

Technical Change and Entrepreneurship*

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February 14, 2019

Abstract

The proportion of entrepreneurs in the US working-age population has declined over the last three decades. Over the same period, there has been a substantial increase in the returns to highly educated workers. This paper relates these two facts. Using individual-level data, I provide evidence on the decline in the population share of entrepreneurs and in the entry rate into entrepreneurship. I also show that the decline is most concentrated among college graduates. Then, using an otherwise standard entrepreneurial choice model with two skill groups of individuals, I show that the decline in entrepreneurship is the equilibrium outcome of two forces that have increased the returns to high skill labor: the skill-biased technical change and the decrease in the cost of capital goods. I find that these two technological forces jointly account for three-quarters of the decline in the share of entrepreneurs observed in the United States over the last 30 years.

Keywords: Productivity, Skill Premium, Entrepreneurship, Occupational Choice

JEL Classification: E21, J24, O33, L26

*I am extremely grateful to my advisors, Fatih Guvenen, Patrick J. Kehoe, and Elena Pastorino for many helpful comments and encouragement. I also thank Nicholas Bloom, Simone Civalé, Luis Díez-Catalán, Carlos Garriga, Eugenia González-Aguado, Parisa Kamali, Sergio Ocampo, John Shea, Guillaume Sublet, Tasaneeya Viratyosin, and seminar participants at the Macro-Labor Workshop at the University of Minnesota, the Innovation and Inequality Workshop at the University of Washington in St. Louis (October 2017), Minneapolis Fed, Dallas Fed, University of Maryland, UC San Diego, UCLA, Georgetown, and Wharton for helpful comments and discussions.

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1 Introduction

Entrepreneurs are widely considered the backbone of the US economy. However, an increasing number of studies document a significant decline in the pace of formation of new businesses and other measures of entrepreneurship starting in the early 1980s.¹ This decrease in entrepreneurship is at the center of the decline in dynamism experienced by the US economy in recent decades (Davis and Haltiwanger, 2014). This has raised concern among scholars and policymakers because of the importance of entrepreneurs for productivity and economic growth.²

Previous researchers have proposed that the decline in firm creation maybe be driven by an increase in the cost to start a firm, stemming possibly from an increase in regulation (Davis and Haltiwanger, 2014), or a shift towards an older population (Karahana, Pugsley and Sahin, 2016). However, in this paper I propose that the decline in entrepreneurship is the equilibrium response to technological improvements that have changed the incentives of individuals to start their own business. In particular, I show that the same aggregate forces that have resulted in an increase in the returns to high skill labor, namely, the skill-biased technical change (Krueger, 1993) and the decrease in the cost of capital goods (Krusell, Ohanian, Ríos-Rull and Violante, 2000), account for a significant fraction of the decrease in entrepreneurship observed in the United States since the mid-1980s.³

The first contribution of this paper is to provide new evidence on the decline of entrepreneurship experienced by the US economy over the last three decades. Using individual-level data from the Panel Study of Income Dynamics (PSID) I show that the decline in the pace of firm creation has been accompanied by a decline in the share of entrepreneurs in the US working-age population. Specifically, I show that the population share of entrepreneurs declined from 7.8% in 1985 to 3.9% in 2014. Moreover, the share of individuals transitioning into entrepreneurship declined by a half

¹Several other papers have discussed the decline in the pace of creation of new businesses and entrepreneurship. Reedy and Strom (2012); Decker, Haltiwanger, Jarmin and Miranda (2014, 2015) show evidence on the decline in the startup rate (the share of the firm population accounted for by age-zero firms) and in the share of fast-growing firms (which are disproportionately young). Pugsley and Sahin (2014) show the evidence of increasing concentration of economic activity on older and larger firms.

²See, for instance Haltiwanger, Decker and Jarmin (2015) and Yellen (2016).

³The rapid increase of the returns to high skill workers has been extensively documented. See, for instance, Acemoglu (2002), Autor, Katz and Kearney (2008), or Acemoglu and Autor (2011) and the references therein.

over the same period. By separating the population into different education groups, I find that the decline in entrepreneurship is most concentrated among the college graduates. In fact, the share of college graduates who are entrepreneurs declined from 12.2% in 1985 to 5.3% in 2014, whereas the share of non-college graduate entrepreneurs declined from 4.7% to 2.7% over the same period.⁴ Finally, I provide evidence of an increase in selection into entrepreneurship. Using past labor earnings as a measure of individual skill, I show that among college graduates, the average past labor income of new entrepreneurs increased by 35 log points over the last 30 years, whereas the average past labor earnings among individuals that stayed as workers grew only by 10 log points. This suggests that newer entrepreneurs are selected from more productive workers.

The second contribution of this paper is to develop a quantitative model of entrepreneurial choice with two distinct skill groups to study the contribution of the skill-biased technical change and the decline in the relative cost of capital to the observed decline in entrepreneurship. In the model, a large number of heterogeneous individuals decide each period whether to be a worker or an entrepreneur conditional on their skill type, entrepreneurial ability, and assets. Additionally, entrepreneurs can borrow to increase the scale of their business but are subject to a collateral constraint.

The mechanism of my model is simple and works through the equilibrium effect of productivity improvements on profits and wages. As workers become more productive and capital becomes cheaper, both wages and profits increase for all entrepreneurs in the economy, existing and potential. However, because of the complementarity between capital and high skill labor, entrepreneurial profits for the marginal entrepreneur increase less than the wages she would obtain as a worker. This reduces individuals' incentives to run a business, thereby generating a decrease in the share of entrepreneurs. Yet, consistent with my empirical evidence, those individuals that do become entrepreneurs are increasingly more productive, raising average entrepreneurial productivity. Furthermore, the remaining entrepreneurs obtain larger profits because the workers they hire are more productive and capital is less costly.⁵

⁴Here I consider a sample of heads of household from the PSID between 22 and 60 years of age. I classify as entrepreneurs those heads of household in the PSID for whom four conditions hold: (i) the household owns a business, (ii) the head is self-employed, (iii) the head of the household declares to have worked for the family business, and (iv) the head has a professional or managerial occupation. However, as I show in section 2, the magnitude of this decline does not significantly depend on the particular definition of entrepreneurs.

⁵My results are consistent with [Michelacci and Schivardi \(2016\)](#) that document a rapid increase in

I calibrate the model to account for several salient features of the US economy in the mid-1980s, such as the share of entrepreneurs, the proportion of high and low skill entrepreneurs, and the wage skill premium. Then, I study the equilibrium transition of my modeled economy generated by three aggregate trends which have affected both entrepreneurial profits and the returns of high skill workers over the last three decades, each of which I consider as exogenous. The first is the skill-biased technical change, which refers to improvements in technology that have increased the productivity of high skill workers (Krueger, 1993). The second is the investment-specific technical change which induces a decrease in the relative cost of capital goods (Greenwood, Hercowitz and Krusell, 1997). Notice that, if capital is more complementary to high skill labor than to low skill labor, a decrease in the relative cost of capital goods increases the demand for high skill labor, generating an increase in the returns to high skill workers (Krusell *et al.*, 2000). The third is the increase in the population share of college graduates observed in the United States over the last 30 years that has raised the supply of high skill labor. I take the decline of the cost of capital goods and the increase in the supply of high skill labor directly from the data, whereas the skill-biased technical change is calibrated to match the increase in the college wage premium observed in the United States between 1985 and 2015.

The main finding of this paper is that a standard model of entrepreneurial choice with the aforementioned trends can account for most of the decline in entrepreneurship observed in the United States between 1985 and 2014. In my modeled economy, the share of entrepreneurs drops 3.8 percentage points, almost all of the 3.9 percentage points decline observed in the data. I then decompose the contribution of each trend. I find that the skill-biased increase in productivity explains half of the reduction in the share of entrepreneurs in the US population, whereas the other half is equally explained by the decrease in the cost of capital goods and the increase in the supply of high skill labor. I find similar results when I decompose the time series of the transition rate into entrepreneurship implied by the model.

In the last part of this paper I consider a simple input cost subsidy that aims to bring the entry rate of new entrepreneurs in 2014 to the level observed in 1985. This subsidy relaxes entrepreneurs' borrowing constraint—the only source of inefficiency in my model—inducing more individuals to start a firm. I find this policy generates a sizable increase in the share of entrepreneurs and an increase in output and productivity.

the profits for entrepreneurs relative to wages, especially at the highest educational level.

Specifically, relative to the baseline stationary economy, the share of entrepreneurs increases by 2.42 percentage points, output grows by 4.0%, and productivity grows by 9.2%. The increase in output and productivity stems from two factors: first, the reallocation of resources to existing entrepreneurs that can operate their firms closer to the optimal scale, and second, the entrance of new entrepreneurs that were borrowing constrained in the unsubsidized equilibrium. Welfare also improves, with the group of high skill entrepreneurs experiencing the largest increase. The cost of this subsidy, however, is quite substantial, amounting to 3.2% of the GDP.

Literature Review

This paper relates to several areas of research. First, my paper contributes to the growing literature on the decline of firm creation and dynamism experienced by the US economy in recent decades. [Hyatt and Spletzer \(2013\)](#) document a decline of several measures of job market dynamism such as job creation, job destruction, and job-to-job flows using firm- and individual-level data. [Davis and Haltiwanger \(2014\)](#) show that the decline of job reallocation rates had harmful effects on employment growth even before the Great Recession. Furthermore, several studies by [Reedy and Strom \(2012\)](#), [Hathaway and Litan \(2014a\)](#), [Decker *et al.* \(2014, 2016\)](#), [Pugsley and Sahin \(2014\)](#), [Gourio *et al.* \(2016\)](#), and others have documented a decrease in the share of activity accounted for by new and small firms. These papers show that this decline is not limited to a particular industry or geographical area. This suggests that structural factors are responsible for the decline in the pace of firm creation experienced by the US economy. My research complements these studies by using individual-level data to show that the decline in the startup rate has been accompanied by a fall in the share of entrepreneurs in the population.

