

Wealth, Tastes, and Entrepreneurial Choice*

Erik G. Hurst

University of Chicago

`erik.hurst@chicagobooth.edu`

Benjamin W. Pugsley

Federal Reserve Bank of New York

`benjamin.pugsley@ny.frb.org`

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Abstract

The non-pecuniary benefits of managing a small business are a first order consideration for many nascent entrepreneurs, yet the preference for business ownership is mostly ignored in models of entrepreneurship and occupational choice. In this paper, study a population with varying entrepreneurial tastes and wealth in a simple general equilibrium model of occupational choice. This choice yields several important results: (1) entrepreneurship can be thought of as a normal good, generating wealth effects independent of any financing constraints, (2) non-pecuniary entrepreneurs select into small scale firms, (3) subsidies designed to stimulate more business entry can have regressive distributional effects. Despite abstracting from other important considerations such as risk, financing constraints, and innovation, we show that non-pecuniary compensation is particularly relevant in discussions of small businesses.

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1 Introduction

What drives small business entry? Why do most firms stay small while only a few grow fast? What explains the distribution of firm size within a country? There is a large and active literature trying to answer these questions. The canonical models on small business formation segment the population into “entrepreneurs” and “workers” where entrepreneurs are often equated with either small business owners or the self-employed. Most of the existing research attributes differences across entrepreneurs with respect to *ex-post* performance to either differences in financing constraints facing the firms (e.g., [Evans and Jovanovic \(1989\)](#) and [Clementi and Hopenhayn \(2006\)](#)), differences in *ex-post* productivity draws across the firms (e.g., [Simon and Bonini \(1958\)](#), [Jovanovic \(1982\)](#), [Pakes and Ericson \(1998\)](#) and [Hopenhayn \(1992\)](#)), or differences in entrepreneurial ability of the firms owners (e.g., [Lucas Jr \(1978\)](#)). These models, however, assume no heterogeneity in preferences for either small business ownership or small business growth.

Even though the canonical models of entrepreneurship assume away preference heterogeneity in the population, recent empirical work suggests that such heterogeneity is an important feature of the data. For example, [Hurst and Pugsley \(2011\)](#) document that roughly fifty percent of small business owners within the U.S. report that non-pecuniary benefits were one of the primary reasons that they started their business.¹ These self reported non-pecuniary benefits included responses such as “wanting to be my own boss”, “tired of working for others”, “wanting flexibility to set my own hours”, or “wanting to pursue my passion”. [Hurst and Pugsley \(2011\)](#) also show that most small business owners report having no desire to grow their business. When asked about their ideal firm size, the median response of new business owners is that they desire their business to only have at most a few employees. Moreover, those reporting that they started their business for non-pecuniary reasons were much more likely than a group motivated by a new business idea to report that their ideal firm size was small. This is not surprising given that the overwhelming majority of small business owners in the U.S. are skilled craftsmen (e.g., plumbers, electricians, painters), skilled professions (e.g., lawyers, dentists, accountants, insurance agents), or small shopkeepers (e.g., dry cleaners, gas stations, restaurants).

Additionally, there is a large literature showing that the median small business owner earns less as a business owner than they would have earned had they remained a wage or

¹Respondents in the Panel Study of Entrepreneurial Dynamics were asked to report the top two reasons they started their business. Hurst and Pugsley classified these responses into five broad categories. Non-pecuniary benefits was one of the categories.

salary worker. Using data from the Survey of Income and Program Participation, [Hamilton \(2000\)](#) documents that the median small business owner receives lower accumulated earnings over time than otherwise comparable wage and salary earnings. [Pugsley \(2011\)](#) expands on Hamilton’s findings showing that these patterns persist for both newly formed businesses as well as older small businesses (those in existence for at least a decade). [Moskowitz and Vissing-Jørgensen \(2002\)](#) document that the returns to investing in private-equity (predominantly business ownership) are no higher than the returns to investing in public-equity despite the poor diversification and higher risk.² Collectively, these papers suggest that non-pecuniary benefits may explain why the total compensation for running a small business (risk adjusted) is much lower for the median small business owner relative to remaining a wage/salary worker.

In this paper, we craft a simple static model of small business entry with selection on the non-pecuniary benefits of small business ownership. The key element in the model is that individuals differ in their preference for owning a small business, and these preferences are the sole drivers of small business entry within the model. To highlight the mechanism, we assume away the standard forces that researchers usually use to model small business entry and growth. For example, individuals in the model do not differ in either their latent ability to create a new business nor do they differ in their ex-post productivity. Furthermore, we assume that capital is not needed to start a new business. As a result, there is no role for liquidity constraints in explaining small business entry within our model. In that sense, our model should be viewed as being in a similar style to [Evans and Jovanovic \(1989\)](#) who also develop a deliberately stylized model to study an alternative mechanism for selection of entrants. The difference is that Evans and Jovanovic focused on differences in ability across entrepreneurs and the role of binding liquidity constraints. We, instead, focus solely on preference heterogeneity with respect to non-pecuniary benefits for small business ownership. As we show, many of the key predictions of these two stylized models are identical.

While wanting to highlight the economic effects of non-pecuniary benefits, we do feel there are benefits from adding a few additional degrees of heterogeneity to our setup. First, like [Evans and Jovanovic \(1989\)](#), we allow households to differ with respect to their initial wealth. Second, we allow for different industries where each industry is defined by its natural scale. Some sectors (e.g., car manufacturing) have large fixed costs and, as a result, a large

²Measurement issues surrounding income reports by the self employed complicate such analyzes. [Hurst, Li, and Pugsley \(2014\)](#), for example, show that the self-employed underreport their income by roughly 25 percent to household surveys. [Moskowitz and Vissing-Jørgensen \(2002\)](#) incorporate the fact that business owners underreport their income when computing the differential returns to private equity.

natural scale. Other sectors (e.g., plumbers) have relatively small fixed costs and, as a result, a smaller natural scale. The heterogeneity across sectors in their natural scale will yield predictions about what sectors will be dominated by small businesses within our model. When entrepreneurs form a business they are more likely to do so in the sectors with a relatively low natural scale. This is because the key tradeoff within the model stems from the benefits the individual gets (in utility terms) from starting her own business relative to the costs imposed from having a small business and losing the benefits of scale.

With these simple features, we show our model yields many key empirical facts without relying on differences in entrepreneurial ability, differences in entrepreneurial luck, or binding liquidity constraints. First, we show that the model predicts that people with large non-pecuniary benefits of small business formation will be concentrated in industries with low natural scale. This results from our assumption that non-pecuniary benefits do not depend on industry or the scale of the business. The intuition is that individuals will want to get their non-pecuniary benefits in the industry with the lowest costs. In these industries, small businesses will also have a competitive advantage, because of their implicit lower pecuniary marginal costs. This matches evidence showing a strong correlation between an industry's share of small businesses (out of all small businesses) and the fraction of employment within that industry that occurs within small businesses. For example, a large fraction of small businesses (out of all small businesses) are skilled craftsmen. Within the detailed skilled craftsmen industries, most employment occurs within small businesses. There are very few big firms in the plumber, electrician, and painter industries. However, there are many old firms in the plumber, electrician and painter industries. Reconciling these two facts is the finding that very few firms in the skilled craftsmen industries ever grow beyond being small (conditional on survival).

Second, the model predicts that earnings will be lower for those who run a small business. Equilibrium forces imply that individuals must be indifferent between working for others or starting their own business. Since at the margin there is a utility flow from owning a business, pecuniary earnings must be lower for small business owners. Again, the fact that small business owners earn less than comparable wage/salary workers seems to be a feature of the data for the median small business owner.

We also show that our model predicts a positive correlation between small business ownership and wealth even though there are no binding liquidity constraints, differences in risk preferences, or *ex-ante* correlation of tastes and initial wealth. The reason for this is that we are modeling the utility flow of owning a business as being separable from the

rest of the individuals consumption bundle. As wealth increases, the marginal utility of the rest of the consumption bundle falls. The cost of running a small business in our model is the foregone market wage less the business's pecuniary earnings. This cost must always be positive in an equilibrium with a small business sector. When wealth is higher, the marginal utility loss from the lower pecuniary earnings is lower. This makes the cost of running a business, in utility terms, lower. To put it another way, our model generates that owning a business is a relative luxury good. In a world with non-pecuniary benefits, there could be a strong correlation between wealth (or exogenous changes in wealth) and business ownership that have nothing to do with binding liquidity constraints. This complicates the inferences made in many empirical studies that look for exogenous changes in wealth and subsequent business entry as evidence of binding liquidity constraints.

Related to the above findings, we show that labor productivity within the economy is declining the greater the level of non-pecuniary benefits in the economy. If there are reasons people prefer the small business sector, there are pecuniary costs to a society in that individuals will forego the benefits of scale to enter the small business sector. This can offer one potential reason why measured labor productivity differs dramatically between countries with differing sizes of the small business sector.³ However, in a world with non-pecuniary benefits of small business ownership, labor productivity differences need not imply utility differences.

Finally, and potentially most provocatively, the model predicts that small business subsidies in this model—funded by lump sum taxes—are regressive. There are no distortions in our model so it is not surprising that small business subsidies strictly reduce welfare. However, because of the fact that wealthy people are more likely to buy the utility flow of small business ownership, the subsidies are regressive. More wealthy individuals are small business owners than poor individuals. The subsidy on small business ownership just transfers resources to the wealthy from the poor. The net gain to the wealthy relative to the poor is strictly positive if the taxes to fund the subsidy are lump sum. The regressivity could be undone if the taxes paid to fund the subsidy also increase in household wealth.

We are well aware that our model is highly stylized and abstracts from many features we believe to be relevant with respect to small business formation. However, our goal is to highlight how a simple model of non-pecuniary benefits of small business ownership has predictions that are similar to many canonical models used in the literature that rely on heterogeneity in ability, luck or liquidity constraints to explain small business entry and

³See, for example, La Porta and Shleifer (2014).

dynamics. In the last section of the paper, we set out a road map for researchers by offering some guidance on new moments that can be used to help discipline the various forces within our model. We then talk about how we can improve measurement to better create empirical counterparts to the moments needed to test among the importance of the various potential drivers of small business ownership and growth. For example, a key prediction that distinguishes non-pecuniary benefits from the other stories is the size of the wage difference between wage/salary workers and small business owners. Researchers can use these gaps as additional moments to help calibrate the average size of the non-pecuniary benefits from small business ownership. However, much additional work needs to be done to measure these gaps empirically. In particular, one needs to account for the potential that business owners may underreport their income, the fact that business income is more volatile, and the fact that employers often provide additional fringe benefits to workers.

In summary, we think researchers should take seriously the potential for non-pecuniary benefits of small business ownership when crafting models of small business entry and firm dynamics. There seems to be a belief by some that small businesses would only grow faster if they were not bound by liquidity constraints or government regulations. This is likely true for some small businesses. However, if people are starting small businesses for non-pecuniary reasons, subsidies to small business owners may actually be welfare reducing. We also show that under some conditions, the subsidies will be regressive. The benefits of the subsidy will go to the wealthier households who were more likely to buy the utility flow of running a business. Understanding the relative importance of different drivers of small business formation and growth will allow researchers and policy makers to assess the potential costs and benefits of different policies.

2 Empirical Facts

In this section, we establish a set of facts that will help to guide our modeling choices below.

2.1 Heterogeneity in Small Business Propensity Across Industries

To establish our first set of facts, we use data from the U.S. Census Longitudinal Business Database (LBD). The LBD is a complete annual census of U.S. business establishments with paid employees that spans the years 1976 to 2011. Establishments are linked to their parent firm through both survey and administrative records within a year. Then the data are longitudinally linked by both establishment and firm identifiers across years in order to

measure entry, growth, and exit.⁴ While the LBD files are available for each year at the establishment level, we transform the data so the unit of observation is at the year and firm level.

