From Population Growth to Firm Demographics: Implications for Concentration, Entrepreneurship and the Labor Share

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April 18, 2019

Abstract

The US economy has undergone a number of puzzling changes in recent decades. Large firms now account for a greater share of economic activity, new firms are being created at a slower rate, and workers are getting paid a smaller share of GDP. This paper shows that changes in population growth provide a unified quantitative explanation for these long-term changes. The mechanism goes through firm entry rates. A decrease in population growth lowers firm entry rates, shifting the firm-age distribution towards older firms. Heterogeneity across firm age groups combined with an aging firm distribution replicates the observed trends. Micro data show that an aging firm distribution fully explains i) the concentration of employment in large firms, ii) and trends in average firm size and exit rates, key determinants of the firm entry rate. Building on empirical work that documents a negative relationship between firm size and labor share, we show that firm aging increases the market share of larger firms, leading to a decline in the aggregate labor share.

J.E.L. Codes: J11, E13, E20, L16, L26

Keywords: Firm Dynamics, Entrepreneurship, Startup Rate, Demographics, Concentra-

tion, Labor Share

1 Introduction

Three long-term changes in the US economy have attracted a great deal of attention. First, economic activity is being concentrated in fewer firms. For example, the fraction of workers employed by large firms increased by 6 percentage points since 1978. Second, the entrepreneurship rate — the ratio of new firms to total firms — has nearly halved since the 1970s. Third, the share of GDP going to labor, once thought to be stable, has declined since 1975. What explains these changes?

Our analysis begins by highlighting the importance of firm demographics in driving these aggregate trends. We first document that the increase in employment concentration is entirely due to changes in firm demographics: an aging firm distribution combined with heterogeneity in employment concentration by firm age. The data shows that there has been no change in employment concentration within firm-age categories. However, across age-categories, older firms have higher employment concentration. Therefore a shift in the age distribution towards older firms drives the increase in concentration. Next, we show that changes in firm demographics can also completely account for changes in two related variables: average firm size and the aggregate firm exit rate. Conditional on age, these variables have not increased over time. Nevertheless, because older firms are larger and exit at lower rates, an aging firm distribution leads to an increase in average firm size and a decline in the aggregate exit rate.

Next, we turn to the entrepreneurship rate. A simple accounting identity shows that the firm entry rate is equal to the aggregate exit rate minus the growth in average firm size, plus labor force growth,¹

$$\underbrace{\lambda}_{\text{Entry Rate}} = \underbrace{\xi}_{\text{Exit Rate}} - \underbrace{\widehat{e}}_{\text{AFS Growth}} + \underbrace{\widehat{N}}_{\text{LF Growth}}.$$
(1)

The exit rate and average firm size are constant in stationary equilibria of standard firm dynamics models. Therefore, changes in labor force growth are a natural candidate to explain changes in the firm entry rate. Can a change in labor force growth, by itself, explain the drop in firm entry rates observed in the data? Qualitatively, yes. Quantitatively, no. US labor force growth has declined, but not by enough. Figure 1 shows US civilian labor force growth rates by decade. Since the 1970s, labor force growth has declined by 2pp, whereas the entry rate has declined by 6pp. The remaining 4pp decline in the entry

¹This identity comes from the definition of average firm size, $e \equiv N/M$, where N is the number of workers and M is the number of firms. It follows that the growth rate in the number of firms equals the growth rate of the labor force minus the growth rate of average firm size, $\widehat{M} = \widehat{N} - \widehat{e}$. The growth in the number of firms also depends on firm entry and exit, $\widehat{M} = \lambda - \xi$. Combining these two equations leads to accounting identity (1).

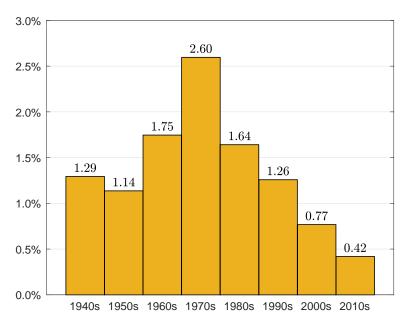


Figure 1: Civilian Labor Force Growth Rate

rate is accounted for by changes in the aggregate exit rate and changes in the growth rate of average firm size. A decline in labor force growth by itself can only account for a third of the decline in the firm entry rate. However, if the decline in labor force growth leads to changes in firm demographics, and therefore to changes in average firm size and aggregate exit rates, labor force growth can account for a larger extent of the decline in firm entry rates.

We show that changes in labor force growth lead to changes in firm demographics in a standard general equilibrium firm dynamics model. Consider an increase in labor force growth. To satisfy labor market clearing, the increase in labor supply must be met by a corresponding increase in labor demand. Incumbent firms are limited by scale, so they cannot absorb the entire increase in labor supply. The residual labor demand must therefore be satisfied by firm entry. Because total labor demand by incumbents depends on past entry, the history of past entry matters for current entry. As the entry rate changes, the age distribution of firms in the current, and therefore in future periods, is affected. However, a shift in the age distribution affects average firm size and aggregate exit only if there is heterogeneity in average firm size and exit by firm age. The standard model generates heterogeneity by firm age because it features selection and firm growth.

The calibrated model fed with the US labor force growth since the 1940s replicates the 6pp. fall in firm entry rates starting in 1978. The rapid rise in labor force growth from the 1940s to the 1970s, seen in Figure 1, amplifies the effects of the subsequent decline in labor force growth. The rapid increase in labor force growth generates a rapid increase in the entry rate and in the number of firms. As these entrants age, they grow in size and absorb

more labor, leaving less room for potential startups to fill when labor force growth declines. Because the history of past entry matters, both the rise and fall of labor force growth are important to generate the 6pp. decline in firm entry rates.

The calibrated model generates an increase of concentration similar to the data. Specifically, the share of employment of firms with 250 employees or more increases by 7pp. vs 6pp. in the data. As in the data, the increase in concentration is entirely due to an aging firm distribution: conditional on age, there is no change in the share of employment of firms with 250+ employees. The role of age vs. size in firm concentration can be seen in the evolution of the share of employment within age-size categories. If the increase in concentration was because of size, the share of employment in large firms should increase, regardless of age. That is not the case in the data. The share of employment of young-large firms declined by 3 percentage points whereas the share employment of mature-small firms increased by 4.5 percentage points. The increase in concentration is driven by age, not size. Our model generates these changes in the share of employment by age-size categories.

Finally, we turn to the labor share. In a recent paper Autor, Dorn, Katz, Patterson and Van Reenen (2017) use micro data to document two facts: (i) firm-level labor shares are negatively related to firm size; (ii) almost all of the decline in the aggregate labor share is due to between-firm reallocation rather than within-firm changes. They argue that an increase in the market share of superstar firms — large firms with low labor shares — is responsible. They propose that larger firms have lower labor shares because of lower overhead labor to employment ratios. We embed their mechanism in our framework and find that firm aging generates a decline in the aggregate labor share that is comparable to the one observed in the data. Because firm age and size are correlated, firm aging increases the market share of large firms, lowering the aggregate labor share.

We close by discussing the sources of labor force growth. We decompose labor force growth into three components: birth rates sixteen years prior, the growth in participation rate, and a residual term that captures rates of migration, death and institutionalization. We find that birth rates sixteen years prior account for the bulk of changes in labor force growth. We conclude that the rise and fall of labor force growth is primarily due to the baby boom.