Recent studies have postulated that an aging population is partly responsible for the decline in entrepreneurship. For instance, [Liang, Wang and Lazear \(2014\)](#) exploit cross-country variation to quantify the importance of differences in the age distribution for entrepreneurship. Similarly, [Hathaway and Litan \(2014b\)](#) and [Karahana *et al.* \(2016\)](#) use differences in population growth across states in the United States to explain the decrease in the startup rate. However, differences in the decrease in the proportion of entrepreneurs across different age groups would suggest that additional factors are also important drivers of the decline in the startup rate.

Another possible explanation for the decline in firm entry is an increasing cost of regulation that affects existing and new entrepreneurs ([Davis and Haltiwanger, 2014](#)). My model captures a regulatory burden by imposing a cost on firm creation, which I can use to quantify the effect of an increase in the entry cost on entrepreneurship. Specifically, I ask what entry cost is necessary to reduce the share of entrepreneurs observed in 1985 to the level in 2014, absent any other change in the economy. Comparing these two stationary economies, I find that an entry cost that is seven times the cost in the initial stationary equilibrium, representing 2% of total output, is necessary to generate the drop in entrepreneurship observed in the data. Furthermore, an increasing cost of firm creation is unable to explain the differential decrease in the share of entrepreneurs between high and low skill individuals.

My paper is also related to the literature on entrepreneurial choice and its macroeconomic consequences. See [Quadrini \(2011\)](#) and [Buera, Kaboski and Shin \(2015\)](#) for excellent reviews on the subject. [Quadrini \(2000\)](#) and [Cagetti and De Nardi \(2006\)](#) build models with an entrepreneurial choice to analyze the relation between entrepreneurs and the level of wealth inequality observed in the US economy. However, these papers study stationary economies and do not consider how aggregate trends, such as the ones that I consider in my quantitative analysis, affect the population share of entrepreneurs and wealth accumulation over time.

The work of [Jian and Sohail \(2017\)](#) is closely related to my paper. The authors document a decline in the transition rate into self-employment using a matched sample of the Current Population Survey (CPS). They show that the decline in the transition rate is stronger among college graduates. Then they study the effects of a skill-biased increase in productivity on the share of entrepreneurs in the context of a static occupational choice model. I depart from these authors in at least three aspects: First, I study the decline in the fraction of entrepreneurs and the transition into entrepreneurship considering a more comprehensive definition of entrepreneurship. Second, I consider a general equilibrium model that incorporates several degrees of heterogeneity and is consistent with the increase in the skill premium and with the extent and increase of wealth inequality observed in the United States. This is crucial because wealth accumulation is an important determinant of the transition into entrepreneurship. Third, in my quantitative exercise, I consider not only the direct effect of the skill-biased technical change, but also the indirect effect of a decline in the relative cost of capital and the increasing share of high skill workers in the population, both of which are absent from the analysis

of [Jian and Sohail \(2017\)](#).

The rest of the paper is organized as follows. Section 2 shows evidence about the decline in the share of entrepreneurs in the US population, for different education and age groups. The evidence of section 2 motivates the entrepreneurial choice model that I describe in section 3. Section 4 presents the results of the model, and section 5 presents the policy and welfare analysis. Section 6 concludes.

2 Measuring Entrepreneurship

In this section, I show that the US economy has experienced a steady decline in the fraction of the population participating in entrepreneurial activities. Moreover, this decline is stronger among individuals with a college degree or more. I also show that the transition rate into entrepreneurship, that is, the share of wage workers that start a business in the following year, has also fallen in recent decades.

2.1 Data and Definitions

In this subsection I describe the sample that I use to study the evolution of the share of entrepreneurs in the population and the transition into entrepreneurship. My main data source is the Panel Study of Income Dynamics (PSID), which is a nationally representative survey that was conducted annually in the United States from 1968 to 1997, and every two years thereafter, on a sample of approximately 5000 families.⁶ My results are based on a sample of heads of households from 1985 to 2015. The sample includes information on gender, income, education attainment, self employment status, and whether the household owns a business. The sample comprises those who are in the labor force and between 22 and 60 years old (both ends of the range included). All the statistics presented below are calculated using sample weights. Appendix A describes in full detail the sample selection and variable construction.

Defining who is an entrepreneur is difficult and the empirical literature on entrepreneurship offers little consensus about which households or individuals should be

⁶In this study I focus on the Survey Research Center sample (SRC). However, the main conclusions of the empirical section remain almost unaltered if we include the Survey of Economic Opportunities sample and use the proper weights.

classified as such.⁷ Henceforth, most of the results in this section refer to four classifications of entrepreneurs that encompass the different alternatives considered in the literature. The PSID provides several questions that can be used to classify individuals by their entrepreneurial status. In my analysis, I use four questions. The first is, “Did you (or anyone else in the family there) own a business at any time in (year) or have a financial interest in any business enterprise?” The second question is, “On your main job, are you (head) self-employed, are you employed by someone else, or what?” Third, starting in 1984 the heads of household are asked, “Did you (head) put in any work time for this business in (year)?” Finally, I use the occupation of the head of the household. Using this information, I separate households into four different groups. The first group considers all households who are “business owners” (those who answered affirmatively to the first question). Between 1985 and 2014, this group represented an average of 16.7% of all households in the United States. Second, I consider business owners that declare having worked for their businesses during the previous year, denoted as “active business owners”. These households account, on average, for 14.8% of the population. The third group considers households who are business owners, worked for their businesses, and whose head is self-employed, that is, “self-employed business owners”. These households represented an average of 10.0% of the population between 1985 and 2014. Finally, I define as “entrepreneurs” those self-employed business owners who have a managerial or professional occupation. These households, which are closer to the definition of an entrepreneur in my model economy, represented an average of 6.0% of the population between 1985 and 2014. Table I reports the average number of households in each class and their average share in the population. Table I also shows the share of entrepreneurs at the start and end of the sample. Notice that independent of the definition used, the share of households participating in entrepreneurial activities has declined substantially, between 3.5% and 5% during the last 30 years. Appendix table VI reports additional characteristics of the sample and within the different classifications of entrepreneurs.

⁷Evans and Leighton (1989) considers as entrepreneurs those that are self-employed, Hurst and Lusardi (2004) all those households that own a business, whereas Gentry and Hubbard (2004) defines as entrepreneurs all those business owners with businesses with a total market value of \$5,000 or more. Quadri (2000) considers both, business owners and self-employed as entrepreneurs. Cagetti and De Nardi (2006) and Michelacci and Schivardi (2016) define entrepreneurs as those self-employed business owners that have an active management in the firm.

TABLE I – PROPORTION OF ENTREPRENEURS IN THE POPULATION

		(1)	(2)	(3)	(4)
Years	Obs.	Business Owner	Active Bus. Owners	Self-Emp. Bus. Owner	Entrepreneurs
[1985 – 2014]	3.664	16.73%	14.84%	10.50%	6.0%
1985	2.902	17.58%	16.32%	11.69%	7.80%
2014	4.140	13.57%	11.33%	7.78%	3.90%
$\Delta(2014 - 1985)$		-4.01%	-5.99%	-3.91%	-3.90%

Note: Table I shows the average proportion of entrepreneurial households for four different classifications. Business owners are households whose head declares that he or another member of the household owns a business. Active business owners are households whose head declares having worked for the family business in a given year. Self-employed business owners are households classified as active business owners whose head declares being self-employed in his or her main job. Finally, entrepreneurs are households classified as self-employed business owners whose head has a managerial or professional occupation. The first row shows the average proportion within each group between 1985 and 2014. The second and third rows show the share of entrepreneurs in 1985 and 2014, respectively. The last row shows the change between 1985 and 2014 (differences are statistically significant at the 1% level of confidence).

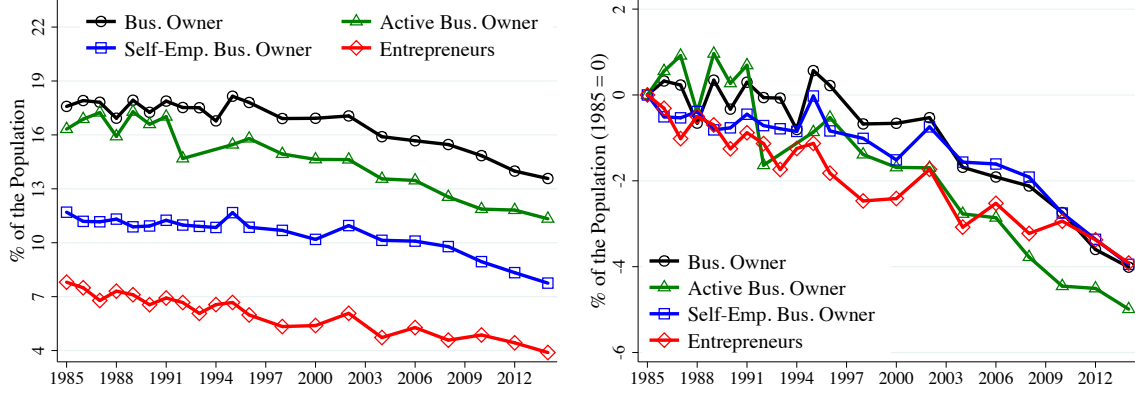
2.2 The Declining Share of Entrepreneurs

In this subsection, I document a decline in the proportion of entrepreneurs in the US population and the drop in the share of households transitioning into entrepreneurship between 1985 and 2014. The left panel of figure 1 shows the substantial drop in the population share of individuals participating in entrepreneurial activities. For instance, in 1985, 16% of households in the United States were active business owners, whereas in 2014 only 12% of households were classified as such. Similarly, in 1985, 7.8% of all households can be classified as entrepreneurs. This figure was 3.9% in 2014. To better appreciate the decline in the rate of entrepreneurship across different definitions, the right panel of figure 1 shows the time series of the share of entrepreneurs rescaled by the level in 1985.⁸

The top panels of figure 2 show the time series of the fraction of entrepreneurs separating the population into two education groups. Two patterns are worth noticing.

⁸In this section, I calculate the fraction of entrepreneurs on a sample of heads of household that considers those that did and did not work for a wage in the corresponding year. Dropping the later group of observations—mostly unemployed heads of household—changes the level of the share of entrepreneurs in the population (it reduces the denominator). However, the declining trend remains almost the same, as I show in appendix figure 21.