We follow the approach adopted in the U.S. Census Business Dynamic Statistics (BDS) and assign the firm’s age as the age of its oldest establishment. For industry information, we assign a 4-digit NAICS industry code to each firm. For multi-unit firms, we assign the firm’s “industry” as the modal industry classification across all of the firm’s establishments.⁵ Our sample pools annual firm-level employment measures from 1992 to 2011 for all firms with non-missing employment data. Because firm age is left censored in 1976, 1992 is the first year where we can identify firm age through age 15.

For the work below, we classify each firm in year t by its size, s , age, a , and 4-digit industry, j . We define “small” firms as those employers with between 1 and 19 employees.⁶ This category accounts for roughly 20 percent of all U.S. business employment. We then consider three mutually exclusive age groups: “young” firms ages 0 to 5, “middle” firms ages 6 to 9, “older” firms ages 10 to 15 and an additional category for all remaining firms over age 15. Using the year/firm files, we compute the total number of firms and total employment for small firms within each age group and year. We define n_{jas} and e_{jas} as the average number of small firms and employment in small firms, respectively, between the 1992 and 2011 period within each 4-digit industry and age group.

For each industry, we define the following:

$$x_j^m = \frac{\sum_a m_{j,a,s=small}}{\sum_j \sum_a m_{j,a,s=small}}$$

where m is either a measure of firm employment, e , or a measure of the number of firms, n . For example, x_j^n is the number of small firms (of any age) in 4-digit industry j as a share of the total number of small businesses regardless of age or industry. Analogously, x_j^e is the total number of employees in small firms (of any age) in 4-digit industry j as a share of all employment in small businesses regardless of age or industry. x_j^m provides a measure to identify the most important industries among small businesses. We also define measures of

⁴See [Jarmin and Miranda \(2002\)](#) for details on the construction of the LBD.

⁵We used the procedure in [Fort \(2013\)](#) to map SIC industry codes to NAICS industry codes. In Fort’s procedure, some of the 4-digit industries cannot be mapped between the NAICS and SIC categories. These industries are mapped at higher levels of aggregation (2 digit or 3 digit). We collapse these unmatched categories into a single cell.

⁶Our results are robust to defining small firms as having less than 50 or less than 100 employees. We focus on firms with less than 20 employees for consistency with the results in [Hurst and Pugsley \(2011\)](#).

x_j^m for young firms and older firms. Specifically,

$$x_{j,a=young}^m = \frac{m_{j,a=young,s=small}}{\sum_j m_{j,a=young,s=small}}$$

$$x_{j,a=older}^m = \frac{m_{j,a=older,s=small}}{\sum_j m_{j,a=older,s=small}}$$

For example, $x_{j,a=young}^e$ is the fraction of employment in young small firms in industry j out of the employment in all young small firms regardless of industry. Finally, we define the fraction of employment (firms) in small businesses in industry j out of all employment (firms) in industry j regardless of size. Formally,

$$y_j^m = \frac{\sum_a m_{j,a,s=small}}{\sum_s \sum_a m_{j,a,s}},$$

where the denominator is total employment, $m = e$, or total number of firms, $m = n$, in industry j across firms of all sizes and ages. As above, we can further define $y_{j,a=young}^e$ and $y_{j,a=older}^e$ as the share of employment among small firms ages 0-5 and ages 10-15 in industry j out of all industry j firms within each respective age group.

Figure 1 plots the cumulative distribution of x_j^n (on the y-axis) against the industry rank of x_j^n . For example, the 4-digit industry with the largest share of small firms out of all small firms is residential building construction. This industry would get a rank of 1. This 4-digit industry comprises roughly 3.5 percent of all firms with less than 20 employees. As seen from Figure 1, roughly twenty-five 4-digit industries in the U.S. comprise one-half of all firms with less than 20 employees. [Hurst and Pugsley \(2011\)](#) list the top forty 4-digit industries which represent over 60 percent of all firms with less than 20 employees. Essentially all of these firms are skilled craftsmen (builder, plumbers, painters, electricians), skill professionals (doctors, dentists, accountants, lawyers, real estate agents, insurance agents) and small shop keepers (dry cleaners, restaurants, grocery stores, bars, gas stations).

The patterns in Figure 1 persist with firm age. Figure 2a replicates Figure 1 for young firms and older firms separately. The cumulative distributions are nearly on top of each other. Of course in this plot, the industry-rank is not held fixed across firm age groups, and one may worry that industry's ranks are shifting as firms age. Figure 2b shows that this is not the case. The figure plots the rank of $x_{j,a=young}^n$ against the rank of $x_{j,a=older}^m$. Industries that dominate the distribution of small young business also dominate the distribution of small older businesses.

Figure 3 plots the rank of $x_{j,a=young}^n$ (x-axis) against the level of y_j^n (y-axis), i.e., it plots

Industries that dominate the share of small businesses (out of all small businesses) are also the same industries for which small firms dominate employment within the industry. The relationship is essentially monotonic. Most small businesses are skilled craftsmen, skilled professionals, and small shop keepers. These industries are also ones where most employment is in small firms. For example, Figure 3 says that in the 10 most prevalent industries among small businesses, small firms account for anywhere from roughly 40 to 90 percent of each industry's employment.

Figure 4 compares $y_{j,a=young}^e$ (x -axis) against $y_{j,a=older}^e$ (y -axis). In words, the x -axis measures the share of employment in industry j that is in small young firms out of all young firms while the y -axis measures the share of employment in industry j this is in small older firms out of all older firms. Again, there is a strong amount of persistence within industries as firms age. For example, the skilled craftsmen have essentially between 60 and 80 percent of employment in small firms when they are young. Those same industries have between roughly 60 and 80 percent of employment in small firms when they are older. These results add to the results in [Hurst and Pugsley \(2011\)](#) showing that most small firms never grow. Put another way, even among older firms, there are still many small firms. In some industries, small firms employ most of the workers in the industry regardless of firm age.

Finally, Figure 5 plots the log of the average size in the industry when the firm was young (x -axis) against the log difference in industry size between when the industry was older (10-15 years) and young (0=5 years). The relationship shows a slight increasing relationship between initial size and subsequent growth. If the industry had relatively large firms when young it was much more likely to grow than industries with smaller firms when young. This figure is in growth rates. What this also implies is that most industries that are small when young never grow by any meaningful measure. For example, if the industry had roughly 7 employees when young (such that log employment was roughly 2), ten years later average employment in that industry was roughly 11 employees (a 50 percent increase in employment). Again, this is consistent with the fact that most small firms do not grow and that these non-growing small firms are concentrated in a narrow industries.

The results in Figures 1-5 will motive some of our modeling choices in the next section. In particular, the model will incorporate different industries. Industries will be defined by their natural scale. As a result, some industries will have small natural scale (e.g., plumbers) while other industries will have larger natural scale (e.g., manufacturers). Even though our model is static, the results in Figures 1-5 also suggest that firms in small scale industries are less likely to grow as they age.

2.2 The Importance of Non-Pecuniary Benefits in Small Business Formation

For our second set of facts, we review the work in [Hurst and Pugsley \(2011\)](#). Using data from the Panel Study of Entrepreneurial Dynamics II (PSED), Hurst and Pugsley show that the median small business reports starting their business for non-pecuniary reasons. The PSED started with a nationally representative sample of 31,845 individuals. An initial screening survey in the fall of 2005 identified 1,214 “nascent entrepreneurs.” To be considered a nascent entrepreneur, individuals had to meet the following four criteria. First, the individual had to currently consider himself or herself as involved in the firm creation process. Second, he or she had to have engaged in some business startup activity in the past 12 months. Third, the individual had to expect to own all or part of the new firm being created. Finally, the initiative, at the time of the initial screening survey, could not have progressed to the point that it could have been considered an operating business. The goal was to sample individuals who were in the process of establishing a new business.

In the winter of 2006, after the initial screening interview, these 1,214 respondents were surveyed about a wide variety of activities associated with their business startup. They were asked detailed questions about their motivations for starting the business, the activities they were currently undertaking as part of the startup process, the competitive environment in which the business would operate, and their expectations about the desired future size and activities of the business. Follow-up interviews occurred annually for 4 years, so that the data also have a panel dimension.

As part of the initial survey of the PSED, the business owners were asked, “Why do [or did] you want to start this new business?” Respondents could report up to two motives. The respondents provided unstructured answers, which the PSED staff coded into 44 specific categories. We took the raw responses to the question and created five broad categories of our own: nonpecuniary reasons, reasons related to the generation of income, reasons related to the desire to develop a new product or implement a good business idea, reasons related to a lack of better job options, and all other reasons. The main responses in the nonpecuniary category include “want to be my own boss,” “flexibility/set own hours,” “work from home,” and “enjoy work, have passion for it/ hobby.” The main responses in the generating income category include “to make money” or “need to supplement income.” The main responses in the new product or business idea category include “satisfy need,” “there is high demand for this product/business,” “untapped market,” and “lots of experience at work.”

[Hurst and Pugsley \(2011\)](#) document that roughly 50 percent of all respondents reported

non-pecuniary benefits as being one of the primary reasons they started their business. The second most common response (38 percent) was the respondent had a good business idea. The fraction who reported non-pecuniary benefits as the primary reason to start the business was consistent across different sub-samples of PSED respondes. For example, for those firms that remained in business through 2010 (four years after the first interview), 52 percent reported that non-pecuniary benefits was a primary reason for starting their business. Hurst and Pugsley show that those that report non-pecuniary benefits as the primary reason for starting a business were less likely to actually grow, were less likely to report ex-ante wanting to grow, were less likely to actually innovate along observable mentions, and were less likely to report ex-ante wanting to innovate. There was variation in the extent to which non-pecuniary benefits were important across industries. For example, those entering retail trade industries were much more likely to report non-pecuniary benefits as a driver of their entry decision. Conversely, very few individuals who entered the manufacturing sector reported non-pecuniary benefits as a driver of their entry decision.

3 A Model of the Small Business Sector

We propose a highly stylized model of the small business sector that matches key features of the data described in Section 2 with few additional free parameters. In particular, we introduce non-pecuniary benefits from small business ownership into a static equilibrium model of occupational choice. As shown above, most business owners report non-pecuniary benefits as an important reason as to why they started their business, and in the model as an equilibrium outcome the small business sector will only be populated by people who start their business for non-pecuniary reasons.

To focus on the allocative role of non-pecuniary benefits, we make a number of additional abstractions. First, we ignore the dynamics of small business formation and growth. As discussed in section 2 and further in [Hurst and Pugsley \(2011\)](#), most small businesses just do not grow or have any intention to grow.⁷ Second, we ignore financial market frictions. [Hurst and Lusardi \(2004\)](#) find that liquidity constraints do not appear to bind and that initial capital requirements for most businesses are quite low. Even without financial frictions, it will become clear that the consumption value of business ownership will imply a strong correlation between wealth and probability of business ownership. Finally, we abstract from differences

⁷Eliminating dynamics and risk excludes pursuing a number of interesting questions, some of which [Pugsley \(2011\)](#) takes up in a dynamic model of entrepreneurship.

in skill or comparative advantage. We treat all workers as equally capable employees or proprietors of their own business. Rather than as a realistic description of the labor market, we view these simplifications as a stepping off point to see how far we can go before needing to confront the more complex issues of skill sorting in a dynamic frictional labor market.

In the model, households differ only in their endowed wealth and their preference (if any) for running a business. They decide whether to use their labor to own and operate a business or instead to work as an employee in the corporate firm sector. If they decide to run a business, they also must decide what goods to sell among the many types of goods sold. Each good is produced using a technology with u-shaped average costs and goods differ by their efficient scale of production. Corporate firms can produce anything small businesses can produce using the same technology, but they are unconstrained in their ability to hire additional labor and may reach their efficient scale. We study an equilibrium where corporate firms and small businesses compete to sell each good and where in equilibrium each good is supplied by the firm offering the lowest price.