Related Literature. Our paper builds on a wealth of recent empirical evidence from seemingly disconnected strands of the literature. One strand of the literature has documented changes in entry rates and the age distribution of firms. Reedy and Strom (2012) documents declining firm entry, while Pugsley and Şahin (2018), Decker, Haltiwanger, Jarmin and Miranda (2014), Hathaway and Litan (2014a), Gourio, Messer and Siemer (2015) and Davis and Haltiwanger (2014) document the pervasiveness of this decline across geographic ar-

eas and industries. Decker, Haltiwanger, Jarmin and Miranda (2014), Hathaway and Litan (2014b) and Pugsley and Şahin (2018) document the aging of the firm distribution and link it to declining firm entry. A different strand of the literature has documented trends in the aggregate labor share and the rise in concentration. Karabarbounis and Neiman (2014) find that the decline in the labor share is primarily a within-industry rather than a cross-industry phenomenon. Grullon, Larkin and Michaely (2017) document increased concentration across most U.S. industries, whereas Barkai (2017) and Autor, Dorn, Katz, Patterson and Van Reenen (2017) both document a positive correlation between industry concentration and the decline in the labor share. Our paper incorporates all of these empirical findings into one unified explanation.

We are not the first paper to propose the decline in labor force growth as an explanation for the decline in firm entry rates. Using lagged fertility rates as an instrument, Karahan, Pugsley and Şahin (2018) find that the entry rate is highly elastic to changes in labor supply across US states.² The authors then explore the role of labor force growth in the steady state of a Hopenhayn (1992a)-style model. There are two main differences between our papers. First, we aim to explain a broader set of facts, such as the increase in concentration and the decline of the labor share. Second our study focuses on transitional dynamics, allowing us to uncover how the history of past entry matters for current entry and firm demographics.

To the best of our knowledge, ours is the first paper that aims to jointly explain trends of entrepreneurship, concentration, and the labor share. Alternative explanations have been proposed for a subset of these trends.³ One related, but distinct, explanation is that of the aging of the workforce (Liang, Wang and Lazear, 2018; Kopecky, 2017; Engbom, 2017). We note that a decline in labor force growth is a different phenomenon than an aging workforce. Another explanation that has gained considerable attention is that of the rise in market power, as measured by increasing markups (Loecker and Eeckhout, 2017). Our framework features a competitive setting, and thus generates an increasing concentration without decreasing competition.⁴

The rest of the paper is organized as follows. Section 2 presents the data exploration,

²Hathaway and Litan (2014c) also note a correlation between declining firm entry rates and population growth across geographic regions. Other explanations for the decline in entrepreneurship include the decline in corporate taxes (Neira and Singhania, 2017), the decline in interest rates, (Liu, Mian and Sufi, 2018; Chatterjee and Eyigungor, 2018), and skill-biased technical change (Salgado, 2018; Jiang and Sohail, 2017).

³Explanations specific to the labor share decline include an increase in firm-level volatility (Hartman-Glaser, Lustig and Xiaolan, 2016), the treatment of intangible capital (Koh, Santaeulalia-Llopis and Zheng, 2015), the decline in the relative price of capital (Karabarbounis and Neiman, 2014), capital accumulation (Piketty and Zucman, 2014), and import competition and globalization (Elsby, Hobijn and Sahin, 2013).

⁴Rossi-Hansberg, Sarte and Trachter (2018) also show that increasing concentration at the aggregate level need not be generated by a decline in competition. They present evidence that the positive trend observed in national product-market concentration becomes a negative trend when focusing on measures of local concentration.

where we conclude that firm aging is primarily responsible for the change in average firm size, exit, and concentration. Section 3 develops the model and presents our theoretical results. Section 5 reports the calibration and the fit along non-targeted moments. Section 6 discusses the sources of labor force growth and the decline of manufacturing employment. Section 7 concludes.

2 Data

We obtain data on firms from the Business Dynamics Statistics (BDS) produced by the US Census Bureau. The BDS dataset has near universal coverage of private sector firms with paid employees in the US from 1977-2014.

We start by looking at the time series evolution of concentration, average firm size and the aggregate exit rate in US data; see top panel of Figure 2. We measure concentration as the share of employment by firms with 250+ employees. Figure 2 shows that concentration in the US has increased from about 51% to 57%. Average firm size in the US has increased steadily from about 20 employees to about 24 employees. The aggregate exit rate has declined steadily from about 9.5 percentage points to about 7.5 percentage points.

What is driving the aggregate trends? The bottom panel of Figure 2 shows concentration, average firm size and exit rates broken down by firm age over time. The figure shows that, conditional on age, these variables have changed little. For example, a typical five year old firm has the same size in 1980 and 2014, with no discernible trend. The same pattern holds for concentration and exit rates: conditional on age, concentration and exit rates do not exhibit a trend over the 1977-2014 time period. It follows that the aggregate trends in concentration, average firm size and exit rates are not being driven by changes in the corresponding variables within firm-age categories.

The bottom panel of Figure 2 also shows how each variable evolves with firm age. Concentration and average firm size increase with firm age. Firm exit rates decrease with firm age. These patterns suggest that changes in the age composition of firms drive the aggregate trend in each variable. In order to investigate this formally, we regress

$$y_{ajt} = \beta_0 + \beta_y \, year + \sum_a \beta_a \, age + \sum_j \beta_j \, sector + \sum_a \sum_j \beta_{aj} (age \times sector) + \varepsilon_{ajt}$$

where y_{ajt} equals the share of employment by firms with 250+ employees, log average firm size or firm exit rates. We start with a specification that features *year* with an intercept term.

⁵The increase in concentration is robust to the firm size cutoff. For size cutoffs of 5, 10, 20, 50, 100, 250, 500, 1000, 2500, 5000, and 10,000 employees, the share of employment has increased by 1.6, 3.1, 4.3, 5.4, 6.0, 5.7, 5.1, 4.6, 3.9, 3.1, and 2.4 percent, respectively.

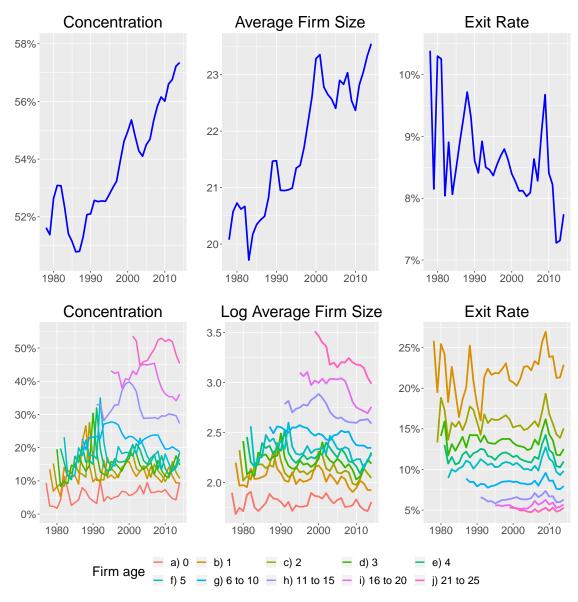


Figure 2

Source. US Business Dynamics Statistics.

Notes. Concentration is the share of employment in firms with 250+ employees. Concentration within an age category is share of employment in firms with 250+ employees within the age category divided by total employment in the age category. Average firm size is number of workers per firm.

