Barriers to Black Entrepreneurship: Implications for Welfare and Aggregate Output over Time

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Abstract

The number of black-owned businesses in the U.S. has increased dramatically since the 1980s, even compared to the number of non-black-owned businesses and the rise in black labor-market participation. In 1982 less than 4 percent of black labor-market participants owned businesses, compared to over 14 percent of other participants. By 2012 more than 16 percent of black participants owned businesses while the analogous rate for non-black participants increased to only 19 percent. Combined with other evidence, this suggests black entrepreneurs have faced significant barriers to starting and running businesses and these barriers have declined over time. We examine the impact of these trends on aggregate output and welfare. Interpreted through a model of entrepreneurship, declining barriers from 1982 to 2012 led to a permanent 1.4 percent increase in (consumption-equivalent) black welfare, a 0.7 percent increase in output per worker (a small fraction of the observed 70 percent increase), and a 0.5 percent decrease in the welfare of other labor-market participants. These impacts are in addition to any gains from declining labor-market barriers.

Keywords: black, minority, distortions, entrepreneurship, business dynamism, misallocation, aggregate productivity, economic growth.
JEL codes: E02, E1, J7, J15, O1, O4.

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1 Introduction

The number of businesses owned by black men and women in the U.S. has increased dramatically over the last several decades, even compared to the rise in black labor-market participation. In 1982 only 3.5 percent of black labor-market participants owned businesses, compared to 14.5 percent of other participants. By 2012 more than 16 percent of black participants owned businesses while the same rate for non-black participants increased to 19 percent. Although growth in the black entrepreneurship rate varied across sectors, every sector saw an increase – from a small increase in retail to at least a doubling in all other sectors. These numbers, along with a large volume of other evidence, suggest that black entrepreneurs have faced significant barriers to starting and running businesses and these barriers have been declining over time. Standard theories of business dynamics suggest changes in barriers to black entrepreneurship may contribute to growth in aggregate output, as well as to the welfare of black labor-market participants. This paper aims to quantify this contribution.

This paper measures the contribution of the rise of black-owned businesses to welfare and aggregate output. We interpret the data through the lens of a model of entrepreneurship, extending Hopenhayn (1992). In the model both black and non-black labor-market participants are characterized by a distribution of entrepreneurial ability and can choose to start a firm. Output produced by black-owned firms is an imperfect substitute for output produced by other firms, implying that the share of consumer expenditure on output from black-owned firms is higher the lower is the relative price of goods from black-owned firms. At the same time, all firms face decreasing returns to scale in production. New entrepreneurs must incur a cost to start a firm, so they base their entry decision in part on their ability. We introduce four forces into the model that can act to distort outcomes for black relative to non-black participants, each affecting the cost or benefit of doing business. The first is a barrier to starting a firm, which raises the fixed (independent of size) cost of starting and running a business. This fixed cost can be interpreted as the cost of generating an idea for a new product or service, the cost of acquiring permits or licenses for particular markets, or the cost of satisfying other

regulatory requirements. For example the fraction of workers with occupational licenses has increased from 5 to 23 percent since the 1950s (Timmons, 2018). To the extent that this has impacted black more or less than non-black entrepreneurs, this trend would imply an increase or decrease in the relative cost of starting a black-owned firm. If society tends to look down on black entrepreneurs, this could act as a fixed cost of running a business. Costs incurred to hide the race of an owner from potential customers can similarly be interpreted as an additional cost of running a black-owned business. Garrett Morgan, businessman and inventor of several innovative products, including a respiratory device that would ultimately be adopted by fire departments across the country, hired a white actor to pose as inventor-owner in order to overcome the prejudices of white potential customers (Cook, 2012). This worked well until he and his brother used Morgan's respiratory device to enter a collapsed underground tunnel filled with natural gas to help save trapped city workers in Cleveland. After helping to save several lives, the resulting publicity hurt sales as the public became aware that Morgan was black. Jackson (2016) discusses more recent anecdotal evidence of this phenomenon, quoting black owners who hide their identities and attribute a significant fraction of their revenue to customers who would not have otherwise contracted with their firms.

The second force is a differential cost of using capital as an input into production for black and non-black firms, which could most-obviously be driven by a higher cost of obtaining credit and less access to credit. For example Greg Calhoun, eventual grocery store magnate, was turned down for a loan by multiple Alabama banks before traveling to New York and finally securing a business loan in 1984 (Harper, 2018). He went on to create and grow a successful business empire spanning multiple sectors. More broadly, a number of observational studies report lower access to credit for black entrepreneurs, controlling for entrepreneur- and firm-specific characteristics like credit worthiness and firm employment.[1] Studies using 'mystery shoppers' find similar results when otherwise-identical black and white entrepreneurs apply for business loans.[2]

[1]For example Cavalluzzo and Cavalluzzo (1998), Blanchflower et al. (2003), and Asiedu et al. (2012).
[2]See Bone et al. (2014) and Bone et al. (2019) for examples.

The third force we allow for in our analysis is a differential cost of employing workers. For example, a higher cost of financing working capital (as described above) can also raise the effective cost of hiring and paying employees. To the extent that workers have preferences over the identity of their employer, black entrepreneurs might also need to provide more at-work amenities or other benefits to attract workers. Giuliano et al. (2011) for example use matched employee-manager data from a large retail enterprise in the late 1990s and document evidence suggesting that employees (both white and black) are more likely to quit when their manager is replaced with a black manager.

The fourth and final force we consider is consumer discrimination against black entrepreneurs, modeled as lower demand for output from black-owned businesses. Borjas and Bronars (1989), building on the work of Becker (1971), offer evidence of consumer discrimination in the early 1980s. Kawaguchi (2005) documents similar and supporting evidence for the 1990s. To the extent consumer preferences have changed over time, demand for output from black-owned businesses may have increased.

To evaluate how barriers have evolved over time, we use a model of entrepreneurship to interpret trends in entrepreneurship rates, average revenues per firm, average labor productivity per firm, and capital-labor ratios for black and non-black entrepreneurs. We then use the model to estimate several counterfactuals with respect to the evolution of aggregate output and the welfare of black and non-black labor-market participants. Interpreted through the model, observed trends suggest that each of the barriers described above have declined over time. Relative to non-black, startup costs for black entrepreneurs have decreased by 64 percent. The effective tax on labor for black-owned firms has decreased from 31 down to 10 percent, and the effective cost of using capital has declined slightly from 67 to 47 percent relative to the cost for non-black firms. Finally, the demand for output from black-owned firms, our measure of (the inverse of) consumer discrimination, rose slightly by 2.8 percent relative to the demand for output from non-black firms. Together, these changes increased the welfare of working black men and women by 1.4 percent, decreased non-black welfare by 0.5 percent, and increased aggregate output per

worker by 0.7 percent.[3] Further, we find that output per worker in 2012 would be at least 1 percent higher if black entrepreneurs were treated identically to other entrepreneurs, while black welfare would be at least an additional 1.8 percent higher. This suggests the potential for additional gains if barriers continue to decline.

In mapping the model to the data we allow for changes in labor-market discrimination and labor productivity over time. For these measures we borrow from Hsieh et al. (2019), an important related work. Hsieh et al. examine labor-market data for black and non-black workers over time, inferring changes in labor-market discrimination (modeled as taxes on black wages) and barriers to human capital investment, relative to non-black workers.[4] From them we take the effective tax on labor income faced by black labor-market participants, as well as relative labor productivity.[5] By treating each of these variables (along with labor-market participation) as exogenous in the model, we can therefore calculate the impact of barriers to black entrepreneurship *over and above* the impact of labor-market barriers calculated by Hsieh et al. (2019).

A large literature has studied the impact on aggregate output and productivity from policies and institutions that cause resources to be misallocated across firms (Restuccia and Rogerson, 2017). Although some of the mechanisms mapping barriers to aggregate output in this paper are highlighted in the misallocation literature, we depart from much of the literature in considering barriers applied to a specific and exogenously-identified group of potential entrepreneurs. This has important implications for inferring the impact of misallocation from firm-level data. It is standard in the misallocation literature to take the observed distribution of producers as given, and infer the distribution of firm-level distortions from firm-level observations. Doing

[3] Welfare here is calculated as the welfare of labor force participants, treating labor-force participation and and relative wages as exogenous.

[4] Hsieh et al. (2019) also consider the evolution of barriers to women.

[5] Hsieh et al. (2019) calculate effective wage taxes for white women, black women, and black men, each relative to white men. We use their results to obtain an effective tax for all black workers relative to all non-black workers by calculating an average tax by group, weighted by incomes. We infer relative labor productivity by assuming relative wages reflect relative productivity after controlling for the effective tax. In Hsieh et al. (2019), differences in productivity are the result of differences in human capital accumulation, selection into employment, and selection into occupations, all affected by the effective wage tax, barriers to human capital accumulation, and differential returns to human capital across occupations.

this for the U.S. in 1982, one would mistakenly infer that only a small fraction of firms face high barriers. Further, such an analysis would take as given average productivity across producers, which ignores the possibility that barriers to black entrepreneurship discourage relatively high-productivity potential black entrepreneurs from starting firms while encouraging more low-productivity non-black entrepreneurs. An important conclusion from our model is that the change in barriers to black entrepreneurship over time led to an increase in black-owned firms, and that these firms replaced less productive non-black entrepreneurs that would have entered had barriers remained at their 1982 levels. Further, our measures of group-specific distortions are less open to common criticisms of the misallocation literature. Because black/non-black status is a relatively well-defined and exogenous characteristic of business owners, we can more confidently interpret measured distortions as a real feature of the business environment. For example to the extent that average revenue products of variable inputs differ systematically across black vs other entrepreneurs within an industry, controlling for firm and entrepreneur characteristics, we can confidently infer the existence of barriers to production for black entrepreneurs. In the broader misallocation literature, in contrast, observed differences in average revenue products across firms can be interpreted in many ways, some policy relevant (like taxes) and some as features of market structure (like markups dependent on firm size).

To date, research on this topic has mostly been either descriptive, documenting the increase in the absolute number of black-owned businesses, for example Howard (2019); or focused on empirically identifying particular barriers to and determinants of black entrepreneurship, for example Cavalluzzo and Cavalluzzo (1998), Fairlie (1999), Blanchflower et al. (2003), Fairlie and Robb (2007), and Asiedu et al. (2012). Two notable exceptions are Becker (1971) and Borjas and Bronars (1989), who use theoretical models to consider how consumer discrimination can impact black entrepreneurship. They find a preference for goods and services from non-black firms lowers demand for black-owned businesses, resulting in less entrepreneurship and lower entrepreneurial income for black participants. Relative to these studies, we contribute by allowing for additional distortions related to doing business, and by focusing on how these barriers

change over time. This paper is the first (to our knowledge) to examine the quantitative impact of observed trends over time in black entrepreneurship on aggregate output and the welfare of black and non-black participants in the labor market. We argue that to make inferences about the impact of trends in black entrepreneurship on aggregate output and welfare, one must be careful to measure the trends relative to labor force participation and relative to non-black entrepreneurs. In particular, the most informative measures for our purposes are differential rates of entrepreneurship for black and non-black participants, the average size of black- versus non-black-owned businesses, the average revenue product of labor of black- versus non-black-owned businesses, and differential capital-labor ratios. The method we use to infer barriers to entrepreneurship from the data generates four composite measures that are meant to capture the strength of all barriers facing black-owned businesses. Our method has the unfortunate implication that we can not speak to particular observed barriers, but the comprehensive measures we end up with allow us to estimate the impact of all barriers, including those that are unobserved or difficult to quantify.