3.1 Intermediates and the Small Business and Corporate Sectors

There is a continuum of intermediate goods represented by the set $B = [\underline{b}, \bar{b}]$ with $\underline{b} > 0$. Each type of good b is characterized by the technology used to produce it, where b serves both as the good's name and as a parameter governing its minimum efficient scale of production, which increases with b .

Good b may be produced by either a corporate-owned firm or a household-owned small business using the technology

$$f_b(n) = An^\theta - b. \quad (1)$$

where n represents the employment. With span of control parameter $\theta < 1$, the fixed cost b implies hump-shaped returns to scale, and because labor is the only factor of production, the scale of production may also be expressed in terms of its required employment n .⁸ We label the natural scale (expressed in terms of employment) as n_b^* . In an equilibrium with a competitive market for good b , free entry will impose that $n_b = n_b^*$. We can locate this value by solving for the value of n that makes the elasticity of scale $\frac{nf'_b(n)}{f_b(n)}$ exactly equal to 1, so for $b > 0$

$$n_b^* = \left(\frac{b}{A} \frac{1}{1 - \theta} \right)^{\frac{1}{\theta}}. \quad (2)$$

⁸Here the fixed cost is paid in units of the intermediate good. Results are very similar using an alternative formulation with a fixed cost in terms of labor input $(An - b)^\theta$

If a plant were to operate at its natural scale n_b^* , then its marginal cost of production (and thus its market price) given wage w would be $w \left(\frac{b^{1-\theta}}{A\chi} \right)^{\frac{1}{\theta}}$ where $\chi \equiv \theta^\theta (1-\theta)^{1-\theta}$.

The technology described by (1) for each b is available to both corporate and small business sectors. They differ only in their flexibility over choosing n .

Small Businesses Sector If a household produces b as a small business it must set $n = 1$. This prevents household-owned and operated small businesses from reaching the minimum efficient scale for any $b > A(1-\theta)$. Depending on the range of B , households producing goods where $b < A(1-\theta)$ would be allocating too much time to the business. Although we later rule out this possibility by our choice of A , this situation may be more common than one initially thinks. Sole proprietors who do not pay themselves a market wage may allocate more of their own or family labor to their business than they would have hired at market rates. Regardless, given the requirement that $n = 1$ and facing a price schedule p_b an entrepreneurial household who produces good b earns $p_b(A-b)$ as proprietor's income. For goods where $b > A$, the required fixed cost exceeds the small business owner's capacity to produce.

Corporate Sector Corporate-owned plants are distinguished by being unconstrained in their choice of $n \geq 0$. For convenience, we refer to each corporate-owned plant as a corporate firm.⁹

3.2 Individual Good Demand

Demand for individual goods b comes from a competitive final good sector that combines intermediate inputs x_b to produce a final good

$$C = \left(\int_B x_b^{\frac{\sigma-1}{\sigma}} db \right)^{\frac{\sigma}{\sigma-1}}, \quad (3)$$

of the type described by [Spence \(1976\)](#) and [Dixit and Stiglitz \(1977\)](#) where σ represents the elasticity of substitution between inputs. A cost-minimizing final good sector implies

⁹While the boundaries of the firm for a household-owned small business are clear, the boundaries in the corporate sector are not well defined. In practice a corporate-owned firm could operate multiple plants in one or more individual good markets. We only require that there are a sufficient number of corporate firms to ensure individual good markets are competitive.

conditional input demand functions for each intermediate good b such that:

$$x_b(p_b) = Cp_b^{-\sigma}, \quad (4)$$

where p_b represents the price of good b . We use the final good as numeraire to normalize its price (and marginal cost) as 1.

3.3 Households and Non-Pecuniary Benefits

There is a unit measure of households who differ in their endowed wealth, y , and in their “taste” for small business ownership γ . We label the joint distribution characterizing household heterogeneity as $F(\gamma, y)$. For simplicity, we assume that $\gamma \geq 0$, $y \geq 0$, and that both variables are independently distributed so that:

$$F(\gamma, y) = F(\gamma)F(y),$$

where $F(\gamma)$ and $F(y)$ represent the marginal distributions of taste and wealth heterogeneity. This imposes no relationship between wealth and entrepreneurial taste *ex-ante*.

Households have preferences over consumption of a final good and whether or not they allocate their labor to running a business ordered by:

$$u = \log c + \gamma \mathbf{1}_e,$$

where c represents consumption of the Spence-Dixit-Stiglitz final good and $\mathbf{1}_e$ is an indicator that is 1 if the household runs a business and 0 otherwise.¹⁰ Here γ has the interpretation of a taste for small business ownership or equivalently, in this context, a preference for not having a boss. For simplicity, we have assumed $\gamma \geq 0$, but this is clearly an innocuous assumption.

If a household chooses employment, it earns the market wage w . If instead it chooses to operate a small business and produce a particular good b it earns proprietor’s income $p_b(A - b)$. Although households must choose a particular b , in an equilibrium, each en-

¹⁰Individuals only get the non-pecuniary benefit from running the business themselves. This is consistent with the fact from Section 2 that the overwhelming majority of small businesses have very few employees if any. The extreme form of the non pecuniary benefits—that they accrue only if the firm has only one employee and that they are diversified completely away among corporately owned firms—is made for simplicity. We could write down a more flexible specification that let the non pecuniary benefits decay as the number of employees increase without altering the main implications of the model.

entrepreneurial household will be indifferent among the set of goods produced by small businesses, and in anticipation this outcome we label the proprietor's income:

$$z \equiv p_b (A - b) ,$$

which does not depend on b .

Propensity to Choose Entrepreneurship An individual household's labor supply is indivisible and equal to 1. Rogerson (1988) shows how the non-convexity associated with indivisible labor supply produces equilibrium allocations that are not Pareto optimal. To restore optimality, he introduces lotteries over the labor supply decision that may be perfectly insured so that households may equalize consumption over either idiosyncratic outcome. We complete markets using the same procedure so that households of type γ choose a probability of business ownership e . The choice of e will represent both the probability of starting a business and the state-contingent price of consumption should the business start. Then $1 - e$ will represent the probability of the business not starting and the price of consumption for that contingency.¹¹ As in Rogerson (1988), optimizing households will equalize consumption across idiosyncratic outcomes and the problem is iso-morphic to choosing c and $e \in [0, 1]$ to maximize

$$\log c + \gamma e \tag{5}$$

subject to

$$c + (w - z) e = w + y . \tag{6}$$

We write the budget constraint so w on the right hand side has the interpretation of the full value of the household's time, and $w - z$ represents the pecuniary opportunity cost (if any) of running a small business. We will later show that $w - z$ is strictly positive in any equilibrium with a small business sector.

3.4 A Competitive Two-Sector Equilibrium

We define an equilibrium where entrepreneurial households compete with firms to supply each good b , and the remaining worker households provide the labor required by the firms. The equilibrium features a cutoff $b^* \in [\underline{b}, \bar{b}]$, dividing B into goods produced by entrepreneur

¹¹This setup does not require there be a sufficient number of each type γ households. So long as markets are complete, each type γ household can insure against the idiosyncratic outcome of E .

households and goods produced by firms.¹²

Definition 1. Given a distribution $F(\gamma)F(y)$ of heterogeneous households who differ in taste γ and endowed wealth y , and production technologies described by (1) and (3), a *two-sector competitive equilibrium* consists of the following:

1. Wage w and intermediate good prices p_b for $b \in B$
2. Allocations $c(\gamma, y)$ and $e(\gamma, y)$ that given prices w and p_b for $b \in B$ maximize (5) subject to (6) for each type γ, y
3. Wealth cutoffs $y_{1\gamma}$ and $y_{2\gamma}$ that depend on γ such that

$$e(\gamma, y) \in \begin{cases} \{0\} & \text{if } y \leq y_{1\gamma} \\ [0, 1] & \text{if } y_{1\gamma} < y \leq y_{2\gamma} \\ \{1\} & \text{otherwise} \end{cases}$$

4. Allocations n_b that maximize profits given w and p_b for corporate firms producing good b
5. A density q_b of operating corporate firms over each good b consistent with free-entry
6. A cutoff $b^* \geq \underline{b}$ where if $b \geq b^*$ then $q_b > 0$ and $q_b = 0$ otherwise
7. And market clearing

(a) Final good market

$$\int \int c(\gamma, y) dF(y) dF(\gamma) = \left(\int_B x_b^{\frac{\sigma-1}{\sigma}} db \right)^{\frac{\sigma}{\sigma-1}}$$

(b) Intermediate good markets

$$x_b = q_b (An_b^\theta - b) \quad \text{when } b \geq b^*$$

¹²In general, the choice of technology implies two cutoffs, b_1 and b_2 , i.e. there are goods $b < b_1$ where firms are the lowest cost producer. For these goods, entrepreneur households would be operating well beyond the good's natural scale of production. To eliminate this possibility, we restrict $\underline{b} > A(1-\theta)$ so that the smallest possible natural scale is at least $n = 1$. This ensures that $b_1 < \underline{b}$.

and

$$\int_{\underline{b}}^{b^*} x_b db = \int \int \left(AE(\gamma, y) - \int_{\underline{b}}^{b^*} b db \right) dF(y) dF(\gamma)$$

(c) Labor market

$$\int_B q_b n_b db = 1 - \int \int e(\gamma, y) dF(y) dF(\gamma) . \quad (7)$$

The following lemma establishes that intermediate prices for any $b < b^*$ must adjust to make the household indifferent over its choice of b .

Lemma. *In an equilibrium where $b^* > \underline{b}$, proprietor's income $z = p_b (A - b)$ does not depend on b .*

Proof. This follows almost immediately from the assumption of access to the same technology. Suppose to the contrary that there exists b' such that $p_{b'} (1 - b') > p_b (1 - b)$ for all other $b < b^*$, then this cannot be an equilibrium since all households that run a business would prefer to produce b' . \square

To solve for this equilibrium, we first address the marginal households, i.e., suppose $y \in (y_{1\gamma}, y_{2\gamma})$ for some household y, γ . From the first order condition for E , an optimal choice of $E(\gamma, y)$ requires

$$\lambda = \frac{\gamma}{w - z} \quad (8)$$

where λ is the marginal utility of income. For these marginal entrepreneurial households $w - z$ represents the opportunity cost of increasing the probability of running a business. With log preferences over consumption, then

$$c(\gamma, y) = \frac{w - z}{\gamma}$$

and the probability of running a business is

$$e(\gamma, y) = \frac{w + y}{w - z} - \frac{1}{\gamma} .$$

The solution of $e(\gamma, y)$ for the marginal households determines the wealth thresholds as the values of y that make $e(\gamma, y)$ exactly equal to 0 or 1

$$y_{1\gamma} = \frac{w - z}{\gamma} - w \quad \text{and} \quad y_{2\gamma} = y_{2\gamma} = \frac{w - z}{\gamma} - z .$$

Consumption for households outside of these thresholds will be equal to their endowment y and any earned income, w or z .

It is useful to define two aggregate quantities. We let E represent the total supply of labor allocated to operating small businesses

$$E \equiv \int \int e(\gamma, y) dF(y) dF(\gamma) .$$

Likewise, we let C represent aggregate demand for the final good

$$C \equiv \int \int (c(y, \gamma) - y) dF(y) dF(\gamma) .$$

In the firm sector (when $b \geq b^*$) free entry ensures that firms operate at their minimum efficient scale $n_b = n_b^*$. This is the only value of n_b at which profits are exactly to zero. With price equal to marginal cost then:

$$p_b = w \left(\frac{b^{1-\theta}}{A\chi} \right)^{\frac{1}{\theta}} . \quad (9)$$

Given intermediate demand x_b from (4) and the required price of b from (9), intermediate good market clearing pins down the quantity of firms q

$$q_b = C w^{-\sigma} \frac{1-\theta}{\theta} (A\chi)^{\frac{\sigma}{\theta}} b^{\frac{(\theta-1)\sigma-\theta}{\theta}} \quad (10)$$

Recall that we have normalized $P = 1$ so all prices are in units of the final good.