FIGURE 1 – SHARE OF ENTREPRENEURS



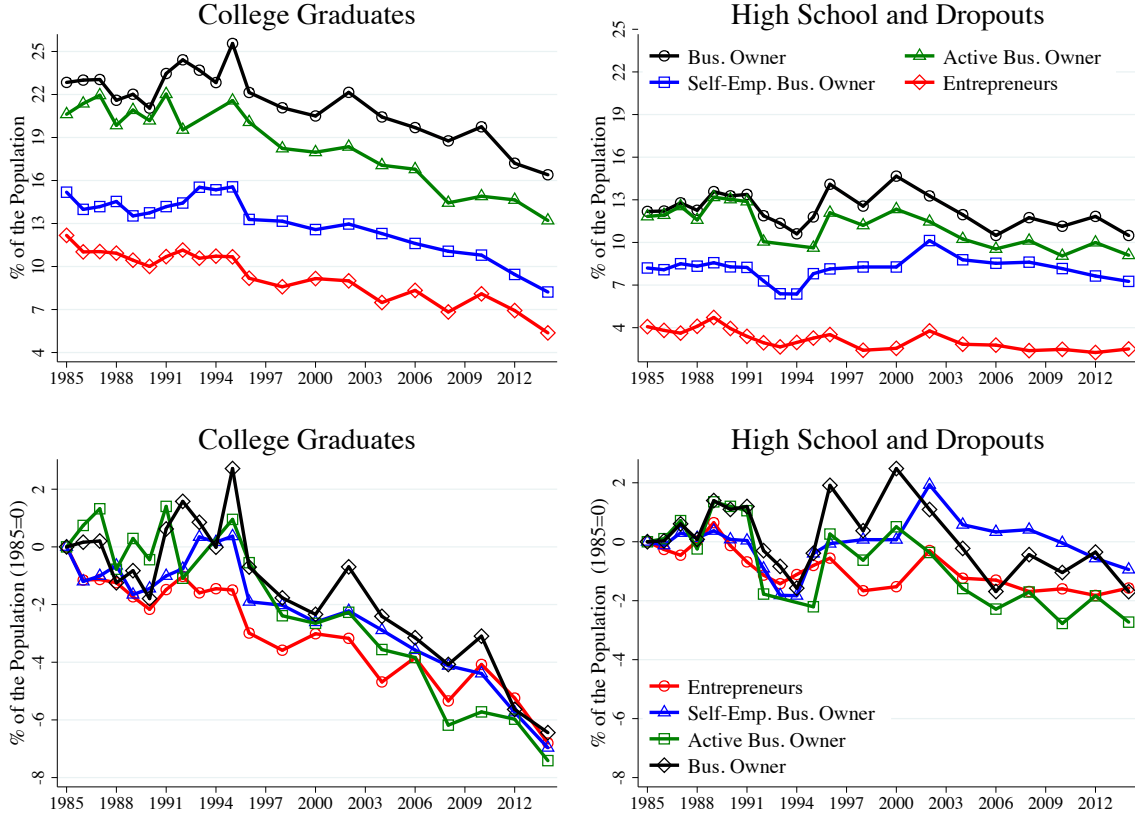
Note: The left panel of figure 1 shows the proportion of entrepreneurial households in each year for different classifications. From top to bottom, the slopes are -0.13, -0.20, -0.10, and -0.12, respectively. All slopes are statistically significant at the 1% level of confidence. The right panel shows the proportion of entrepreneurial households normalized by the value in 1985. See notes in table I for more details on the classification of entrepreneurial households.

First, the share of entrepreneurs among college graduates is significantly larger than the share of entrepreneurs among high school graduates and dropouts. This is true independent of the definition of entrepreneur that one uses. Second, although both groups have experienced a decline in the share of entrepreneurs, the drop is steeper for the group of households with college education. This is more clearly shown in the bottom panels of figure 2, which display the share of entrepreneurial households rescaled to the level in 1985: the group of households whose head is a college graduate experienced a decline of roughly 7 percentage points between 1985 and 2014 (a 50% decline), whereas the decline for the group with a high school diploma or less is about 2 percentage points (a 20% decline).

Transition into Entrepreneurship

The decline in the share of entrepreneurs has been accompanied by a decrease in the rate at which workers decide to start new businesses. To illustrate this, I calculate the transition rate into entrepreneurship across the population and over the years. In order to have a more direct comparison between the different classifications of entrepreneurial households, I measure the transition rate as the share of the population that is neither a business owner nor self-employed in year t , but transitions into one of the four classi-

FIGURE 2 – SHARE OF ENTREPRENEURS BY EDUCATION GROUPS



Note: Figure 2 shows the proportion of entrepreneurs within education groups. Individuals with some college are not considered. The bottom plots show the same statistics rescaled to their corresponding levels in 1985. See notes in table I for more details on the classification of entrepreneurial households.

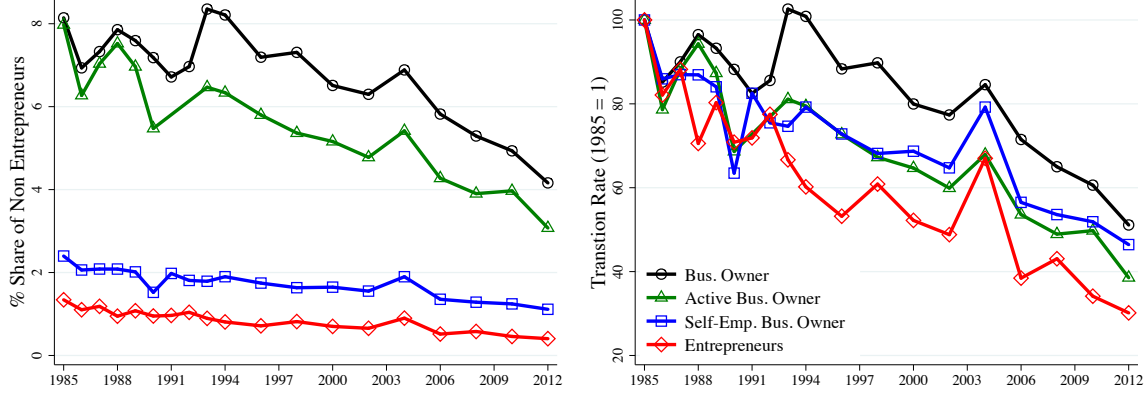
fications in year $t + 2$.⁹ Figure 3 shows that the transition rates have declined for each classification since 1985. The drop is substantial: in 1985, 8.1% of the households that did not own a business or were self-employed started a business two years after. This figure was only 4.2% in 2014, which implies a decline of 50% in the transition rate. I find a similar drop in the transition rates for the rest of the definitions of entrepreneurial households (see right panel of figure 3). The exit rate out of entrepreneurship, that is, the share of active entrepreneurs in period t that transitioned to being wage workers in $t + 2$, does not show any particular trend between 1985 and 2014.¹⁰

Next, I use the panel dimension of the PSID to study how the characteristics of the households that start new businesses have changed over time. Specifically, I look to

⁹I construct two-year transition rates to accommodate the biannual waves of the PSID after 1997.

¹⁰Using data from the Survey of Consumer Finances, Michelacci and Schivardi (2016) show that the exit rate from entrepreneurship has declined since 1989.

FIGURE 3 – TRANSITION RATE TO ENTREPRENEURSHIP



Note: Figure 3 shows the proportion of households that are neither business owners nor self-employed in period t that are classified as entrepreneurial households in period $t + 2$ for the different definitions of entrepreneurship. See notes in table I for additional details of the definition of entrepreneurial households.

the wage level of entrepreneurs before they started their business. Arguably, workers with higher wages are more skilled than workers with lower wages. Therefore, an increase in the wage of the households that transition into entrepreneurship might be indicative that new entrepreneurs are more skilled and expect higher future profits, since they gave up higher earnings to start their firms. Hence, the decline in the share of entrepreneurs would have been accompanied by a selection of more talented individuals. To see whether this is the case, I consider a sample of male, heads of household who are neither self-employed nor business owners in year t (wage workers in period t). For each individual, I measure recent labor earnings as the average of total labor earnings between years t and $t - 2$.¹¹ I divide the sample into two groups: those with a high school diploma or less and those with at least some college studies.¹² Then, I calculate the average recent labor earnings within the group of individuals that become business owners in $t + 2$ (switching households) and within those that stay as workers (non-switching households).

Figure 4 shows that, within the group of individuals with some college, the average wage of those who became entrepreneurs grew faster than the average wage of individuals who remained as workers. The difference in the growth rate of earnings is both

¹¹I calculate recent labor earnings to reduce business cycle variations which can heavily affect workers at the bottom of the skill distribution.

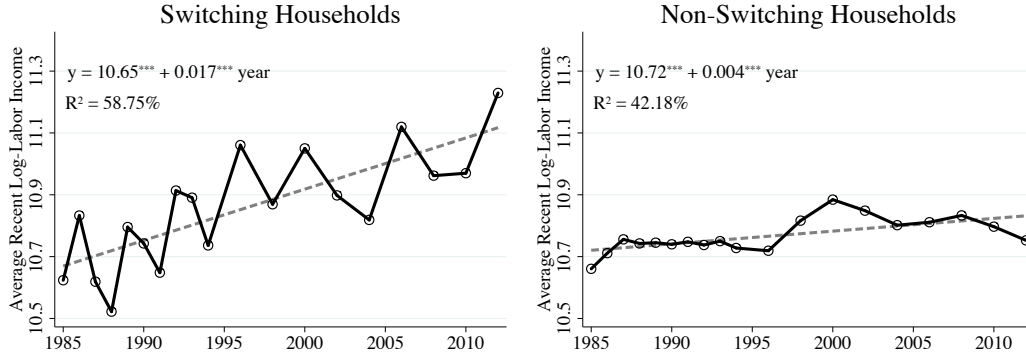
¹²The results are stronger if one includes workers with some years college in the first group strengthens my results.

economically and statistically significant (at the 1% level of confidence): the average recent earnings of workers that became entrepreneurs grew 1.7% per year between 1985 and 2014, accumulating more than 35% increase in three decades. On the other hand, the average earnings for those that remained as workers grew less than 0.4% on average during the same period of time, accumulating roughly a 10% increase. This suggests that new high skill entrepreneurs are increasingly selected from a pool of workers with higher average wages and are therefore more talented. In contrast, the growth rate of wages did not differ significantly between switching and non-switching workers within the group of individuals with a high school diploma or less. Figure 5 shows that the average recent earnings for less educated households transitioning to entrepreneurship decreased during the sample period, whereas earnings increased less than 0.1% per year for individuals that remained as workers.¹³

Several studies have shown the importance of wealth and borrowing constraints to explain entrepreneurial choices. In particular, the transition rate into entrepreneurship varies greatly across the wealth distribution and between individuals of different education groups (see, for instance, [Hurst and Lusardi \(2004\)](#) and [Mondragón-Vélez \(2009\)](#)). Similarly to other studies, I find significant differences in the wealth accumulation of workers before they start their own business relative to those workers that do not transit to entrepreneurship. Specifically, the median wealth of workers transitioning into entrepreneurship in the following period is 30% higher than the wealth of workers that stay as such. These differences increase if one considers higher percentiles of the wealth distribution (the differences are 37% and 46% at the 90th and 95th percentiles of the wealth distribution respectively).