The theoretical model we use to interpret the data follows that used by Bento (2020) to quantify the impact of observed trends in female entrepreneurship in the U.S., and has similarities with the model developed by Chiplunkar and Goldberg (2021) to infer gender-specific barriers from Indian data. At its root, the model is based on Hopenhayn (1992), but extended to allow for important aspects of firm decisions in the context of black entrepreneurship and black-specific barriers to entrepreneurship. For example Hurst and Pugsley (2011) document that about 54 percent of all new entrepreneurs identify non-monetary reasons for becoming entrepreneurs, a neglected aspect of entrepreneurship in Hopenhayn (1992) and extensions thereof. We compliment their analysis by considering black and non-black entrepreneurs separately, finding that black entrepreneurs are 22 percent more likely to cite non-pecuniary considerations as their primary reason for starting a business.[6] This evidence is consistent with reports from other less-representative surveys, for example Kauffman Foundation (2020), that report black entrepreneurs as more likely to cite flexibility of hours, 'being my own boss', and other non-

[6] Bento (2020) documents similar evidence for female entrepreneurs, relative to male.

monetary reasons as being very important for self-employment decisions. This is therefore a potentially important aspect of black entrepreneurship when estimating the welfare impact of evolving barriers to black-owned firms, so we allow for non-monetary gains to entrepreneurship that differ by group.

Several factors that may have contributed to changes in labor-market participation in recent decades are not explicitly addressed by the model we use to interpret entrepreneurship data. For example, the marriage rate for the black population has fallen faster than that for the white population, while divorce rates (conditional on marriage) have increased faster for the white population. The number of children per household (with children) has fallen faster for black families, while the incarceration rate has increased faster for the white population.[7] An important identifying assumption for the analysis in the present paper is that these factors may have affected labor-market participation rates, but not the decision to become an entrepreneur conditional on choosing to engage in market work. To the extent this assumption is violated, these factors may affect the model's inferred barrier to starting a black-owned business. For example, if lower marriage rates raise the opportunity cost of entrepreneurship (say, because married people have access to a second income and are less averse to risk), then our measured decline in the entry cost for black entrepreneurship may in part be due to lower marriage rates for black labor-market participants, relative to non-black. Relatedly, there is evidence that black-owned businesses tend to hire more black workers than do non-black. Although not explicitly modeled here, this could potentially help explain observed trends in black entrepreneurship.[8] We show that if this difference in employee composition is due to less discrimination by black entrepreneurs, relative to non-black, then our measures underestimate the relative cost of employing workers for black entrepreneurs (the third barrier described above).

The paper proceeds as follows. In the next section, we describe the data and document trends

[7]These statements are based on data from the Current Population Survey and National Prisoner Statistics (U..S Bureau of Justice Statistics). Incarceration statistics are based on State and Federal prisoners.

[8]For example, the Characteristics of Business Owners Survey for 1992 reports that minority workers make up at least half of the employees at almost 80 percent of black-owned businesses (with employees), while only 20 percent of non-black-owned businesses report the same. Unfortunately, surveyed firms in 1992 do not report actual percentages and surveys in other years do not report comparable data.

in black entrepreneurship over time. In Section 3 we describe a model of entrepreneurship that can be used to interpret the data. In Section 4 we infer barriers to black-owned businesses and report how they change over time, and Section 5 uses the model to infer how the evolution of these barriers affected welfare and aggregate output per worker. Section 6 reports the robustness of our results to alternative assumptions, and Section 7 concludes.

2 Black-Owned Businesses 1982 – 2012

We use firm data from the Survey of Business Owners, for census years from 1982 to 2012.[9] Data is available for the number of firms and total revenue, by race and industry, for several revenue-size bins. Employment data is from the Current Population Survey (CPS), by race and industry, and measures the total employed civilian non-institutional population.

Public corporations are not included in the data, and so we ignore them in our analysis, although we emphasize most corporations are not public and are still accounted for in the data. The universe of businesses included in the data changed in 1997, so we make adjustments to earlier data as follows.[10] As part of the 1997 publication, 1992 data is recalculated under the new methodology. For 1992 we therefore use the recalculated data. For earlier years we multiply the reported value of each variable by the adjustment factor implied for the same variable in 1992 (adjusted/reported).

Figure 1a illustrates how the fraction of firms belonging to black men and women changed from 1982 to 2012 across the entire economy. This fraction increased steadily from 2.4 percent in 1982 to 9.5 percent by 2012, a 4-fold increase. These decades also saw an increase in the number of black people in the labor force (from 9 to 11 percent of aggregate employment), which may partially account for the surge in black-owned firms. Figure 1b controls for this, showing how the number of firms relative to the number of people employed (what we call the entrepreneurship

[9]These data are published as 'Survey of Minority-Owned Business Enterprises' (1982-1997), 'Black-Owned Firms' (2002), and available online in digital form from 2007 onwards.

[10]Prior to 1997 Subchapter C corporations were not included.

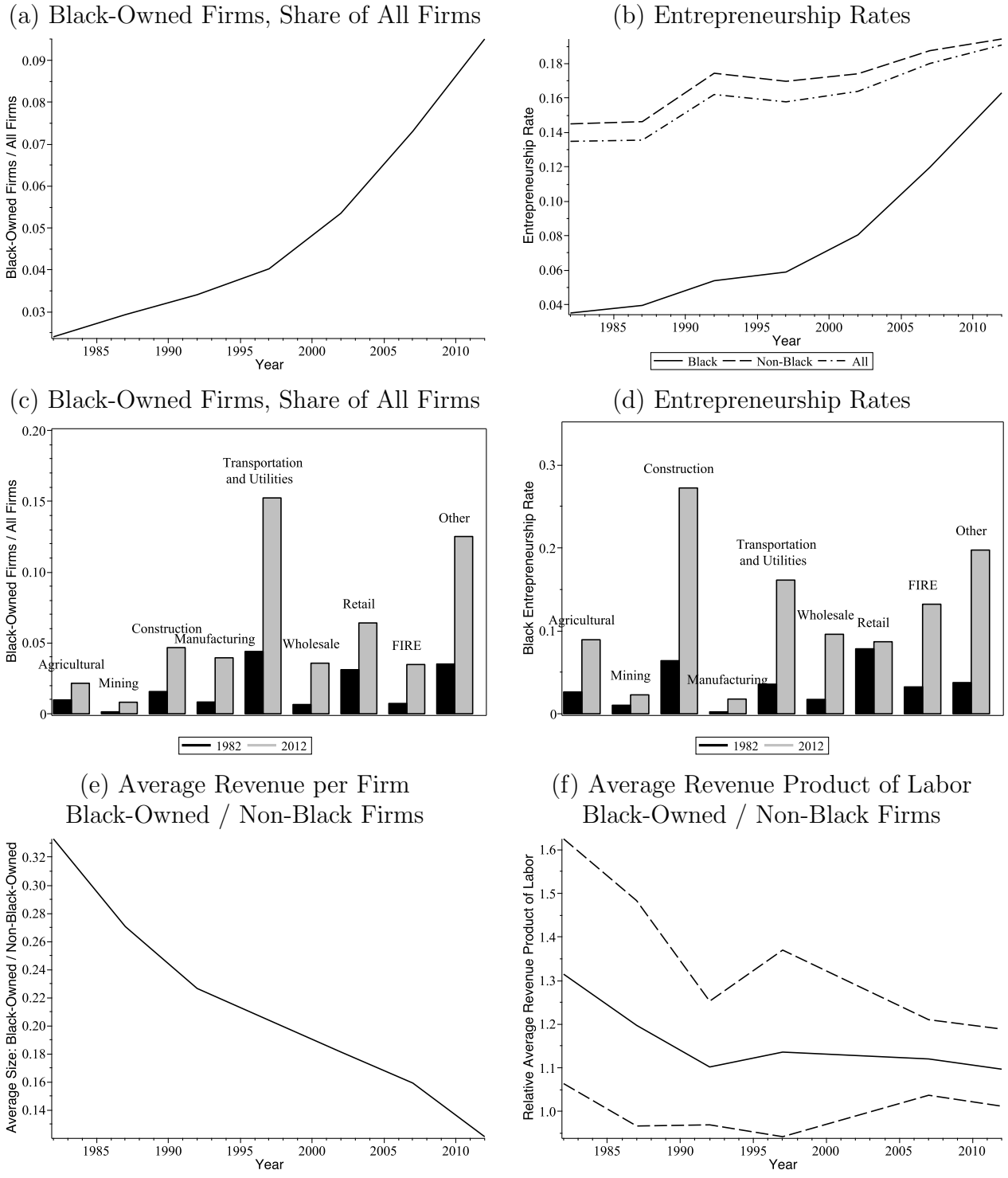
rate) changed over time. These decades saw a dramatic rise in the total number of firms per person (Bento and Restuccia, 2021), and Figure 1b shows that the black entrepreneurship rate contributed to this. The black entrepreneurship rate increased dramatically from 3.5 percent in 1982 to 16.3 percent in 2012, an almost 5-fold increase. The analogous rate for non-black participants increased less, from 14.5 to 19.4 percent. These trends are not merely the result of structural change in the U.S. economy. Figures 1c and 1d show how the black-owned share of firms and the black entrepreneurship rate grew from 1982 to 2012 for nine sectors of the economy (those for which data is available by sector and comparable over time). Note the ninth sector 'other' aggregates all industries not included in the other eight sectors.[11] In every sector, growth in the black-owned share of firms is substantial. And while the black entrepreneurship rate in Retail increased only slightly, in every other sector black entrepreneurship rates increased significantly.

The average revenue size of black-owned firms (relative to non-black) shows a very different trend. While entrepreneurship rates show strong convergence over our sample period, average revenue for black-owned firms dropped from 33 to 12 percent of that for non-black firms, as illustrated in Figure 1e.

Hsieh and Klenow (2009) use a structural model similar to the one we build on to show differential production-based barriers on labor inputs can be inferred by comparing average revenue products across firms. If firms competing within an industry face a common price for variable labor inputs, then profit maximization implies an equalized revenue product of labor across firms. To the extent average revenue products are higher for black-owned firms, we can (under some assumptions) infer that black entrepreneurs face a higher effective 'tax' when hiring labor. One can think of this inferred tax as capturing a higher cost of acquiring short-term credit to finance labor costs due to credit-market discrimination, or the cost of compensating workers

[11]For sector-level data from 1982, we make the same adjustments to the data as for the aggregate data, described above. Note the sectoral measures of black-owned firms in 1982 include large public corporations that are excluded from the aggregate numbers. This should result in only a small discrepancy in the 1982 'share of all firms' numbers in Figure 1a, as the number of large public corporations is insignificant relative to the total number of firms.