The coefficient on *year* captures the aggregate trend in dependent variable. We then add age controls and see how the year coefficient changes. For the average firm size and firm exit rate regressions, we add further controls for sector and age-sector interaction effects in successive specifications.⁶

The regression results confirm that changes in the age composition drive the aggregate

⁶To protect the identity of firms, the Business Dynamics Statistics do not report data on share of employment by firm size, age and sector. Therefore, we cannot include controls for sector and age-sector interactions in the concentration regression.

trends. (The regression tables are presented in Tables 3-5 in Appendix B.) Without controls, the average trend across age groups and sectors in each variable is statistically significant and non-zero. Once we control for age, the trend disappears or reverses sign. The inclusion of controls for sector and age-sector interactions has no further effect on the trend. The coefficients on the age controls exhibit the same patterns as Figure 2: they increase with age for average firm size and concentration, and decrease with age for exit rates.

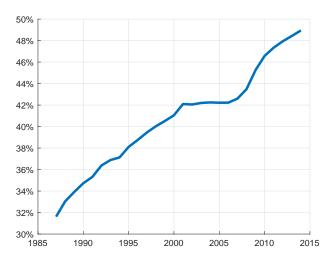


Figure 3: Share of Firms of Age 11+

Figure 3 presents direct evidence that US firms are aging. The figure shows that the share of firms aged 11+ has risen steadily from 32 percent in 1986 to 48 percent in 2014. Why are US firms aging? The next section presents a firm dynamics model that shows how changes in population growth can generate firm aging.

3 The Model

There is a single homogenous good and a fixed endowment of a resource (labor) N_t inelastically supplied that is also the numeraire. A production unit has production function $s_{it}f(n_{it})$ where s_{it} corresponds to a productivity shock, that follows a Markov process with conditional distribution $F(s_{t+1}|s_t)$, independent across firms. In addition, production units have a fixed cost c_f denominated in units of labor, which can include an entrepreneur and other labor overhead. If a production unit is shut down, its residual value is normalized to zero. All agents in the economy have common discount factor β .

Assumption 1. The conditional distribution F is continuous and strictly decreasing in s_t .

Let c(s,q) and $\pi(s,p)$ denote cost and profit functions derived from the above technology, where q is output and p the price of the good in terms of labor and let n(s,p) denote

labor demand. Assume the last two functions are continuous and strictly increasing in s and p. The value of a production unit is given by the Bellman equation:

$$v(s, \mathbf{p}_t) = \max \{0, \pi(s, p_t) + \beta E v(s', \mathbf{p}_{t+1}|s)\}$$

when confronted with a deterministic path of prices $\mathbf{p}_t = \{p_\tau\}_{\tau \geq t}$ Here zero is the value of exit while the right hand side under the maximization is the continuation value of this productive unit. As shown in Hopenhayn (1992b), the value function is strictly increasing in s and p_t when nonzero. Letting

$$s_t^* = \inf \{ s | \pi(s, p_t) + \beta Ev(s', \mathbf{p}_{t+1}|s) > 0 \},$$
 (2)

a production unit is shut down iff $s \leq s_t^*$.

The technology for entry of a new productive unit is as follows. Upon paying a cost of entry of c_e units of labor, the initial productivity is drawn from distribution G, independently across entrants and time. Prior to entry, the expected value of an entrant net of the entry cost

$$v^{e}\left(\mathbf{p}_{t}\right) = \int v\left(s, \mathbf{p}_{t}\right) dG\left(s\right) - c_{e}. \tag{3}$$

Let μ_t denote the measure of productive units operating at time t, where for a fixed set A of firm types, $\mu_t(A)$ measures the magnitude of firms that at time t have $s_{it} \in A$. Given an initial measure μ_0 , the exit thresholds s_t^* together with entry flows m_t determine uniquely the sequence of measures $\{\mu_t\}$ as follows. For any set of productivities A, define recursively

$$\mu_{t+1}(A) = m_{t+1} \left(\int_{s \in A, s \ge s_{t+1}^*} dG(s) \right) + \int \int_{s \in A, s \ge s_{t+1}^*} dF(s|x) \, d\mu(x)$$
 (4)

The first term in the right hand side corresponds to entrants, excluding those that exit immediately while the second term includes incumbents after the realization of new productivities, excluding those that exit.

3.1 Equilibrium

Let $M_t = \int d\mu_t(s)$ denote the total mass of firms. Denote by m_t the mass of entrants at time t. Labor market clearing requires that:

$$\int n(s, p_t) d\mu_t(s) + \int c_f(s) d\mu_t(s) + m_t c_e = N_t.$$
 (5)

The first term is productive labor demand, the second term overhead and the third labor utilized for entry, e.g. entrepreneurs in startups. The right hand side represents total labor inelastically supplied.

An equilibrium for a given sequence $\{N_t\}$ and given initial measure μ_0 is given by shutdown thresholds $\{s_t^*\}$, mass of entrants $\{m_t\}$, measures of production units $\{\mu_t\}$ and prices $\mathbf{p}_t = \{p_t\}$ such that:

- 1. Shutdown thresholds are given by equation (2);
- 2. No rents for entrants: $v^{e}(\mathbf{p}_{t}) \leq 0$ and $v^{e}(\mathbf{p}_{t}) m_{t} = 0$;
- 3. Market clearing condition (5) holds.
- 4. The sequence μ_t is generated recursively by equation (4) given the initial measure μ_0 .

Following Hopenhayn (1992b), there exists a unique equilibrium. It can be easily characterized when entry is strictly positive in every period, that is in reality the relevant case. Let p^* be a constant price such that $v^e(p^*) = 0$ for all t. Under the above assumptions this price is unique, corresponding to the stationary equilibrium price in Hopenhayn (1992b). Let $s_t^* = s^*$ be the corresponding shutdown threshold. Given the initial distribution μ_0 we derive recursively a sequence m_t^* so that the market clearing condition is satisfied in every period as follows.

Let S_n denote the probability that an entrant survives at least n periods, i.e. that the state $s_{i\tau} \ge s^*$ for ages τ from 0 to n. Let $\tilde{\mu}_n$ denote the cross-sectional probability distribution of productivities for production units in the age n cohort. These can be obtained recursively as follows:

- 1. Let $S_0 = (1 G(s^*))$ and $\tilde{\mu}_0(ds) = G(ds)/S_0$, that is the distribution for entrants draws G conditional on $s_0 \ge s^*$.
- 2. Let $S_n = S_{n-1} \int P(s_n \ge s^* | s_{n-1}) d\tilde{\mu}_{n-1}(s_{n-1})$, where the term under the integral is the probability that a productive unit in cohort n-1 is not shutdown in the next period, and let

$$\tilde{\mu}_n(ds) = \frac{\int P(ds_n|s_{n-1}) d\tilde{\mu}_{n-1}(s_{n-1})}{S_n/S_{n-1}}.$$