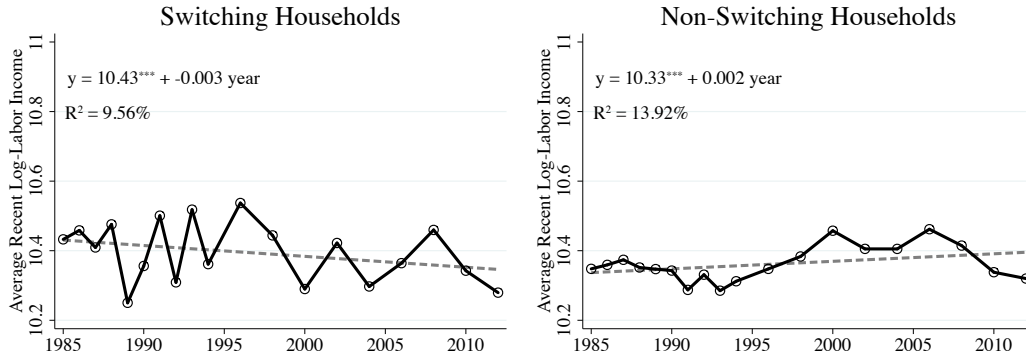
¹³Figure 20 in appendix D shows the results using a pooled sample of entrepreneurs. In such case, the growth rate of recent earnings for switching workers grew an average of 1.3% per year between 1985 and 2014 but only 0.5% for non-switching workers. In appendix D I also show that these results are quite robust and do not change much if we consider wages and salaries instead of total labor earnings (figure 24), if we consider current labor earnings (figure 25), or if we look at the 50th percentile of the labor earnings distribution (figure 26). The differences in the growth rate of earnings between those that switch to being business owners and those that remain as workers tend to vanish at higher levels of the recent income distribution. This can be seen in figure 27, which shows the evolution of the 90th percentile of the recent labor income distribution.

FIGURE 4 – LABOR INCOME FOR WORKERS WITH SOME COLLEGE OR MORE



Note: Figure 4 shows the average log of recent labor earnings for a sample of men, heads of household, who are neither business owner nor self-employed in year t and have some college studies or more. The left panel shows the average recent earnings within the group of households that become business owners in year $t + 2$, whereas the right panel shows the same statistics for individuals that remain as workers in period $t + 2$. The difference in the slope between the left and right panels is statistically significant at the 1% level.

FIGURE 5 – LABOR INCOME FOR WORKERS WITH HIGH SCHOOL DIPLOMA OR LESS



Note: Figure 5 shows the average log of recent labor earnings for a sample of men, heads of household, who are neither a business owner nor self-employed in year t and have a high school diploma or less. The left panel shows the average recent earnings within the group of households that become business owners in year $t + 2$, whereas the right panel shows the same statistics for individuals that remain as workers in period $t + 2$. There is no statistical difference between the slopes in the left and right panels.

2.3 Evidence from the Survey of Consumer Finances

In this subsection, I present additional evidence on the decline in the share of entrepreneurs in the United States using information from the Survey of Consumer Finances. The SCF is a nationally representative survey conducted every three years since 1983. The SCF over samples wealthy households, which are more likely to be

entrepreneurs ([Cagetti and De Nardi, 2006](#)), allowing for a more precise measure of the share of entrepreneurs in the population. Besides collecting information on household assets and business ownership, the SCF asks whether the head or another member of the family has an active management role in any of the businesses he or she owns. The main disadvantage of the SCF is that it does not follow individuals over time.

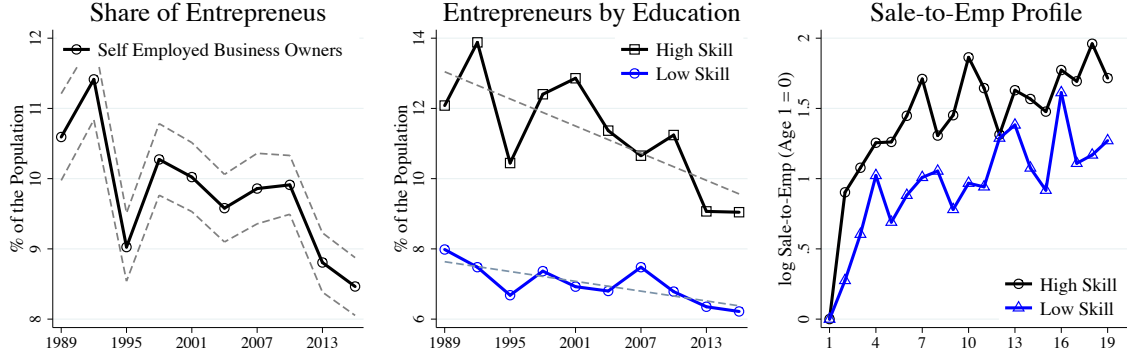
I use information from the SCF from 1989 to 2016. Following the definitions of the previous section, I define as self-employed business owners those households whose head or spouse has an active management role in a business owned by the family and whose head is self-employed.¹⁴ These households represented an average of 9.2% of the total population between 1989 and 2016. The left panel of figure 6 shows that the share of self-employed business owners in the SCF declines over time, from 10.1 in 1989 to 7.8 in 2016. Separating the sample by education groups, I find that the decrease in the share of entrepreneurs is concentrated among households whose head has at least some college education (center panel of figure 6).¹⁵

The firms of high skill entrepreneurs are more profitable than the firms of low skill entrepreneurs. The right panel of figure 6 displays the (average) age profile of the log real sales-to-employment ratio after controlling for industry and year fixed effects, and by the gender and age of the entrepreneur. For better comparison, I have normalized each profile by the sales-to-employment ratio in the first year. The firms of high and low skill entrepreneurs generate a similar amount of dollars per worker in their first year of operation (an average of \$16,400 per employee in the case of high skill entrepreneurs relative to \$15,500 for low skill entrepreneurs), but the firms of high skill entrepreneurs

¹⁴See Appendix E for additional details on the construction of the SCF sample.

¹⁵[Michelacci and Schivardi \(2016\)](#) also use the SCF and suggest that the share of entrepreneurs is stable between 1989 and 2013. The difference is mainly due to the sample selection. Similar to [Hurst and Lusardi \(2004\)](#), I consider individuals between 22 and 60 years old, whereas [Michelacci and Schivardi \(2016\)](#) consider the entire sample of heads of household, independent of their age. Appendix figure 32 shows the share of entrepreneurs with and without this age restriction (left panel) and within each age group (center panel). The share of entrepreneurs within the group of individuals of more than 60 years old has increased over time. Since this group has increased its population share, it is not surprising to find that the share of entrepreneurs is more stable if these individuals are considered in the sample: between 1989 and 2016, the share of entrepreneurs declines 1.55 percentage points among individuals between 22 and 60, but only 0.5 percentage points considering the entire sample. In this paper, I focus on the 22 to 60 range because these individuals are more likely to switch between workers and entrepreneurs and are more inclined to start new businesses. The right panel of appendix figure 32 shows that the share of startup entrepreneurs (entrepreneurs whose main business is one year old or less) among individuals 22 and 60 averages 17% between 1989 and 2016 and has been declining over time, much like the evidence presented by [Pugsley and Sahin \(2014\)](#) using firm-level data, whereas the share of startups within the group of entrepreneurs older than 60 is smaller (average of 5%) and has increased over the last 25 years.

FIGURE 6 – CHARACTERISTICS OF ENTREPRENEURS IN THE SCF



Note: The left and center panels of figure 6 display the time series of the share of self-employed business owners in the SCF. High skill entrepreneurs are heads of household with some college studies or more. Low skill entrepreneurs are heads of households with a high school diploma or less. Self-employed business owners are households that own a business, declare having an active management role, and whose head is self-employed. The slopes in the center plot are statistically different at the 5% level. The right panel shows the average sales-to-employment ratio. Each point is the value of the age fixed effect on a regression of the log sales-to-employment on industry, year, and gender fixed effects, and a quadratic in the age of the entrepreneur. All monetary values are expressed in 2012 US dollars. See Appendix E for additional details on the construction of the SCF sample.

grow much faster than the firms of low skill entrepreneurs. The average sales-per-employee ratio of the firms managed by low skill entrepreneurs grows by 21% in the second year of operation and grows by 80% when the firm has reached the age of five. This increase is more substantial among the firms managed by high skill entrepreneurs: in the second year, these entrepreneurs are selling 80% more per worker than in their first year, and after five years of operation, the sales-to-employment ratio is 150% higher than in the first year. The differences are also economically significant. The median high skill entrepreneur running a firm that has been operating for five years generates \$77,812 per worker, while a firm of the same age but owned by a low skill entrepreneur generates \$28,874 per worker. I do not find important differences between average employment size of firms of high and low skill entrepreneurs after I have controlled for industry.

