among such jobs is negligible across the two Central American economies. The prevalence of barriers in El Salvador is not innocuous with the median gross barrier standing at 1.35 for all occupations and at 1.22 for the education-intensive ones.

Table 5: Cross-country comparison of barriers in 2015

	Costa Rica	El Salvador	Panama
	Panel A: Barriers in labor markets		
No. of occupations in which women are at a disadvantage	8	4	7
– of which how many are education-intensive	3	1	3
Median gross barrier			
All occupations	1.30	1.00	1.43
Occupations in which women are at a disadvantage	1.32	1.10	1.50
Education-intensive occupations	1.33	1.00	1.50
	Panel B: Barriers in human capital		
No. of occupations in which women are at a disadvantage	4	8	2
– of which how many are education-intensive	0	3	0
Median gross barrier			
All occupations	0.97	1.35	0.82
Occupations in which women are at a disadvantage	1.32	1.35	2.41
Education-intensive occupations	0.78	1.22	0.76
	Panel C: Composite barriers		
No. of occupations in which women are at a disadvantage	9	9	8
– of which how many are education-intensive	3	3	3
Median gross barrier			
All occupations	1.26	1.18	1.24
Occupations in which women are at a disadvantage	1.26	1.18	1.24
Education-intensive occupations	1.13	1.14	1.13

Finally, consider the composite barriers. As I discussed earlier, there is not much difference in the prevalence of obstacles faced by women across the three countries. The combined effect almost always works against women. However, three notable observations stand out when I consider magnitudes. First,

the quantitative estimates of barriers are not notional with the median estimate lying firmly above unity in each country. Second, the median is relatively lower in El Salvador than in the other two countries, across which it varies little. Third, the median barrier among the three education-intensive occupations is invariant across the three countries. The above discussion highlights that there are similarities in the incidence of barriers. But more importantly, there are deviations which are crucial for policy. For instance, reforms need to focus more on the labor markets in Costa Rica and Panama whereas El Salvador can benefit from education and training interventions. Table 5 provides a summary of the cross-country comparison of the barriers in 2015.

5.3 Preference for market occupations

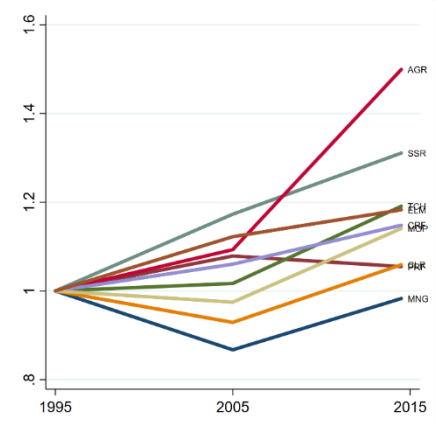
Apart from barriers operating in the labor markets and in human capital accumulation, preferences z_{igt}^{y} also affect occupational choices. The calibration strategy normalizes preference for home-sector to unity and measures preference for market occupations relative to that for the home-sector. Unlike the identification in Hsieh *et al.* (2019), the calibration strategy does not impose $z_{i,men,t}^{y} = 1$ for all non-market occupations. Agriculture is the only market occupation for which I invoke this restriction. Thus, it is possible for men to favor certain occupations over the home-sector, and vice-versa. Moreover, like for women, the identification strategy admits dynamic preferences for men as well. As such, men can also find certain occupations to become relatively more desirable over time. First, let me consider the changes in preferences over time. Figure 4 plots z_{igt}^{y} for women (panel (a)) and men (panel (b)) after normalizing preferences in 1995 to unity to facilitate comparison.

Figure 4.1(a) plots the change in women's preferences in Costa Rica. Women increasingly prefer to work in market occupations compared to working at home. Except for managerial occupations, all categories have seen a relative rise over the last two decades. The median change in $z_{i,women,t}^{y}$ is 15 percent with skilled-agricultural occupations leading the charge. Figure 4.1(b) charts the developments in men preferences. Though the relative preferences have risen for most market occupations, the trend is less general compared to women. Preference to stay in the home-sector has gone up relative to working in three market occupations. Two of these are intensive in human capital. In fact, the sharpest contraction has occurred for professional jobs. The median growth in $z_{i,men,t}^{y}$ nears 5 percent.

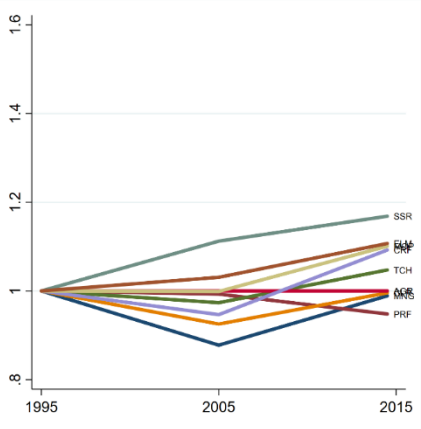
Figure 4.2(a) and 4.2(b) show how the relative preferences of women and men have changed over time in El Salvador. In contrast to Costa Rica (and Panama as I show later), the preferences of both women and men have shifted away from the market occupations towards the home-sector. The swing has been general, and every occupation has become relatively less preferable. This widespread weakening in labor market participation of both genders appears alarming. The median decline in z_{igt}^{y} over the period for both groups is similar and stands at approximately 35 percent. Preference for professional jobs has taken the largest hit for both women and men.

Figure 4: Preferences over time, women and men (1995=1)[1,2]

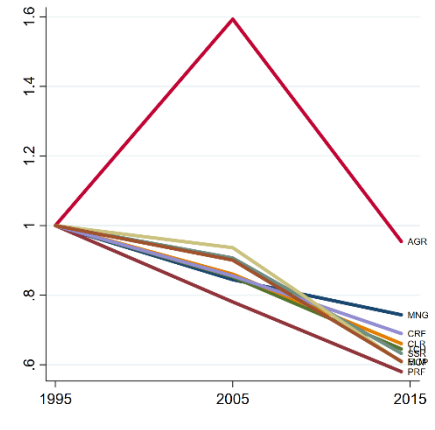
4.1 (a) Women: Costa Rica



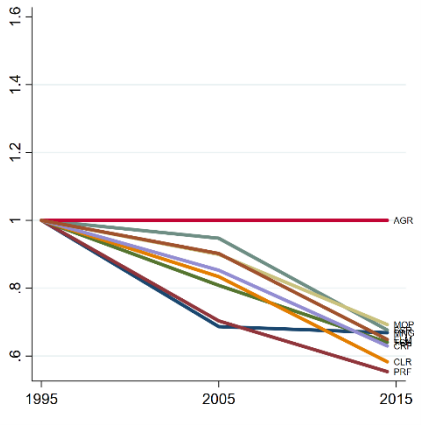
4.1 (b) Men: Costa Rica



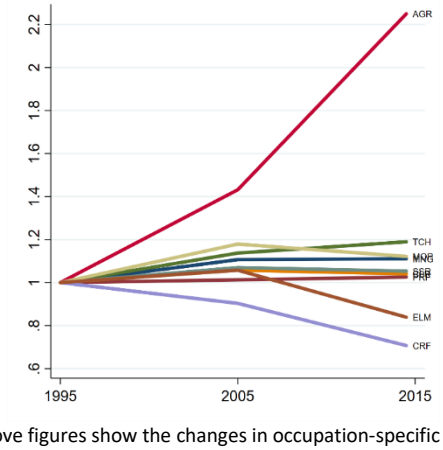
4.2 (a) Women: El Salvador



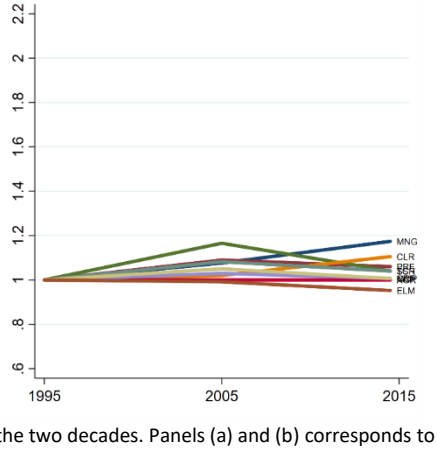
4.2 (b) Men: El Salvador



4.3 (a) Women: Panama



4.3 (b) Men: Panama



[1]The above figures show the changes in occupation-specific preferences z_{igt}^{y} over the two decades. Panels (a) and (b) corresponds to women and men respectively, with 1995 values normalized to unity. Values above one in 2005 and 2015 imply a relatively higher preference for the market occupations. The scales on the vertical axis vary across countries to facilitate inter-temporal comparisons at the country-level.
[2]MNG: managers, PRF: professionals, TCH: technicians, CLR: clerks, SSR: sales & personal services, AGR: skilled agricultural workers, CRF: craft workers, MOP: machine operators, ELM: elementary occupations.