Figure 1: Black-Owned Businesses Over Time



Notes: Entrepreneurship Rate calculated as number of firms relative to employed population (by race). 'FIRE' refers to Finance, Insurance, and Real Estate.

who dislike black owners with additional fringe benefits or at-work amenities. To investigate this possibility, we calculate the average revenue product of labor for black- and non-black-owned firms from 1982 to 2012. We then test whether average products differed by race and observe whether this difference changed over time. To control for any differences in the composition of employees across firms, we use the wage bill as a human-capital-weighted measure of employment (Hsieh and Klenow, 2009). The equation we estimate for each year is;

$$\ln(\text{average product})_{r,s,i} = \alpha + \beta_0 \cdot \text{black} + \beta_1 \cdot \ln(\text{size})_{r,s,i} + \epsilon_{r,s,i},$$

where 'average product' is revenue over wage bill for firms in group r in size bin s and industry i *relative to* total output over the wage bill for the same industry i, 'size' is average revenue per firm for the same observation relative to average revenue per firm for industry i, 'black' is a variable equal to 1 for black-owned firms and 0 otherwise, and each observation is weighted by the number of firms represented. Data is reported by size bin, where size is defined as revenue per firm. There are up to 9 revenue ranges in the data, from "less than $ 5,000" to "more than $1 million." It is important to control for size, as data for intermediate inputs are not available and the share of intermediates in revenue is systematically related to firm size. As a result calculated average products are not very meaningful, but differences in average products across firms controlling for size can be used to infer relative production-based barriers. In the 1982-1997 industry-level data, public corporations are included in the 'all firms' counts by industry. We therefore exclude 'all firms' within the largest size bin (revenue over $1 million) for these years. Finally, industry-level data for black-owned firms are not reported by size in 1982. We therefore estimate the difference in average revenue products between 'black-owned' and 'all firms' (still controlling for industry and size), transform this difference into one relating black-owned firms to non-black-owned firms using total numbers of each in 1982, and recalculate standard errors.

Figure 1f reports estimates for the average product of labor for black-owned firms relative to non-black (β_0), with dashed lines representing 95 percent confidence bounds. Data for 2002

by industry and revenue size is not available, so for that year Figure 1f reports the average of 1997 and 2007 estimates. The point estimates suggest black-owned firms faced high barriers to hiring labor in 1982 which dropped significantly by 1992 and stayed relatively constant thereafter. Following Hsieh and Klenow (2009), if these differences in average products are interpreted as reflecting differences in labor costs for different entrepreneurs, then black-owned firms effectively faced a 31 percent higher cost of labor than other firms in 1982.

In addition to differences in entrepreneurship rates and average revenue per firm, it would be useful for our analysis to know whether black-owned businesses grow at different rates after entry. Unfortunately data on the age of businesses by race is only available for 2007 and 2012. But we can at least consider whether black-owned businesses grew faster or slower than comparable non-black businesses from 2007 to 2012. To do this we categorize businesses in both 2007 and 2012 by race, date of birth, and industry. For this analysis we can identify firms born between 1980-1990, between 1990-2000, and between 2000-2007. Further, firms are categorized as belonging to one of twenty NAICS industries. Table 1 reports the resulting coefficients when we regress (logged) average revenue per firm in 2012 on average revenue in 2007, with dummy variables included for industry and race. For the oldest and youngest cohorts, the average growth rates of black- and non-black-owned firms are statistically indistinguishable from each other. For those born between 1990-2000, black-owned firms grew slower than non-black firms, but the point estimate of the difference in growth is only marginally statistically different than zero. Although evidence for our entire sample period would be ideal, we interpret these results as suggesting that any quantitatively important differences between black- and non-black-owned firms are determined at entry and are persistent over the life-cycles of these firms.

It is worth noting that the measures of firm growth by race used in Table 1 are averages conditional on firm survival. Given that Business Dynamics Statistics data (for example) show a clear positive relationship between the size/age of a firm and its annual probability of survival, the relatively small average size of black-owned firms illustrated in Figure 1e suggests they should experience a lower probability of survival on average, relative to other firms. Indeed

Table 1: Firm Growth by Race

dependent variable:	logged average revenue per firm in 2012		
born:	1980-1990	1990-2000	2000-2007
Black	-0.01	-0.55*	-0.07
	(0.19)	(0.31)	(0.17)
Ln(average revenue) in 2007	0.88	1.04	0.77
	(0.24)	(0.27)	(0.07)

Notes: All regressions control for industry. Robust standard errors in parentheses. * represents statistical significance level of 10%.

Fairlie (1999) and others have documented a higher transition rate out of self-employment for black entrepreneurs before the 1990s.[12] Unfortunately our data does not include measures of exit or survival, so we can not properly account for this in our framework. But in Section 6 we discuss how robust our results are to different survival rates. We identify which measures of barriers are likely to absorb any underlying differences in survival rates, and argue that our estimates of the net impacts of barriers over time should be robust to allowing for these differences.

We consider how preferences for entrepreneurship differ between black and non-black labor-market participants by looking at data from the Panel Study of Entrepreneurial Dynamics II (PSED). The PSED data reflects a nationally representative cross-section of individuals who were surveyed in 2005 to identify those who were about to start new firms ('nascent entrepreneurs'). In 2006, those who had actually started firms and generated positive revenue were surveyed about their reasons for starting a firm. Using this data, Hurst and Pugsley (2011) report that of the 602 entrepreneurs surveyed, 53.9 percent cited non-pecuniary reasons for starting their firm.[13] Splitting these respondents by race, we find that 63.2 percent of the 57 black entrepreneurs cited non-pecuniary reasons, compared to only 52 percent of the 534 non-

[12]From 1968-1989, Fairlie (1999) finds the average probability of leaving self-employment is almost doubled for black entrepreneurs.

[13]This result is reported in their Table 9, with percentages weighted by sampling weights. Entrepreneurs were asked, "Why did you want to start this new business?" and were allowed up to two responses in their own words. We thank Erik Hurst and Benjamin Pugsley for making their code and data available.

black entrepreneurs.[14] These numbers suggest that black participants give greater weight to factors like independence and flexibility of hours than non-black, consistent with other evidence such as Kauffman Foundation (2020). As the PSED surveys are replicated over time, we will gain a better understanding of how these preferences might change and how they might depend on other factors.

3 A Model of Entrepreneurship

3.1 Environment

Here we describe the model we use to interpret the trends reported in Section 2 and infer how barriers to black entrepreneurship in the U.S. have changed over time. Consider a one-sector model economy consisting of L_b black and L_{nb} non-black workers, with N_b and N_{nb} of them working as entrepreneurs. Worker productivity is homogenous within population groups, but we allow for differences across groups due to differences in average human capital, and allow for these differences to change (exogenously) over time. We further assume black workers are paid a fraction $1-\tau_W$ of the non-black wage per effective unit of labor w_{nb}. Following Hsieh et al. (2019), we assume τ_W exactly compensates business owners for hiring a black worker, and so they perceive their marginal cost of black labor (per effective unit) to be equal to w_{nb}.[15] L_b and L_{nb} are exogenous, as are levels of human capital.

Although the model economy has only one sector, goods produced by black-owned firms are imperfect substitutes for those produced by non-black-owned firms. We assume a stylized representative final-good firm which produces a final consumption good (also the numéraire) using the output of black- and non-black-owned firms as intermediate inputs according to;

$$Y = \left[\phi Y_b^{\frac{\sigma-1}{\sigma}} + Y_{nb}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

[14] We ignore the small number of observations in the PSED data that are not categorized race.

[15] In reality the presence of τ_W could be due to the preferences of customers or business owners. For simplicity we assume only owners discriminate against workers, and all business owners dislike black employees equally.

where Y_b is total intermediates demanded from black-owned firms, Y_{nb} is the same demanded from other firms, and $\sigma > 1$ is the constant elasticity of substitution between the two types of goods. ϕ is meant to reflect a 'real' difference in demand for the output produced by black-owned firms, relative to non-black, due to a real difference in the types of goods produced by entrepreneurs of each group and not due to any consumer discrimination. We distinguish aggregate output above from 'perceived' aggregate output $\hat{Y}$, which additionally takes into account any further impact on demand from consumer discrimination toward output from black-owned firms:

$$\hat{Y} = \left[(1-\tau_D)\phi \cdot Y_b^{\frac{\sigma-1}{\sigma}} + Y_{nb}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}. \tag{2}$$

τ_D represents consumer discrimination toward output from black-owned firms, effectively a tax on demand. The representative final-good firm takes all prices as given and chooses intermediates to maximize $\hat{Y}$.

Within each group $i \in \{b, nb\}$, firms produce a homogenous good using the following technology;

$$y = (AA_i z)^{1-\gamma}\left(\ell^{1-\alpha}k^{\alpha}\right)^{\gamma}, \quad \gamma \in (0,1),\ \alpha \in (0,1),$$

where k is capital, A is a productivity term common to all firms in the economy, A_i represents the human capital of entrepreneurs in group i, and z is firm-level productivity which is heterogeneous across firms. ℓ represents units of composite labor, and we assume the composition of employment at each firm is constant across firms. As a result, the following two expressions hold for every firm in each period;

$$\ell = A_b^{1-\gamma}\ell^b + A_{nb}^{1-\gamma}\ell^{nb},$$

$$\frac{\ell^b}{\ell^{nb}} = \frac{L_b}{L_{nb}},$$

where $A_i^{1-\gamma}$ again denotes group-specific human capital, and is assumed to affect both labor

productivity and entrepreneurial ability.[16] Producers take output prices P_i and input prices w and r as given. Black-owned firms must pay a proportional tax τ_L on their wage bill. One can think of τ_L as a simple way of capturing a higher cost of acquiring short-term credit to finance labor costs due to credit-market discrimination, or the cost of compensating workers who dislike black owners with additional fringe benefits or at-work amenities. Similarly, black-owned firms must pay a proportional tax τ_K on the rental price of capital. We assume labor and capital markets are otherwise frictionless. Operating profit for an entrepreneur from group i with productivity z is therefore;

$$\pi_i = P_i(AA_iz)^{1-\gamma}\left(\ell^{1-\alpha}k^{\alpha}\right)^{\gamma} - w(1+\tau_L)\ell - r(1+\tau_K)k, \tag{3}$$

where τ_L and τ_K should be understood to apply only to black-owned firms. w represents the total wage per unit of composite labor ℓ, as perceived by business owners.

All workers are potential entrepreneurs, and know their ability (which we assume is their initial productivity at entry) before deciding whether to start a business. Idiosyncratic entrepreneurial ability is denoted by $z_0^{1-\gamma}$, and we assume the distribution of $z_0 \in (1,\infty)$ across the black population is identical to that across the non-black population, described by a Pareto distribution with shape parameter $\xi > 1$. Starting a firm requires an entrepreneur to incur a group-specific entry cost. We specify this cost in terms of the numèraire, but we assume it scales up with the wage.[17] Non-black entrants must incur a cost equal to $w_{nb} \cdot A_{L,nb}^{1-\gamma} \cdot c_{E,nb}$, while black entrants must incur a cost equal to $w_b \cdot A_{L,b}^{1-\gamma} \cdot c_{E,b}$, $c_{E,b} \equiv \hat{c}_{E,b} \cdot (1+\tau_E)$. τ_E is effectively a 'tax' faced by black entrants, representing any barriers or social norms impacting the perceived cost of starting and running a black-owned firm that are fixed in nature. We allow for 'real' differences in entry costs ($\hat{c}_{E,b}$ vs $c_{E,nb}$) due to differences in the types of firms across groups. This last

[16] In Section 6 we discuss how our results change when we assume human capital does not affect entrepreneurial ability.

[17] Having the entry cost scale up with the wage is consistent with Bollard et al. (2016). If the entry cost were a fixed goods cost, then a growing economy would reduce the entry cost relative to firm profits. With exponential economic growth and free entry, the number of firms would explode. Specifying the entry cost in terms of the final good (rather than in terms of labor) simplifies the exposition.

complements our assumptions that black-owned and other firms are imperfect substitutes for each other, and that the difference in demand for output from black-owned firms relative to other firms is in part due to a difference in the type of businesses they run (represented by ϕ). Assuming entry costs depend on group-specific wages captures a lower opportunity cost of entry if black workers earn lower wages.