Using the SCF one also can study in more detail the changing characteristics of entrepreneurs and their firms. For instance, one would like to know whether the decline in the share of entrepreneurs is concentrated among those managing small, medium, or large firms. This would give us a sense of how important is the decrease in the share of entrepreneurs. To see this, I separate the sample of entrepreneurs in the SCF into four size categories, measured by the amount of sales (expressed in 2012 dollars). I consider

FIGURE 7 – SIZE DISTRIBUTION OF ENTREPRENEURS



Note: The figure 7 shows the evolution of the share of entrepreneurs for different size classifications. All monetary values are expressed in 2012 US dollars. See appendix E for additional details on the construction of the SCF sample.

three cut-offs, one at 0.1 million dollars, a second at 1 million dollars, and the third at 10 million. Then, I calculate the share of entrepreneurs within each of these groups. Figure 7 shows that the decline of the proportion of entrepreneurs has been accompanied by a shift in entrepreneurs' size distribution. In particular, the share of the smallest group has stayed constant over the years, the share of middle-sized entrepreneurs, with sales between 0.1M and 1M, has declined, whereas the group of entrepreneurs selling more than 10 million has increased substantially over time. Importantly, this change in the sales-size distribution of entrepreneurs is mostly explained by changes in the distribution of high skill entrepreneurs, which represent a disproportionate share of the group or large entrepreneurs: high skill entrepreneurs represent 80% of all entrepreneurs selling more than 10M dollars per year, but less than 20% in the group of entrepreneurs selling less than 0.1M. Furthermore, the sales-size distribution among low skill entrepreneurs almost did not change over the sample period as shown in Appendix figure 33.¹⁶

In summary, I have shown that the US economy has experienced a decline in the

¹⁶This results are robust to other classification in terms of sales size and if I use employment instead of sales as a measure of entrepreneur's firm size.

proportion of households involved in entrepreneurial activities. The decline is stronger among more skilled households. I also find a decline in the transition rate into entrepreneurship and an increase in the selection of entrepreneurs with higher wages. Building on this evidence, the next section presents an equilibrium model that is consistent with the decline in the share of entrepreneurs, with the differential decrease in the share of entrepreneurs across education groups, and with the increase in the selection of more talented workers to start new firms.¹⁷

3 The Model

3.1 Households and Production

This section describes the model I use to study the effect of technical change and the increase in the supply of skilled labor on the decision to become an entrepreneur.

Demographics

Consider an economy with a continuum of individuals of measure one. In each period, there is a proportion H_t of high skill individuals and a proportion L_t of low skill individuals. An individual dies with probability $(1 - \chi)$, in which case her offspring enters the model carrying the same skill type of her parents with probability ζ_s , with $s \in \{H, L\}$. She also inherits the assets bequeathed by her parent and her parent's business in the case the parent dies as an entrepreneur.

Preferences and Discounting

Each individual values consumption by means of the utility function $c_t^{1-\sigma}/(1-\sigma)$ and supplies one unit of labor inelastically. Individuals discount future streams of utility at the rate $\beta < 1$, and the utility of their offspring by a proportion $\beta\eta$ with $\eta \in [0, 1]$.

¹⁷For further robustness, appendix A.2 presents additional evidence on the declining share of entrepreneurs using a sample drawn from the CPS.

Production Technology

In each period, an individual decides whether to work or to become an entrepreneur (labor is indivisible).¹⁸ If the individual decides to be a worker, she receives an income of $\omega_{s,t}y_t$, where $s \in \{H, L\}$, y_t is an idiosyncratic, positively autocorrelated shock, and $\omega_{s,t}$ is the wage of a worker of type s in period t . A worker cannot borrow but can save in a riskless asset, a_t , with return r_t .

If the individual chooses to be an entrepreneur, she gains access to a productive technology that uses four different factors: Her own entrepreneurial ability, low skilled labor, $n_{L,t}$, high skilled labor, $n_{H,t}$, and capital, k_t . All entrepreneurs produce the same homogeneous good. Entrepreneurial ability has two components: a fixed part, denoted by θ_s , which depends on the skill type of the individual, and an idiosyncratic part, z_t , which is positively autocorrelated and independent of y_t . The production technology available to the entrepreneur is $z_t\theta_s [f(n_{H,t}, n_{L,t}, k_t)]^\gamma$, where $\gamma < 1$ is the span-of-control parameter that determines the degree of decreasing returns to scale, and hence, the returns to entrepreneurial ability (Lucas, 1978). The function $f(n_{H,t}, n_{L,t}, k_t)$ is given by

$$f(n_{H,t}, n_{L,t}, k_t) = \left[\psi (\tau (A_{H,t} n_{H,t})^\rho + (1 - \tau) k_t^\rho)^\frac{\alpha}{\rho} + (1 - \psi) n_{L,t}^\alpha \right]^\frac{1}{\alpha}. \quad (1)$$

The value of ρ determines the elasticity of substitution between high skill labor and capital, and α determines the elasticity of substitution between the composite of capital and low skill labor. The parameter τ determines the output share of capital whereas ψ determines the output share of labor. The value of $A_{H,t}$ captures a skill-biased change in productivity that directly affects the relative contribution of high skill workers to output. There is no fixed cost of production; however, creating a new firm implies a one period cost, κ . Notice this cost affects only individuals transitioning from wage worker to entrepreneur.

¹⁸In this model, the assumption of indivisibility of labor is important. Alternatively, one could assume that individuals can receive a wage and run a business at the same time. In such case, since firms profits are always positive and there is no uncertainty about firms returns, the individual does not face any tradeoff between be a worker or be an entrepreneurs. In this case, an increase of the productivity of high skill workers (or a decrease in the price of investment) results in an increase in the share of entrepreneurs. However, in such model, individuals are not entrepreneurs in the sense that I consider in this paper, but business owners that have a firm as an investment opportunity.

In reality, a large fraction of firms are not managed by individuals weighing the cost and benefit of running their own business or working in someone else's company. Therefore, as in [Quadrini \(2000\)](#) and [Cagetti and De Nardi \(2006\)](#), I model a second sector of production populated by a large number of homogeneous firms operating a constant returns to scale production technology given by

$$F(N_{H,t}, N_{L,t}, K_t) = A \left[\psi (\tau (A_{H,t} N_{H,t})^\rho + (1 - \tau) K_t^\rho)^{\frac{\alpha}{\rho}} + (1 - \psi) N_{L,t}^\alpha \right]^{\frac{1}{\alpha}},$$

which I will refer to as the non-entrepreneurial sector. Both sectors produce the same good, and in both sectors capital depreciates at the rate δ .

Borrowing Constraint

Several papers have documented the importance of borrowing constraints to the decision to become an entrepreneur.¹⁹ Here I assume that entrepreneurs need to buy capital and pay wages before revenues are realized. This captures that idea that an entrepreneur needs some working capital to run her business. To finance this working capital, entrepreneurs obtain an intraperiod loan with gross interest of $(1 + r_t)$ and total amount $p_{k,t}k_t + \omega_{H,t}n_{H,t} + \omega_{L,t}n_{L,t}$, where $p_{k,t}$ is the price of capital goods in terms of consumption.²⁰ The maximum amount of the loan is constrained by the wealth of the household. In particular, each entrepreneur faces a simple collateral constraint of the form

$$p_{k,t}k_t + \omega_{H,t}n_{H,t} + \omega_{L,t}n_{L,t} \leq \lambda a_t,$$

with $\lambda \geq 1$.²¹

¹⁹See, for instance, [Evans and Jovanovic \(1989\)](#), [Hurst and Lusardi \(2004\)](#), or [Mondragón-Vélez \(2009\)](#).

²⁰My baseline results do not depend on this particular form of the borrowing constraint. Appendix [C.1](#) compares my quantitative exercise under a different collateral constraint.

²¹This type of borrowing constraint can arise from a limited enforcement problem as in [Jermann and Quadrini \(2012\)](#) and has been used in several other papers. See, for instance, [Evans and Jovanovic \(1989\)](#), [Buera \(2009\)](#), [Buera and Shin \(2013\)](#), [Moll \(2014\)](#), [Guvenen, Kambourov, Kuruscu, Ocampo and Chen \(2015\)](#), among others.

Exogenous Aggregate Processes

The economy is subject to three exogenous aggregate processes: investment-specific technological change that decreases the relative price of capital goods, $p_{k,t}$, an increase in the supply of high skill workers, H_t , and a skill-biased improvement in technology that increases the productivity of high skill workers, $A_{H,t}$. In my baseline exercise I assume there is no aggregate uncertainty and the time series of each of these processes are fully known by the individuals.²²

The Problem of the Individuals

At the beginning of the period, an individual is characterized by her fixed skill type, $s \in \{H, L\}$, asset level, a_t , entrepreneurial ability, z_t , worker ability, y_t , and previous occupation, $d_t \in \{w, e\}$, where w identifies a worker and e an entrepreneur. To simplify the notation, name the vector of idiosyncratic states by $\Omega_t \equiv \{a_t, z_t, y_t, d_{t-1}\}$, and the distribution of individuals of type s in period t over idiosyncratic states by $\mu_{s,t}$ with $\mu_t \equiv \{\mu_{H,t}, \mu_{L,t}\}$. Denote the vector of aggregate states by $\Theta_t \equiv \{p_{k,t}, A_{H,t}, H_t\}$. Then, a s - *type* individual solves

$$V_{s,t}(\Omega_t, \Theta_t, \mu_t) = \max \{V_{s,t}^w(\Omega_t, \Theta_t, \mu_t), V_{s,t}^e(\Omega_t, \Theta_t, \mu_t)\}, \quad (2)$$

where $V_{s,t}^w(\Omega_t, \Theta_t, \mu_t)$ is the value of being a worker in period t and $V_{s,t}^e(\Omega_t, \Theta_t, \mu_t)$ is the value of being an entrepreneur. The value of being a worker is given by

$$V_{s,t}^w(\Omega_t, \Theta_t, \mu_t) = \max_{c_t, a_{t+1}} \left\{ \frac{c_t^{1-\sigma}}{1-\sigma} + \beta \left[\chi \mathbb{E}_{z_{t+1}|z_t, y_{t+1}|y_t} V_{s,t+1}(\Omega_{t+1}, \Theta_{t+1}, \mu_{t+1}) + \right. \right. \\ \left. \left. (1-\chi) \eta \sum_{j \in \{H, L\}} \zeta_{s,j} \mathbb{E} V_{s,t+1}(\Omega_{t+1}, \Theta_{t+1}, \mu_{t+1}) \right] \right\} \quad (3)$$

²²I assume that the price of capital goods is exogenously given. This is equivalent to modeling a third productive sector with a linear production technology that transforms consumption goods into capital goods. A decrease in the relative price of capital would result from an increase in this sector's productivity.

$$c_t + a_{t+1} \leq (1 + r_t(\Theta_t, \mu_t)) a_t + \omega_{s,t}(\Theta_t, \mu_t) y_t,$$

$$a_{t+1} \geq 0,$$

subject to the laws of motion of y_t and z_t , the law of motion of the distribution of individuals over idiosyncratic states, $\mu_{t+1} = \Psi(\Theta_t, \mu_t)$, and the evolution of the aggregate states, Θ_{t+1} . In the problem of the worker described by equation (3), the first expectation is taken over the conditional distributions of z_{t+1} and y_{t+1} , and over the next period's distribution of individuals over idiosyncratic states, while the second expectation is taken over the unconditional distributions of z_{t+1} and y_{t+1} , and over the next period's distribution of idiosyncratic states.