The evolution of women preferences in Panama (figure 4.3(a)) resembles that in Costa Rica in many respects. There is general shift towards market occupations. Barring craft-related and elementary occupations, preference for working in every other market occupation has increased relative to the home sector. More importantly, this shift is recorded in all three education-intensive occupations. However, the largest change has been in skilled-agricultural work. The median change in $z^{y}_{i,women,t}$ is lower compared to Costa Rica and is just over 5 percent. The shift towards working in market occupations has traversed gender lines (figure 4.3(b)). Barring elementary occupations, relative preferences in each market occupation in 2015 are higher than in 1995. The quantitative gains for men are muted compared to those for women. The median change in $z^{y}_{i,men,t}$ is 4 percent with managerial occupations experiencing the most extensive gains.

To summarize, I find that preferences have shifted towards working in market occupations in Costa Rica and Panama. This transformation applies to both genders, though the spread is a bit restricted for Costa Rican men. In sharp contrast, both men and women are finding it less appealing to work in market occupations in El Salvador with the quantitative decline in preferences being considerable too. Next, I show where the relative preferences stand in 2015.

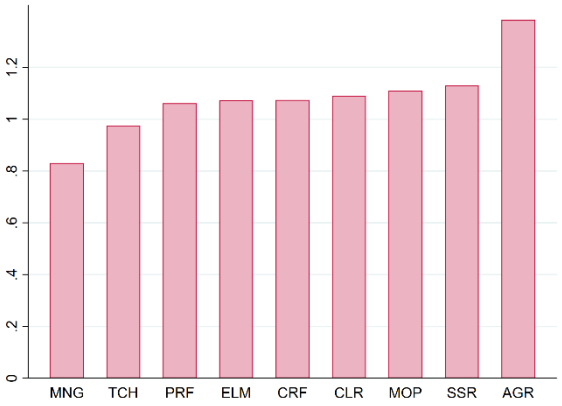
Figure 5 plots the estimates z^{y}_{igt} in 2015 for both women (panel (a)) and men (panel (b)) in the three Central American economies. A value greater than unity for an occupation indicates is preference over the home-sector. To reiterate, I assume that men are indifferent towards working in skilled-agriculture compared to working in the home-sector.

As seen earlier, preferences have moved towards the market occupations in Costa Rica (figure 5.1). The shift has been more widespread for women. Figure 5.1(a) further shows that not only have women's preferences moved away from the home-sector, they prefer working in seven occupations relative to working at home on an absolute basis as well. Skilled-agricultural work is the most preferred occupation. The preference standing does not extend to education-intensive occupations. Somewhat surprisingly, working in the home-sector is still favored relative to taking managerial and technician positions. Men prefer every market occupation to skilled-agricultural work implying they also favor them to working in the home-sector (figure 5.1(b)). The median $z^{y}_{i,men,2015}$ stands at 1.15 with clerical and elementary occupations being the most preferred. Surprisingly, managerial and technical jobs are among the least preferred jobs.

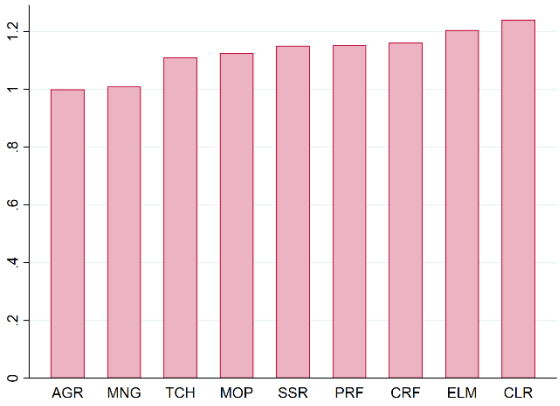
In a break from the general trend, both women and men are increasingly finding it preferable to work in the home-sector compared to other occupations over time in El Salvador. Figure 5.2(a) and 5.2(b) indicate that every market occupation is less preferred than the home-sector in 2015. The median $z^{y}_{ig,2015}$ for women is 0.77 while being closer to parity at 0.95 for men. The median among the education-intensive occupations is closer to the overall median for both women and men. Nonetheless, both groups absolutely prefer any occupation over managerial jobs.

Figure 5: Preference for market occupations in 2015[1,2]

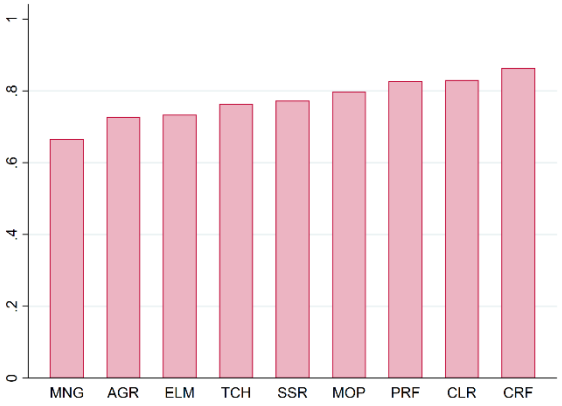
5.1 (a) Women: Costa Rica



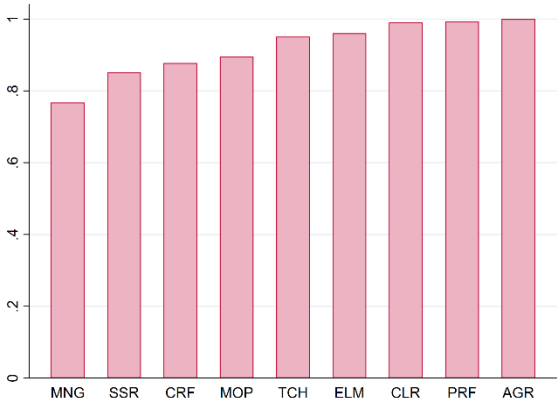
5.1 (b) Men: Costa Rica



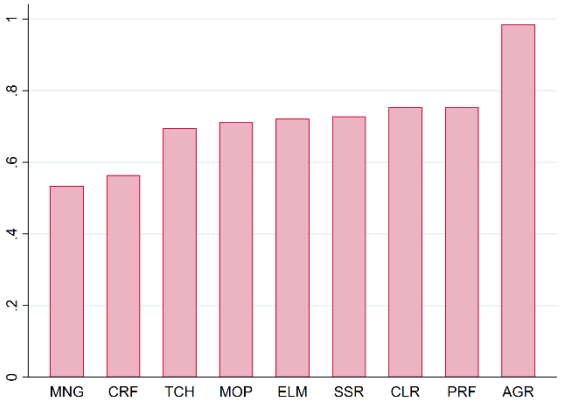
5.2 (a) Women: El Salvador



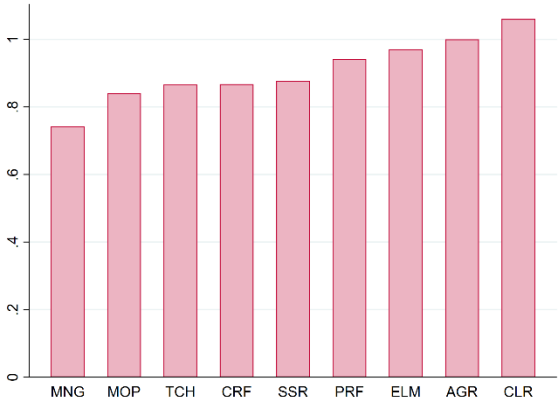
5.2 (b) Men: El Salvador



5.3 (a) Women: Panama



5.3 (b) Men: Panama



[1]Values above unity indicate occupations that are preferred to the home sector.
[2]MNG: managers, PRF: professionals, TCH: technicians, CLR: clerks, SSR: sales & personal services, AGR: skilled agricultural workers, CRF: craft workers, MOP: machine operators, ELM: elementary occupations.

Despite the shift in preferences towards the market occupations in Panama, the home-sector remains the occupation of choice for women in 2015 (figure 5.3(a)). The median $z^{y}_{i,women,2015}$ in Panama is even lower than in El Salvador and stands at 0.72. Managerial and technical jobs are among the three least preferred occupations. The situation is not very different for men. Barring clerical positions, men prefer home-sector work over all other occupations (figure 5.3(b)). Like women, men find managerial and technical trades to be particularly less preferable. The median $z^{y}_{i,men,2015}$ in Panama is 0.88 which is lower than in El Salvador. However, the country might move closer in the future if the individual time trends in preferences hold.

This concludes the discussion on the quantitative aspects of barriers and preferences. In the next section, I quantify the aggregate impact of these exogenous variables in a series of counterfactual experiments.