Next we determine the small business sector and firm sector partitions. In a competitive market with free entry, each good b will be supplied by the producer offering the lowest price. We locate a cutoff good b^* that equates the marginal cost of firms with the price charged by small businesses.

Proposition 1. *If $B^e \neq \emptyset$, then $B^e = [\underline{b}, b^*]$ and $B^f = [b^*, \bar{b}]$, where b^* is the root within the interval $[\underline{b}, \min\{A, \bar{b}\}]$ of the following equation*

$$w \left(\frac{b^{*1-\theta}}{A\chi} \right)^{\frac{1}{\theta}} = \frac{z}{A - b^*} , \quad (11)$$

Proof. See Appendix □

With all equilibrium objects expressed in terms of the market wage w and equilibrium proprietor's income z , it only remains to identify these prices by clearing the labor and intermediates markets. Since the intermediates markets for $b \in B^f$ has already been cleared to determine q_b , we focus on $b \in B^e$. Market clearing requires that $(A - b) E_{\gamma y b} = C p_b^{-\sigma}$, and since we have established that entrepreneur households are indifferent over $b \in B^e$ we need only check that this holds for aggregate small business production. By multiplying market clearing through by $(A - b)^{-\sigma}$, since $p_b = \frac{z}{A-b}$ we can write the equation as $(A - b)^{1-\sigma} E_{\gamma y b} = C z^{-\sigma}$ for each b . Integrated over all B^e requires

$$C z^{-\sigma} \int_{\underline{b}}^{b^*} (A - b)^{\sigma-1} db = E, \quad (12)$$

where b^* is the root defined by proposition 1. Likewise, after substituting in n_b^* and q_b using equations (2) and (10), labor market clearing may be simplified as

$$1 - E = \int_{b^*}^{\bar{b}} C \left(\frac{b^{1-\theta}}{A\chi} \right)^{\frac{1-\sigma}{\theta}} db. \quad (13)$$

Unfortunately it is not possible to obtain algebraic solutions for w , z , and b^* even when making simplified assumptions for both the distributions of y and γ . However given parameter values, we can numerically solve for the roots of the 3 simultaneous equations (11)-(13) where the first equation must be solved for the appropriate root.

4 The Importance of Non-Pecuniary Benefits

In this section, we show that the introduction of non-pecuniary motives into our simple equilibrium model generates sharp implications for the relationships between earnings, productivity, wealth, and firm size that are consistent with the evidence we present in section 2 as well as additional established empirical regularities highlighted in the broader literature. As we highlight throughout this paper, the inferences drawn from these empirical regularities can be altered significantly if one fails to account for the potential of non-pecuniary benefits to small business formation.

For the remainder of the paper, we consider an example where y and γ are independently distributed as uniform random variables with supports $[\underline{y}, \bar{y}]$ and $[\underline{\gamma}, \bar{\gamma}]$. Independence imposes no *ex-ante* relationship between wealth y and tastes γ . If both y and γ have independent uniform distributions, then one can simplify the expressions for the aggregates

E and C as

$$E = \frac{\frac{1}{2} (w + 2\bar{y} + z) (\bar{\gamma} - \underline{\gamma}) - (w - z) \log\left(\frac{\bar{\gamma}}{\underline{\gamma}}\right)}{(\bar{y} - \underline{y}) (\bar{\gamma} - \underline{\gamma})},$$

when $y_{1\gamma}$ and $y_{2\gamma}$ are inside the support of y for all γ and

$$C = \frac{(w - z)^2 \log\left(\frac{\bar{\gamma}}{\underline{\gamma}}\right) - \frac{1}{2} (w^2 - z^2 + 2(w\underline{y} - z\bar{y})) (\bar{\gamma} - \underline{\gamma})}{(\bar{y} - \underline{y}) (\bar{\gamma} - \underline{\gamma})}.$$

4.1 Earnings Gaps and Aggregate Productivity

First, consistent with the empirical findings of [Hamilton \(2000\)](#), [Moskowitz and Vissing-Jørgensen \(2002\)](#) and [Pugsley \(2011\)](#) the model generates a gap in earnings between wage workers and business owners. The small business owners are willing to produce the good at a wage lower than they could have earned in the firm sector because they receive some of their compensation in the form of non-pecuniary benefits. The following proposition establishes that the pecuniary opportunity cost of running a small business is always positive in an equilibrium with a small business sector.

Proposition 2. *If $B^f \neq \emptyset$ and $\underline{\gamma} > 0$ then $w - z > 0$.*

Proof. Since B^f is non empty, at least some household type must be willing to work as an employee. That household is either marginal or an inframarginal employee. If the household is marginal then it satisfies (8) with equality. Since $\gamma > 0$ and $\lambda > 0$ then $w - z$ must also be positive. If the household is inframarginal and $E_{y\gamma} = 0$ then $\gamma < \lambda(w - z)$ and again $w - z$ must be positive. \square

Notice that this result does not rely on that labor that is less effective when operating a business instead of employed at a firm.

The existence of non-pecuniary benefits also informs the well documented relationship between wages and firm size. Many researchers have documented that workers in smaller firms earn less than workers in larger firms (see [Brown and Medoff, 1989](#)). In [Figure 6](#), we plot the equilibrium wage gap, normalized by total value added C , over alternative parametrizations of the distribution of γ . We show how the wage gap increases with the average strength of the non-pecuniary benefit. non-pecuniary compensating differentials for running a business are a key aspect of understanding the relationship between wages and firm size at least on the low end of the firm size distribution.

The wage gap is also tied to measured aggregate productivity. If there were no non-pecuniary motives and every household worked in the firm sector so $B^f = B$, average labor productivity AP (total value added / total hours) would equal w . We will continue to refer to this case as the “zero gamma” economy. With a small business sector:

$$AP = w - (w - z) E .$$

To see this we just integrate over all the households budget constraints. We can think of AP as a weighted average of income from either sector, or as the wage w adjusted for the wage gap $w - z$, as we have written here. Figure 7 plots how measured aggregate productivity also declines with the mean of the distribution of γ .¹³ For reference we plot aggregate productivity of the zero gamma economy as the dot on the vertical axis.¹⁴ As non-pecuniary motives become more important, the wage gap and the size of the small business sector E both grow, lowering AP . It is true that w also grows as wages adjust for a small firm labor supply, but this effect is always offset by the losses from $(w - z) E$, as we establish in the following proposition.

Proposition 3. *If $B^e \neq \emptyset$, and $\underline{\gamma} > 0$, then $\frac{\partial AP}{\partial E[\gamma]} < 0$.*

The proof of this claim relies on a careful application of the implicit function theorem. The resulting algebra is extremely tedious and lengthy and we omit it from the main text.

In summary, the simple model shows that the a model with non-pecuniary benefits will result in individuals in the firm sector earning higher pecuniary returns than workers in the self employed sector. This results in a very discrete relationship that implies a positive firm size/wage relationship. Finally, the extent of non-pecuniary benefits will affect measured labor productivity within the economy. Even though no technology parameters will change, differences in the distribution of non-pecuniary benefits across locations or across time will result in differences in measured labor productivity.

¹³We omit the plot for small values of $E[\gamma]$ to avoid complications from corner solutions for the wealth thresholds.

¹⁴With $\gamma = 0$, the equilibrium wage w_0 is easy to work out since $C = w$, you can show that

$$w_0 = \left(A (1 - \theta)^{1-\theta} \theta^\theta \right)^{\frac{1}{\theta}} \left(\int b^{\frac{(1-\theta)(1-\sigma)}{\theta}} db \right)^{\frac{1}{\sigma-1}} .$$

4.2 Wealth and Business Ownership

The second important implication of our model is that without any financial frictions, the model produces an increasing relationship between initial wealth y and the probability of owning a business E .

Proposition 4. *If $B^e \neq \emptyset$ then $\frac{\partial E_{\gamma y}}{\partial y} \geq 0$*

Proof. If the household is a worker, then $E_{\gamma y} = 0$ and $\frac{\partial E_{\gamma y}}{\partial y} = 0$. If the household is marginal, then $\frac{\partial E_{\gamma y}}{\partial y} = \frac{1}{w-z} > 0$ by the previous proposition, and when the household is an inframarginal entrepreneur, then $E_{\gamma y} = 1$ and $\frac{\partial E_{\gamma y}}{\partial y} = 0$. \square

An increasing relationship between wealth and entry is often interpreted as evidence of binding liquidity constraints for small business owners. The presence of non-pecuniary benefits raises questions about relying on such an identification strategy. Figure 8 plots the probability of business ownership $E_{y\gamma}$ over the wealth distribution. For each y we average over the conditional distribution $F(\gamma|y)$. For a particular value of γ the wealth cutoffs are relatively close together and the probability of entry is increasing linearly in y . However heterogeneity in γ makes E_y a smooth non linear function of y as these thresholds evolve over the entire distribution of γ . The shape of this relationship is consistent with Probit estimations of entry on wealth, see for example [Hurst and Lusardi \(2004\)](#). In our model, the probability is flat over a segment of the population that is not liquidity constrained. At low levels of initial income, the marginal utility of consumption is large relative to the marginal utility of the non-pecuniary benefits of business ownership. Likewise the wealthy pay an opportunity cost to run the business in the form lost wages because they enjoy running a business relative to other forms of consumption.

Again, this result undermines much of the empirical strategy performed by [Evans and Leighton \(1989\)](#), [Evans and Jovanovic \(1989\)](#), [Quadrini \(1999\)](#), [Gentry and Hubbard \(2004\)](#), [Cagetti and De Nardi \(2006\)](#), [Fairlie and Woodruff \(2007\)](#), [Fairlie and Krashinsky \(2006\)](#). In these models, the relationship between wealth and the probability of starting a business (or even exogenous changes in wealth and the probability of starting a business) are evidence that liquidity constraints bind. Our model yields the same predictions in a world with no financial frictions. If one takes the non-pecuniary benefits of owning a small business seriously, using the relationship between exogenous changes and wealth and the probability of starting a business as being de-facto evidence of liquidity constraints is invalid.

4.3 What Do Small Businesses Produce?

Third, the model of non-pecuniary benefits informs the type of goods we should observe a high concentration of small business owners. In our model, small business owner households only produce goods that would have been produced by small to medium scale firms. Recall that the interval $[b, b^*]$ defines the small business sector B^e . Then any factor that enlarges the size of the small business sector does so by increasing the equilibrium cutoff b^* . This tells us that if any $b \in B^e$ were to be produced by a firm in a competitive market, the firm would have a smaller efficient scale than any other firm producing in the firm sector b^f . This is consistent with the sorting we document in section 2 where most household owned businesses start in a very narrow set of industries that operate at a small scale in the long run. This results suggest that using the concentration of small businesses within a sector can inform researchers about the average returns to scale in that sector. To our knowledge, this approach has never been pursued to estimate the returns to scale across various industries.

Additionally, the magnitude of the distribution of non-pecuniary benefits has a direct impact on the size of the small business sector.

Proposition 5. *The size of B^e increases with $E[\gamma]$*

Proof. See Appendix □

To see how the small business sector B^e depends on the distribution of γ , Figure 9 plots the equilibrium cutoff b^* for various $E[\gamma]$ holding all other moments and parameters fixed. As non-pecuniary motives become more important, the small business sector grows by successfully competing with higher b firms. The firms costs are higher because of the tighter labor market, and entrepreneur households are willing to bear the additional cost in lost wages in return for the non-pecuniary compensation.