The value of being an entrepreneur is given by

$$V_{s,t}^e(\Omega_t, \Theta_t, \mu_t) = \max_{c_t, a_{t+1}} \left\{ \frac{c_t^{1-\sigma}}{1-\sigma} + \beta \left[\chi \mathbb{E}_{z_{t+1}|z_t, y_{t+1}|y_t} V_{s,t+1}(\Omega_{t+1}, \Theta_{t+1}, \mu_{t+1}) + \right. \right. \\ \left. \left. (1-\chi) \eta \sum_{j \in \{H,L\}} \zeta_{s,j} \mathbb{E} V_{s,t+1}(\Omega_{t+1}, \Theta_{t+1}, \mu_{t+1}) \right] \right\}, \quad (4)$$

$$\pi_{s,t}(z_t, a_t) = \max_{n_{H,t}, n_{L,t}, k_t} \left\{ z_t \theta_s [f(n_{H,t}, n_{L,t}, k_t)]^\gamma - p_{k,t} (r + \delta) k_t - \right. \\ \left. (1 + r(\Theta_t, \mu_t)) (\omega_{H,t}(\Theta_t, \mu_t) n_{H,t} + \omega_{L,t}(\Theta_t, \mu_t) n_{L,t}) \right\},$$

$$c_t + a_{t+1} + \mathbb{I}(d_{t-1} = w_{t-1}) \kappa \leq (1 + r(\Theta_t, \mu_t)) a_t + \pi_{s,t}(z_t, a_t),$$

$$p_{k,t} k_t + \omega_{H,t}(\Theta_t, \mu_t) n_{H,t} + \omega_{L,t}(\Theta_t, \mu_t) n_{L,t} \leq \lambda a_t$$

$$a_{t+1} \geq 0,$$

subject to the non-negativity constraints of factor demands, the laws of motion of y_t and z_t , the law of motion of the distribution of individuals over idiosyncratic states, $\mu_{t+1} = \Psi(\Theta_t, \mu_t)$, and the law of motion of the aggregate states, Θ_{t+1} . Here, $\mathbb{I}(d_{t-1} = w_{t-1})$ is

an indicator function which is equal to 1 if the individual was a worker in the previous period and is equal to zero otherwise. This function captures the assumption that the fixed cost of creating a firm is paid only by those individuals transitioning from worker to entrepreneur. The solution of the problem of the household is characterized by a z -threshold which depends on the individual's level of assets, the labor productivity, and the previous period's occupation.

The Problem of the Non-Entrepreneurial Sector

The problem of the non-entrepreneurial sector is simple and is given by

$$\pi_{c,t} = \max_{N_{H,t}, N_{L,t}, K_t} \left\{ F(N_{H,t}, N_{L,t}, K_t) - p_{k,t} (r(\Theta_t, \mu_t) + \delta) K_t - \omega_{H,t}(\Theta_t, \mu_t) N_{H,t} - \omega_{L,t}(\Theta_t, \mu_t) N_{L,t} \right\}, \quad (5)$$

subject to the non-negativity constraints of factor demands.

3.2 Equilibrium

Given an initial distribution μ_0 and an exogenous path of $\Theta_t = \{p_{k,t}, A_{H,t}, H_t\}_{t=0}^{\infty}$, a recursive competitive equilibrium in this economy is

- A time path for prices, $\{\omega_{H,t}(\Theta_t, \mu_t), \omega_{L,t}(\Theta_t, \mu_t), r_t(\Theta_t, \mu_t)\}_{t=0}^{\infty}$, and a sequence of distributions over idiosyncratic states $\{\mu_{t+1}(\Theta_t, \mu_t)\}_{t=0}^{\infty}$,
- a sequence of individual's policy functions $\{c_t^s(\Omega_t, \Theta_t, \mu_t), a_{t+1}^s(\Omega_t, \Theta_t, \mu_t), d_t^s(\Omega_t, \Theta_t, \mu_t)\}_{t=0}^{\infty}$, with $\{V_{s,t}(\Omega_t, \Theta_t, \mu_t)\}_{t=0}^{\infty}$, the associated value functions and $s \in \{H, L\}$,
- factor demands for the entrepreneurs, $\{k_t^s(\Omega_t, \Theta_t, \mu_t), n_{H,t}^s(\Omega_t, \Theta_t, \mu_t), n_{L,t}^s(\Omega_t, \Theta_t, \mu_t)\}_{t=0}^{\infty}$,
- demands of the non-entrepreneurial sector, $\{K_t(\Theta_t, \mu_t), N_{H,t}(\Theta_t, \mu_t), N_{L,t}(\Theta_t, \mu_t)\}_{t=0}^{\infty}$,

such that

- The policy functions, value functions, and factor demands solve the individual's problem given by (3) and (4),

- The factor demands of the non-entrepreneurial sector solve (5),
- Labor markets for high and low skill workers clear,

$$\int (1 - d_t^H(\Omega_t, \Theta_t, \mu_t)) d\mu_t^H(\Omega_t) = N_{H,t}(\Theta_t, \mu_t) + \sum_{s \in H,L} \int n_{H,t}^s(\Omega_t, \Theta_t, \mu_t) d_t^s(\Omega_t, \Theta_t, \mu_t) d\mu_t^s(\Omega_t), \quad (6)$$

$$\int (1 - d_t^L(\Omega_t, \Theta_t, \mu_t)) d\mu_t^L(\Omega_t) = N_{L,t}(\Theta_t, \mu_t) + \sum_{s \in H,L} \int n_{L,t}^s(\Omega_t, \Theta_t, \mu_t) d_t^s(\Omega_t, \Theta_t, \mu_t) d\mu_t^s(\Omega_t), \quad (7)$$

- Capital market clears,

$$\sum_{s \in H,L} \int a_t^s(\Omega_t, \Theta_t, \mu_t) d\mu_t^s(\Omega_t) = p_{k,t} K_t(\Theta_t, \mu_t) + \sum_{s \in H,L} \int \left(p_{k,t} k_t^s(\Omega_t, \Theta_t, \mu_t) + \omega_{H,t}(\Theta_t, \mu_t) n_{H,t}^s(\Omega_t, \Theta_t, \mu_t) + \omega_{L,t}(\Theta_t, \mu_t) n_{L,t}^s(\Omega_t, \Theta_t, \mu_t) \right) d_t^s(\Omega_t, \Theta_t, \mu_t) d\mu_t^s(\Omega_t). \quad (8)$$

A stationary competitive equilibrium is similarly defined but over a constant path of Θ_t , which implies a constant sequence of prices and distributions over idiosyncratic states. The solution of the model requires an initial and a final steady state, and the complete transition path of aggregate states and factor prices, given an exogenous sequence of Θ_t . Appendix B describes in detail the algorithm that I use to solve the model.

3.3 Calibration

This section describes the quantitative specification of the model. To maintain the tractability of the calibration, I take some parameters directly from the literature (e.g., the risk aversion or the depreciation rate), I calculate other parameters directly from

the data (e.g., the parameters governing the labor income process), and I choose other parameters such that the stationary equilibrium matches several features of the US data in the mid 1980s. In this section, I also describe how I pin down the three exogenous time series (the price of capital, the share of high skill workers, and relative productivity of high skill workers) that I will incorporate into the model. In order to highlight the effects of the change in wages on entrepreneurs, I will assume, for the moment, that this is a small open economy and the interest rate is constant over time. In section 4.4, I show how my quantitative results change when considering a full-fledged general equilibrium model.

Frequency, Preferences, and Discounting

I set the time period to equal a year. I take a standard value of 2.0 for the coefficient of risk aversion. In the baseline case, I set $\eta = 1$ so parents are perfectly altruistic. I assume β to be 0.88, and a fixed interest rate of 3.0%.²³

Demographics

I set the value of χ equal to 0.025 so that the average working life of an individual is 40 years. In the baseline calibration, I assume when an individual dies, the offspring inherits her parent's skill type with probability one, so $\zeta_{hh} = \zeta_{ll} = 1$.

Production and Capital Depreciation

Following Krusell *et al.* (2000), I assume that capital is more complementary to skilled than to unskilled workers. Hence, I set α equal to 0.401 and ρ equal to -0.495. The value of γ in the technology of the entrepreneur is equal to 0.88, as in Cagetti and De Nardi (2006), and the depreciation rate of capital, δ , is set at an annual value of 0.06.

Labor Income Shocks

I assume that the process of y_t is such that $\log y_{t+1} = \rho_y \log y_t + \sigma_{\epsilon,y} \epsilon_{y,t+1}$ where $\epsilon_{y,t+1}$ is distributed normal with mean zero and unitary variance. The values of ρ_y and σ_y

²³I choose the value of β equal to 0.88 to be consistent with my calibration in the general equilibrium case which I discuss in the robustness section.