6 Aggregate implications of barriers and preferences

The calibrated model allows quantifying the effect of barriers and preferences on aggregate output. This section presents the counterfactual change in output when I replace the present exogenous conditions with those in 1995 and 2005.[17]

There are three points to note here. First, the counterfactuals relate to the labor market barriers faced by all cohorts. Still, it is only the young workers who realize a shock in preferences and barriers to human capital accumulation. Hence, the exercises cause a change in the occupational choices of only young workers. However, this does not mean that the non-young cohorts are immune to counterfactual changes. Changes in labor market barriers $\tau^{c}_{igt(w)}$ in period t affect all cohorts and bear a direct influence on wages (equation (8)). Similarly, changes in τ^{y}_{igt} and z^{y}_{igt} apply only to the young cohort but these changes have general equilibrium effects that have implications for other cohorts. Second, in all the counterfactuals, I keep occupation specific TFPs A_{it} fixed to focus on the effect borne by the barriers and preferences. Finally, I consider only the share of output that is produced in the market occupations so that it maps to real GDP following the method in Hsieh *et al.* (2019).

6.1 Aggregate output and labor earnings

Let me begin by investigating the change in market output when I replace $\tau^{c}_{ig,2015(w)}$, $\tau^{y}_{ig,2015(h)}$ and $z^{y}_{ig,2015}$ with their prior values. A decline in market output will indicate that the changes contributed to economic growth and vice versa.[18] Thus, this exercise assists in answering two vital questions. First, which of the three channels is critical in explaining the aggregate growth over the last two decades? Second, has any channel provided headwinds to economic expansion? If so, how large has been this drag?

[17] The robustness checks on the baseline results are relegated to the appendix.

[18] A more intuitive approach will be to plug the 2015 values of barriers and preferences into a model calibrated to earlier periods. However, calibrating the model for prior periods requires information on wages and occupational data from the pre-1985 years. Unfortunately, the surveys do not go as far back for any country.

Table 6: Counterfactual change in market output and labor earnings: Using barriers and preferences from 1995, 2005

	Labor market only		Human capital only		Preferences only		All		Data	
	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Market output, relative to 2015										
Costa Rica	1.468	1.008	0.587	0.798	0.981	1.064	0.689	0.855	0.584	0.700
El Salvador	1.013	1.001	0.971	1.017	1.074	1.034	1.038	1.067	0.522	0.762
Panama	2.999	1.754	0.146	0.298	0.718	0.819	0.149	0.385	0.354	0.575
Panel B: Labor earnings, relative to 2015										
Costa Rica	1.445	1.007	0.599	0.804	0.988	1.065	0.703	0.863	0.139	0.424
El Salvador	1.014	1.001	0.973	1.016	1.050	1.017	1.019	1.047	0.659	0.886
Panama	2.987	1.750	0.148	0.300	0.719	0.819	0.151	0.386	0.494	0.576

Panel A of table 6 reports the results of the exercise. Columns (1)-(8) report the counterfactual market output relative to the baseline calibrated value as I make exogenous changes in $\tau^{c}_{ig,2015(w)}$, $\tau^{y}_{ig,2015(h)}$ and $z^{y}_{ig,2015}$. In columns (1)-(6), I make changes in one set of parameters while keeping the others fixed at the 2015 levels. For example, columns (1) and (2) corresponds to changes when I replace $\tau^{c}_{ig,2015(w)}$ with $\tau^{c}_{ig,1995(w)}$ and $\tau^{c}_{ig,2005(w)}$ respectively. Columns (7) and (8) report the changes when I replace both barriers and preferences jointly. To gauge how large these variations are, I report the relative real GDP per capita in 1995 and 2005 in columns (9) and (10) respectively.

All figures in columns (1) and (2) exceed unity. Hence, changes in labor market discrimination have dragged economic expansion in all the economies. The impact is most pronounced in Panama. Market output increases by 200 and 75 percent when I supplant barriers from 1995 and 2005 respectively. Replacing barriers from 1995 causes output to rise considerably in Costa Rica as well. The counterfactual expansion is expected given the earlier evidence of rising labor market barriers in the two countries (figures 2.1(a) and 2.3(a)). The predicted shift is marginal for El Salvador where the impact from rising discrimination in some occupations is offset by declining barriers in others (figure 2.2(a)).

Columns (3) and (4) report the aggregate effect of changes in human capital barriers. Recall that all the countries were generally successful in reducing these distortions (figure 2, panel (b)). Hence, it is no surprise that the counterfactual output usually diminishes when past barriers replace the present ones. Like in the case of labor market barriers, the channel is quantitatively most influential in Panama. Output contracts by 70-85 percent relative to the present level. Though comparatively much weaker, the channel is quantitatively relevant for Costa Rica too. The aggregate implications for El Salvador are again trivial.

Columns (5) and (6) quantify the impact of the preference channel. The model estimates a net expansionary effect for Panama. Past preferences exert a qualitatively variable influence in Costa Rica. Substituting the preference profile from 1995 indicates a minor economic loss. However, market output expands when I use preferences from a decade ago. Preferences in El Salvador have evolved somewhat peculiarly over the years. Relative to past decades, both women and men find it preferable to work in the home-sector compared to the market occupations (figures 4.2(a) and 4.2(b)). In line with this, I find that the output in 2015 will increase by 7.5 and 3.5 percent if the preferences of the young workers are replaced with the preferences of the old and middle cohorts respectively. Interestingly, the channel is the strongest among the three considered.

Finally, columns (7) and (8) report relative output associated with the collective effect of the three channels. In Costa Rica and Panama, human capital and preference channels are strong enough to offset the impact of the labor market channel. In El Salvador, the impact of lower human capital barriers relative to 1995 is not enough to compensate for the change exerted by the other two channels. In conclusion, if there were no changes in barriers and preferences over the decades, the market output would be lower in Costa Rica (15-31 percent) and Panama (62-85 percent). In contrast, the output would be marginally higher (4-7 percent) in El Salvador.

Columns (9) and (10) provide perspective on whether these effects are notable compared to actual changes in GDP per capita. GDP per capita is not an exact benchmark for model output. The latter is derived using information from labor surveys. Moreover, the lack of data before 1995 does not allow me to solve the model for any period other than 2015. Even so, the change in real GDP per capita can serve as a first yardstick to assess the strength of the three channels. In general, the three channels –

independently and jointly, are relatively consequential. I discuss this in more detail by comparing the changes in real labor earnings. Unlike GDP per capita, real labor earnings in the model match transparently to the data.

The calibration of the model ensures that the labor earnings of all cohorts match the data in 2015. Besides, the earnings of the young in all years and those of the middle cohorts except in 1995 in the model are the same as in the data. Panel B of table 6 reports the relative labor earnings under the various counterfactual scenarios and in the data.

The figures in columns (1)-(8) of panel B are close to those in panel A. However, the actual figures in columns (9) and (10) vary considerably across the two panels highlighting the survey nature of the household data. The discrepancies are particularly substantial for Costa Rica. Like GDP per capita, labor earnings have grown substantially over the decades. Since 1995, the growth ranges from 50 percent in El Salvador to more than 600 percent in Costa Rica. Though smaller, the shift over the last decade is also not trivial.

First, let me consider the joint effect of the three channels. Together they provided support for earnings expansion in two of the three economies. For Costa Rica, this represents 24-35 of the actual increase. The channels are even more active in Panama. The thrust they generate accounts for more than the actual change. In contrast, the changes in barriers and preferences over time have led to a fall in earnings. The negative impact boils down to 6 and 41 percent of the actual change since 1995 and 2005 respectively.

Now, let's look at the channels individually. The findings are in line with the previous discussion. In Costa Rica, the human capital channel overpowers the negative effects generally spawned by the others. The labor market channel generates significant drag on earnings in Panama. However, the other channels more than offset it. The human capital channel is factors more effective than the preference mechanism. With one exception – changes in human capital barriers since 1995, all channels drag earnings down in El Salvador. The relative importance of the channels has evolved. The preference channel dominates the labor market barriers in producing the aggregate drag since 1995. However, the latter has proved innocuous in the last decade while the other two have been equally influential.

To summarize, there are two key insights from the above exercises. First, in general, changes in human capital barriers have aided economic expansion. On the other hand, changes in labor market barriers have cut into these gains. The impact of the preference channel varies across countries and periods. Second, the aggregate effects of the three channels are quantitatively relevant relative to the actual shifts.

6.2 Labor force participation

The model also provides insights on how labor force participation rates (LFPR) respond to exogenous changes in barriers and preferences. Development policy often targets the rates specifically. Table 7 reports the counterfactual changes in the participation rates of young women (panel A) and men (panel B). Recall that the counterfactual exercises can only affect the occupational decisions of the young. All figures are in percentage points (pp) and correspond to changes over the 2015 level. Thus, a positive number indicates an increase over the actual rate.