Entrants start production immediately, and all producers face an exogenous probability of exit each period after production equal to λ. The productivity of every producer grows deterministically by a factor $(1+g)^{1-\gamma}$, conditional on survival. If a firm exits, its entrepreneur is free to start a new firm and again incur an entry cost. We assume entrepreneurs do not use up their labor when running a firm, and so they continue to earn the market wage.[18] To capture the possibility that people have non-pecuniary reasons for becoming entrepreneurs, we assume the preferences of every person in group i attach a weight $X_i \in (0,1)$ to net income from entrepreneurship (including returns to capital purchased with that income), and $1 - X_i$ to other income.

Every person in the economy has linear preferences for consumption (subject to preferences for the source of income and source of consumption), supplies one unit of labor inelastically, and discounts the future using an exogenous interest rate of R. We assume a representative competitive financial intermediation firm borrows capital from the rest of the world, paying the rental rate r, and rents out this capital to entrepreneurs in each period. This intermediary charges $r(1+\tau_K)$ to black-owned firms and r to other firms, but perceives the rate it receives to be equal to r in all cases. Assuming capital depreciates at rate $\delta \in (0,1)$, and given the exogenous interest rate, the rental rate on capital r must be such that the real return on capital investment is equal to the interest rate, $r - \delta = R$. Note that under these assumptions, perceived profits for the financial intermediary are zero. We focus on the steady-state equilibrium of the

[18] One can think of owners of larger firms paying themselves a wage, and owners of very small (low-productivity) firms working part-time for other firms. U.S. data suggests most entrepreneurs (especially those without employees) continue to work for other firms while running their own business. For example in 2017 only about one third of all entrepreneurs identified self-employment as their main occupation according to Current Population Survey data.

economy, in which aggregate variables, prices, the number of black-owned and other firms, the number of black and other entrants, and the cross-sectional distributions of productivity across i-firms are all invariant over time. When we use the model to interpret the data we assume the economy is in a new steady state in each observed period, and so we implicitly assume here that all decision makers always believe they exist in an unchanging economy.[19]

3.2 Production

A producer from group i with productivity z chooses labor to maximize operating profit (3), taking all prices as given. This leads to the following optimal demand for labor, demand for capital, output, and operating profit, all as functions of z;

$$\ell_i(z) = AA_i z \left[\frac{\gamma P_i}{(1+\tau_K)^{\alpha\gamma}(1+\tau_L)^{1-\alpha\gamma}} \left(\frac{1-\alpha}{w}\right)^{1-\alpha\gamma} \left(\frac{\alpha}{r}\right)^{\alpha\gamma} \right]^{\frac{1}{1-\gamma}}, \tag{4}$$

$$k_i(z) = \ell_i(z) \frac{1+\tau_L}{1+\tau_K} \left(\frac{w}{1-\alpha}\right) \left(\frac{\alpha}{r}\right), \tag{5}$$

$$y_i(z) = AA_i z \left[\frac{\gamma P_i}{(1+\tau_K)^{\alpha}(1+\tau_L)^{1-\alpha}} \left(\frac{1-\alpha}{w}\right)^{1-\alpha} \left(\frac{\alpha}{r}\right)^{\alpha} \right]^{\frac{\gamma}{1-\gamma}}, \tag{6}$$

$$\pi_i(z) = (1-\gamma) P_i y_i(z), \tag{7}$$

where r is the rental rate for capital, ℓ_i is units of composite labor demanded by an i-firm, and τ_L and τ_K are again understood to apply only to black-owned firms. Note that the (perceived) composite labor wage as a function of w_{nb} is;

$$w = w_{nb} \left(\frac{A_b^{1-\gamma} L_b + A_{nb}^{1-\gamma} L_{nb}}{L} \right), \tag{8}$$

where $L \equiv L_b + L_{nb}$.

[19] This last assumption follows Hsieh et al. (2019) and simplifies the analysis.

Average Revenue Product of Labor It is immediately clear from (4) and (6) that the average revenue product of labor for a black-owned firm relative to a non-black-owned firm is;

$$\frac{P_b y_b/\ell_b}{P_{nb} y_{nb}/\ell_{nb}} = 1 + \tau_L. \tag{9}$$

Note that average revenue products are independent of productivity z, output prices P_i, and the capital 'tax' τ_K. Interpreting the observed average revenue product ratios over time in Figure 1f using the above expression, we infer that τ_L dropped from 31 percent in 1982 to 10 percent in 2012.

Capital-Labor Ratio It is similarly clear from (4) and (5) that the capital-labor ratio for a black-owned firm relative to a non-black-owned firm is;

$$\frac{k_b/\ell_b}{k_{nb}/\ell_{nb}} = \frac{1+\tau_L}{1+\tau_K}. \tag{10}$$

We note that capital labor ratios are also independent of productivity z and output prices P_i. Fairlie et al. (2020) estimate this ratio, controlling for industry as well as owner and firm characteristics, and report that black-owned startups in 2004 use 39.5% less capital on average than comparable white-owned startups with the same level of employment. Before using equation (10) to infer a value for τ_K, we need to take into account that the data suggests black-owned firms systematically hire more black workers (as a fraction of total employment) than other firms. For 1992 (the only year with this data), black workers were approximately 93% of all workers at black-owned firms and 17% at other firms.[20] Assuming each of these differences hold for 2002, we use the following adjusted equation to calculate τ_K;

$$1 + \tau_K = \left(\frac{1+\tau_L}{0.605}\right) \frac{0.93 \cdot A_b + 0.07 \cdot A_{nb}}{0.17 \cdot A_b + 0.83 \cdot A_{nb}}. \tag{11}$$

[20]Note that without analogous data for other years, we can not account for these differences in labor composition in the model. As a result, we can not account for how changes in other barriers over time could affect differences in labor composition.

Given a calculated value for τ_L of 12.8% in 2002, we infer $\tau_K = 46\%$ in 2002.[21]

3.3 Entrants

The value of starting a firm for a potential entrepreneur from group i with ability z_0 is;[22]

$$V_i(z_0) = \pi_i(z_0) \cdot \left(\frac{1+R}{1+R-(1-\lambda)(1+g)} \right) - w_i A_i^{1-\gamma} c_{E,i}, \tag{12}$$

where τ_E applies only to black entrepreneurs. Free entry then implies a threshold $z^*_{0,i}$ such that potential entrepreneurs in group i start firms if and only if $z_0 \geq z^*_{0,i}$. This threshold for each group is characterized by the following expression;

$$w_i A_i^{1-\gamma} c_{E,i} = \pi_i(z^*_{0,i}) \cdot \left(\frac{1+R}{1+R-(1-\lambda)(1+g)} \right). \tag{13}$$

Note that since black- and non-black-owned businesses exit and grow at the same rates, average productivity across all i-firms as a function of average productivity across i-entrants is;[23]

$$\mathbb{E}_i^{all}(z) = \mathbb{E}_i^{ent}(z_0) \cdot \left(\frac{\lambda}{1-(1-\lambda)(1+g)} \right),$$

where the expectations operator here is used to signify an average. This in turn implies that the average z of black entrants relative to non-black entrants is equal to the average z of all black producers, relative to other producers;

$$\frac{\mathbb{E}_b^{all}(z)}{\mathbb{E}_{nb}^{all}(z)} = \frac{\mathbb{E}_b^{ent}(z)}{\mathbb{E}_{nb}^{ent}(z)} = \frac{\mathbb{E}(z_0 \mid z_0 > z^*_{0,b})}{\mathbb{E}(z_0 \mid z_0 > z^*_{0,nb})} = \frac{z^*_{0,b}}{z^*_{0,nb}}, \tag{14}$$

[21] We do not have analogous measures of capital-labor ratios in other years. We discuss below how we infer τ_K in years other than 2002.

[22] Since X_b applies to entrepreneurial income net of costs and entrepreneurs continue to earn a wage, X_b does not affect decisions. We therefore ignore it here.

[23] WIth a constant number of i-firms in steady state, the fraction of firms that are entrants must be equal to the fraction that exit, λ. With each firm's z growing at rate g, average z across firms is therefore equal to average z_0 multiplied by $\lambda \cdot \left[1 + (1-\lambda)(1+g) + (1-\lambda)^2(1+g)^2 + ...\right]$.

where the Pareto distribution of ability implies $\mathbb{E}(z_0 \mid z_0 > z^*_{0,i}) = z^*_{0,i} \cdot \xi \cdot (\xi - 1)^{-1}$.

Entry Costs Combining equations (6), (7), (13), and (14), the following relationship between the cost of entry for black and non-black entrepreneurs must hold;

$$\frac{w_b A_b^{1-\gamma} c_{E,b}}{w_{nb} A_{nb}^{1-\gamma} c_{E,nb}} = \left(\frac{P_b}{P_{nb}}\right)^{\frac{1}{1-\gamma}} \frac{A_b z^*_{0,b}}{A_{nb} z^*_{0,nb}} \left[(1+\tau_K)^{\alpha}(1+\tau_L)^{1-\alpha}\right]^{\frac{-\gamma}{1-\gamma}} = \frac{\mathbb{E}(P_b y_b)}{\mathbb{E}(P_{nb} y_{nb})}. \tag{15}$$

This expression tells us that relative entry costs (adjusted for differences in wage income) are equal to average revenue per black-owned firm relative to the same for other firms. Equivalently, (adjusted) relative entry costs must be equal to the present value of expected life-time profits for the marginal black entrant ($z_0 = z^*_{0,b}$), relative to the marginal non-black entrant. To see the intuition here, imagine something happens to make black-owned firms more profitable for any given z_0, relative to other firms. If entry costs remain unchanged, this reduces the threshold $z^*_{0,b}$ required to justify entry, encouraging more (less productive) black entrepreneurs to enter and reducing relative average revenue until equation (15) holds once again. A decrease in relative profits in equilibrium therefore implies that the relative opportunity cost of entering for black entrepreneurs must have decreased. Since revenue per firm decreased from 1982 to 2012 for black-owned firms relative to other firms, the opportunity cost of becoming an entrepreneur must similarly have declined for black entrepreneurs relative to others. Data from Hsieh et al. (2019) show a slight increase in average wage income for black workers relative to white workers over this period from 66 to 67 percent. Assuming $\hat{c}_{E,b}/c_{E,nb}$ has remained constant over time, we therefore infer that the entry cost 'tax' for black entrepreneurs $1 + \tau_E$ decreased by 64.3% from 1982 to 2012. Combined, these two trends suggest the relative opportunity cost of entering decreased over the same period by 63.7% percent.