TABLE II – FIXED PARAMETERS IN THE BENCHMARK MODEL

		VALUE	SOURCE
Risk Aversion	σ	2.0	-
Prob. Dying	$1 - \chi$	2.5%	Average working life of 40 years
Perfect Altruism	η	1	Perfect Altruism
Depreciation	δ	0.06	-
Capital-High Skill ES	ρ	-0.49	Krusell <i>et al.</i> (2000)
Capital-Low Skill ES	α	0.40	Krusell <i>et al.</i> (2000)
Span-of-Control	γ	0.88	Cagetti and De Nardi (2006)
Autocorrelation of y	ρ_y	0.75	PSID
Standard Dev. of ϵ_y	$\sigma_{\epsilon,y}$	0.53	PSID

Note: Table II reports the set of fixed parameters used in the baseline model.

are estimated using data from the PSID using a sample of workers for the period 1970 to 1996.²⁴ In the model, all households are subject to the same stochastic shocks. Therefore, I select a pooled sample of heads of household with valid labor income that are neither business owners nor self-employed in periods t and $t - 1$. Then, I estimate the following equation:

$$\log w_{i,t} = \beta_0 + \beta_1 A_{i,t} + \beta_2 A_{i,t}^2 + \beta_3 A_{i,t}^3 + \rho_w \log w_{i,t-1} + \nu_{i,t}, \quad (9)$$

where $w_{i,t}$ is the total real labor earnings of the head of the household in period t .²⁵ The right-hand side includes a polynomial in age to control for life-cycle patterns. The estimated autocorrelation of earnings, ρ_w , is 0.73, and the standard deviation of $\nu_{i,t}$ is 0.53. Using these values for ρ_y and σ_y , I discretize the continuous process using the method developed by Tauchen (1986). The sample selection and additional estimation results are described in appendix A.1. Table II shows the fixed parameters chosen from the literature or calculated directly from the data.

Exogenous Aggregate Processes

In this section, I discuss how I choose the time series of the relative price of capital goods, $p_{k,t}$, the supply of high skill labor, H_t , and the productivity of high skill workers,

²⁴After 1997 the PSID becomes biannual and it is not possible to calculate the one-year changes.

²⁵Here, total labor income includes only wages and salaries, bonuses, tips, and commissions. The labor part of businesses income and the income from farm are excluded as I am considering in the sample individuals that work for a wage only and do not own a businesses neither in period t nor in period $t - 1$.

$A_{H,t}$. The first two time series have obvious empirical counterparts, whereas the third needs to be pinned down using additional conditions.

For the time series of $p_{k,t}$ I use the quality-adjusted relative price of capital goods calculated by DiCecio (2009) and normalized to 1 in 1985.²⁶ Using this time series, the relative price of capital declined 55% between 1985 and 2015.²⁷ In my simulation, I will assume that from 2015 on, $p_{k,t}$ remains fixed at its 2015 level for the rest of the simulation. This is an extreme case and therefore, in the robustness section, I study how sensitive my results are to a different assumption on the time trend of the price of capital and the rest of the exogenous trends after 2015.

I equate the share of high skill workers in the model, H_t , to the fraction of individuals with a college degree or more calculated from a sample of heads of household between ages 22 to 60 years drawn from the CPS. The share of college graduates in this sample increased from 26% in 1985 to 39% in 2015. In my baseline results, I assume that the share of high skill workers remains at its 2015 level for the rest of the transition.

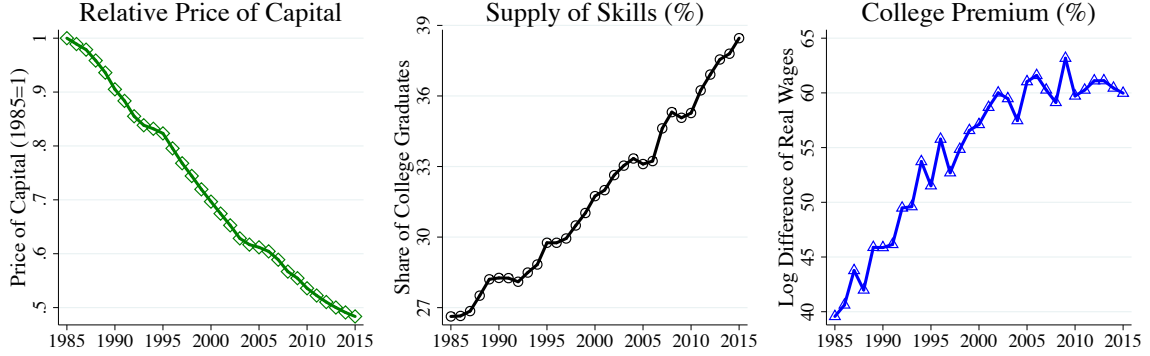
Finally, I need to choose the time series for the skill-biased technological progress, $A_{H,t}$. I select the time series of $A_{H,t}$ such that the increase in the skill premium implied by the model (the log difference between the wage of high skill workers and the wage of low skill workers) matches the increase in the college premium observed over the last 30 years in the United States. I measure the college premium as the log difference of the real annual labor income of college graduates and the real annual labor income of high school graduates over a sample of workers from the CPS. Additional details of the construction of the skill premium are discussed in appendix A.2. Using this sample, the college premium increased from 39% in 1985 to 60% in 2015.

Because my model economy is subject to two additional aggregate trends (the price of capital and the supply of high skill workers), there is no clear mapping between the college premium implied by the model and the evolution of $A_{H,t}$. In particular, since high skill workers are more complementary to capital than low skill workers (recall $\alpha > \rho$ in the production function), the decline in $p_{k,t}$ and the rise in H_t will affect the

²⁶DiCecio (2009) extrapolates the quality-adjusted price time series of Gordon (2007) to 2010 using the same techniques of Cummins and Violante (2002). I take the updated time series up to 2015 from FRED.

²⁷Alternatively, one could use the measure of the price of capital goods calculated by the Bureau of Economic Analysis (BEA) to compute the relative price of capital goods. Using this measure, the relative price of capital declined 50% between 1985 and 2015. See appendix A.3 for additional details and a comparison of the relative price of investment calculated by DiCecio (2009), the time series using the BEA's data, and an additional measure that only considers equipment and software.

FIGURE 8 – AGGREGATE PROCESSES



Note: Figure 8 displays the time series of the relative price of capital goods (left panel), the share of college graduates in the population (center panel), and the college premium (right panel). The relative price of capital goods (calculated by DiCecio (2009)) is normalized to 1 in 1985. The supply of college graduates is calculated over a sample of heads of household drawn from the CPS. The supply of college graduates in each year is the share of heads of household between ages 22 and 60 that have a college degree or more. The college premium is calculated as the difference between the average of the log of real wages of heads of household with a college degree or more and the average of the log of the real wages of heads of household that have a high school degree over a sample of wage workers. See appendix A.2 for additional details on the calculation of the supply of college graduates and the college premium.

skill premium in opposite directions. To solve this issue, I take a very simple approach: I fix the value of $A_{H,t}$ in the initial stationary economy to be equal to 1 and select the value of $A_{H,t}$ at the final stationary equilibrium so that my model matches a skill premium of 60% conditional on the values of $p_{k,t}$ and H_t in 2015. Then, the sequence of $\{A_{H,t}\}_{t=1}^T$ grows linearly between these two fixed points for 30 years. As I do with the other two aggregate exogenous processes, I assume that the value of $A_{H,t}$ is fixed for the rest of the transition. Figure 8 displays the time series of the relative price of capital goods, the share of college graduates, and the college premium in the data that I use to discipline the aggregate processes in my model.

Parameters Determined Jointly in Equilibrium

The parameters that are calibrated simultaneously with the equilibrium of the model are the factor shares in the production function, τ and ψ , the borrowing limit, λ , the entry cost, κ , and the parameters of entrepreneurial ability, θ_s and z_t . I normalize θ_H to 1, and I assume that $\log z_{t+1} = \rho_z \log z_t + \sigma_{\epsilon,z} \epsilon_{z,t+1}$. This leaves seven parameters that need to be calibrated jointly with the equilibrium of the model. I use these seven parameters to pin down the same number of moments generated by my model in 1985.

I select this particular year because it is the first for which I have information about each of the moments that I seek to match. I normalize the relative price of capital goods, $p_{k,t}$, and the productivity of high skill workers, $A_{H,t}$, to 1 in 1985, and I set the share of high skill workers, H_t , to 0.26, which is the fraction of heads of household with a college degree in the CPS sample in 1985. Conditional on these three fixed values, I choose the rest of the parameters to match:

- a skill premium of 39%, which is the value of the college premium in 1985, as shown in figure 8,
- a labor share of output of 63%, which is the average labor share of non-farm business sector output between 1980 and 1985 calculated by the Bureau of Labor Statistics,
- a ratio of liabilities plus equity in the non-financial sector to non-financial private sector output of 0.88,²⁸
- a population share of entrepreneurs of 7.80%, which is the fraction of entrepreneurs calculated from the PSID for 1985,
- a population share of entrepreneurs that are high skill of 4.2%, which is the fraction of entrepreneurs with a college degree or more calculated from the PSID for 1985,
- a share of households transitioning from being wage workers into entrepreneurship of 2.4%, which is the fraction of wage workers transitioning to entrepreneurship calculated from the PSID for 1985,
- and a share of new entrepreneurs of 23%, which is the fraction of households that switched to entrepreneurship in 1985 over the total number of entrepreneurs in 1985.

Table III reports the parameters calibrated jointly with the equilibrium of the model and table IV shows the calibration targets and the model generated moments. The

²⁸The ratio of liabilities plus equity of the non-financial sector is the sum of the total liabilities of the non-financial non-corporate sector as reported by the Federal Reserve Bank of St. Louis Economic Data (FRED) – time series NNBTLQ027S – plus total liabilities plus equity of the non-financial corporate sector – time series NCBLEYQ027S – divided by the total nominal output of the private non financial sector as reported by the BEA. See appendix A.3 for additional details.