Table 7: Counterfactual change in labor force participation rate: Using barriers and preferences from 1995, 2005

	Labor market only		Human capital only		Preferences only		All		Data	
	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Labor force participation rate, difference over 2015: women aged 25-34 (pp)										
Costa Rica	15.3	2.4	3.7	2.1	-23.4	-12.1	-15.9	-14.0	-22.8	-10.8
El Salvador	-6.5	-1.2	-0.3	-0.2	38.9	34.1	35.3	32.3	-3.9	0.0
Panama	20.1	7.9	12.1	9.8	5.4	9.7	18.8	17.2	-18.2	-8.5
Panel B: Labor force participation rate, difference over 2015: men aged 25-34 (pp)										
Costa Rica	-2.8	-0.5	2.4	1.5	-0.8	-2.0	1.1	-0.1	1.9	2.2
El Salvador	0.3	0.1	0.2	0.0	7.3	6.3	7.4	6.3	2.7	-0.3
Panama	-2.5	-1.7	2.9	2.4	1.0	1.0	2.7	2.4	-0.8	-0.3

The LFPR rate of young women in the three economies varies over a 6 pp range – from 61 percent in Panama to 55 percent in El Salvador. Columns (7) and (8) show that the LFPR in Costa Rica declines by 14-16 pp when I supplant the present barriers and preferences with their past values. The effect is significant from a historical perspective. Columns (9) and (10) report the actual change over the decades that ranges between 11-23 pp. A quantitatively opposite change materializes in the other two countries. According to the model, the same exercise leads to a 32-35 pp and 17-19 pp expansion in LFPR of El Salvador and Panama respectively. The preference channel is instrumental in driving the aggregate change in Costa Rica and El Salvador. Its effect is also non-trivial in Panama. The dominance of the channel contrasts with the earlier output exercises where it played a secondary role.

The magnitude of change in the LFPR of young men is much smaller. The joint effect of the three channels lifts the rates by 0-1 pp, 6-7 pp, and 2-3 pp in Costa Rica, El Salvador, and Panama respectively. The human capital channel drives the shifts in Costa Rica and Panama. However, like for women, it is the changes in preferences that generate the maximum impact in LFPR of men in El Salvador.

Factors that lead to an increase in the participation of women might reduce that of men. An increase in women's labor supply will cause the wage rate in market occupations to fall relative to that of the home sector. The talent endowment of many men will not be able to support participation under the new wage structure. Hence, men with sufficiently high talents in the home sector will exit the labor force. The results indicate that such general equilibrium effects are offset by changes elsewhere.

6.3 Robustness checks

Recall that the benchmark calibration uses an arbitrary assumption regarding the Cobb-Douglas parameter α that splits the composite barriers $\tau^{c}_{ig,1995}$ equally into its two constituents $\left(\tau^{c}_{ig,1995(w)}, \tau^{c}_{ig,1995(h)}\right)$. I check the sensitivity of the results by considering two extreme values of α. In the first, I assume that almost all the initial weight falls on the human capital barriers and set α to 0.05. Alternatively, I set α to 0.95 which implies that labor markets constitute the bulk of the initial barriers. Table 8 reports the results of the robustness exercise.

Table 8: Counterfactual change in market output: Varying CD split α

	Labor market only		Human capital only		Preferences only		All	
	1995	2005	1995	2005	1995	2005	1995	2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Market output, relative to 2015 ($\alpha = 0.05$)								
Costa Rica	1.399	0.985	0.663	0.850	1.013	1.081	0.772	0.914
El Salvador	1.018	1.009	0.993	1.038	1.046	1.012	1.058	1.080
Panama	2.975	1.644	0.249	0.391	0.651	0.774	0.249	0.491
Panel B: Market output, relative to 2015 ($\alpha = 0.95$)								
Costa Rica	1.524	1.041	0.514	0.736	0.939	1.036	0.598	0.782
El Salvador	1.016	0.971	0.810	0.912	1.161	1.132	0.866	0.997
Panama	2.227	1.781	0.059	0.134	1.163	1.074	0.062	0.158

The exercise helps set bounds on the aggregate effects. Reading results in tables 6 and 8 together allows me to arrive at some general conclusions on a country basis. The aggregate effect of changes in barriers and preferences on output has been expansionary in Costa Rica and Panama. Replacing the present values with those from 1995 and 2005 in the former implies a contraction of 23-40 and 9-20 percent respectively. The analogous figures for Panama stand at 75-94 and 51-84 percent. Shifts in barriers to human capital accumulation drive these economic gains. On the other hand, intertemporal variations in labor market barriers have usually proved a hindrance to growth. The qualitative role of the preference channel is difficult to pin down as it is acutely sensitive to the choice of α.

Taken together, the qualitative effect of the three channels on aggregate output in El Salvador is inconclusive. Moreover, the joint impact is relatively mild compared to Costa Rica and Panama. Still, it is possible to ascertain the role of some individual channels. Over the decades, both women and men are finding it preferable to stay in the home sector rather than working in market occupations. These changes are dragging the economy down. Replacing the present preferences with those in 1995 and 2005 can increase output by 5-16 and 1-13 percent respectively. The analysis also shows that shifts in human capital barriers since 1995 have been growth-enhancing. However, the estimated impact varies over a broad range. Going back to 1995 levels will lead to a compression that can be either trivial (1 percent) or sizable (19 percent).

7 Conclusion

Costa Rica, El Salvador, and Panama have seen considerable economic growth over the last two decades. During the period, there has been a phenomenal shift in the occupational choices of women in these countries. Do these changes imply declines in barriers that women face in labor markets and human capital accumulation? And how important are these trends in explaining the accompanying economic growth? Building on recent literature that ties occupational distribution to the allocation of talent, I find that a better allocation of talent in Costa Rica and Panama provided substantial tailwinds for economic expansion. Conservative estimates suggest that the channel can account for almost half of the actual growth in market output per capita and a quarter of the increase in real labor earnings in Costa Rica. In Panama, the channel is even more potent and explains more than the actual growth in both variables. The aggregate implications are milder in El Salvador. Still, I find that shifts in social norms created a notable drag on growth.

I conclude by making a couple of points that have policy implications and require further consideration. First, the shift in social norms in El Salvador is surprising given the trend in other countries. Why have the preferences to be engaged in the home sector, as opposed to participating in market work, increased in the last two decades? Variation in crime and violence might be one of the factors driving the trend. For instance, the surveys will record men who join gangs as being occupied in the home sector to the extent they are not engaged in any other occupation. The income earned due to criminal activity is likely to go unreported as well. The model will interpret the two outcomes as an increase in preference for the home sector. Additionally, workers of both genders who participate in market occupations may be incrementally more exposed to victimization. If the differential risks do not lead to a loss of wages or

schooling, the model will reconcile them with shifts in preferences. Separation of such effects from traditional sources of change, such as fertility decisions, is essential for policy intervention.

Second, the identification of barriers is only a first step towards successful policy intervention. Removing them in one sphere can have unintended consequences, raising barriers elsewhere. For instance, boys are more prone to victimization due to gang activity in El Salvador. As expected, the educational outcomes of boys improved due to a decline in homicide rates. At the same time, it also led to a decline in attendance rates of girls. This suggests that intra-household allocation of resources that favors boys kicked in raising obstacles for girls, as a result of external barriers for boys going down (Dahbura, 2018). The unintended consequences of policies aimed at reducing barriers can also spill over to unrelated spheres. For example, Chant (2000) reports that the improvements in the labor market outcomes of women in Guanacaste (Costa Rica) are not without their side effects. The ensuing loss of power held by men increased the stress among the family members bound by marital associations. Hence, corrective policies need to be cognizant of a range of inter-related factors and should be carefully implemented.

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Online Appendix

A1. Data

Household surveys are retrieved from the SEDLAC database (CEDLAS and the World Bank, 2019). The data repository covers the period from 1974 to 2015. However, for most countries, the surveys are only available since the 1990s.

To add power to the analysis, I pool data from the adjacent year surveys to the reference years whenever possible. Table A1 lists the mapping of survey years to model year for each country.

Table A1: Surveys constituting model years

Model Year	Survey years included		
	Costa Rica	El Salvador	Panama
1995	1995, 1996	1995, 1996	1995, 1997
2005	2004, 2005, 2006	2004, 2005, 2006	2004, 2005, 2006
2015	2013, 2014, 2015	2013, 2014, 2015	2013, 2014, 2015

The sample selection of workers is discussed in detail in the main paper. For the sample, I extract the following variables from the survey – sex, age, years of schooling, occupation, hours worked and labor income.