4.4 Distribution of Firm Size

Finally, the distribution of γ has important implications for the equilibrium cross sectional distribution of firms. Entrepreneur households draw business away from the small to medium size firms. This is the flip side of the previous point about b^* . Here we use a change of variables to express the density of firms as a function of size n . After a change of variables the density q may be written in terms of employment n as

$$q(n) \propto Cw^{-\sigma}n^{\sigma(\theta-1)-\theta} \quad n > 1.$$

where the constant of proportionality is $(A^\theta \theta)^{\sigma-1}$ and with a mass point of E at $n = 1$. Note that the firm size distribution for $n > 1$ satisfies Zipf's law when $\sigma > 1$, i.e., the density for n is Pareto with parameter $\sigma(\theta - 1) - \theta$. This is a robust feature of the distribution of firms in the U.S.¹⁵ In figure 10 we plot this distribution of firm sizes measured by employment n . For reference, we also include a dashed line representing the distribution of firms in a zero gamma economy. Perhaps in this picture it is especially clear that entrepreneur households specialize in the types of goods that would have been produced by smaller scale firms.

5 A Regressive Small Business Subsidy

In this section, we consider how a model of non-pecuniary benefits could inform the costs and benefits of subsidizing small business ownership. Despite their political appeal, the welfare calculus of a small business subsidy is not at all obvious. The importance of non-pecuniary benefits in the decision to become a small business owner makes this especially difficult. To make this point we introduce a very simple subsidy into our model funded by a lump sum tax levied equally across all households. We show that the redistributive role of this subsidy could actually benefit the wealthy at the expense of the poor. We want to stress that our model offers no reason for policy makers to want to subsidize small businesses. Our goal is to highlight (1) the potential costs of subsidies to small business owners and (2) the distributional effects of subsidizing small business owners. We realize that any costs must be weighed against potential benefits. Most of the literature focuses only on the benefit. We feel the model is well suited to highlight some of the costs.

To begin, we introduce a simple proportional subsidy to the model. An unsubsidized small business household producing b earns p_b per unit sold. we let s represent a proportional subsidy to small business households so that small business owners will instead earn $p_b(1 + s)$ per unit sold.¹⁶

We augment the earlier equilibrium definition to include the subsidy and a new requirement that the government balance its budget through a lump sum tax levied across all households.

Definition 2. With $P = 1$ and small business subsidy $s > 0$, given a distribution of households $F(\gamma, y)$ characterized by preference parameter γ and initial wealth y , and production

¹⁵See [Axtell \(2001\)](#).

¹⁶This subsidy may be interpreted as a $s(A - b)$ reduction in fixed operating costs b for each small business of type b .

technologies described by (3) and (1), a *two-sector subsidized competitive equilibrium* consists of the following:

1. A lump sum tax T , paid by all households
2. Wage w and intermediate good prices p_b
3. Allocations $c(\gamma, y)$ and $e(\gamma, y)$ that given prices w and p_b maximize (5) subject to (6) for households of type γ, y
4. Wealth cutoffs $y_{1\gamma}$ and $y_{2\gamma}$ that depend on γ such that

$$E_{y\gamma} \in \begin{cases} \{0\} & \text{if } y \leq y_{1\gamma} \\ [0, 1] & \text{if } y_{1\gamma} < y \leq y_{2\gamma} \\ \{1\} & \text{otherwise} \end{cases}$$

5. Allocations n_b that maximize firm profits given w and p_b for firms producing good b
6. A density of firms q_b producing b that may freely enter or exit the market
7. A cutoff $b^* \geq \underline{b}$ where if $b \geq b^*$ then $q_b > 0$ and $q_b = 0$ otherwise
8. Market clearing

(a) Final good market

$$\int \int c(\gamma, y) dF(y) dF(\gamma) = \left(\int_B x_b^{\frac{\sigma-1}{\sigma}} db \right)^{\frac{\sigma}{\sigma-1}}$$

(b) Intermediate good markets

$$x_b = q_b (An_b^\theta - b) \quad \text{when } b \geq b^*$$

and

$$\int_{\underline{b}}^{b^*} x_b db = \int \int \left(Ae(\gamma, y) - \int_{\underline{b}}^{b^*} b db \right) dF(y) dF(\gamma)$$

(c) Labor market

$$\int_B q_b n_b db = 1 - \int \int e(\gamma, y) dF(y) dF(\gamma) .$$

9. And the government balances its budget

$$T = \int (A - b) p_b (1 + s) E_b db . \quad (14)$$

We repeat the steps from section 3.4 to compute the equilibrium with a subsidy. In this case we must replace proprietor's income z with $(1 + s)z$ in equations(12) and (7), leaving (11) (where $z/A - b$ represents the selling price p_b) unchanged. Since E is linear in y , the government budget balance equation may be solved analytically for T as a function of w , $z(1 + s)$, and b^* . With all endogenous quantities as a function of w , $z(1 + s)$, and b^* , then given parameter values, these may be recovered as the roots of the 3 simultaneous equations using numerical solutions.

We take two approaches to quantify the welfare gains or losses from the subsidy. First we consider aggregate welfare, as measured by a utilitarian planner. Second, because the aggregate measure obscures some interesting redistribution, we look at the households' individual burdens computing an equivalent variation measure of the subsidy's cost.

Using the first approach, the model implies that small business subsidies reduce aggregate welfare. To see this, we define a utilitarian measure of aggregate welfare W_s as the equally weighted sum of each household's utility in equilibrium under subsidy $s \geq 0$.

$$W_s = \int \int (\log c_{y\gamma} + \gamma e_{y\gamma}) dF(y|\gamma) dF(\gamma) .$$

Figure 11 plots W_s as a function of s . The overall reduction in welfare is not surprising. In our example there are no market failures that would provide a beneficial role for a subsidy, and the unsubsidized competitive outcome is first best. With equal Pareto weights, the $s = 0$ allocation can be supported as a solution to a planning problem where increasing $s > 0$ simply distorts the allocation of labor across the two sectors. Holding $\text{Var}[\gamma]$ fixed, varying $E[\gamma]$ does not change the rate at which the subsidy trades off aggregate welfare. The more interesting result is the redistribution hidden behind the aggregate measure.

The existence of non-pecuniary motives makes the individual welfare effects of the subsidy highly non-linear. To study the household level effects of the subsidy we introduce a measure of equivalent variation. we compute $EV_{y\gamma}$ as

$$EV_{y\gamma}(s) = c(u_s; w, z) - (w + y)$$

where u_s is household y, γ equilibrium utility under subsidy s , and $c(u_s; w, z)$ is the minimum

expenditures required at the unsubsidized equilibrium prices w and z in order to achieve u_s and $(w + y)$ is the unsubsidized equilibrium expenditures (or total wealth). We normalize this measure by $w + y$ and express equivalent variation $EV_{y\gamma}/(w + y)$ as a fraction of the household's total wealth. Using the subsidized and unsubsidized equilibrium allocations we can compute this measure over the entire joint distribution of households to study the household level welfare costs of the subsidy.

Using this measure we find this simple small business subsidy to be regressive, actually benefiting wealthy business owners at the expense of wage employees. Figure 12 plots this welfare measure for the baseline case. The left panel plots the normalized EV measure over the entire joint distribution $F(y, \gamma)$ for a small subsidy policy $s = 0.05$. It is a little difficult to read the surface plot, but it is evident that for some households (with $EV/(w + y) > 0$) the subsidy is a net benefit. In the right hand plot we integrate over γ to recover

$$EV_y = \int EV_{y\gamma} dF(\gamma|y)$$

the total welfare gain or loss for all households with wealth y and plot this measure over the wealth distribution $F(y)$. We plot several policies ranging from a small subsidy $s = 0.05$ to a large subsidy $s = 0.25$. From this graph it is evident that even when summing across high and low γ households, wealthy households stand to benefit from a subsidy. Figure 13 makes this point more apparent by considering the three distributions of γ we have studied under a low subsidy in the left hand panel and a high subsidy in the right hand panel.

Part of the large welfare cost to the poorer households is driven by the lump sum taxation assumption. This is an extreme example where all households equally share the tax burden regardless of their total wealth $w + y$. A more progressive policy where tax rates are based on wealth could reverse this policy. In fact, poorer households' wage income actually increases. To see why consider the effect of a subsidy. It makes entrepreneurship more lucrative to all households. Many would have run businesses anyway, but some will switch from wage employment to business ownership constricting the labor supply. The downward sloping aggregate labor demand curve implies a higher equilibrium wage. In the lump sum taxation example, the modest increase in wages for poorer worker households is dominated by the additional tax burden needed to fund the subsidy.

These mechanics also give some intuition for the result that wealthy entrepreneur households stand to benefit from the subsidy. While the subsidy entices some worker households into a higher probability of business ownership, the effect on this margin is relatively small.

However, all business owning households stand to benefit from the subsidy, and the wealthy business owners who would have started their businesses anyway especially so. The best case scenario for them is a subsidy with small group of existing business owners, this way the individual benefit of the subsidy is not diluted by a larger tax needed to pay for a subsidy across a larger small business sector.

6 Implications

The goals of this paper were two fold. The first goal was empirical. In section 2, we expand on the work in [Hurst and Pugsley \(2011\)](#) using restricted-access administrative data in the Census LBD. We document the large amount of heterogeneity across narrow industries in the extent to which small businesses are important. For many narrow industries like dentists or florists almost all employment within the industry is in small businesses. For other narrow industries like natural gas pipelines and scheduled air transport, essentially none of the employment within the industry takes place within small businesses. Also, in section 2, we highlighted the fact that most young small businesses do not eventually grow, even conditional on survival for 10 or more years. Put another way, while most new and young businesses are small, most old businesses also remain small. The facts in section 2 are consistent with the facts documented [Haltiwanger, Jarmin, and Miranda \(2013\)](#) and [Hurst and Pugsley \(2011\)](#).

The second goal of the paper was theoretical. We developed a highly stylized and static equilibrium model of an economy with a small business sector. The model included three key elements. First, we allow for different industries of the economy to differ in their natural scale of production. In any industry firms may be incorporated or run by small business owners (households), where the only difference is small business owners are limited in their capacity to grow. This modeling choice was motivated by the facts presented in section 2 showing that the size of the small business sector differs markedly across industries, and further, that the vast majority of young small businesses become old small businesses conditional on their survival. Second, we allow at least some individuals to have a preference for owning and working in a small business over employment within a corporate firm. The magnitude of the utility flow may vary across the population. With no differences in skill, non-pecuniary benefits generated from a taste for small business ownership are the only source of selection. This modeling choice was motivated by the work of [Hurst and Pugsley \(2011\)](#) documenting that non-pecuniary benefits were a key driver of small business formation. Nevertheless the

relative value of the non-pecuniary versus pecuniary benefits will vary with the marginal utility of consumption. So third and finally, we allow individuals to differ in their initial wealth, generating dispersion in the equilibrium marginal utility of consumption across the population. Collectively, these assumptions yielded a variety of predictions about the small business sector that are consistent with the data. In particular, the model predicts: (1) small businesses are concentrated in a few industries, (2) higher wealth individuals are more likely to be small business owners, and (3) small business owners earn lower earnings on average relative to what they would have earned if they remained a wage/salary worker.

Our model abstracted from many of the common drivers of small business formation. For example, most of the existing research attributes differences across firms with respect to ex-post performance to either differences in financing constraints facing the firms (e.g., [Evans and Jovanovic \(1989\)](#) and [Clementi and Hopenhayn \(2006\)](#)), differences in ex-post productivity draws across the firms (e.g., [Simon and Bonini \(1958\)](#), [Jovanovic \(1982\)](#), [Pakes and Ericson \(1998\)](#), [Hopenhayn \(1992\)](#)), or differences in entrepreneurial ability of the firms owners (e.g., [Lucas Jr \(1978\)](#)). It is not that we do not believe these to be empirically important or that all of the model's predictions are reasonable. For example, the market structure generated adjustment in the quantity if individual goods sold entirely on the extensive margin of firm or small business entry. Instead, we offered a stark model to illustrate that preference heterogeneity alone yields many of the same predictions as models with heterogeneous entrepreneurial ability across individuals and liquidity constraints. It is straightforward to introduce differences in skill and liquidity constraints to the model, and [Pugsley \(2011\)](#) incorporates these features into dynamic model of the small business sector. One question we think is important going forward, also considered in [Pugsley \(2011\)](#), is what are the relative importance of the different factors in explaining both the mass of small businesses we observe in the data and why some firms grow while others do not? To be concrete, we think it is important to assess the relative importance of (1) non-pecuniary benefits, (2) technological differences in scall across industries, (3) differences in ex-ante entrepreneurial ability, (4) differences in ex-post luck, and (5) binding liquidity constraints in explaining the distribution of firm size within the economy. It is challenging to robustly differentiate these factors, and as we show, the policy and growth implications of these different factors differ markedly.