3.4 Final-Good Firm

The final-good firm demands Y_b and Y_{nb} to maximize perceived profit each period, given prices P_b and P_{nb}. This implies the following relationships between the price, total perceived output, and total revenue of black-owned firms relative to those of other firms;

$$P_b = \left(\frac{Y_b}{\hat{Y}}\right)^{-\frac{1}{\sigma}} (1-\tau_D)\phi, \quad P_{nb} = \left(\frac{Y_{nb}}{\hat{Y}}\right)^{-\frac{1}{\sigma}}$$

$$\left(\frac{P_b}{P_{nb}}\right)^{\sigma-1} = \frac{P_{nb}Y_{nb}}{P_bY_b}(1-\tau_D)^\sigma\phi^\sigma = \frac{N_{nb}}{N_b}\cdot\frac{\mathbb{E}(P_{nb}y_{nb})}{\mathbb{E}(P_by_b)}(1-\tau_D)^\sigma\phi^\sigma, \tag{16}$$

where the number of i-firms N_i is equal to the number of people in group i with ability above $z^*_{0,i}$. With a Pareto distribution of ability, this is equal to;

$$N_i = L_i \cdot \left[1 - F(z^*_{0,i})\right] = L_i \cdot (z^*_{0,i})^{-\xi}. \tag{17}$$

Productivity, τ_K, and τ_D Given average revenue per black-owned firm relative to other firms, the numbers of black-owned and other firms, and the numbers of black and non-black labor-market participants, (6) and (16) can be used to back out the relative average firm-level productivity of black-owned firms as a function of τ_L, τ_K, and τ_D;[24]

$$\frac{A_bz^*_{0,b}}{A_{nb}z^*_{0,nb}} = \frac{\mathbb{E}(P_by_b)}{\mathbb{E}(P_{nb}y_{nb})}\cdot\left(\frac{P_{nb}}{P_b}\right)^{\frac{1}{1-\gamma}}\left[(1+\tau_K)^\alpha(1+\tau_L)^{1-\alpha}\right]^{\frac{\gamma}{1-\gamma}}$$

$$= \left(\frac{\mathbb{E}(P_by_b)}{\mathbb{E}(P_{nb}y_{nb})}\right)^{1+\frac{1}{(\sigma-1)(1-\gamma)}}\left(\frac{N_b}{N_{nb}}\right)^{\frac{1}{(\sigma-1)(1-\gamma)}}\left[\mathcal{T}_{KD}(1+\tau_L)^{\gamma(1-\alpha)}\phi^{\frac{\sigma}{1-\sigma}}\right]^{\frac{1}{1-\gamma}}, \tag{18}$$

$$\mathcal{T}_{KD} \equiv \frac{(1+\tau_K)^{\alpha\gamma}}{(1-\tau_D)^{\frac{\sigma}{\sigma-1}}}. \tag{19}$$

Higher revenue per black-owned relative to other firms can be due to higher relative average productivity, higher prices, lower τ_K, and lower τ_L. $\mathcal{T}_{KD}$ is a composite barrier combining τ_K and τ_D. Given relative average revenue, ability, number of firms, τ_L, and τ_K, the above

[24]Note that firm-level productivity is specified as $(A_iz)^{1-\gamma}$. We ignore the exponent here for ease of exposition.

expression can be used to infer τ_D in 2002. The evolution of $\mathcal{T}_{KD}$ relative to its 2002 value can be inferred in a similar way.

3.5 Equilibrium

We now solve for the steady-state equilibrium of the model, allowing us to evaluate the impact of changing barriers on aggregate output and the welfare of both groups. We start by imposing labor market clearing. Using (4) and (15), labor market clearing implies;

$$\hat{L} = AA_b \left[\gamma P_b \left(\frac{1-\alpha}{w(1+\tau_L)} \right)^{1-\alpha\gamma} \left(\frac{\alpha}{r(1+\tau_K)} \right)^{\alpha\gamma} \right]^{\frac{1}{1-\gamma}}$$
$$\cdot \mathbb{E}_b^{all}(z) \left[N_b + N_{nb} \frac{c_{E,nb}(1+\tau_L)}{c_{E,b}(1-\tau_W)(1+\tau_E)} \left(\frac{A_{nb}}{A_b} \right)^{1-\gamma} \right], \tag{20}$$

where average z across all black-owned firms is equal to;

$$\mathbb{E}_b^{all}(z) = z_{0,b}^* \left(\frac{\xi}{\xi - 1} \right) \left(\frac{\lambda}{1-(1-\lambda)(1+g)} \right),$$

and aggregate human capital $\hat{L}$ is defined as;

$$\hat{L} \equiv A_{L,b}^{1-\gamma} L_b + A_{L,nb}^{1-\gamma} L_{nb}.$$

Equation (20) can be solved for the composite wage w. Plugging this w into (13) results in the following relationship between N_b and N_{nb};

$$N_b c_{E,b} \left(\frac{1-\tau_W}{1+\tau_L} \right) A_b^{1-\gamma} + N_{nb} c_{E,nb} A_{nb}^{1-\gamma} = \Psi \cdot \hat{L} \left(\frac{\hat{L}}{L} \right), \tag{21}$$

$$\Psi \equiv \gamma^{-1} \left(\frac{\xi - 1}{\xi} \right) \left(\frac{1-\gamma}{1-\alpha} \right) \left(\frac{1+R}{1+R-(1-\lambda)(1+g)} \right) \left(\frac{1-(1-\lambda)(1+g)}{\lambda} \right).$$

Note that the above equation can also be used to infer the value of $c_{E,nb}$, given N_b, N_{nb}, (15), and values for other exogenous variables and parameters. We make use of this in Section 5. Combining (15), (16), and (17) results in a second expression relating N_b and N_{nb};

$$\frac{N_b}{N_{nb}} = \left(\frac{z^*_{0,b}}{z^*_{0,nb}}\right)^{(\sigma-1)(1-\gamma)} \left(\frac{A_b}{A_{nb}}\right)^{\gamma(\sigma-1)-1} \left(\frac{c_{E,nb}}{c_{E,b}(1-\tau_W)}\right)^{\gamma+\sigma(1-\gamma)} \left[\mathcal{T}_{KD}(1+\tau_L)^{\gamma(1-\alpha)}\phi^{\frac{\sigma}{1-\sigma}}\right]^{1-\sigma},$$

or

$$\left(\frac{N_b}{N_{nb}}\right)^{1+\frac{(\sigma-1)(1-\gamma)}{\xi}} = \left(\frac{L_b}{L_{nb}}\right)^{\frac{(\sigma-1)(1-\gamma)}{\xi}} \left(\frac{A_b}{A_{nb}}\right)^{\gamma(\sigma-1)-1}$$
$$\cdot \left(\frac{c_{E,nb}}{c_{E,b}(1-\tau_W)}\right)^{\gamma+\sigma(1-\gamma)} \left[\mathcal{T}_{KD}(1+\tau_L)^{\gamma(1-\alpha)}\phi^{\frac{\sigma}{1-\sigma}}\right]^{1-\sigma}. \tag{22}$$

Together, (21) and (22) characterize N_b and N_{nb} (or $z^*_{0,b}$ and $z^*_{0,nb}$) as functions of exogenous variables.

The following characterization of aggregate output per worker can be derived using (1), (6), (15), (16), and (20);

$$\frac{Y}{L} = \left(\frac{\hat{L}}{L}\right)^{\frac{\gamma(1-\alpha)}{1-\alpha\gamma}} \left[\frac{(1-\tau_D)^{\frac{\sigma}{\sigma-1}}}{1+\tau_K}\right]^{\frac{\alpha\gamma}{1-\alpha\gamma}} \left[\left(\frac{N_b}{L}\right) A A_b z^*_{0,b} \Psi'\right]^{\frac{1-\gamma}{1-\alpha\gamma}}$$
$$\cdot \frac{\left(1+\frac{N_{nb}c_{E,nb}A^{1-\gamma}_{L,nb}}{N_b c_{E,b}(1-\tau_W)A^{1-\gamma}_{L,b}}\right)^{\frac{\alpha\gamma}{(\sigma-1)(1-\alpha\gamma)}}}{\left(1+\frac{N_{nb}c_{E,nb}(1+\tau_L)A^{1-\gamma}_{L,nb}}{N_b c_{E,b}(1-\tau_W)A^{1-\gamma}_{L,b}}\right)^{\frac{\gamma(1-\alpha)}{1-\alpha\gamma}}} \cdot \left(1+\frac{N_{nb}c_{E,nb}(1-\tau_D)A^{1-\gamma}_{L,nb}}{N_b c_{E,b}(1-\tau_W)A^{1-\gamma}_{L,b}}\right)^{\frac{\sigma}{\sigma-1}}, \tag{23}$$

$$\Psi' \equiv \left(\frac{\alpha\gamma}{r}\right)^{\frac{\alpha\gamma}{1-\gamma}} \left(\frac{\xi}{\xi-1}\right) \left(\frac{\lambda}{1-(1-\lambda)(1+g)}\right) \phi^{\frac{\sigma}{(\sigma-1)(1-\gamma)}}.$$

Perceived output per worker can be derived in a similar fashion;

$$\frac{\hat{Y}}{L} = \frac{Y}{L}\left[(1-\tau_D)\frac{\left(1+\frac{N_{nb}c_{E,nb}A_{L,nb}^{1-\gamma}}{N_b c_{E,b}(1-\tau_W)A_{L,b}^{1-\gamma}}\right)}{\left(1+\frac{N_{nb}c_{E,nb}(1-\tau_D)A_{L,nb}^{1-\gamma}}{N_b c_{E,b}(1-\tau_W)A_{L,b}^{1-\gamma}}\right)}\right]^{\frac{\sigma}{\sigma-1}}. \tag{24}$$

Combining (16) and (20) results in an expression for w relative to output per worker;

$$w = \frac{Y}{L}\left(\frac{L}{\hat{L}}\right)\gamma(1-\alpha)\cdot\frac{(1-\tau_D)^{\frac{\sigma}{\sigma-1}}}{1+\tau_L}$$
$$\cdot\left(1+\frac{N_{nb}c_{E,nb}(1+\tau_L)A_{L,nb}^{1-\gamma}}{N_b c_{E,b}(1-\tau_W)A_{L,b}^{1-\gamma}}\right)\frac{\left(1+\frac{N_{nb}c_{E,nb}A_{L,nb}^{1-\gamma}}{N_b c_{E,b}(1-\tau_W)A_{L,b}^{1-\gamma}}\right)^{\frac{1}{\sigma-1}}}{\left(1+\frac{N_{nb}c_{E,nb}(1-\tau_D)A_{L,nb}^{1-\gamma}}{N_b c_{E,b}(1-\tau_W)A_{L,b}^{1-\gamma}}\right)^{\frac{\sigma}{\sigma-1}}}. \tag{25}$$

The aggregate capital-labor ratio can be characterized using (5), (16), (20), and capital market clearing;

$$\frac{K}{L} = \left(\frac{\hat{L}}{L}\right)\left(\frac{w}{1-\alpha}\right)\left(\frac{\alpha}{r}\right)\left(\frac{1+\tau_L}{1+\tau_K}\right)\left(\frac{N_b c_{E,b}(1-\tau_W)A_{L,b}^{1-\gamma}+N_{nb}c_{E,nb}(1+\tau_K)A_{L,nb}^{1-\gamma}}{N_b c_{E,b}(1-\tau_W)A_{L,b}^{1-\gamma}+N_{nb}c_{E,nb}(1+\tau_L)A_{L,nb}^{1-\gamma}}\right). \tag{26}$$