Generalities: The occupational taxonomy assigns workers into 10 professions which correspond to the major groups of the International Standard Classification of Occupations, 1988 (ISCO-88) (ILO, 2012). Following Hsieh *et al.* (2019), the workers engaged in armed forces are dropped. Respondents not in the labor force are assumed to be employed in the home sector. Hence, together with the home sector, a worker can choose from a set of 10 occupations. For Costa Rica and Panama, some recoding is needed to map workers to the same occupational taxonomy.

Besides the number of workers in each *cohort-gender-occupation* category, I also need the years of schooling, labor income, and hours worked associated with them. Hours worked in the main occupation are reported weekly in each survey, while income is reported on a monthly basis. Years of schooling and labor income are coded by the SEDLAC. The labor income is deflated using the consumer price index (2011=100). Beyond this general transformation, each country presents its own idiosyncrasies, which are discussed below.

Costa Rica: There are two different surveys available for the country in SEDLAC. For 1990-2009, the repository contains the surveys from *Encuesta de Hogares de Propósitos Múltiples* (NISC, 2009) and from 2010 onward the surveys correspond to *Encuesta Nacional de Hogares* (NISC, 2020). The sampling methodology varies a bit across the two surveys which raises the concern of consistency. However, in practice there are no unusual jumps in the time series of variables around 2010. The yearly change from 2009 to 2010 in the series appears reasonable given the past variations.

Beginning in 2001, the household surveys in Costa Rica adopted the ISCO-88 occupational taxonomy. Before 2001, a national classification was employed. The system was based on the second

revision of the International Standard Classification of Occupations (ISCO-68). To make the classification consistent, I first convert the national classification into the ISCO-68. Following, I remap the ISCO-68 occupations to ISCO-88 following the scheme in Ganzeboom and Treiman (1996). Again, I do not find any unusual kinks in the share of occupations as a result of these transformations.

El Salvador: The country dollarized its economy on January 1, 2001. Hence, labor income in the preceding survey years, was divided by the exchange rate to convert it to dollars.

Panama: From 2011 to 2013 occupations in the national surveys match the major groups of the ISCO-88. For previous years, Panama has its own classification of occupations (NCO-2000). The system follows the ISCO-88 taxonomy and it is straightforward to construct correspondence between the two. The NCO-2000 classification was used from 2001 to 2010. Before 2001, a different classification was in use (NCO-90). The working manual from the National Institute of Statistics and Census (1999) provides the correspondence tables between the NCO-1990 and the NCO-2000 taxonomies. Using these, I harmonize the occupations across the survey years.

A2. Calibration details

Parameters invariant over time: There are seven parameters in the model that are invariant over time. Barring the elasticity of substitution across occupation-specific labor inputs σ, all time-invariant parameters are calibrated for each country separately. For the baseline results, I assume $\sigma = 4$ and report the responsiveness of the results by considering other values of σ.

a. Preference parameter $\boldsymbol{\beta}$: The parameter captures the trade-off between consumption and time dedicated in accumulating human capital. To calibrate the parameter, I match the Mincerian returns to schooling. The first step is to collect ψ_t for year t using the following regression

$$\ln\left(\overline{wage}_{igt}\right) = \alpha_t + \psi_t\, \bar{s}_{igt} + D_g + \epsilon_{igt}$$

where variables under bars represent the average for a group g in any occupation i and D_g are group dummies. The preference parameter is then given by

$$\beta_t = \ln\left(\frac{\dfrac{1 - \bar{s}_{igt} + 0.04}{1 - \bar{s}_{igt} - 0.04}}{6\psi_t}\right)$$

The above relationship is derived from the fact that the return ± 1 year of mean schooling satisfies

$$e^{2\psi_t} = \left(\frac{1 - \bar{s}_{igt} + 0.04}{1 - \bar{s}_{igt} - 0.04}\right)^{\frac{-1}{3\beta_t}}$$

As a worker's lifetime endowment of time is 1 spread over 25 years of that in the data, the model equivalent of 1 year is $\frac{1}{25} = 0.04$. The average estimates of β_t across all years serves as the time-invariant measure used in the quantitative analysis.

b. Elasticity of human capita $\boldsymbol{\eta}$: To calibrate the elasticity of human capital with respect to associated expenditures, I use the share of GDP (adjusted for the share attributed to labor) spent on education. Whenever data availability permits, the education share includes both private and public spending. Specifically,

$$\eta = \frac{share\ of\ GDP\ spent\ on\ education}{labor\ income\ share\ of\ GDP}$$

c. Talent distribution parameter $\boldsymbol{\theta}$: The parameter directs the skill dispersion and an increase in its value reduces the variability. The first step in estimating the parameter is to collect the residuals after regressing the log of hourly wage of a worker on occupation-group-cohort dummies

$$\ln\left(whour_{wigt}^{c}\right) = D_{igc} + \epsilon_{wigct}$$

In the next step, a generalized extreme value distribution (GEV) is fit across the collected residuals. The estimate of GEV parameter ξ equals $\left(\theta(1-\eta)\right)^{-1}$. Given η, the relationship yields the value of the shape parameter θ.

d. Experience-related human capital accumulation $\boldsymbol{\gamma_0, \gamma_1, \gamma_2}$: The human capital of workers increases with experience and middle and old cohorts have higher human capital compared to when they were young. The parameters γ_0, γ_1, γ_2 are related to the young, middle and old cohorts and γ_0 is normalized to 1. To pin down the experience-related human capital gain for the other cohorts, I target the wage growth of the group that faces no frictions in labor markets and in human capital accumulation after controlling for the occupational choice. I consider wage growth of young workers in all later life periods for which data are available and then average across them to arrive at a figure for a country (see more details on the calibration of γ_j in the following pages where I discuss the estimation of taste parameters z_{igt}^{c}).

Parameters that vary over time: Remaining parameters of the model vary over time. These parameters also vary across occupations, and often also across groups and cohorts. Their order below roughly follows the chronology needed to estimate them.

a. Occupation-specific time elasticity of human capital $\boldsymbol{\phi_{it}}$: The parameter captures the effect that time allotted to human capital accumulation varies across occupations and time. Hence, a higher observed schooling intensity in some occupation can be due to its high elasticity. Similarly, an intertemporal shift in elasticity will also lead to shifts in amount of time spent in school. Note that workers make their occupational and schooling choices when young, and their decisions depend only on the elasticity they observe when young. The time elasticity when they are in middle and old cohort is orthogonal to their decision-making. The calibration focuses on the young cohort of the reference group r which does not face any frictions. Using the worker optimization condition, the elasticity is estimated using

$$\phi_{it} = \frac{\bar{s}_{igt}^{y}}{1-\bar{s}_{igt}^{y}} \frac{1-\eta}{3\beta}$$

where $\bar{s}_{igt}^{y}$ is the average years of schooling[19] of the young cohort of reference group r in occupation i in period t.

b. Taste parameters z_{igt}^{c}: The parameters capture preference of certain groups towards some occupations. The preferences for occupations are measured relative to the home sector ($z_{home,gt}^{c} = 1\ \forall\ g, c, t$). Hence, the preference for an occupation by any group is measured relative to the preference of reference group and the preference for home sector. Next, I assume the preference for agricultural work to be unity as well for the reference group r ($z_{agr,rt}^{y} = 1$). Note that preferences of a worker are invariant over time.[20]

Rearranging the average wage equation for the young agricultural workers of the reference group yields

$$m_{rt}^{y} = \left[\frac{\overline{wage}_{agr,rt}^{y}\left(1 - \bar{s}_{agr,rt}^{y}\right)^{\frac{1}{3\beta}}}{\Gamma\bar{\eta}}\frac{\bar{\gamma}}{\gamma_0}\right]^{\theta(1-\eta)}$$

The same equation is used to estimate $\overline{wage}_{home,rt}^{y}$ once the value of m_{rt}^{y} is known.[21] Applying the relative propensity equation for the home sector gives

$$\frac{p_{home,gt}^{y}}{p_{home,rt}^{y}} = \left(\frac{\overline{wage}_{home,gt}^{y}}{\overline{wage}_{home,rt}^{y}}\right)^{-\theta(1-\eta)}$$

as gross frictions in the home sector are set to zero ($\tau_{home,gt}^{c} = 1\ \forall g, t$). This helps in recovering m_{gt}^{y} for non-reference groups g. Given data on average wages and schooling, the taste parameters are identified using

$$z_{igt}^{y} = \frac{1}{1 - \bar{s}_{it}^{y}}\left[\Gamma\bar{\eta}\left(m_{gt}^{y}\right)^{\frac{1}{\theta(1-\eta)}}\frac{\gamma_0}{\bar{\gamma}}\frac{1}{\overline{wage}_{igt}^{y}}\right]^{3\beta}$$

At this point, it is also useful to recover the efficiency wage w_{it} using

$$w_{it} = \frac{\left(p_{irt}^{y} m_{rt}^{y}\right)^{\frac{1}{\theta}}}{\bar{\gamma}\left(\bar{s}_{it}^{y}\right)^{\phi_{it}}\left(\left(1 - \bar{s}_{it}^{y}\right)z_{irt}^{y}\right)^{\frac{1-\eta}{3\beta}}}$$

as it will be used in the estimation of barriers in the next step.