Let $\tilde{e}_n = \int (n(s, p^*) + c_f) d\tilde{\mu}_n$, the average employment of a productive unit in the cohort of age n. Total employment of that cohort at time t depends on the original number of entrants in that cohort and the survival rate, namely

$$E_{tn} = m_{t-n} S_n \tilde{e}_n$$

Thus at time t employment from incumbents (i.e. excluding new entrants) is given by $E_t^I = \sum_{1}^{t} E_{tn}$. Adding the employment of entrants $m_t (S_0 \tilde{e}_0 + c_e)$ we get the market clearing condition:

$$N_t = m_t \left(S_0 \tilde{e}_0 + c_e \right) + E_t^I. \tag{6}$$

This determines implicitly m_t , the only unknown in the above equation at time t. Provided that $E_t^I < N_t$, entry will be strictly positive in every period and all equilibrium conditions are satisfied. Assuming N_t is an increasing sequence, a sufficient condition for positive entry every period is that $N_t - E_{t+1}^I > 0$. Note that

$$N_t = m_t c_e + m_t S_0 \tilde{e}_0 + m_{t-1} S_1 \tilde{e}_1 + \dots + m_0 S_t \tilde{e}_t$$

$$E_{t+1}^I = m_t S_1 \tilde{e}_1 + m_{t-1} S_2 \tilde{e}_2 + \dots + m_0 S_{t+1} \tilde{e}_{t+1},$$

so E_{t+1}^I is the inner product of the same vector of the mass of entrants with a forward shift in the corresponding terms $S_n\tilde{e}_n$ and excluding entry costs. Thus a sufficient condition for entry to be positive every period is that the term $S_n\tilde{e}_n$ decreases with n. This condition says that, adjusting for differences in entry rates, the total employment of a cohort is decreasing in age. Survival rates are decreasing in n by definition but average size of a cohort, if properly calibrated to the data, is increasing. Thus shutdown rates must be sufficiently high to offset the latter growth. In the model, this is a property that depends on the stochastic process for the shocks s_{it} and the threshold s^* . But given these parameters its easy to verify.⁷

Proposition 1. Suppose that N_t is a nondecreasing sequence and $S_n\tilde{e}_n$ is non-increasing. Then the unique equilibrium has constant price $p_t = p^*$ and exit thresholds $s_t^* = s^*$.

Corollary 1. Under the Assumptions of Proposition 1, exit rates and average firm size, by cohorts are time invariant.

This Corollary implies that changes in aggregate entry and exit rates as well as average firm size will be driven only by changes in firm demographics, the age distribution of firms and the rate of increase in population.

3.2 The Turnover of Production Units

In this section we examine the determinants of aggregate rates of entry and exit and in particular the role of firm demographics, i.e. the age distribution of production units.

⁷Models that assume permanent productivity shocks and exogenous exit trivially satisfy this condition as well as the technology in Mortensen and Pissarides (1994) where productivity shocks are redrawn with some probability from the same distribution as entrants.

Total exit ξ_t at time t is the sum of exit masses of different age cohorts. Exit of productive units of age n equals the difference in survival rates between $S_{n-1} - S_n$ multiplied by the size of that cohort, that is the entry mass at the time that cohort entered, m_{t-n} . We follow here the convention that the age at which a unit is shut down corresponds to the age at which this unit was last productive. As for the new entrants, while the model allows for immediate exit we will consider that $m_t S_0$ is in practice the measure of entry in this economy and thus exclude $m_t (1 - S_0)$ from total exits. It follows that

$$\xi_t = \sum_{n=1}^t m_{t-n} (S_{n-1} - S_n)$$

The number of firms at t-1 is given by:

$$M_{t-1} = \sum_{n=1}^{t} m_{t-n} S_{n-1}$$

Letting α_{tn} denote the share of units of age n in the total population of productive units at time t and $h_{n-1} = (S_{n-1} - S_n)/S_{n-1}$ the hazard rate of exit of units of age n-1, the aggregate exit rate ξ_t/M_{t-1} can be expressed as the weighted average of different cohort hazard rates of exit

$$\xi_t/M_{t-1} = \sum_{n=1}^t \alpha_{t-1,n-1} h_{n-1}.$$

Taking these hazard rates as fixed, this is only a function of the age distribution of productive units, which in turn is determined by past entry rates. The exception of course is when exit rates are the same for all cohorts in which case firm demographics plays no role.

Consider now entry rates.⁸ Let $e_t = N_t/M_t$. It follows that the rate of growth in the number of firms

$$\frac{M_t}{M_{t-1}} = \frac{N_t}{N_{t-1}} \frac{e_{t-1}}{e_t}. (7)$$

Now the mass of productive units can be decomposed in incumbents that survived plus entrants. Letting \overline{S}_t denote the average survival rate from t-1 to t, it follows that

$$M_t = \overline{S}_t M_{t-1} + m_t S_0$$

Substituting from M_t in (7) gives the following expression for the entry rate:

$$\lambda_t = \frac{m_t S_0}{M_{t-1}} = \frac{N_t}{N_{t-1}} \frac{e_{t-1}}{e_t} - \overline{S}_t \tag{8}$$

⁸We are defining as $m_t S_0$ as "measured entry". Had we assumed that all entrants must remain at least one period in the market, then $S_0 = 1$ so m_t would then be measured entry.

In the special case where average employment is constant, this equation reduces to

$$\lambda_t = \frac{N_t - N_{t-1}}{N_{t-1}} + \frac{\xi_t}{M_{t-1}}$$

so the entry rate equals the sum of the population growth rate and the exit rate; as average firm size is constant, the total mass of firms needs to grow at the rate of population growth to clear the market. Entry rate must be enough to replace the exiting units and in addition create this extra employment. This justifies the above formula.

In a balanced growth path where population grows at a constant rate, cohort entry weights decay as a function of age at this rate and average firm size is constant. More precisely, if $N_{t+1}/N_t = \gamma$, then

$$N_t = m_t \sum_{n=0}^{\infty} \gamma^{-n} S_n \tilde{e}_n + m_t c_e$$

the total number of firms

$$M_t = m_t \sum_{n=0}^{\infty} \gamma^{-n} S_n$$

Exit at time t is $m_t \sum_{n=1}^{\infty} \gamma^{-n} (S_{n-1} - S_n)$ so the exit rate is given by

$$\xi_{t} = \frac{m_{t} \sum_{n=1}^{\infty} \gamma^{-n} (S_{n-1} - S_{n})}{M_{t-1}}$$

$$= \frac{m_{t} \sum_{n=1}^{\infty} \gamma^{-n} (S_{n-1} - S_{n})}{\gamma^{-1} M_{t}}$$

$$= \frac{\sum_{n=1}^{\infty} \gamma^{-n} (S_{n-1} - S_{n})}{\sum_{n=0}^{\infty} \gamma^{-n} S_{n}}.$$

Which is independent of *t* and so is the entry rate. The same holds in a model where productivity shocks are fully persistent or randomly redrawn from the same distribution as the one faced by entrants (as in Mortensen and Pissarides (1994)), average firm size is constant so the above formula applies. In particular this means that the rate of entry is independent of history and only depends on current population growth. If exit rates are not age dependent, the same will also be true for exit.

More generally, exit rates will depend on the age distribution of firms and thus the history of past entry. As conditional exit rates are decreasing in age, a larger share of young firms will be associated with higher exit rates and consequently higher entry. In addition, changes in average firm size will impact entry rates. A rise in entry rates will increase the share of younger productive units which tend to be smaller. This should lower average firm size, and from equation (8) increase the rate of entry. Thus a rise in population

growth will lead to increased entry rates over and above those needed to accommodate the increase in the labor force. This multiplier effect will operate similarly in the opposite direction when facing a decrease in the rate of growth in the labor force. Our main result is stated below.

Theorem 1. Assume conditional exit rates $(S_{n-1} - S_n)/S_{n-1}$ are decreasing in age, and average firm size \tilde{e}_n is increasing in age. An increase (decrease) in the rate of growth of the labor force will result in an increase (decrease) of entry rates over and beyond the rate of increase (decrease) in the labor force.