Our measure of welfare is equivalent to average income by race from work and entrepreneurship, adjusted for differences in preferences for entrepreneurship, preferences for the source of consumption, entrepreneurs' preferences for the race of employees, and the preferences of factor suppliers with respect to entrepreneurs. In particular, we take into account that workers in group i perceive their wage per effective unit of labor to be equal to w_i, financial intermediaries perceive the rental rate they receive for loaned-out capital to be equal to r, and entrepreneurs perceive their cost per unit of (composite) labor to be equal to $(1+\tau_L)w$, again with τ_L applying only to black entrepreneurs. In the cross-section, everyone expects to earn w_i forever, and those choosing to be entrepreneurs expect to start a new firm immediately in the event of exiting in the future. Average welfare for black labor-market participants is therefore;

$$U_b = \frac{\hat{Y}}{Y}\left[(1-X_b)(1-\tau_W)w_{nb}A_b^{1-\gamma}\left(\frac{1+R}{R}\right)\right.$$
$$+X_b\left(\frac{N_b}{L_b}\right)\mathbb{E}[\pi_b(z)]\left(\frac{1+R}{1+R-(1-\lambda)(1+g)}\right)$$
$$+X_b\left(\frac{N_b}{L_b}\right)\mathbb{E}[\pi_b(z_0)]\left(\frac{1+R}{1+R-(1-\lambda)(1+g)}\right)\left(\frac{\lambda}{R}\right)$$
$$\left.-X_b\left(\frac{N_b}{L_b}\right)(1-\tau_W)w_{nb}A_b^{1-\gamma}c_{E,b}\lambda\left(\frac{1+R}{R}\right)\right],$$

where the first line represents labor earnings, the second expected discounted profits from current producers (per person), the third expected discounted profits from future firms, and the last represents current and discounted future expenditure on entry costs. Given the relationships between $\mathbb{E}[z]$, $\mathbb{E}[z_0]$, and $c_{e,b}$, the above collapses to the following simple expression;

$$U_b = \frac{\hat{Y}}{Y}(1-\tau_W)w_{nb}A_b^{1-\gamma}\left[(1-X_b)\left(\frac{1+R}{R}\right)+X_b\left(\frac{N_b}{L_b}\right)\frac{\lambda c_{e,b}}{R(\xi-1)}\right]. \tag{27}$$

Average welfare for non-black labor-market participants can be derived in an analogous way to obtain the following expression;

$$U_{nb} = \frac{\hat{Y}}{Y}w_{nb}A_b^{1-\gamma}\left[(1-X_{nb})\left(\frac{1+R}{R}\right)+X_{nb}\left(\frac{N_{nb}}{L_{nb}}\right)\frac{\lambda c_{e,nb}}{R(\xi-1)}\right]. \tag{28}$$

Given our assumption of linearity in utility (with respect to perceived consumption), a given percentage increase in utility can be straightforwardly interpreted as equivalent to the utility gain from the same permanent percentage increase in actual consumption (keeping constant the fraction of income from each source, the fraction of consumption from each source, etc...).

Comparative Statics We have focused our discussion above on how various barriers to black entrepreneurship can be inferred from the data. We conclude our description of the model by summarizing how these barriers (along with the quantity of labor) affect steady-state outcomes. Equation 21 shows that a proportional decrease in all entry costs, $c_{E,b}$ and $c_{E,nb}$, results in a

proportional increase in black- and non-black-owned firms. Mechanically, this leads to lower average ability across all entrepreneurs. But from (17) and (23), the product of $z^*_{0,i}$ and N_i and therefore aggregate output increase. Relative average productivity and relative average revenue both remain unaffected.

If barriers to starting a black-owned firm (τ_E) decrease, then (21) and (22) show that entry by black-owned firms will increase, while the number of other firms will contract in response to higher wages and lower profits. Now the lower average ability of black entrepreneurs results in lower average revenue for black- relative to non-black-owned firms. Aggregate output increases along with the product of $z^*_{0,i}$ and N_i, but this effect is partially offset by the fall in non-black entrepreneurship. Any decrease in τ_W increases the opportunity cost of starting a firm for black entrepreneurs, and is therefore analogous to an increase in τ_E (except for its effect on welfare).

All else equal, a decrease in τ_L, the effective tax rate on payments to labor in black-owned firms, increases labor demanded, revenue, and profits for a black-owned firm with a given level of productivity. But this encourages entry by black entrepreneurs and discourages entry by other entrepreneurs such that relative average revenue remains unchanged (equations 21 and 22). For a given distribution of firms, a lower τ_L reduces the misallocation of labor, encouraging labor to flow from non-black- to black-owned firms. Aggregate output increases due to both the increase in the number of black-owned firms and the lower level of misallocated labor. A decrease in τ_K propagates similarly through the economy, but with the further effect of encouraging a higher stock of capital and further increasing aggregate output. Lower consumer discrimination, represented by a lower τ_D, directly affects relative prices by increasing the demand for output from black-owned firms. The end result is similar to that from a lower τ_L – a higher black entrepreneurship rate, lower non-black entrepreneurship, and higher aggregate output.

From 1982 to 2012 the number of black labor-market participants increased much faster over time than the number of non-black participants, by 73 compared to 40 percent. In this model, a proportional increase in the quantity of black and other labor increases N_b and N_{nb} in equal proportions (equations 21 and 22). If L_b increases faster than L_{nb}, then the black entrepreneur-

ship rate grows less than the non-black rate. This implies an increase in the relative average ability of black entrepreneurs. Relative average revenue stays constant, however, as the change in relative abilities is exactly offset by a change in relative prices (equations 15 and 16). And since the number of black-owned firms still grows faster than non-black firms, a greater share of aggregate revenue is generated by black-owned firms. Because black labor-market participants have lower levels human capital, an increase in L_b/L_{nb} or L_{nb} (all else equal) reduces output per worker.

4 Barriers Faced by Black-Owned Businesses

Before documenting the barriers faced by black-owned businesses we need values for four parameters: γ, α, σ, and ξ. The product $\alpha \cdot \gamma$ represents the elasticity of output with respect to capital, while $(1-\alpha)\cdot\gamma$ represents the same with respect to labor. For these two parameters we use values commonly used in the literature, $\gamma = 0.8$ and $\alpha = 1/3$. σ represents the elasticity of substitution between the output of black-owned and other firms. Estimated elasticities between products vary widely across sectors (Broda and Weinstein, 2006), but Imbs and Méjean (2015) suggest a value of 6.5 for one-sector models. We use their value ($\sigma = 6.5$), but acknowledge that this choice is somewhat arbitrary given the lack of any estimates of elasticities based on race.[25] In Section 6 we discuss the robustness of our findings to different values for σ and other parameters. ξ determines the shape of the firm size distribution within each group. We choose ξ by targeting the revenue-size distribution across non-black-owned manufacturing firms in 2007.[26] Revenue per firm at the 53rd percentile of this distribution is 4.5 percent of the average. Given the direct mapping from relative productivity to relative revenue in (6), this ratio (rev_{53}/rev_{ave}) is equal to $(\xi-1)\xi^{-1}(1-0.53)^{-1/\xi}$ in a Pareto distribution. This implies $\xi = 1.022$.

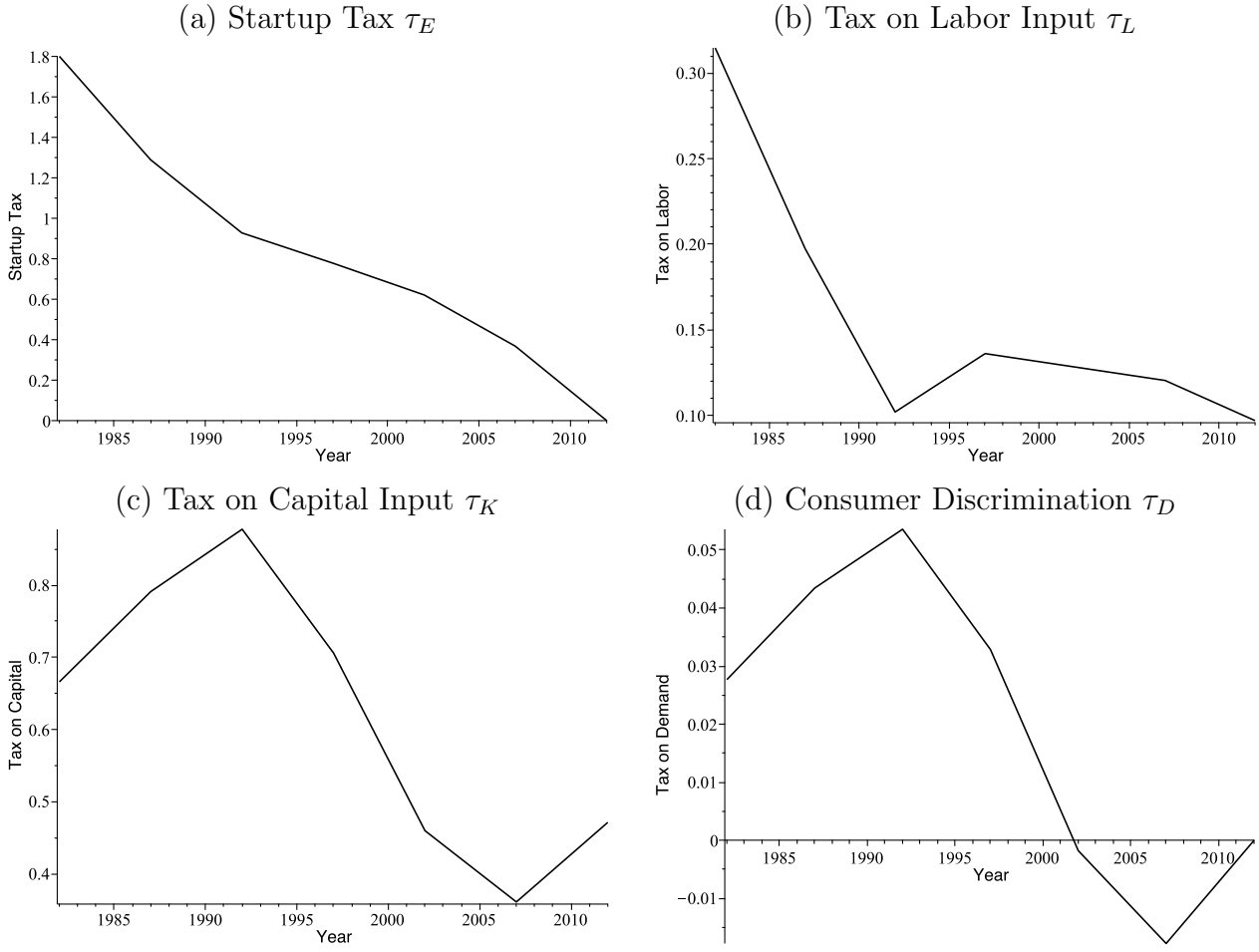
We now infer how differences in the labor-input tax, the startup tax, consumer discrimination,

[25] Bento (2020) uses the same value for the elasticity of substitution between female- and male-owned firms.

[26] The revenue-size distribution of non-black-owned manufacturing firms is more broadly spread over reported size bins, relative to other sectors and relative to black-owned firms, allowing for a better estimate of ξ. We use the reported moment closest to the median.

and the capital-input tax changed between 1982–2012 using equations (9), (11), (15), and (18). These are illustrated in Figure 2.

Figure 2: Barriers to Black Entrepreneurship Over Time



Notes: Panels (a), (b), (c), and (d) calculated using equations (9), (11), (15), and (18).