The values of experience-related human capital accumulation parameters γ_1, γ_2 are inputs in the above equation. However, the efficiency wage w_{it} is required to back out the experience parameters and I employ a convergence strategy to isolate the two set of parameters. Specifically, assuming some starting

[19] Adjusted for total number of years. For example, if y_{irt}^{y} is the actual years of mean schooling in the data, then $\bar{s}_{igt}^{y} = \frac{\bar{y}_{igt}^{y}}{25}$.

[20] $z_{igt}^{y} = z_{ig,t+1}^{m} = z_{ig,t+2}^{o}\ \forall\ i, g, t$.

[21] $\bar{\gamma} = \gamma_0 + \gamma_1 + \gamma_2 = 1 + \gamma_1 + \gamma_2$.

value of γ_1 and γ_2, the estimate of w_{it} is obtained. Using this value, the guesses of γ_1, γ_2 are updated using the following relationships

$$\frac{\overline{wage}^{m}_{ir,t+1}}{\overline{wage}^{y}_{irt}} = \frac{\gamma_1}{\gamma_0}\frac{w_{i,t+1}}{w_{it}}\left(\bar{s}^{y}_{it}\right)^{\phi_{i,t+1}-\phi_{it}}$$

$$\frac{\overline{wage}^{o}_{ir,t+2}}{\overline{wage}^{y}_{irt}} = \frac{\gamma_2}{\gamma_0}\frac{w_{i,t+2}}{w_{it}}\left(\bar{s}^{y}_{it}\right)^{\phi_{i,t+2}-\phi_{it}}$$

till convergence is achieved.

c. Labor market frictions $\tau^{c}_{igt(w)}$ and barriers to human capital accumulation $\tau^{y}_{igt(h)}$: The frictions are estimated in two steps. In the first step, the composite frictions are identified using propensity and wage data. Following, the composite frictions are decomposed into the two constituents based on the variation in the timing and cohort impact across the two barriers. Barriers to human capital accumulation are only faced by young cohorts when they are choosing occupations and the level of schooling. Nonetheless, abusing the notation helps in generalizing composite frictions τ^{c}_{igt} which can be expressed as

$$\tau^{c}_{igt} = \frac{\left(1+\tau^{c}_{igt(h)}\right)^{\eta}}{1-\tau^{c}_{igt(w)}}$$

while noting that $\tau^{y}_{igt(h)} = \tau^{m}_{ig,t+1(h)} = \tau^{o}_{ig,t+2(h)}$.

The relative propensity equation applied relative to the reference group r delivers composite frictions for the young cohorts

$$\tau^{y}_{igt} = \left(\frac{p^{y}_{igt}}{p^{y}_{irt}}\right)^{-\frac{1}{\theta}}\left(\frac{\bar{w}^{y}_{igt}}{\bar{w}^{y}_{irt}}\right)^{-(1-\eta)}$$

For the baseline estimation, I choose a Cobb-Douglas separation share of $\alpha = 0.5$ in the initial period t_0. Using the share α, the two barriers in the initial period are given by

$$\tau^{y}_{igt_0(w)} = 1 - \left(\tau^{y}_{igt_0}\right)^{-\alpha}$$

$$\tau^{y}_{igt_0(h)} = \left(\left(\tau^{y}_{igt_0}\right)^{1-\alpha}\right)^{\frac{1}{\eta}} - 1$$

Using the average wage equations for a young cohort in period t_0 and the cohort's equation in the next period when in middle-age and taking the ratio of the latter to the former yields

$$\frac{\overline{wage}^{y}_{ig,t_0+1}}{\overline{wage}^{y}_{igt_0}} = \frac{\gamma_1}{\gamma_0}\frac{w_{i,t_0+1}}{w_{it_0}}\frac{1-\tau^{m}_{ig,t_0+1(w)}}{1-\tau^{y}_{igt_0(w)}}\left(\bar{s}^{y}_{it_0}\right)^{\phi_{i,t_0+1}-\phi_{it_0}}$$

which identifies $\tau^{m}_{ig,t_0+1(w)}$. Note that as all cohorts of any group g in any period t face same labor market frictions, $\tau^{m}_{ig,t+1(w)} = \tau^{y}_{ig,t+1(w)} = \tau^{o}_{ig,t+1(w)}\ \forall\ i, g, t$. Similarly, labor market frictions for future periods can be recovered.

Finally, the barriers to human capital accumulation in any period can be decomposed from the composite frictions once the labor market frictions have been identified.

d. Occupation-specific productivity A_{it}: The only parameters left to be calibrated are the productivity parameters and equilibrium conditions are used to pin them down. Given schooling choice s_{it}^{c}, relative propensities p_{igt}^{y}, frictions $\tau_{ig(t)}^{c}$ and $\tau_{igt(h)}^{c}$, and efficiency wages w_{it}, the average quality of workers is obtained. The average quality then pins down the labor supply LS_{it} in each occupation and starting with some initial guess of productivities, the total output Y_t is determined using the production technology. Once, total output is known, the productivities consistent with firm optimization are given by

$$A_{it} = \left(\frac{LS_{it}}{Y_t}\, w_{it}^{\sigma}\right)^{\frac{1}{\sigma-1}}$$

which are used to update labor supply till convergence is achieved.

A3. Adjustments to the wage data

As mentioned previously, I drop workers who earn less than threshold income and when data permit work fewer than threshold number of weeks. There are two additional model related adjustments that I make to the wage data.

a. Adjusting for changes in LFPR across periods for a cohort: In the model, the LFPR of a cohort is determined when the cohort is young and remains invariant in later stages of life. This is not true in the data. The elasticity of average wage to LFPR in the model is $\frac{1}{\theta(1-\eta)}$ and I use this elasticity to adjust average wages that I use in the quantitative exercises. Thus, the adjusted mean wage $\overline{wage}_{ig,t+1}^{m(adj1)}$ for the middle-aged workers is given by

$$\overline{wage}_{ig,t+1}^{m(adj1)} = \overline{wage}_{ig,t+1}^{m} \left(\frac{LFPR_{g,t+1}^{m}}{LFPR_{gt}^{y}}\right)^{\frac{1}{\theta(1-\eta)}}$$

Similarly, the average wages of workers in the old cohort are also adjusted to reflect changes in LFPR.

b. Adjustment needed to normalize barriers for the reference group to zero: In the estimation steps outlined in appendix A1, there is no condition implicit that forces $\tau_{irt}^{c(w)}$ to be zero. To correct for this, I assume that the wages are observed with some measurement error in each occupation. The adjustment factor $\Omega_{i,t+1}$ is then recovered to move labor market barriers for reference group to zero and is given by

$$\Omega_{i,t+1}^{m} = \left(\frac{\gamma_1}{\gamma_0}\right)\left(\frac{w_{i,t+1}}{w_{it}}\right)\left(\frac{\overline{wage}_{irt}^{y}}{\overline{wage}_{ir,t+1}^{m(adj1)}}\right)\left(\bar{s}_{it}^{y}\right)^{\phi_{i,t+1}-\phi_{it}}$$

and the mean wages that I use for estimation $\overline{wage}_{igt}^{m*}$ is the product of adjusted wage $\overline{wage}_{igt}^{m(adj)}$ obtained previously and the adjustment factor Ω_{it}^{m}.

A4. Proofs of propositions

The proofs of the propositions also appear in the appendix of Hsieh *et al.* (2019). I reproduce them here for reference.