3.3 Temporary Increase in Population Growth

The results described in the previous section can be illustrated in the face of a temporary increase in the growth rate of the labor force. Suppose initially the labor force is stationary. It then grows at a constant rate γ for T periods to then return indefinitely to its initial zero level. The rate of exit is exogenous, so $S_n = (1-\delta)^n$ and average firm size \tilde{e}_n increases with the age of the cohort at rate g, so $\tilde{e}_n = (1+g)^n$ where $0 < g < \delta$. At the original steady state there is a mass M_0 if firms, so $m = \delta M_0$ and average firm size is $e_0 = \delta \tilde{e}_0 / (\delta - g)$. For long T, the rate of entry converges to $\lambda_T = \delta + \gamma$, the relative share of firms of the cohort of age n to $\left(\frac{\delta + \gamma}{1 + \gamma}\right) \left(\frac{1 - \delta}{1 + \gamma}\right)^n$ and average firm size to

$$\left(\frac{\delta+\gamma}{1+\gamma}\right)\sum\left(\frac{\left(1-\delta\right)\left(1+g\right)}{1+\gamma}\right)^{n}\tilde{e}_{0}=\left(\frac{\delta+\gamma}{1+\gamma-\left(1-\delta\right)\left(1+g\right)}\right)\tilde{e}_{0}$$

4 Quantitative Approach 1: Shift-share analysis

Ideally, we would find direct evidence of the mechanism using a shift-share decomposition. To do this, we need to observe both levels and shares of all age groups at the beginning and the end of the sample. The effect of aging could then be computed as the *between* effect. The problem with applying this approach is that we do not observe the age distribution of firms (levels or shares) of firms born before 1977. The BDS groups all such firms together in the Left Censored category. Because the Left Censored group ages substantially over the sample, aging in that group affects levels. Therefore the between effect does not isolate the role of aging.

In this section we run a shift-share style analysis, using two theoretical results to recover unobservable weights and levels in 1978. Our modeling framework implies that the dynamic entry equation XX can be used to recover the evolution of weights, given an initial distribution, hazard rates, and exogenous series of labor force growth. We therefore start

our evolution in 1940, which is as far back as we can the civilian labor force growth series allows. Corollary 1 tells us that in the constant price equilibrium exit rates, firm size and concentration by age is constant. This result implies that levels for the whole period can be infered from sample averages for observed levels, interpolation for in between values, and extrapolating right tail levels (those past age 25) for exit, size, and concentration. We achieve this extrapolation by setting the levels for ages 25 to 63 such that it matches 38 moments of size, exit and concentration of left-censored firms. The initial distribution in 1940 is calibrated to match the 38 employment weights of left censored firms. Two more parameters need to be assigned values. S_0 and c_e determine the volatility of the entry rate in the dynamic entry equation. Since only the ratio of the two matters, we normalize c_e to one and set S_0 to match the volatility of the entry rate.

Figure 4 shows our findings for the entry rate, average firm size, and concentration. The evolution of shares implied by changes in the civilian labor force growth rate track closely the shares of entrants, mature firms, and the employment share of mature firms. These changing shares generate increases in firm size and concentration similar to those observed in the data, and a decline in exit rates of similar magnitude of that observed in the data.

In the next section we calibrate a structural model and show that these weights and levels by age groups can be supported as equilibrium outcomes of a parsimonious firm dynamics model.

5 Quantitative Approach 2: Calibrate a structural model

The quantitative exercise is as follows. We assume the US economy was in a stationary equilibrium before the 1940s. We then feed the time series of the civilian labor force growth rate in the data, starting in 1940, through the model economy. We calibrate the model such that the model-implied time series match the data in 1978. This calibration strategy allows us to capture the effects of the rise and the fall in the labor force on firm demographics, without requiring firm-level data from the 1940s.

Functional forms. The production function of a firm is $f(s,n) = sn^{\alpha}$, where $0 < \alpha < 1$ captures decreasing returns to scale at the firm level. Firm productivity follows an AR(1) process:

$$\log(s_{t+1}) = \mu_s + \rho \log(s_t) + \varepsilon_{t+1}; \qquad \varepsilon_{t+1} \sim \mathcal{N}(0, \sigma_{\varepsilon}^2)$$
(9)

with ρ as the persistence, μ_s as the drift and σ_{ε}^2 as the variance of shocks. The distribution of startup productivities G is lognormal with mean s_0 and variance σ_0^2 . We allow overhead labor to increase linearly with firm size, $c_f(n) = c_{fa} + c_{fb}n$. This specification captures the

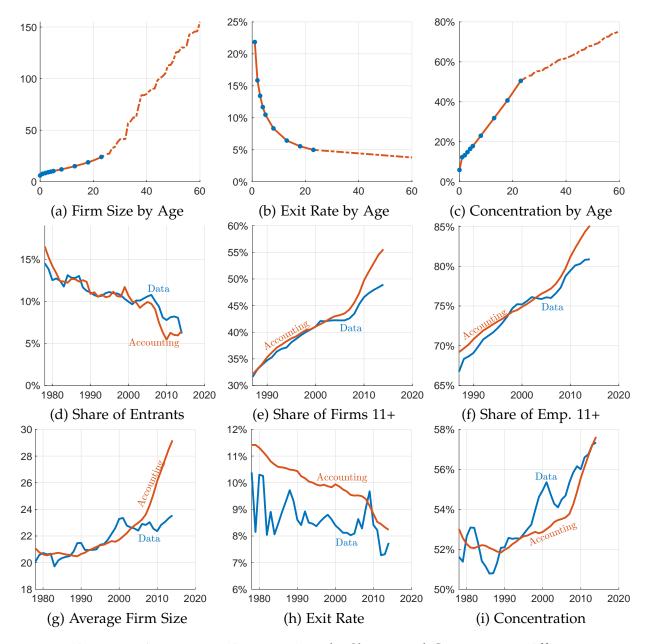


Figure 4: Accounting Exercise: Levels, Shares and Composition Effects

Notes. First row: Levels. Second row: Shares. Third row: Composition effects. The solid dots on the first row represent data. Values in between dots are interpolated. Dashed lines are extrapolations based on the techniques described in the text.

intuitive idea that overhead labor increases with the number of production workers in the firm.

Calibration. The model period is set to one year. The time discount factor is $\beta = 0.96$, which implies an annual interest rate of 4%. The worker's share of output, α , is set to the standard value of 0.64. The steady-state labor force growth rate g is set to the standard value of one percent.

The parameters c_e , c_{fa} , c_{fb} , μ_s , ρ , σ_{ε} , s_0 and σ_0 need to be calibrated. The entry cost parameter c_e is set such that $p^* = 1$. As discussed in Hopenhayn and Rogerson (1993), normalizing the equilibrium price gets around the identification problem that arises because price and the idiosyncratic shock enter the firm's objective function multiplicatively. The remaining parameters are calibrated to match the entry rate in 1978, the average size of entrants in 1978, average firm size in 1978, average concentration of entrants in the sample, unconditional 5-year firm exit rates and conditional 5-year firm growth rates.

We target the entry rate in 1978 in order to have a common starting point for the time series of the entry rate in the model and the data. We can then evaluate model performance by comparing how the two series evolve over the subsequent years. From the dynamic entry equation, matching the average entrant size in 1978 is necessary to match the entry rate in 1978, so we target this moment. Average entrant size in the model is constant over time. It is determined primarily by the s_0 , the mean of the entrant productivity distribution G. The dispersion σ_0 determines the thickness of the right tail of G, and therefore targets the concentration of entrants. The dispersion of the productivity process affects the weight on productivity gridpoints at which firms exit, so it primarily targets the 5-year exit rate. As with the entry rate, the average firm size in 1978 is targeted because we use 1978 as the common starting point for the model. The persistence parameter ρ determines how quickly firms grow, so we use it to target the 5-year growth rate of firms. The operating cost intercept parameter c_{fa} enters into the firm size calculation and plays an important role in determining average firm size. The operating cost slope parameter c_{fb} plays an important role in matching labor productivity dispersion, and so we set it to match the standard deviation of log labor productivity reported in Bartelsman, Haltiwanger and Scarpetta (2013). Table 1 summarizes the calibration targets in the model and the data along with the corresponding parameter values.