6.1 Modeling Needs

To facilitate testing among these different drivers of small business growth new models need be developed and new data brought to bear on the issue. Going forward we believe that traditional models of small business formation and growth should allow for heterogeneous non-pecuniary benefits of owning a small business across individuals in the population. Theoretically, the importance of non-pecuniary benefits can be distinguished from the other factors by examining earnings data. Individuals are willing to take lower pecuniary benefits (earnings) to run a small business if non-pecuniary benefits exist. However, the ability stories, the luck stories, and the liquidity constraints story all predict that earnings for those that remain business owners should be larger (in expectation) than they would be if the individual remained a wage/salary worker. By incorporating non-pecuniary benefits into standard models of firm dynamics, the models could then illustrate how wage data could be used to test among the various drivers of small business entry.

One attempt to do this was [Pugsley \(2011\)](#), which introduces preference heterogeneity to an otherwise standard model of entrepreneurship with credit frictions similar to [Cagetti and De Nardi \(2006\)](#). The preference heterogeneity, similar to the form in this paper, generates non-pecuniary compensation from business ownership that effectively shifts the productivity and wealth thresholds for which business ownership is viable. He uses the model to determine to what extent the distribution of firm size is driven by selection on tastes, and finds using the structural model that roughly 40 percent of the distribution of firms (all very small firms) would not be viable without some further non-pecuniary compensation from running the business. This helps the model fit the existence of small firms with relatively low exit rates and no growth that are traditionally harder to understand with pure productivity or credit friction driven distributions of firm size.

Additionally, it would be useful to amend our current models to allow for multiple sectors. As we illustrated in section 2, there is a large amount of heterogeneity in the firm size distribution across industries. By developing models with multiple sectors, richer predictions can be developed. The detailed industry level data can then be exploited to potentially test among some of the model ingredients.

6.2 Data Needs

With the advent of the restricted use Longitudinal Business Database (LBD), researchers have had access to a wealth of information about firm dynamics. As seen from our work

in Section 2, researchers can track employment at the establishment level for businesses of differing age across different sectors. Some measures of sales and total payroll can be merged into this data. However, these data do not contain much information about the owner(s) of the businesses. As seen above, one way to distinguish between the importance of non-pecuniary benefits and other factors in driving the firm size distribution is to measure the wages of the owner as they transition into and out of self employment. The LBD, in its current form, is not well suited to provide this information.

To examine the earnings movements of individuals as they transition in and out of business ownership researchers have relied on household surveys. Because of the need to follow an individual as they move in and out of business ownership panel data is necessary. Also, because business owners represent such a small fraction of the population, large samples are needed. Finally, the panel dimension of the data needs to be long enough to measure an individual's permanent income both before and after owning a business. Very few household surveys within the United States are constructed such that they are nationally representative, have large sample sizes, and have long panel dimensions. The Survey of Income and Program Participation (SIPP) is essentially the only household data set that meets this criteria. Even then, the panel component of the SIPP is relatively short (up to 4 years). As a result, essentially all work assessing whether individuals earn less as small business owners (or the self employed) relative to what they would have earned as wage/salary workers is done using the SIPP. For example, both [Hamilton \(2000\)](#) and [Pugsley \(2011\)](#) document that the median small business owner earns about 20-30 percent less than they would have as a wage/salary worker.

Even with the SIPP data, however, there are limitations to what can be done with the SIPP with regards to this question. First, as discussed in [Hurst and Pugsley \(2011\)](#), the self employed tend to underreport their income to household surveys (relative to wage/salary workers). Second, it is conceptually hard to measure the labor earnings of the self employed. How much of the reported earnings are the return to labor and how much are the return to capital? Third, household surveys often do not measure fringe benefits provided by the firm. If there are differences in fringe benefits provided by large employers to wage/salary workers relative to what is provided to the small business owner, earnings differences will be further mismeasured. Finally, most of the existing research does not measure well the variability of earnings of small business owners. Ideally, one would want to measure risk adjusted differences in earnings between the self employed and wage/salary workers. The work by [Hamilton \(2000\)](#) and [Pugsley \(2011\)](#) abstract from the potential differences in

measurement error in earnings between small business owners and wage/salary workers as well as differences in the variability of the earnings between the two groups.

Going forward, it would be useful to think about ways to better measure the earnings differentials of the self employed relative to wage/salary workers. Subjective survey questions, like those from the Panel Study of Entrepreneurial Dynamics, suggest that non-pecuniary benefits are an important driver of small business entry. However, it would be nice to quantify their importance. The only way we can see to do this is to measure the earnings differentials that occur as individuals transition into and out of small business ownership.

Finally, and perhaps the most useful would be to leverage the existing survey and administrative records to create matched databases available for researcher access. It may be technologically feasible to merge covariates of business owners identified in the SIPP into the LBD. Similarly, other Census-run survey instruments, such as the Current Population Survey, which is joint with the Bureau of Labor Statistics, could be linked to existing administrative data. A similar effort is already underway to link the SIPP to Social Security Administration records on lifetime earnings histories. These sorts of projects are cost-effective because they make use of the already existing (and very expensive) fielding of surveys.

6.3 Policy Implications

Policy makers on both the left and the right often discuss the importance of subsidizing small business formation. For example, the recent health care reform within the U.S. exempts small business (those with less than 50 full-time equivalent employees) from a mandate to provide their employees with health insurance. The U.S. Small Business Administration (SBA) in 2010 guaranteed over \$20 billion of loans to small businesses (primarily those with less than 500 employees).¹⁷ Looney (2011) outlines many other regulatory exemptions and preferential tax treatment provided to small businesses. For example, small business are also exempt from some provisions of the Americans with Disabilities Act (ADA) and some rules set forth by the Occupational Safety and Health Administration (OSHA).

Economic arguments for subsidizing small businesses hinge on small businesses being important contributors to aggregate innovation and growth where market forces alone fail to allocate sufficient resources to the sector. For example, the social returns from technological spillovers or improving communities may far exceed the private returns to the small business owner. Even absent positive spillovers, financial constraints may limit the scale of small businesses or whether or not they even form. The subject of entrepreneurship and technological

¹⁷See Adam Looney's published comments to [Hurst and Pugsley \(2011\)](#).

spillovers is well studied in the growth literature (e.g. [Audretsch, Keilbach, and Lehmann \(2006\)](#), [Acs et al. \(2009\)](#)). If a substantial portion of R&D occurs in small firms, the social returns to entrepreneurship could far exceed the private returns. [Jones and Williams \(1998\)](#), for example, find the optimal level of investment in R&D to be 2 to 4 times the observed level of investment. Additionally, subsidizing small businesses may be appropriate if liquidity constraints or other financial market imperfections prevent small businesses from securing the financing they need to bring their innovations to market ([Evans and Jovanovic \(1989\)](#); [Evans and Leighton \(1989\)](#)). While it is hard to think that the government can better allocate funding to small businesses than private lenders, the argument for governments trying to relax small business liquidity constraints is more persuasive if the social return to small business ownership is higher than the private return. Thus, there is some interaction between the two common economic justifications for subsidizing small businesses.

Policy makers, however, also believe that small businesses are the engines of economic growth. Recent research by [Haltiwanger, Jarmin, and Miranda \(2013\)](#) suggest that is the young firms not the small firms that are likely to grow. The work in [Haltiwanger, Jarmin, and Miranda \(2013\)](#) and our work above documents that most small firms do not grow. Additionally, our findings above, coupled with those in [Hurst and Pugsley \(2011\)](#), document that while it is young firms that contribute disproportionately to growth, most young firms also never grow. This fact remains true even conditional on the business surviving. So while young firms are more likely to grow than older firms, most firms conditional on survival never grow. Collectively, our work shows that in a world with non-pecuniary benefits of owning a small business, subsidies to small businesses may have little affect on business growth. Furthermore, as we document above, these subsidies may be regressive in that the wealthy may be more likely to purchase the consumption flow of small business ownership.

The fact that the non-pecuniary benefits of small business ownership are not taxed results in sectors where non-pecuniary benefits are a larger fraction of total compensation being tax preferred relative to other sectors. To the extent that small business ownership offers larger non-pecuniary benefits relative to owning a larger business or being a wage worker, the small business sector would be tax preferred even if there are no other direct subsidies offered by the government. Additionally, there is a large literature showing that small business owners are much more likely to underreport their income to tax authorities relative to wage and salary workers. Again, if it is easier to underreport income to tax authorities if one owns a small business, the small business sector again would be tax preferred relative to other sectors even if there are no additional direct small business subsidies.

The point we want to emphasize in this subsection is that while policy makers and researchers often invoke the potential benefits of direct small business subsidies, there is very little quantitative research documenting the actual benefits and costs of small business subsidies. The results in our paper suggest that the potential costs may be nontrivial. To our knowledge, there is no empirical work that evaluates whether subsidizing small businesses is a positive net present value venture. Addressing this question seems like a very important area for future research. Our work in this paper and the work in [Hurst and Pugsley \(2011\)](#) suggests that subsidies may be less distortionary if they were targeted at growth and innovation as opposed to being mostly linked to firm size. Such policies could address the concerns raised by our results in at least two ways. First, we show that most small businesses operate in industries with potentially smaller natural scales. Business owners with little intention to grow or innovate may select into these industries for that very reason. By focusing the subsidy on the intensive margin, the subsidy is more likely to be taken up by a business owner focused on growth or innovative activity. Subsidies could lower the cost of credit for existing firms, and by increasing their value entice productive entrepreneurs with high wage employment opportunity costs. Second, if non-pecuniary compensation is independent of the scale of the firm, the incidence of an expansion subsidy would be undistorted by non-pecuniary benefits. If anything, non-pecuniary benefits may help separate businesses that want to grow from businesses that would prefer to remain small. Of course there may be other social virtues to non-innovative small businesses, such as supporting communities and neighborhoods, which are aided by subsidizing the entry and exit margins. However, when targeting job creation or innovative risk taking, our findings suggest caution when supporting businesses purely by size.

In conclusion, our work suggests that more work is needed both empirically and theoretically to help policy makers assess the costs and benefits of subsidizing small business activity.