Proposition 1

Conditional on choosing an occupation i, the lifetime utility of a young worker in period t of group g is proportional to $\left(\sum_c \gamma_c \left(\widetilde{w}_{igt}^y \epsilon_i\right)\right)^{\frac{3\beta}{1-\eta}}$, where $\widetilde{w}_{igt}^y = \frac{w_{it}(s_{it}^y)^{\phi_{it}}\left((1-s_{it}^y)z_{igt}^y\right)^{\frac{1-\eta}{3\beta}}}{\tau_{igt}^y}$. Note that the schooling choice s_{it}^y is endogenous and is given by the equation (5). Let U_{igt}^{y*} be the lifetime utility from choosing occupation i, then the propensity of choosing that occupation p_{igt}^y is given by

$$
\begin{aligned}
p_{igt}^y &= \text{Prob}\left(U_{igt}^{y*} \geq U_{jgt}^{y*}\right) \forall j \neq i \\
&= \text{Prob}\left(\widetilde{w}_{igt}^y \epsilon_i \geq \widetilde{w}_{jgt}^y \epsilon_j\right) \forall j \neq i \\
&= \int F_i(\epsilon, \boldsymbol{\epsilon}_{-\boldsymbol{i}}^*) d\epsilon \quad \left(\boldsymbol{\epsilon}_{-\boldsymbol{i}}^* \equiv \left(\left\{\frac{\widetilde{w}_{igt}^y}{\widetilde{w}_{jgt}^y}\epsilon_j\right\}\right) \forall j \neq i, \text{and } F_i \text{ is derivative of the CDF with respect to } \epsilon_i\right)
\end{aligned}
$$

The endowment of innate talent follows Fréchet

$F(\epsilon_1, \dots, \epsilon_I) = \exp\left(\sum_j \epsilon_j^{-\theta}\right)$

Taking derivative of the CDF with respect to ϵ_i and applying the arguments from above yields

$$
F_i(\epsilon, \boldsymbol{\epsilon}_{-\boldsymbol{i}}^*) = \theta \epsilon^{-\theta-1} \exp\left(\bar{\alpha}\epsilon^{-\theta}\right) \qquad \left(\bar{\alpha} \equiv \sum_j \left(\frac{\widetilde{w}_{igt}^y}{\widetilde{w}_{jgt}^y}\right)^{-\theta}\right)
$$

Using this expression in the above equation of p_{igt}^y gives

$$
\begin{aligned}
p_{igt}^y &= \int F_i(\epsilon, \boldsymbol{\epsilon}_{-\boldsymbol{i}}^*) d\epsilon \\
&= \frac{1}{\bar{\alpha}} \int \bar{\alpha}\theta\epsilon^{-\theta-1} \exp\left(\bar{\alpha}\epsilon^{-\theta}\right) d\epsilon \\
&= \frac{1}{\bar{\alpha}} \int dF(\epsilon) \\
&= \frac{1}{\bar{\alpha}} \\
&= \frac{\left(\widetilde{w}_{igt}^y\right)^\theta}{\sum_j \left(\widetilde{w}_{jgt}^y\right)^\theta}
\end{aligned}
$$

Proposition 2

Consider the young workers in period t with innate talent ϵ in occupation i. Conditional of choosing occupation i, the time spent in school s_{igt}^y is given by

$$
s_{igt}^y = \frac{1}{1 + \frac{1-\eta}{3\beta\phi_{it}}}
$$

and the expenditure on human capital goods and services is given by

$$e_{igt}^{y} = \left(\frac{\eta \left(1 - \tau_{igt(w)}^{y}\right) w_{it}\, \bar{\gamma} \left(s_{igt}^{y}\right)^{\phi_{it}} \epsilon}{1 + \tau_{igt(h)}^{y}} \right)^{\frac{1}{1-\eta}} \qquad \left(\bar{\gamma} \equiv \sum_{c} \gamma_c \right)$$

The worker's supply of efficiency units is given by

$$\left(s_{igt}^{y}\right)^{\phi_{it}} \left(e_{igt}^{y}\right)^{\eta} \epsilon = \left(s_{igt}^{y}\right)^{\phi_{it}} \gamma_y \left(\frac{\eta \left(s_{igt}^{y}\right)^{\phi_{it}} w_{it} \left(1 - \tau_{igt(w)}^{y}\right) \bar{\gamma}}{1 + \tau_{igt(h)}^{y}} \right)^{\frac{\eta}{1-\eta}} \epsilon^{\frac{1}{1-\eta}}$$

Then, for any group g, the average supply of efficiency units is

$$E\left[\left(s_{igt}^{y}\right)^{\phi_{it}} \left(e_{igt}^{y}\right)^{\eta} \epsilon \mid \text{choose } i \right] = \left(s_{igt}^{y}\right)^{\phi_{it}} \gamma_y \left(\frac{\eta \left(s_{igt}^{y}\right)^{\phi_{it}} w_{it} \left(1 - \tau_{igt(w)}^{y}\right) \bar{\gamma}}{1 + \tau_{igt(h)}^{y}} \right)^{\frac{\eta}{1-\eta}} E\left[\epsilon^{\frac{1}{1-\eta}} \mid choose\ i \right]$$

The next step involves making use of a property of the Fréchet distribution. Let $y_i = \widetilde{w}_i \epsilon_i$. Then,

$$\begin{aligned}
& y^* \equiv \max_{\mathrm{i}} \{y_i\} = \max_{\mathrm{i}} \{\widetilde{w}_i \epsilon_i\} \\
\Rightarrow\ & \mathrm{Prob}[y^* < z] = \mathrm{Prob}[y_i < z]\ \forall i \\
& \qquad = \mathrm{Prob}\left[\epsilon_i < \frac{z}{\widetilde{w}_i}\right] \forall i \\
& \qquad = F\left(\frac{z}{\widetilde{w}_1}, \dots, \frac{z}{\widetilde{w}_I}\right) \\
& \qquad = \exp\left[-\sum \widetilde{w}_j^{\theta} z^{-\theta}\right]
\end{aligned}$$

From above it follows that the innate ability ϵ^* of a worker who chooses occupation i is also follows the Fréchet distribution:

$$\begin{aligned}
G(x) \equiv \mathrm{Prob}(\epsilon^* < x) &\equiv \exp\left(-\sum_{j} \left(\left(\frac{\widetilde{w}_{jgt}^{y}}{\widetilde{w}_{igt}^{y}} \right)^{\theta} \right) x^{-\theta} \right) \\
&= \exp\left(-\left(\frac{1}{p_{igt}^{y}} \right) x^{-\theta} \right) \qquad \text{(from proposition 1)}
\end{aligned}$$

Let $\lambda \equiv \frac{1}{1-\eta}$. Then,

$$\begin{aligned}
E\left(\epsilon^{*\lambda}\right) &= \int_0^{\infty} \epsilon^{*\lambda}\, dG(\epsilon^*) \\
&= \int_0^{\infty} \theta \left(\frac{1}{p_{igt}^{y}} \right) \epsilon^{*(-\theta-1+\lambda)} \exp\left(-\left(\frac{1}{p_{igt}^{y}} \right) \epsilon^{*-\theta} \right) d\epsilon^* \\
&= \left(\frac{1}{p_{igt}^{y}} \right)^{\frac{\lambda}{\theta}} \int_0^{\infty} x^{-\frac{\lambda}{\theta}} \exp(-x) dx \qquad \left(\text{replacing } x \equiv \left(\frac{1}{p_{igt}^{y}} \right) \epsilon^{*-\theta} \right) \\
&= \left(\frac{1}{p_{igt}^{y}} \right)^{\frac{\lambda}{\theta}} \Gamma\left(1 - \frac{\lambda}{\theta}\right)
\end{aligned}$$

$$= \left(\frac{1}{p_{igt}^{y}}\right)^{\frac{1}{\theta(1-\eta)}} \Gamma\left(1 - \frac{1}{\theta(1-\eta)}\right)$$

Replacing the above in the expression for $E\left[\left(s_{igt}^{y}\right)^{\phi_{it}}\left(e_{igt}^{y}\right)^{\eta}\epsilon \mid \text{choose } i\right]$ yields the expression for average quality of young workers. The average quality of middle and old cohorts is arrived at using the same steps.

Proposition 3

The average wage equation is the product of efficiency wage (adjusted for labor market barriers and returns to experience) and average quality

$\overline{wage}_{igt}^{c} = \left(1 - \tau_{igt(w)}^{c}\right)\gamma_c w_{it} \cdot \kappa_{igt}^{c}$

Replacing the expression of κ_{igt}^{c} from proposition 2 yields the expression for average wage.

A5. Aggregate output and barriers

In this appendix, I use a much simpler version of the model to show that aggregate output is not necessarily at its maximum when the two barriers are set to 0.

Suppose that the economy features only young workers and two occupations ($c \in \{y\}, i \in \{1,2\}$). Additionally, let me make three parameter choices to further cut down on the algebra: 1) $\sigma \to \infty$, 2) $\phi_i = 0$ and 3) $z_{ig} = 1$. I drop the time and cohort subscripts as they are no longer relevant.