Results. As Table 1 shows, the parsimonious model does a good job of matching the targets.

Figure 5 shows how the model generated time series for the entry rate compares to the entry rate in the data. The figure includes the growth rate of the civilian labor force in the data that is fed through the model. The rise and fall of labor force growth is evident in the inverse U-shape observed in the data, with the peak around 1978. The entry rate follows the same inverse-U pattern. We are calibrating the model to 1978 only, so there is no apriori reason why the entry rate in the data for other years should match the model-implied series. As the figure shows, the model does an excellent job of matching key features of the data. The model generates the steady decline in the entry rate observed since the 1980s. The entry rate in the data declined from 14.52% to 7.67%, whereas the entry rate in the model

Table 1

Assigned					
	Value	Definition	Basis		
β	0.96	Discount factor	Standard		
α	0.64	Worker's share of output	Standard		
8	0.01	Labor force growth rate (SS)	Standard		

Jointly Calibrated							
Parameters			Moments				
	Value	Definition		Data	Model		
c_e	3e-7	Entry cost	$p^* = 1$				
c_{fa}	3.760	Operating cost intercept	Avg. firm size 1978	20.08	20.08		
c_{fb}	0.007	Operating cost slope	SD log-LP 1993-01	0.58	0.60		
s_0	-11.189	Mean of G	Avg. entrant size 1978	5.40	5.36		
σ_0^2	3.966	Variance of <i>G</i>	Avg. conc. of entrants	5.90%	5.87%		
μ_s	-0.025	Drift in AR(1)	Entry rate 1978	14.75%	14.33%		
ρ	0.973	Persistence of AR(1)	5-year growth rate	70.49%	73.82%		
$\sigma_{arepsilon}^2$	0.073	Variance of AR(1) shocks	5-year exit rate	48.42 %	45.83%		

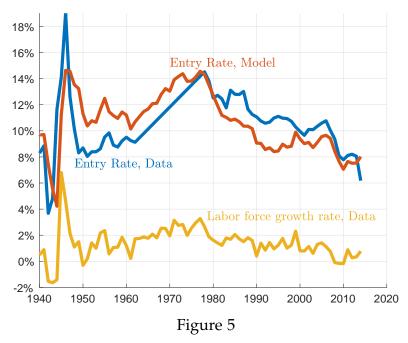
declined from 14.33% to 8.02%. Therefore the model generates almost all of the decline observed in the data.

The recent literature on the entry rate focuses on the steady decline observed in the data since 1978. As Figure 5 shows, the decline was preceded by an increase in the entry rate. The data exhibit a steady increase in the entry rate from 1950 to 1978. The model generates the increase in the entry rate observed in the data.

The civilian labor force growth rate dropped and then spiked during World War II. Figure 5 shows that there was a corresponding drop and spike in entry rate in both the model and the data. The ability of the calibrated model to match both the long term trends and short term fluctuations indicates that the central role of changes in the labor force growth rate in the evolution of the entry rate.

The entry rate declined by roughly 6 percentage points from its peak in 1978 to the 2010s. However, the labor force growth rate in the data declined by roughly 2 percentage points over the same time period. By the accounting identity (1), the remaining 4 percentage point decline must be accounted-for by the aggregate exit rate and by changes in average firm size. Figure ?? compares the model generated time series of average firm size, the aggregate

⁹Karahan, Pugsley and Şahin (2018) find that the entry rate for establishments increased from 1965 to 1978.



Notes. The entry rate from 1963 to 1977 is linearly interpolated. Sources. Entry rate 1940-1962: Survey of Current Business. Entry rate 1978-2014: Business Dynamics Statistics. Labor force growth 1940-1946: Lebergott (1964). Labor force growth 1947-2014: Current Population Survey.

exit rate and employment concentration to the data. As the figure shows, average firm size increases in both the data and the calibrated model. However, the model overshoots the magnitude of the increase. This occurs because average firm size by age in the model is constant over time, whereas the average size of firms aged 11+ declined after 2000 in the data. The model does an excellent job of matching the decline in exit rates and the increase in employment concentration observed in the data since 1978.



Table 2 presents exit rate and average firm size by firm age. Overall the model does an excellent job matching average exit rate by firm age. This is perhaps not very surpris-

ing, given that we are calibrating to the 5-year unconditional exit rate. The model slightly undershoots average firm size for younger firms and overshoots for older firms. The undershooting and overshooting is coming from a higher growth rate in the model than in the data. In the data, firm growth exhibits a discontinuity: the growth rate of 0-year old firms is almost twice that of 1-year olds, but the growth rate of 1-year olds is only slightly higher than 2-year olds. This discontinuity is absent in the model, so the model overshoots firm growth rates.

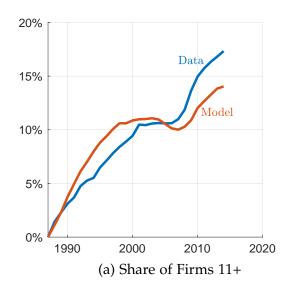
Table 2: Exit rate, average firm size and concentration by age in the data and model

Age	Exit rate		Average firm size		Concen	Concentration	
	Data(%)	Model(%)	Data	Model	Data(%)	Model(%)	
0	_	_	6.05	5.35	5.90	5.87	
1	21.85	29.22	7.73	6.01	12.29	7.53	
2	15.86	18.73	8.46	6.71	13.29	9.07	
3	13.43	14.53	9.14	7.47	14.83	10.68	
4	11.68	12.18	9.77	8.34	16.45	12.44	
5	10.48	10.66	10.36	9.29	17.84	14.43	
6-10	8.30	8.40	11.98	12.66	23.00	22.38	
11-15	6.40	6.47	15.08	20.52	31.85	37.62	
16-20	5.56	5.60	18.81	30.46	40.68	50.85	
21-25	4.99	5.12	24.03	41.43	50.47	60.25	
26+	4.29	4.53	81.59	72.70	78.91	73.90	

Given that the model does a good job of matching firm exit rates and average firm size by age, the ability of the model to match the change in the aggregate time series of these variables depends on how well it matches firm aging. Figure ?? shows the model generates similar aging as that observed in the data. The share of 11+ firms in the data increased by 17 percentage points in the data and by 13 percentage points in the model. The aging of the firms in the model is driven by the change in labor force growth: as the rate of labor force growth declines, the entry rate declines and the firm-age distribution shifts towards older firms.

5.1 Exploring the Mechanism: Counterfactuals

Firm demographics and the initial rise of labor force growth each have important quantitative roles in producing the benchmark results. Firm demographics generates a feedback effect. If older firms are larger and exit at a lower rate, the aging generated by an initial drop in the entry rate will lead to lower exit and higher average firm size, which decreases the entry rate further. The initial rise in labor force growth generates an increase in entry,



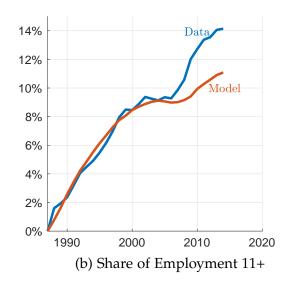


Figure 7: Cumulative Changes in Distribution

which is followed by an expansion of the pool of incumbents. As labor force growth slows down, incumbent growth exceeds labor force growth, leaving less room for new firms. We explore the quantitative effect of each of these amplifying forces by shutting each individually and recalibrating the model.