As discussed in Section 3, we cannot separately identify τ_E and $\hat{c}_{E,b}/c_{E,nb}$ for any given year. We therefore assume that $\hat{c}_{E,b}/c_{E,nb}$ is constant and $\tau_E = 0$ in 2012. Our choice of $1+\tau_E = 1$ in 2012 is innocuous with respect to our calculation of the impact of these barriers over time, since only the proportional change in $1 + \tau_E$ is relevant for this calculation. But since we assume no barrier to entry exists in 2012, our calculation below of the scope for further gains can arguably be considered a conservative one. Two features of Figure 2a are worth highlighting. First, the inferred entry tax for black entrants consistently declined over time. Over the whole time period, black startup costs dropped 64 percent relative to non-black startup costs. Second,

although not shown in Figure 2a, the inferred 'real' startup cost $\hat{c}_E$ for black entrants is only one fifth of the cost for other entrants.

The decline in τ_W suggested by Hsieh et al. (2019), from 19 to 14 percent over this time period, reflects the fact that wage gaps between black and other workers, controlling for human capital and occupational choice, have narrowed over time.[27] This and Figure 2a together suggest the total opportunity cost of starting a firm has decreased significantly over time for black entrepreneurs, relative to that for non-black entrepreneurs.

Figure 2b shows a clear decrease in τ_L over time, down from 31 percent in 1982 to 10 percent in 2012, with the entire decline observed by 1992. This suggests that black-owned businesses paid higher costs for labor than other businesses in all years. Again, this may be due to a higher cost of obtaining short-term credit to pay wages, a need to offer higher non-pecuniary benefits or work-place amenities to attract workers, or some combination of these and other related reasons. By 2012, differences in labor costs between black- and non-black-owned businesses were smaller but still present.

Given (11), the relative capital-labor ratio for black entrepreneurs reported by Fairlie et al. (2020) suggests $\tau_K = 0.46$ in 2002. Using (18) and (19), we infer $(1 - \tau_D) \cdot \phi = 0.49$ in 2002. For all other years, measures of relative average revenue, relative human capital, $z^*_{0,b}/z^*_{0,nb}$, and τ_L can be used with (18) to infer how $\mathcal{T}_{KD}$ – a combination of τ_K and τ_D – evolves over time relative to 2002. The available data does not allow us to separately identify τ_K and τ_D in other years, so we assume each of these barriers contributes proportionately to changes in $\mathcal{T}_{KD}$:

$$\left(\frac{1+\tau_{K,t}}{1+\tau_{K,2002}}\right)^{\alpha\gamma} = \left(\frac{1-\tau_{D,t}}{1-\tau_{D,2002}}\right)^{\frac{\sigma}{1-\sigma}} = \left(\frac{\mathcal{T}_{KD,t}}{\mathcal{T}_{KD,2002}}\right)^{1/2}.$$

Given that τ_D and ϕ also can not be separately identified, we assume $\tau_D = 0$ in the last year of our sample. This implies that any differences in demand in 2012 are due to real differences in the nature of firms started by black and non-black entrepreneurs (ϕ), similar to

[27] See Hsieh et al. (2019) for details about how τ_W is inferred from the data.

our assumption about 'real' entry costs above. This implies $\phi = 0.49$. Again, we emphasize that the value chosen for ϕ does not affect the implied impact of changing τ_D over time. With these assumptions in hand, Figures 2c and 2d show how τ_K and τ_D evolve over time. Figure 2c shows black-owned firms faced a cost of using capital much higher than that of other firms in 1982, and that this difference decreased somewhat by 2012, from 67 to 47 percent. The significant difference still persisting in 2012 suggests that black entrepreneurs still face barriers to financing capital expenditures relative to other entrepreneurs. This is consistent with Robb (2018), who documents evidence that differences in available credit and rates between black and non-black entrepreneurs still persist in 2014. See also Mills and Battisto (2020) who report a disproportionate impact on black-owned firms from the COVID-19 pandemic and pandemic-related policies, due in part to persistent differences in access to credit and access to the federal government's Paycheck Protection Program. Our inferred measure of τ_D shows an increase from 1982 to 1992, but a drop thereafter. Overall, we infer that τ_D was only 3 percentage points higher in 1982 than at the end of our sample.

5 Impact Over Time

We now use the model developed in Section 3 to calculate the impact of the barriers from Section 4 on aggregate output per worker and the welfare of black and non-black labor-market participants. For this we need values for five more parameters: the real interest rate R, the probability of firm exit from the market λ, the growth rate of productivity over a firm's life (a function of g), and preference parameters for entrepreneurship X_f and X_m. For the first two, we use standard values from the literature, $R = 0.05$ and $\lambda = 0.1$. g is the growth rate of firm-level employment over the life of a firm, conditional on survival. We use $g = 0.05$ from Hsieh and Klenow (2014), also standard. For X_s we assign values equal to the fraction of entrepreneurs by race from the PSED survey who cited non-pecuniary reasons for starting a firm. As reported in Section 2, we use $X_b = 0.63$ and $X_{nb} = 0.52$.

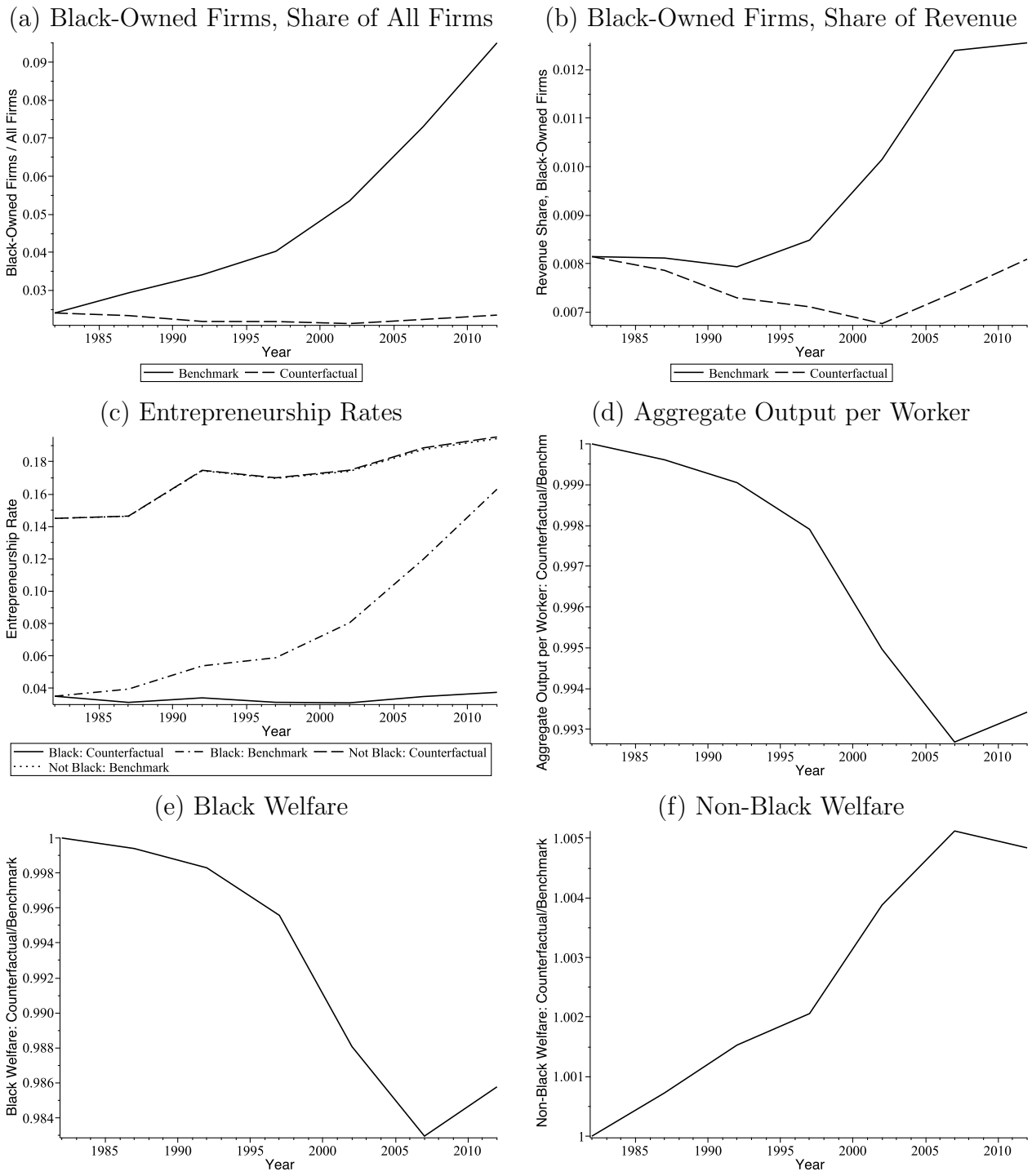
For the benchmark economy, given the barriers derived in Section 4, we assume the entry cost for non-black entrants $c_{E,nb}$ in each reported year is equal to the value required to match the number of black-owned and other firms in that year (equation 21). This implies a non-black entry cost that decreased by 25 percent from 1982 to 2012. Note that after accounting for all implied changes to entrepreneurship due to barriers to black (relative to non-black) entrepreneurship, the model attributes any residual changes in observed entrepreneurship rates to proportional changes in both entry costs. The implied drop in the non-black entry cost should therefore be interpreted as a catch-all for any trends in the economy that led to higher entrepreneurship across the board but not to differential changes in black and non-black entrepreneurship. Similarly, any change over time in U.S. aggregate output per worker not otherwise generated by the model can be attributed to exogenous changes in A.

Total Net Impact We start by answering the following question: How would outcomes have differed over time if barriers facing black entrepreneurs had remained at their 1982 levels? To answer this we calculate outcomes in each year under the assumption that τ_E, τ_L, τ_K, and τ_D remain constant at 1982 levels while $\hat{c}_{E,b}$, $c_{E,nb}$, τ_W, L_b, L_{nb}, A_b, A_{nb}, and A change as in the benchmark. Figure 3 illustrates how the black-owned share of firms and revenue, entrepreneurship rates, aggregate output per worker, and the welfare of black and non-black participants would have behaved under this counterfactual, compared to benchmark outcomes.[28]

If barriers facing black entrepreneurs had stayed at their 1982 levels, Figure 3a shows the share of firms that are black-owned would have decreased slightly over time, due to the relative increase in black labor-market participants (equation 22). With no change in τ_E, relative average revenue per firm would have increased slightly along with relative wages. Figure 3b shows that these offsetting impacts would result in a slightly lower share of aggregate revenue generated by black-owned firms, compared to 54 percent increase observed in the data. The counterfactual black entrepreneurship rate would have increased to only 3.8 percent by 2012, rather than the observed 16.3 (Figure 3c). Without a large increase in black entrepreneurship,

[28]These outcomes are calculated using (15), (17), and (21) through (28).

Figure 3: Counterfactual Outcomes



Notes: Panel (a) calculated using (21) and (22). Panel (b) calculated using (15), (21), and (22). Panels (c) and (d) calculated using equations (17) and (23). Panels (e) and (f) calculated using equations (27) and (28).

the non-black entrepreneurship rate would have increased slightly more, to 19.5 rather than 19.4 percent. In total, the number of firms would have been 6.8 percent lower than the observed number in 2012. Relative to the benchmark, Figure 3d shows aggregate output per worker would have been 0.7 percent lower by 2012.

How do the above findings compare to aggregate output growth in the data? From 1982 to 2012, gross domestic product (GDP) per worker in the U.S. grew by about 70 percent, suggesting the decline in barriers to black entrepreneurship over time only marginally contributed to observed growth.[29] This is the case for two reasons. First, the most impactful barrier, higher costs of using capital, only declined by a small amount over time. Second, even with the higher growth in black labor force participation (relative to non-black), black workers still accounted for only 11 percent of all labor-market participants.