Setting σ extremely large makes the production function in equation (10) linear. The first order condition from the firm's optimization implies $w_i = A_i$. Using this in equation (6) gives the equilibrium propensity as a function of occupation-specific productivity A_i and gross barrier τ_{ig}

$$p_{ig} = \frac{\frac{A_i}{\tau_{ig}}}{\sum\left(\frac{A_j}{\tau_{jg}}\right)}$$

Similarly, the average quality of workers κ_{ig} reduces to

$$\kappa_{ig} = \gamma_0 \left[\eta \frac{1 - \tau_{ig(w)}}{1 + \tau_{ig(h)}} w_i \bar{\gamma}\right]^{\bar{\eta}} \Gamma\left(\frac{1}{p_{ig}}\right)^{\frac{1}{\theta(1-\eta)}}$$

Then, the equilibrium output Y_g produced by a group g such that $\sum_g Y_g = Y$ can be defined as following using expressions of p_{ig} and κ_{ig} and noting that their product equals that labor supplied LS_{ig} by group g in occupation i

$$Y_g = \sum_i A_i LS_{ig} = \sum_i \Delta A_i^{1+\bar{\eta}} \left[\frac{A_i \tau_{ig}^{-1}}{\sum_j A_j \tau_{jg}^{-1}}\right]^{\theta_n} \left[\frac{1 - \tau_{ig(w)}}{1 + \tau_{ig(h)}}\right]^{\bar{\eta}}$$

where $\Delta \equiv \gamma_0 \eta^{\bar{\eta}} \Gamma \bar{\gamma}^{\bar{\eta}}$ and $\theta_n \equiv 1 - \frac{1}{\theta(1-\eta)}$. It is possible to show that signs of $dY_g/d\tau_{ig(w)}$ and $dY_g/d\tau_{ig(h)}$ can take positive or negative values at $\tau_{ig(w)} = \tau_{ig(h)} = 0$. Still, consider the case when $\tau_{ih(w)} = 0$ which further simplifies the algebra without losing on the main implication. Setting $\tau_{jg(w)} = 0$ and $A_j = 1\ \forall j$ in above yields

$$Y_g = \Delta \frac{\sum_j \left(1 - \tau_{jg(w)}\right)^{\theta_n + \bar{\eta}}}{\left[\sum_j \left(1 - \tau_{jg(w)}\right)\right]^{\theta_n}}$$

$$\Rightarrow \frac{dY_g}{d\tau_{ig(w)}} = \Delta \left[\sum_j \left(1 - \tau_{jg(w)}\right)^{\theta_n + \bar{\eta}} \left(\frac{\theta_n}{\left(\sum_j \left(1 - \tau_{jh(w)}\right)\right)^{\theta_n - 1}} \right) - \frac{(\theta_n + \bar{\eta})\left(1 - \tau_{ig(w)}\right)^{\theta_n + \overline{\eta+1}}}{\left(\sum_j \left(1 - \tau_{jg(w)}\right)\right)^{\theta_n}} \right]$$

$$\Rightarrow \frac{dY_g}{d\tau_{ig(w)}} \left(\tau_{jg(w)} = 0\ \forall j\right) = \Delta \left(\theta_n - \frac{\theta_n + \bar{\eta}}{J} \right)$$

As $J \to \infty$, $\frac{dY_g}{d\tau_{ig(w)}} \to \Delta\theta_n = \Delta \left(1 - \frac{1}{\theta(1-\eta)}\right)$ which implies that $\frac{dY_g}{d\tau_{ig(w)}} > 0$ if $\theta(1-\eta) > 1$. Hence, output produced by group g increases as they start facing higher barriers. Relatedly, if $\theta(1-\eta) < 1$, giving subsidies will also lead to higher output.

In summary, this simplified case analytically shows that aggregate output is not necessarily maximized when $\tau_{ig(w)} = \tau_{ig(h)} = 0\ \forall i, g$.

A6. Supplementary results

The following tables report results and robustness checks not included in the main paper for brevity.

A6.1 Robustness: Choice of initial Cobb-Douglas split α

Table A2: Counterfactual change in women's LFPR: Using barriers and preferences from 1995, 2005

	Labor market only		Human capital only		Preferences only		All	
	1995	2005	1995	2005	1995	2005	1995	2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Labor force participation rate, difference over 2015: women aged 25-34 (pp) $(\boldsymbol{\alpha = 0.05})$								
Costa Rica	16.7	3.6	4.5	0.8	-24.2	-12.7	-19.0	-16.8
El Salvador	-6.7	-1.4	-0.5	-0.5	39.2	34.4	35.2	32.3
Panama	20.6	9.7	9.4	6.1	8.3	10.8	10.0	11.3
Panel B: Labor force participation rate, difference over 2015: women aged 25-34 (pp) $(\boldsymbol{\alpha = 0.95})$								
Costa Rica	14.2	1.7	0.3	3.1	-22.6	-11.6	-12.3	-11.1
El Salvador	-6.5	-1.0	0.6	0.7	38.4	33.4	36.0	32.4
Panama	20.4	7.4	15.8	17.0	4.4	9.1	32.7	30.8

Table A3: Counterfactual change in men's LFPR: Using barriers and preferences from 1995, 2005

	Labor market only		Human capital only		Preferences only		All	
	1995	2005	1995	2005	1995	2005	1995	2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Labor force participation rate, difference over 2015: women aged 25-34 (pp) $(\boldsymbol{\alpha = 0.05})$								
Costa Rica	-2.7	-0.5	1.7	1.0	-1.0	-2.2	0.4	-0.6
El Salvador	0.2	0.0	0.1	-0.1	7.3	6.4	7.4	6.3
Panama	-2.3	-1.4	2.4	1.6	0.9	1.0	2.2	1.7
Panel B: Labor force participation rate, difference over 2015: women aged 25-34 (pp) $(\boldsymbol{\alpha = 0.95})$								
Costa Rica	-2.9	-0.4	3.3	2.1	-0.5	-1.9	1.7	0.5
El Salvador	0.4	0.2	1.5	0.5	7.2	6.2	7.5	6.3
Panama	-2.4	-1.8	3.3	3.2	1.1	1.0	3.3	3.2

A6.2 Robustness: Choice of elasticity σ

Table A4: Counterfactual change in market output: Varying elasticity σ

	Labor market only		Human capital only		Preferences only		All	
	1995	2005	1995	2005	1995	2005	1995	2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Market output, relative to 2015 $(\sigma = 2)$								
Costa Rica	1.388	1.011	0.604	0.810	0.983	1.049	0.701	0.858
El Salvador	1.012	1.001	0.972	1.014	1.065	1.030	1.031	1.054
Panama	2.602	1.624	0.146	0.328	0.727	0.826	0.150	0.403
Panel B: Market output, relative to 2015 $(\sigma = 4)$								
Costa Rica	1.529	1.006	0.576	0.790	0.980	1.075	0.680	0.852
El Salvador	1.014	1.001	0.970	1.020	1.080	1.037	1.043	1.076
Panama	3.261	1.852	0.147	0.279	0.712	0.814	0.148	0.371

Table A5: Counterfactual change in women's LFPR: Varying elasticity σ

	Labor market only		Human capital only		Preferences only		All	
	1995	2005	1995	2005	1995	2005	1995	2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Labor force participation rate, difference over 2015: women aged 25-34 (pp) $(\sigma = 2)$								
Costa Rica	12.1	1.3	4.8	3.3	-21.1	-10.7	-10.6	-10.6
El Salvador	-6.4	-1.2	-0.2	-0.3	37.7	32.5	33.8	30.4
Panama	13.5	4.9	19.8	15.8	6.4	10.0	30.0	22.6
Panel B: Labor force participation rate, difference over 2015: women aged 25-34 (pp) $(\sigma = 4)$								
Costa Rica	17.6	3.4	3.3	1.3	-24.9	-12.9	-19.2	-16.4
El Salvador	-6.6	-1.3	-0.4	-0.2	39.5	34.9	36.1	33.3
Panama	24.6	10.0	8.4	6.1	5.3	9.7	11.0	13.8

Table A6: Counterfactual change in men's LFPR: Varying elasticity σ

	Labor market only		Human capital only		Preferences only		All	
	1995	2005	1995	2005	1995	2005	1995	2005
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Labor force participation rate, difference over 2015: men aged 25-34 (pp) $(\sigma = 2)$								
Costa Rica	-3.3	-0.5	3.1	1.9	-0.1	-1.5	2.0	0.7
El Salvador	0.4	0.1	0.3	0.0	7.1	6.0	7.2	6.0
Panama	-3.3	-2.2	3.2	2.8	1.6	1.2	3.1	2.7
Panel B: Labor force participation rate, difference over 2015: men aged 25-34 (pp) $(\sigma = 4)$								
Costa Rica	-2.4	-0.4	2.0	1.3	-1.3	-2.4	0.4	-0.6
El Salvador	0.2	0.1	0.2	0.0	7.4	6.5	7.5	6.5
Panama	-2.0	-1.4	2.5	2.1	0.7	0.9	2.4	2.1

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