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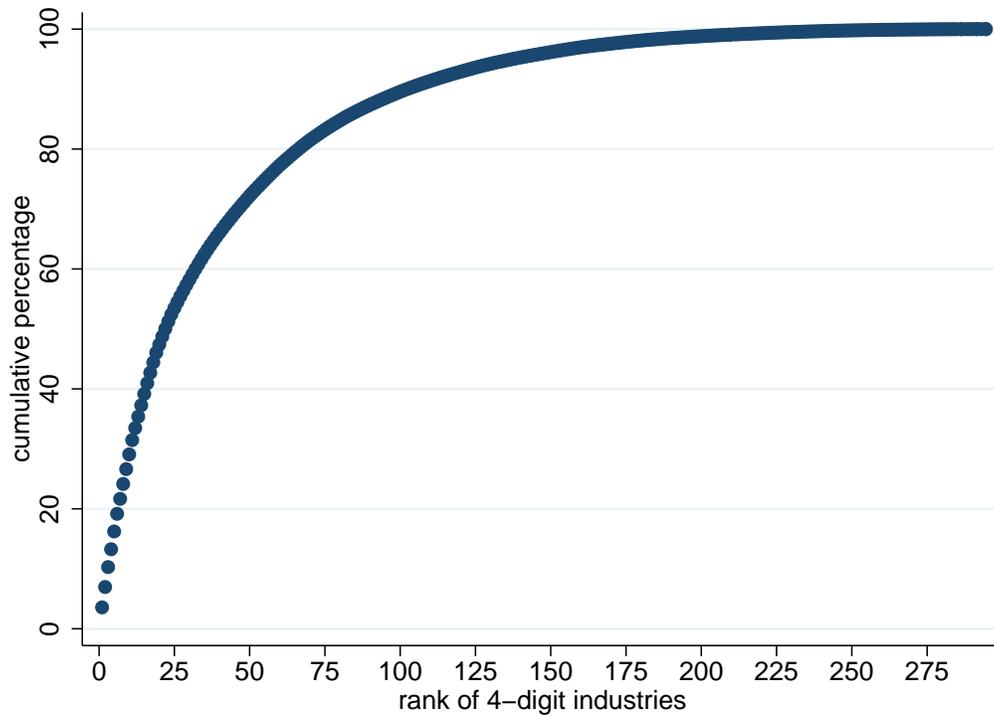
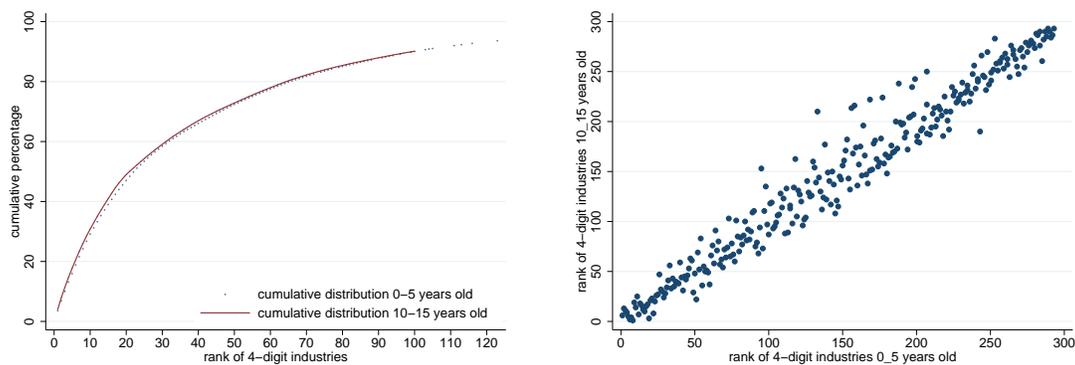


Figure 1: Cumulative distribution of x_j^n (on the y-axis) against the industry rank of x_n^j .

Notes: We select all firms with up to 20 employees. These firms are grouped by their 4-digit NAICS industry code. There are 295 such industries. Industries are then ranked by the average fraction of small businesses (out of all small businesses) that are in each industry. A rank of 1 means that industry had the largest fraction of small businesses (out of all small businesses). The rank is then plotted against the cumulative percentage of small businesses (out of all small businesses) in an industry of a given rank.



(a) Cumulative distribution by age group

(b) Industry ranks of young versus old firms

Figure 2: Comparing cumulative distribution and rank of x_j^n by age group

We select all firms with up to 20 employees. These firms are grouped by their 4-digit NAICS industry code, and age group (0 to 5 years old, and 10 to 15 years old). For each age group, industries are then ranked by the average fraction of small businesses (out of all small businesses) that are in each industry. A rank of 1 means that industry has the largest fraction of small businesses (out of all small businesses). The rank is then plotted against the cumulative percentage of small businesses (out of all small businesses) in an industry of a given rank. The figure plots the 100 industries with the highest fraction of small businesses with age 10-15 (out of all small businesses with age 10-15).

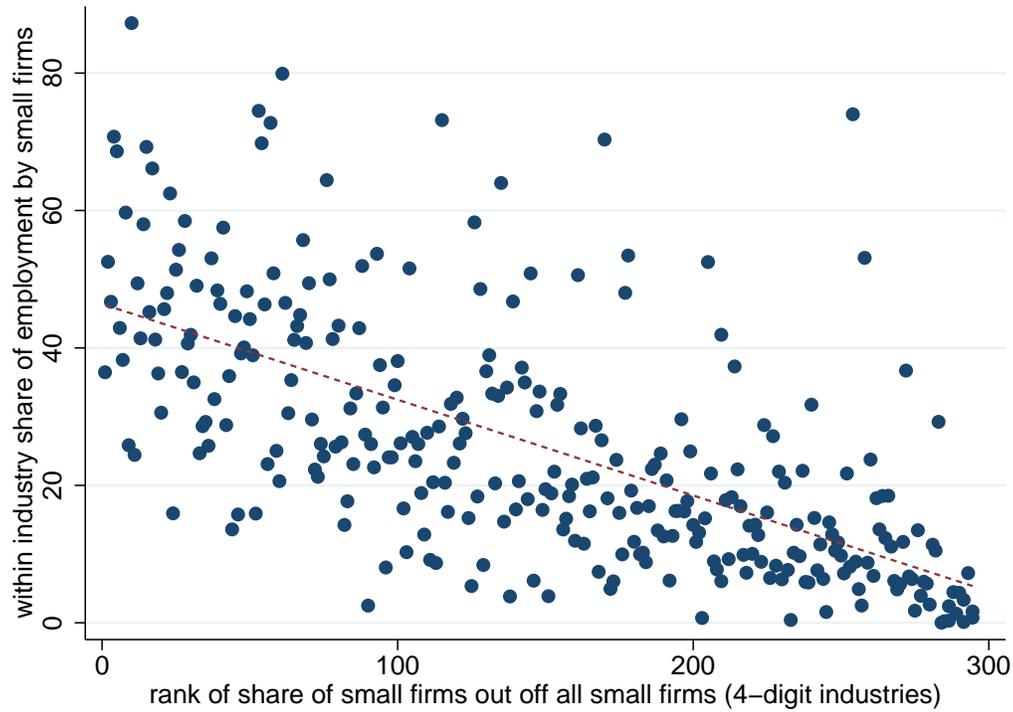


Figure 3: Rank of young firms versus level of y_j^e

Notes: Firms are grouped by their 4-digit NAICS industry code, age group, and size. For each age group (ages 0-5, and ages 10-15), we computed the percentage of small firms (up to 20 employees) in a given industry out of all firms in that industry y_h^e and the percentage of each industry's small firms out of all small firms x_j^e . For concerns regarding the disclosure rules of the Censes Bureau, we trimmed the sample of industries to those with fractions between percentile 2.5 and 97.5. For the sample industries, the figure plots the percentage of small firms (up to 20 employees) in a given industry out of all firms in that industry, for firms with ages 0-5 and ages 10-15. The line represents the 45-degree line.

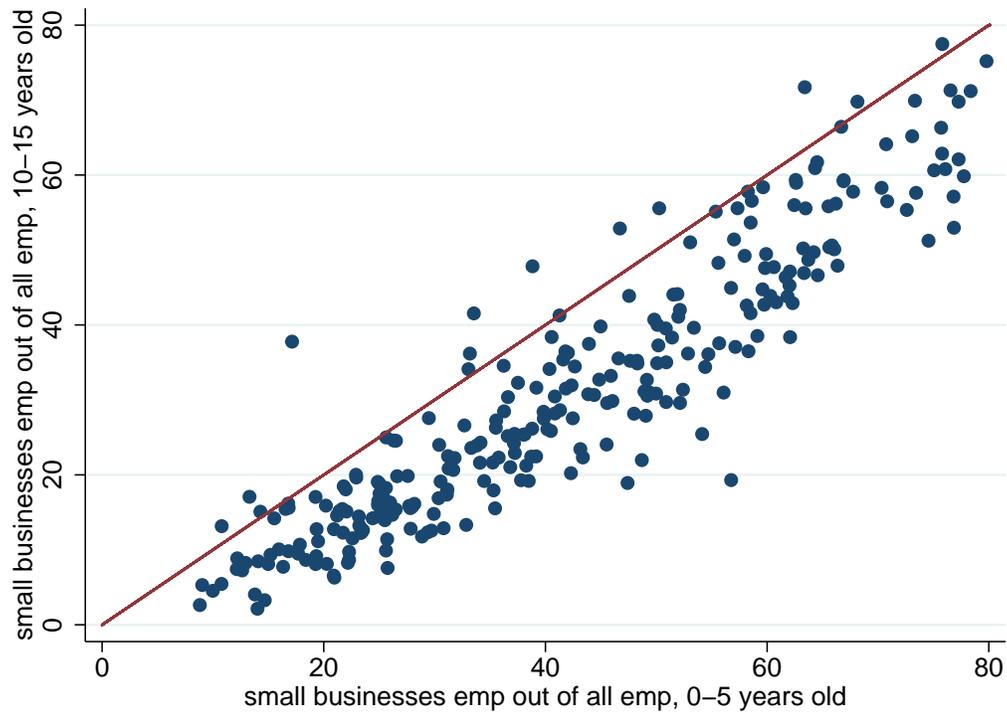


Figure 4: Small business share of total industry employment for young versus old firms

Notes: Firms are grouped by their 4-digit NAICS industry code, age group, and size. For each age group (ages 0-5, and ages 10-15), we computed the percentage of employment by small firms (up to 20 employees) in a given industry out of the employment of all firms in that industry. For concerns regarding the disclosure rules of the Censes Bureau we trimmed the sample of industries to those with fractions between percentile 2.5 and 97.5. For those industries, the figure plots the percentage of employment by small firms (up to 20 employees) in a given industry out of all employment in that industry, for firms with ages 0-5 and ages 10-15. The line represents the 45-degree line.

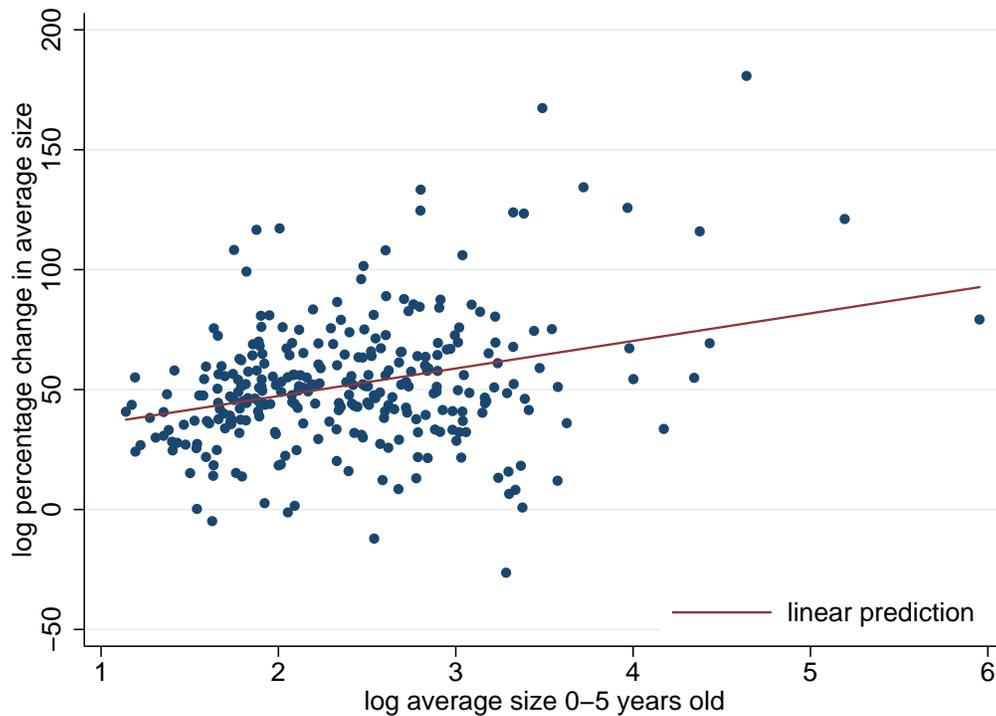


Figure 5: Industry average size and conditional growth rate

Notes: Firms are grouped by their 4-digit NAICS industry code, age group, and size. For each age group (ages 0-5, and ages 10-15) and industry, we computed the average size as total employment divided by total number of firms. The y-axis is the difference in logs between firms with age 10-15 and firms with age 0-5, multiplied by 100. The x-axis is the average size (logs) of young firms. Each dot represents that relation for each 4-digit NAICS industry. The line represents the linear fit of the log percentage change of size and the average size of young firms (ages 0-5).