In the first counterfactual, we shut down firm demographics by shutting down the i.i.d. shock process. This is done by setting $\mu_s = 0$, $\rho = 1$ and $\sigma_\epsilon = 0$. The resulting transition matrix is the identity matrix, $F = \mathbf{I}$, implying that the productivity of a firm equals its productivity drawn at birth. Firms do not grow or shrink in this economy, and therefore do not exhibit differences in average firm size or exit rates across age groups. In the second counterfactual, we shut down the rise in labor force growth that preceded the decline. We do this by assuming the economy is at a stationary equilibrium in 1977, effectively assuming a constant labor force growth and entry rate pre-1978.

Figure 8 plots the entry rate counterfactuals along the benchmark and data. Shutting down the pre-1978 rise in labor force growth reduces the 6 percent entry rate decline to a 4 percent decline. Therefore the pre-1978 rise of labor force growth amplifies the decline of the entry rate by about 50 percent. Shutting down firm demographics reduces the entry rate decline to only 2 percentage points. Therefore, firm demographics triples the magnitude of the decline of the entry rate.

¹⁰We generate exit in this economy by assuming that all firms exit at a constant rate δ . We calibrate δ and mean of startup productivity distribution s_0 to match the entry rate and the average firm size in 1978. All other parameters, except c_e , equal their benchmark values. As in the benchmark, the entry cost c_e is set such that $p^* = 1$. The calibrated parameter values are $\delta = 12.02\%$, $s_0 = -3.63$ and $c_e = 0$.

¹¹The no-rise calibration has a steady state labor force growth rate of 2.65 percent, same as its 1978 value.

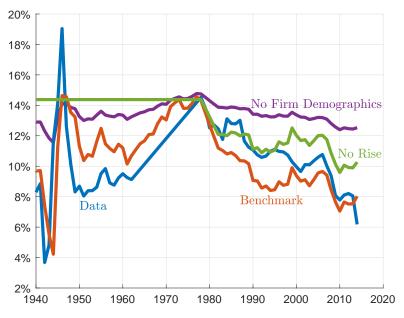


Figure 8: Entry Rate Counterfactuals

6 Discussion

In this section we explore the relationship between firm aging and the decline of the labor share. We also discuss the sources of labor force growth and alternative measure of labor supply.

6.1 Superstar Firms and the Aggregate Labor Share

Autor, Dorn, Katz, Patterson and Van Reenen (2017) document a negative relationship between firm size and firm labor share, and find that almost all of the decline of the labor share is due to between-firm reallocation rather than within-firm changes. These authors propose a model in which labor shares vary across firms because of overhead labor. A firm's labor share can be broken down into the share of value added paid to production workers and to overhead labor. In equilibrium, the share paid to production workers is equal to α for all firms. Therefore, all differences in firm level labor shares are due to the share paid to overhead labor. We have

Firm *i*'s labor share
$$= \alpha + \frac{wc_{fi}}{py_i} = \alpha \left(1 + \frac{c_{fi}}{n_i}\right)$$
 (10)

If overhead labor are identical across firms, $c_{fi} = c_f$, then firm-level labor shares are decreasing in firm size. In our calibration we allow c_{fi} to vary with firm size to capture the intuitive idea that larger firms have higher overhead labor. Nevertheless, we find that larger firms have lower labor shares because the ratio c_{fi}/n_i declines with firm size. Firm aging

reallocates market shares towards older firms, which are larger and have lower labor shares on average, leading to a decline in the labor share.

Figure 9 plots the cumulative change in the aggregate labor share in the model and the data. The aggregate labor share in the model is measured as the sum of firm-level labor shares, weighted by the value-added weight of the firm. Quantitatively, firm aging generates a large drop in the aggregate labor share. The labor share in the data declines by 6 percentage points, while that in the model declines by 5 percentage points.

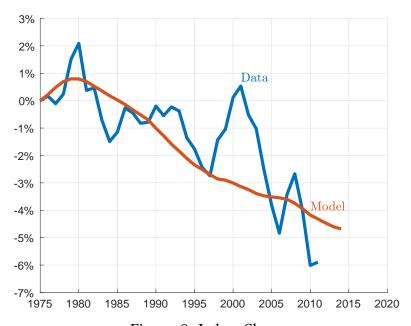


Figure 9: Labor Share

Source. Karababounis and Neiman (2014)

6.2 Sources of Labor Force Growth

What explains the rise and fall of labor force growth? To answer this question, we decompose labor force growth into each of its components. We start from the BLS' definition of labor force,

Labor Force_t = Civilian Noninstitutional Population Age 16 And Over_t × Participation Rate_t.

It follows that labor force growth rate is the sum of the growth rate of each component,

LF Growth Rate_t = CNP16 Growth Rate_t + PR Growth Rate_t.

We can further decompose CNP16 growth rate at time t into the birth rate at time t-16

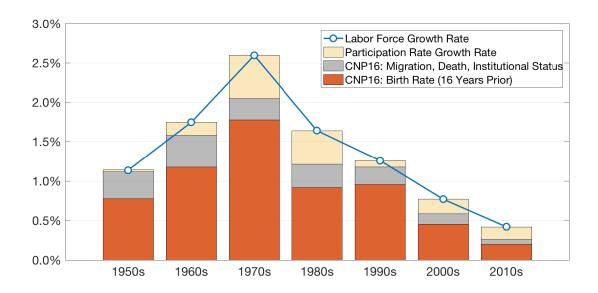


Figure 10: Decomposition of Labor Force Growth

and a residual term *Other*_t

where the *Other* term includes death rates, net migration rates, and rates of entry and exit into institutional status. Figure 10 plots labor force growth rate for each decade, dividing the bars into the percentage contribution of birth rates, growth rate of participation rates, and other. The decomposition shows that birth rates sixteen years prior account for the bulk of changes in labor force growth, accounting for an average of 64 percent of the labor force growth rate across decades.

The actual contribution of the birth rate to labor force growth is likely higher than 64 percent because the birth rate also has an effect on participation rates. For example, an important fraction of the decline of participation rates since the year 2000 is due to the baby boomer generation reaching the age of 55 and over, whose age group has low participation rates.

6.3 Alternative Measures of Labor Supply

One potential source of concern when using the civilian labor force as a measure of labor supply is that it includes the unemployed population, those employed by government, and the self-employed. Figure 11 shows that the pattern for total employment growth, which excludes unemployment, and for private sector employment growth, which excludes government and self-employment, follow a similar rise and fall pattern as labor force growth.

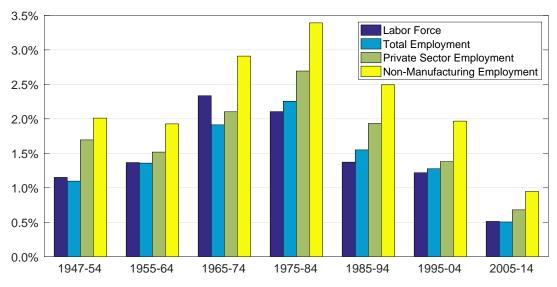


Figure 11: Growth Rates

Sources. Current Population Survey and Current Employment Statistics.