Figure 3e shows that lower barriers to black entrepreneurship over time increased the welfare of black labor-market participants by 1.4 percent. This increase is only slightly due to higher associated wages, which increased by 0.25 percent due to lower barriers. The remainder of the increase in welfare is due to a higher level of entrepreneurial income as more black-owned businesses were started and became established. Conversely, 3f shows that lower barriers to black entrepreneurship over time lowered the welfare of non-black labor-market participants by 0.5 percent. While non-black workers gained slightly from higher wages, this was more than offset by slower growth in entrepreneurial income (relative to the counterfactual).

Impact by Barrier How much did the drop in each barrier contribute to the increase in output per worker and welfare? We answer this question by calculating counterfactual outcomes when all but one of the barriers change over time as in Section 4. Columns 2-5 in Table 2 report counterfactual outcomes in 2012 when one barrier is kept fixed at its 1982 level, relative to the benchmark. The last column reports outcomes in 2012 when all barriers remain fixed at 1982 levels, corresponding to Figures 3e through 3f.

[29] GDP per worker over time is from the Penn World Table v9.0.

Table 2: Contribution of Each Barrier

	fixed barrier				
	τ_E	τ_L	τ_K	τ_D	*all*
output per worker	1.000	0.996	0.998	0.999	0.993
black welfare	1.000	0.991	0.997	0.996	0.986
non-black welfare	1.000	1.003	1.001	1.000	1.005

Notes: Each column (except the last) reports outcomes in 2012 when only one barrier is fixed at its 1982 level. The last column reports outcomes when all barriers are fixed at 1982 levels. All outcomes are reported relative to benchmark where all barriers change over time.

Table 2 shows that changes in relative startup costs barely contributed to net outcomes, even while relative startup costs declined dramatically. This is the case for two reasons. First, changes in the number of black-owned firms are somewhat offset by opposite changes in the number of other firms. Second, and most important, the observed dispersion in firm size within sectors in the data implies that when the number of firms changes, the drop in average ability largely offsets the impact on aggregate output.

Most of the changes over time in output and welfare implied by the model are due to the large drop in production-based barriers, τ_L and τ_K. The model suggests that as these barriers were reduced over time, black-owned firms were able to operate closer to their efficient size, reducing the level of misallocation in the economy. At the same time, the higher profits from this more efficient production led to more entry by black entrepreneurs.

Scope for Future Gains Section 4 suggests further scope for improvement in the economic environment facing black entrepreneurs. For example as of 2012, black-owned firms still face a much higher cost of using capital in production. Of what magnitude are the changes in outcomes we could expect if black entrepreneurs were treated identically to other entrepreneurs? To answer this question, we recalculate outcomes for 2012 under the assumption $\tau_L = \tau_K = 0$.[30] Under these assumptions, we find that aggregate output per worker would increase an

[30]We continue to compare this counterfactual to the benchmark where we assume $\tau_E = \tau_D = 0$.

additional 1 percent. The average welfare of black labor-market participants would increase by an additional 1.8 percent, while welfare for non-black participants would decrease by an additional 0.7 percent. These results suggest additional gains are still possible in the future for the U.S. economy, more than those made in the previous three decades. And to the extent that consumer discrimination and barriers to entry may still exist for black-owned firms in 2012 (in contrast to our assumptions), these results may understate the scope for further gains.

6 Robustness to Alternative Assumptions

Here we explore the robustness of our results to alternative assumptions. We fist consider alternative values for the elasticity of substitution between output from black- and non-black-owned firms σ, the parameter governing decreasing returns to scale in production γ, and parameters governing preferences for entrepreneurship by race X_i. We then consider different rates of change for τ_K and τ_D, and also discuss how our interpretation of the data changes if black entrepreneurs disproportionately hire black workers.

Alternative Parameter Values When considering alternative parameter values for σ and γ, we recalibrate the model to obtain alternative inferred barriers to capital usage and demand over time and then recalculate counterfactual outcomes in 2012 when all barriers are held constant at 1982 levels.[31] Recalculated outcomes are reported in Table 3.

The high value for σ used in the second column corresponds to the elasticity of substitution used by Atkeson and Burstein (2010) for firms competing in the same narrowly-defined product market (for example, competing Italian restaurants). A high value for σ reflects an assumption that the products and services produced by black-owned firms are very similar to those produced by other firms. As a result, output per worker rises by only 0.4 percent as a result of changing barriers, while welfare changes differ marginally from the benchmark. If we assume the output

[31]Inferred values for τ_E and τ_L over time are independent of the parameter values used. Using alternative values for preferences X_i does not affect our calculation of inferred barriers.

Table 3: Counterfactual Outcomes in 2012 Under Alternative Parameter Assumptions

		alternative assumption			
	benchmark	$\sigma = 5$	$\sigma = \infty$	$\gamma = 2/3$	$X_f = X_m = 0.5$
output per worker	0.993	0.991	0.999	0.991	0.993
black welfare	0.986	0.988	0.968	0.975	0.993
non-black welfare	1.005	1.007	1.008	1.007	1.005

Notes: Each column reports outcomes in 2012 when all barriers are held constant at their 1982 levels, relative to 2012 outcomes when barriers are allowed to change over time. The first column reflects the benchmark results illustrated by Figure 3. Other columns reflect an alternative assumption with respect to parameter values.

from black-owned and other firms are perfect substitutes (though still facing differences in demand), as represented by the third column of Table 3, welfare impacts are magnified while aggregate output per worker is impacted less than in the benchmark.

In the second-to-last column we assume a lower value for γ, corresponding to Hsieh and Klenow (2009). This lower value reduces the implied impact on output per worker coming from misallocation, as noted by Hsieh and Klenow (2009). At the same time, however, it increases the impact on output per worker from changes in the total number of firms, which we take from the data.[32] This last effect dominates, leading to a larger implied impact from lower barriers on each outcome.

The last column of Table 3 recalculates changes in welfare when the entire population is assumed to have identical preferences for entrepreneurship. Different preferences for entrepreneurship do not impact output per capita in the model, but black welfare gains are cut in half relative to the benchmark.

Taken together, the numbers reported in Table 3 suggest the benchmark results reported in Section 5 are robust to reasonable changes in the parameter values used.

[32]With decreasing returns to scale in production, more firms per worker implies all firms operate at a more efficient scale of production.

Alternative Rates of Change, τ_K and τ_D In Section 4 we note that the data does not allow us to separately identify how τ_K and τ_D change over time. In the benchmark analysis we therefore assume each contributes proportionately to changes in $\mathcal{T}_{KD}$. We now consider two extreme alternative possibilities, where each barrier is assumed to be responsible for all changes in $\mathcal{T}_{KD}$ while the other barrier remains constant.

$$\text{Case 1:} \quad \left(\frac{1+\tau_{K,t}}{1+\tau_{K,2002}}\right)^{\alpha\gamma} = \left(\frac{\mathcal{T}_{KD,t}}{\mathcal{T}_{KD,2002}}\right) \qquad \text{Case 2:} \quad \left(\frac{1-\tau_{D,t}}{1-\tau_{D,2002}}\right)^{\frac{\sigma}{1-\sigma}} = \left(\frac{\mathcal{T}_{KD,t}}{\mathcal{T}_{KD,2002}}\right).$$

In both cases we assume $\tau_D = 0$ in 2012, and choose a value for real demand ϕ to satisfy (18). In Case 1, we infer τ_K drops from 90 to 48 percent from 1982 to 2012. In Case 2, τ_D drops from 5.5 percent to zero.

Table 4: Counterfactual Outcomes in 2012 Under Alternative Rates of Change (τ_K, τ_D)

	benchmark	Case 1	Case 2
output per worker	0.993	0.993	0.994
black welfare	0.986	0.986	0.985
non-black welfare	1.005	1.006	1.004

Notes: Each column reports outcomes in 2012 when all barriers are held constant at their 1982 levels, relative to 2012 outcomes when barriers are allowed to change over time. The first column reflects the benchmark results illustrated by Figure 3. Other columns reflect an alternative assumption with respect to how τ_K and τ_D change over time.

Table 4 shows how counterfactual outcomes differ relative to the benchmark in each case. Clearly, the benchmark results are robust to different assumptions about how τ_K and τ_D contribute to changes in $\mathcal{T}_{KD}$ over time.

Different Composition of Workers Across Firms Data from the Characteristics of Business Owners Survey for 1992 suggests that black-owned firms disproportionately hire black workers, relative to other firms. In Section 4 we adjust our measure of τ_K to take this into

account, but are unable to take into account the possibility that differences in the racial composition of workers between black-owned and other firms changes over time. Here we explicitly consider the possibility that differences in worker composition exist because black entrepreneurs discriminate less than other entrepreneurs against black workers. If this were the case then, given a lower wage per unit of human capital for black workers w_b, a black-owned firm should hire more effective units of human capital than an identical non-black-owned firm. We can therefore infer that for any given wage bill, a black-owned firm uses a higher level of total human capital than a non-black-owned firm. This implies that for any given difference in the average revenue product of labor between black-owned and other firms, we are in fact *underestimating* τ_L. Given the decrease over time in τ_W, this bias would largest in the early 1980s, suggesting that our estimate of the impact of changing barriers over time is in fact a conservative one. If additional data on differences in labor composition across firms becomes available, we will be able to better identify differences in owners' preferences over workers, and how they change over time.

Different Exit Rates for Black-Owned Firms Fairlie (1999) uses household survey data from the Panel Study of Income Dynamics from 1968 to 1989 to show that self-employed black males exit self-employment with a much higher annual probability than self-employed white males. To the extent that this is a persistent phenomenon, equation (15) shows that assuming exogenously higher exit rates for black-owned firms would result in a lower inferred level of $\hat{c}_{E,b}/c_{E,nb}$ in all periods, without affecting our inferred measure of τ_E. This suggests our results (which do not depend on $\hat{c}_{E,b}/c_{E,nb}$) would be robust to this extension.

In summary, reasonable variations in the assumptions used in Sections 4 and 5 only marginally affect the implications of the benchmark analysis. Barriers to black entrepreneurship have been large, and have declined somewhat over time. While this convergence has led to some increases in output per worker and welfare, there is still scope for further gains in the future.

7 Conclusion

Several measures related to black-owned firms suggest a dramatic increase in the contribution of black entrepreneurship to economic activity in the U.S. over time, both relative to non-black entrepreneurship and relative to the rise in black labor-market participation. In this paper we extend the framework developed by Bento (2020) to interpret these trends over time. This framework extends the Hopenhayn (1992) model of firm dynamics by introducing four distortions faced by black entrepreneurs, relative to non-black entrepreneurs – differential costs of employing labor and capital in production, a differential cost to start a business, and consumer discrimination – as well as preferences for entrepreneurship that differ by race. We infer how each of these distortions evolved from 1982 to 2012, showing that in each case conditions facing black entrepreneurs improved at least somewhat over time. The model suggests these changes are responsible for a 0.7 percent increase in GDP per worker from 1982 to 2012, as well as a 2 percent increase in the welfare of black labor-market participants and a 0.7 percent decrease in the welfare of other participants. Further, the data suggest opportunities for further gains. If barriers to black entrepreneurship are eliminated entirely, output per capita could increase by an additional 1.7 percent and black welfare could increase by an additional 4.5 percent. All of these gains are *in addition to* any changes to output per worker and welfare coming directly from a reduction in labor-market barriers to black workers.

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