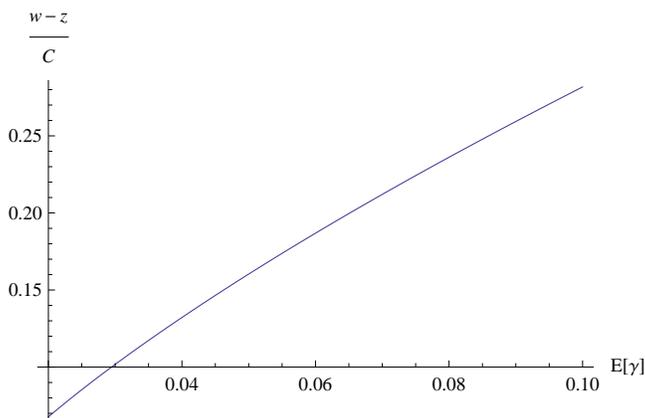


Figure 6: Wage gap (as a fraction of aggregate output), $\theta = 0.75$, $\underline{b} = 1$, $\bar{b} = 5$, $\sigma = 2$, $\underline{y} = 0$, $\bar{y} = 30$, $\bar{\gamma} - \underline{\gamma} = 0.02$.

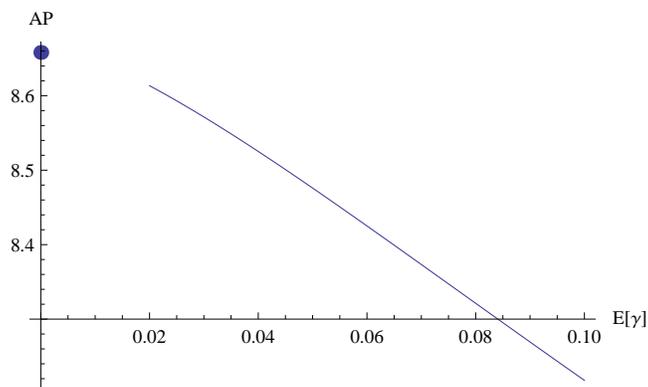


Figure 7: Average Product of Labor (AP), $\theta = 0.75$, $\underline{b} = 1$, $\bar{b} = 5$, $\sigma = 2$, $\underline{y} = 0$, $\bar{y} = 30$, $\bar{\gamma} - \underline{\gamma} = 0.02$.

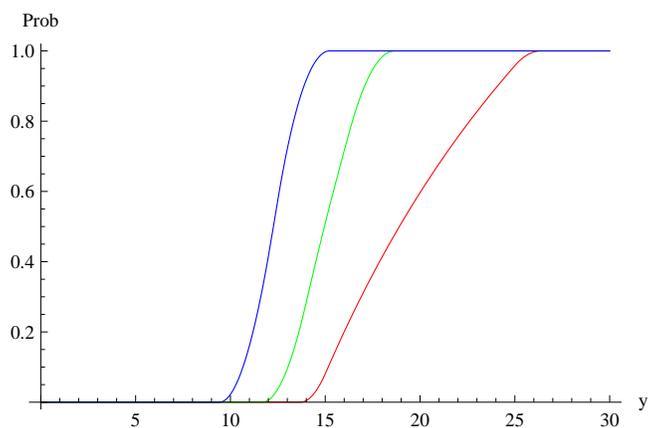


Figure 8: Probability of business ownership for y households, $\theta = 0.75$, $\underline{b} = 1$, $\bar{b} = 5$, $\sigma = 2$, $\underline{y} = 0$, $\bar{y} = 30$, $\bar{\gamma} - \underline{\gamma} = 0.02$, and with $E[\gamma] = 0.05$ (red), 0.10 (green), 0.15 (blue).

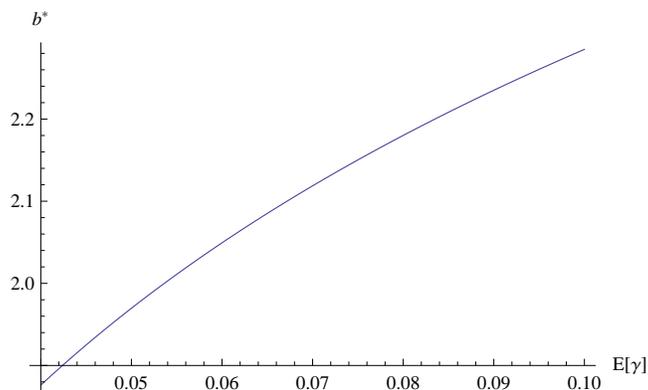


Figure 9: Small business cutoff b^* , $\theta = 0.75$, $\underline{b} = 1$, $\bar{b} = 5$, $\sigma = 2$, $\underline{y} = 0$, $\bar{y} = 30$, $\bar{\gamma} - \underline{\gamma} = 0.02$.

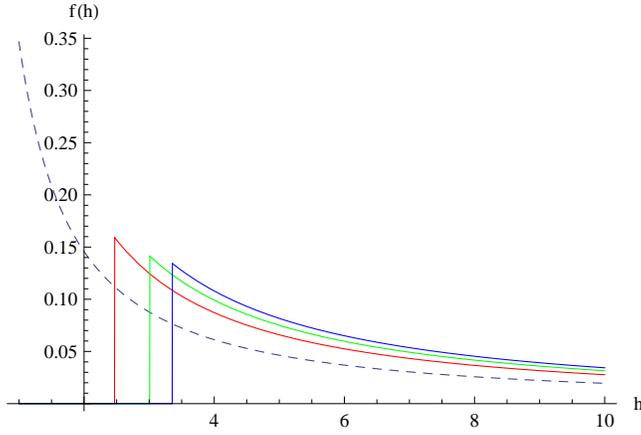


Figure 10: Distribution of firm sizes, $\theta = 0.75$, $\underline{b} = 1$, $\bar{b} = 5$, $\sigma = 2$, $\underline{y} = 0$, $\bar{y} = 30$, $\bar{\gamma} - \underline{\gamma} = 0.02$, and with $E[\gamma] = 0.05$ (red), 0.10 (green), 0.15 (blue). The dashed line represents the distribution of firms in the zero gamma economy.

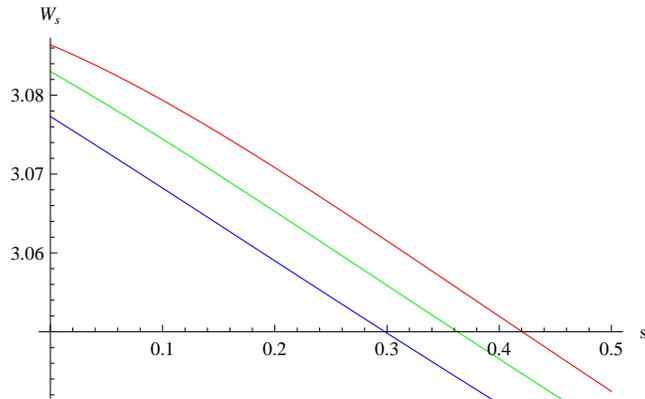
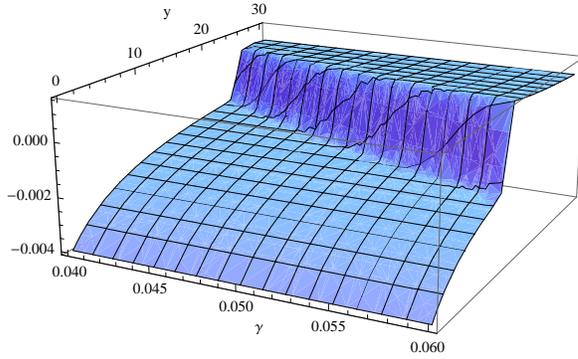
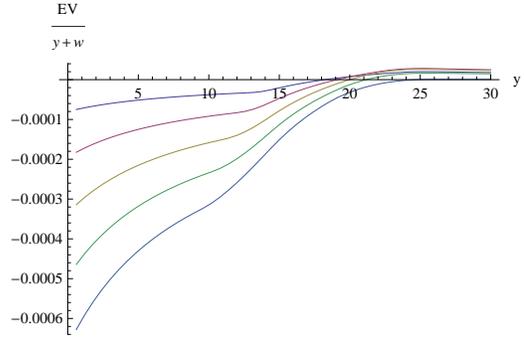


Figure 11: Aggregate welfare effect of small business subsidy $s \geq 0$, $\theta = 0.75$, $\underline{b} = 1$, $\bar{b} = 5$, $\sigma = 2$, $\underline{y} = 0$, $\bar{y} = 30$, $\bar{\gamma} - \underline{\gamma} = 0.02$, and with $E[\gamma] = 0.05$ (red), 0.10 (green), 0.15 (blue)

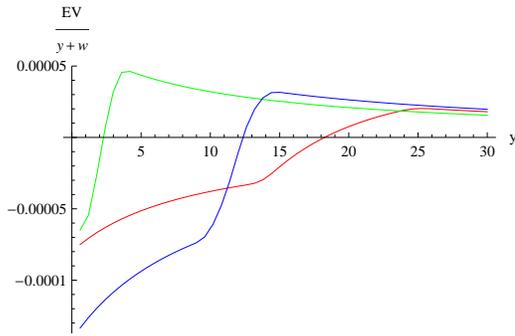


(a) $\frac{EV}{w+y}$ over $F(y, \gamma)$ for $s = 0.05$

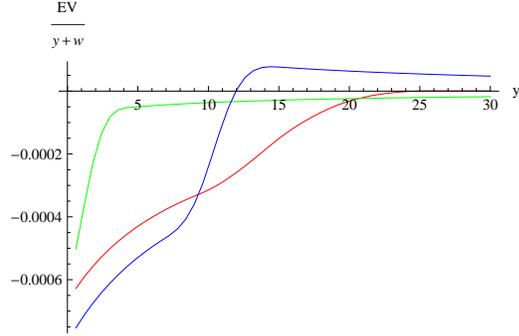


(b) $\frac{EV}{w+y}$ over $F(y)$ for $s = 0.05, 0.10, 0.15, 0.20,$ and 0.25

Figure 12: Equivalent variation as a fraction of full income ($w + y$) of subsidy s policies, $\theta = 0.75$, $\underline{b} = 1$, $\bar{b} = 5$, $\sigma = 2$, $\underline{y} = 0$, $\bar{y} = 30$, $\bar{\gamma} - \underline{\gamma} = 0.02$, and with $E[\gamma] = 0.05$.



(a) $\frac{EV}{w+y}$ over $F(y)$ for $s = 0.05$



(b) $\frac{EV}{w+y}$ over $F(y)$ for $s = 0.25$

Figure 13: Equivalent variation as a fraction of full income ($w + y$) of high and low subsidy s policies, $\theta = 0.75$, $\underline{b} = 1$, $\bar{b} = 5$, $\sigma = 2$, $\underline{y} = 0$, $\bar{y} = 30$, $\bar{\gamma} - \underline{\gamma} = 0.02$, and with $E[\gamma] = 0.05$ (red), 0.10 (green), 0.15 (blue)