Notes. Data starts in 1947. Decade cutoffs are chosen so that full business cycles fall within the decade bin, effectively capturing the trend component in growth rates.

The manufacturing sector is another potential source of concern, as it has experienced overall negative employment growth since the 1980s (Fort, Pierce and Schott, 2018). This raises the possibility that an exodus of workers from manufacturing into non-manufacturing reverses the trend of declining employment growth in non-manufacturing sectors. Figure 11 shows that this is not the case. Non-manufacturing employment growth also follows a similar rise and fall pattern as labor force growth.

The decline of manufacturing employment does not have a large effect on non-manufacturing employment growth partly because the flow of workers out of manufacturing is small compared to the flows of workers entering the labor force. From 1977 to 2014, manufacturing employment shrank by 6 million workers while the labor force grew by 57 million and total employment grew by 54 million workers.

7 Conclusion

Recent decades have witnessed an increase in concentration and average firm size, and a decline in firm entry, exit rates and the labor share. We show that the interplay of population growth and firm demographics can account for much of these trends. We study the transitional dynamics generated by feeding observed labor force growth rates through a standard general equilibrium firm dynamics model. We emphasize the role of firm demographics as well as the role of the rise of labor force from the 1940s to 1970s in amplifying subsequent changes in aggregate trends. Overall, our paper provides a unified quantitative

explanation for a set of apparently disparate trends.

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Appendix A Data Appendix

Civilian Labor Force Growth Rate 1940-2014. We obtain civilian labor force data from the Bureau of Labor Statistics (BLS) Current Population Survey for the years 1947 to 2014, and from Lebergott (1964) from 1940 to 1946. The civilian labor force definition in BLS includes population 16 years of age and over while in Lebergott the definition includes population 14 years of age and over. We can use Lebergott's series from 1947 to 1960 to compare the difference in growth rates using either definition. Figure 12 shows that the labor force growth rates of ages 14+ and 16+ are nearly identical.

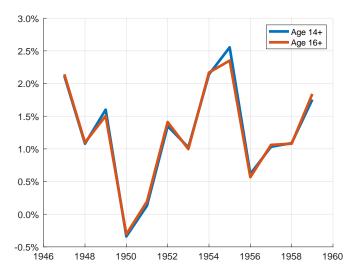


Figure 12: US Civilian Labor Force Growth Rate

Firm-level data 1978-2014. Data to calculate firm-level data comes from the **U.S. Census Bureau**'s Business Dynamics Statistics (BDS). The BDS dataset has near universal coverage of private sector firms with paid employees. BDS data starts in 1977, but best practice suggests dropping 1977 and 1978 due to suspected measurement error (e.g. Moscarini and Postel-Vinay, 2012). We drop 1977, but keep 1978, as calibrating to 1978 or 1979 does not affect our quantitative results (the model matches the startup rate in both 1978 and 1979 almost exactly).

Firm Entry Rates 1940-1962. The firm entry rate from 1940 to 1962 is obtained from the now-discontinued U.S. Department of Commerce's Survey of Current Business. The entry rate is 'New Businesses' divided by 'Operating Businesses'. The 1963 edition was the last one to report a 'Business Population and Turnover' section. From 1963, the Survey of Current Business reported instead 'Business Incorporations', which only include stock corporations. All nonfarm businesses are included, regardless of size.

Birth Rates. The 1930 to 2000 birth rate series is from the CDC National Center for Health Statistics.

Employment 1947-2014. Total employment corresponds to the civilian employment in the BLS Current Population Survey. Private sector employment and manufacturing employment are from the BLS Current Employment Statistics (Establishment Survey). Non-manufacturing employment is private sector employment minus manufacturing employment.

Appendix B Firm Age Regressions

Table 3: Regression of concentration (employment share of firms sized 250+) on year

Variable	Specification			
	(1)	(2)		
Year	0.003***	-0.000		
	(0.001)	(0.000)		
AGE:				
Age 0		0.065***		
O		(0.007)		
Age 1		0.129***		
		(0.007)		
Age 2		0.139***		
		(0.007)		
Age 3		0.154***		
A 4	(0.007) 0.171***			
Age 4				
Age 5		(0.008) 0.185***		
Age 3		(0.008)		
Age 6 to 10		0.237***		
1160 0 10 10		(0.009)		
Age 11 to 15		0.326***		
O		(0.009)		
Age 16 to 20		0.415***		
		(0.010)		
Age 21 to 25		0.514***		
2		(0.011)		
R^2	0.026	0.976		
Observations	351	301		

^{***} p < 0.01; ** p < 0.05; * p < 0.1

Table 4: Regression of log average firm size on year

Variable	Specification			
	(1)	(2)	(3)	(4)
Year	0.009***	-0.005***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.000)	(0.000)
AGE:				
Age 0		1.844***	1.442***	1.465***
		(0.023)	(0.014)	(0.025)
Age 1		2.089***	1.687***	1.724***
		(0.023)	(0.015)	(0.025)
Age 2		2.179***	1.777***	1.814***
		(0.024)	(0.015)	(0.026)
Age 3		2.256***	1.854***	1.876***
		(0.024)	(0.015)	(0.026)
Age 4		2.327***	1.925***	1.949***
		(0.025)	(0.015)	(0.027)
Age 5		2.386***	1.984***	2.010***
_		(0.025)	(0.015)	(0.027)
Age 6 to 10		2.534***	2.132***	2.167***
		(0.028)	(0.016)	(0.029)
Age 11 to 15		2.756***	2.354***	2.331***
		(0.030)	(0.017)	(0.032)
Age 16 to 20		2.985***	2.583***	2.480***
<u> </u>		(0.033)	(0.018)	(0.035)
Age 21 to 25		3.258***	2.857***	2.586***
G		(0.036)	(0.020)	(0.039)
SECTOR CONTROLS	No	No	Yes	Yes
SECTOR×AGE CONTROLS	No	No	No	Yes
Observations	3,159	2,709	2,709	2,709
R^2	0.014	0.978	0.995	0.996

^{***} *p* < 0.01; ** *p* < 0.05; * *p* < 0.1

Table 5: Regression of exit rate on year

Variable	Specification			
	(1)	(2)	(3)	(4)
Year	-0.146***	-0.014**	-0.014***	-0.014***
	(0.011)	(0.006)	(0.005)	(0.005)
AGE:				
Age 1		21.967***	19.577***	19.304***
		(0.182)	(0.191)	(0.341)
Age 2		16.227***	13.837***	12.786***
		(0.186)	(0.193)	(0.346)
Age 3		13.758***	11.369***	10.850***
		(0.189)	(0.195)	(0.352)
Age 4		12.115***	9.726***	9.466***
		(0.193)	(0.198)	(0.357)
Age 5		10.842***	8.452***	8.419***
		(0.196)	(0.200)	(0.363)
Age 6 to 10		8.743***	6.353***	6.791***
		(0.216)	(0.212)	(0.395)
Age 11 to 15		6.814***	4.425***	5.263***
		(0.234)	(0.224)	(0.426)
Age 16 to 20		6.010***	3.620***	4.691***
		(0.254)	(0.238)	(0.466)
Age 21 to 25		5.531***	3.142***	4.535***
		(0.280)	(0.256)	(0.520)
SECTOR CONTROLS	No	No	Yes	Yes
SECTOR×AGE CONTROLS	No	No	No	Yes
Observations	2,817	2,367	2,367	2,367
R^2	0.061	0.962	0.975	0.978

^{***} *p* < 0.01; ** *p* < 0.05; * *p* < 0.1