TABLE III – CALIBRATED PARAMETERS IN THE BENCHMARK MODEL

Parameter		Value
Capital Share	τ	0.48
Labor Share	ψ	0.50
Borrowing Limit	λ	2.5
Entry Cost	κ	0.10
Relative Productivity of Low Skill	θ_L	0.96
Autocorrelation of z	ρ_z	0.82
Standard Dev. of ϵ_z	$\sigma_{\epsilon,z}$	0.22

Note: Table III reports the set of calibrated parameters and their corresponding values. The data and analogous model generated moments are reported in table IV.

TABLE IV – DATA AND MODEL-GENERATED MOMENTS

	Data	Model	Source
log-Skill Premium	0.39	0.39	CPS
Labor share	0.63	0.63	BLS
Debt and Equity to GDP	0.88	0.90	Flow of Funds
Share of Entrepreneurs (%)	7.80	7.87	PSID
Share High Skill of Entrepreneurs (%)	4.20	4.15	PSID
Transition Rate (%)	2.40	3.10	PSID
Share of New Entrepreneurs (%)	23.1	35.0	PSID

Note: Table IV shows the set of moments that are targeted to choose the parameters in table III.

model matches well the population share of entrepreneurs, the population share of entrepreneurs that are high skill, and the skill premium, all of which are key for my quantitative exercise. However, the share of new entrepreneurs and the transition rate of workers into entrepreneurship implied by the model are larger than the corresponding values calculated from the data. The model also generates substantial wealth inequality although the calibration did not intend to match any of the moments of the wealth distribution. As reported by [Bricker, Henriques, Krimmel and Sabelhaus \(2016\)](#), the Gini coefficient on wealth in 1989 was 0.84, while the Gini coefficient implied by the model for the same year is 0.83. Similarly, the share of wealth accrued by the top 1% of the population was 32% in 1989 and 34.2% in the model.²⁹

²⁹The moments reported by [Bricker et al. \(2016\)](#) are start in 1989. Hence, the model moments are taken from the fourth year of the transition generated by the model, which corresponds to 1989. For 1985, the model generates a Gini coefficient of 0.84 and a share of wealth of the top 1% of 33.2%.

4 Results

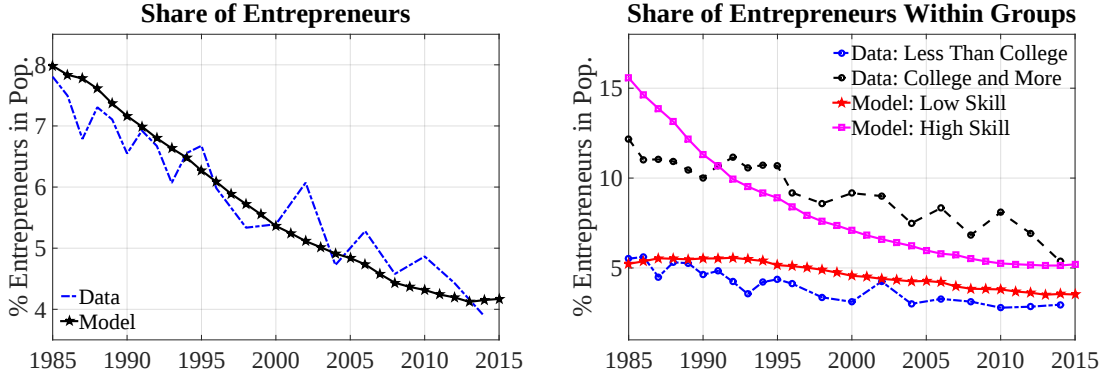
4.1 Transition

This section shows the main quantitative results of my model. The economy is assumed to be at a stationary equilibrium in 1985. Then, individuals learn about the future path of the three aggregate time series (the cost of capital goods, the share of skilled workers, and the relative productivity of high skill workers), the evolution of the distribution of individuals over idiosyncratic states, and consequently, factor prices. In other words, individuals have perfect foresight about the evolution all the relevant variables from 1985 to the infinite future.³⁰ In my benchmark exercise, the time series of each of these variables are as shown in figure 8 and remain constant after 2015 for the rest of the transition.³¹ The left panel of figure 9 shows the evolution of the fraction of entrepreneurs in the data (blue-dashed line) and in the model (black-starred line). The model accounts well for the decline in the share of entrepreneurs in the population and the speed of the decline. In the model, the fraction of entrepreneurs drops 3.8 percentage points between 1985 and 2014, accounting for almost all of the 3.9 percentage points decline observed in the data. The model is also consistent with differences in the evolution of the share of entrepreneurs between high and low skill workers, as shown in the right panel of figure 9. In the model, however, the decline in the share of high skill entrepreneurs is faster than the decline observed in the data (for the group of college graduates), especially in the first years of the transition. The model more closely matches the evolution of the share of low skill workers, although it underpredicts the speed of the decline. Finally, the decline in the entry rate implied by my model economy is similar to the decline observed in the data, as is shown in figure 10.

³⁰I choose 1985 as my starting point because of data availability. However, as I show in the robustness section, my main quantitative results do not change substantially if I assume that the economy was at steady state in 1970.

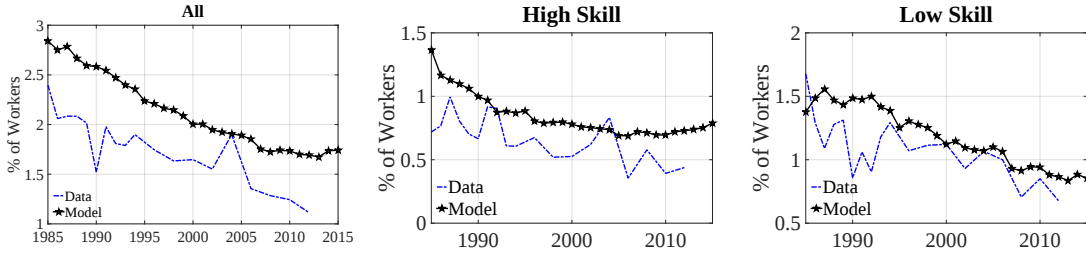
³¹The entire transition consists of 300 periods, from 1985 to 2285.

FIGURE 9 – EVOLUTION OF THE SHARE OF ENTREPRENEURS



Note: The left panel of figure 9 shows the evolution of the share of entrepreneurs as calculated from the PSID data (blue dashed line) and the share of entrepreneurs implied by the model (black-starred line). The right panel shows the share of entrepreneurs within skill groups.

FIGURE 10 – TRANSITION RATE OF WORKERS TO ENTREPRENEURSHIP



Note: Figure 10 shows the evolution of the transition rate into entrepreneurship as calculated from the PSID data (blue-dashed line) and the corresponding measure obtained from the model. The transition rate is equal to the proportion of households that were not entrepreneurs in period t but transitioned to entrepreneurship in period $t + 2$.

4.2 Decomposition

What is the relative contribution of each of the exogenous trends to the decline in the share of entrepreneurs? To answer this question, I study the evolution of the fraction of entrepreneurs considering the effect of each of the aggregate trends, starting with the skill-biased technological progress, $A_{H,t}$.³² Here I consider the same values of $A_{H,t}$ used in my baseline exercise but I fix the values of $p_{k,t}$ and H_t to their levels in 1985 (the initial stationary equilibrium). The evolution of the population share of entrepreneurs in this case is shown in the left panel of figure 11. The black-starred line is the population

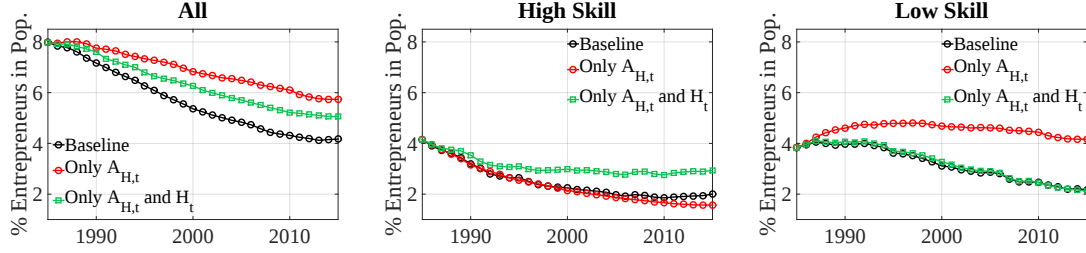
³²This decomposition might be influenced by the order in which each exogenous trend is considered. I have run several robustness checks for different combinations, yielding similar results.

share of entrepreneurs implied by the model in the baseline case and the red-circled line shows the proportion of entrepreneurs for the case in which only $A_{H,t}$ moves. This can be thought of as the direct effect of skill-biased technological change on the share of entrepreneurs. In this case, the proportion of entrepreneurs drops 2.1 percentage points between 1985 and 2015, or 55% of the overall decline implied by the model (and 53% of the decline in the data). The discrepancy between my baseline results and this case is explained by the response of the low skill individuals. First, the center panel of figure 11 shows that an increase in $A_{H,t}$ reduces the share of high skill entrepreneurs slightly more than in the baseline case. This is because an increase in $A_{H,t}$, coupled with the relative scarcity of high skill workers in the economy, makes the wages for this group increase very fast, decreasing the incentives for high skill workers to become entrepreneurs. On the other hand, although low skill workers are relatively less able as entrepreneurs, they experience an increase in their profits as the high skill workers that they hire are, in fact, more productive. Moreover, the relative abundance of low skill workers implies that their wages do not increase as much compared to my baseline results. Consequently, the share of low skill entrepreneurs increases, as shown by the red-circled line in the right panel of figure 11.

Next, I consider the transition of the economy when both $A_{H,t}$ and H_t change over time. In this case, the share of entrepreneurs declines even further, as shown by the green-squared line in the left panel of figure 11. An increase in the relative supply of high skill workers has two opposite effects. First, it depresses the wage of high skill workers, increasing the incentives for this group to become entrepreneurs. Moreover, since high skill individuals are more productive than low skill individuals as entrepreneurs (recall the differences in θ_s), the total effect is an increase in the share of high skill entrepreneurs in the economy, as shown by the green-squared line in the center panel of figure 11. On the other hand, the surge in the demand for labor and the decreasing share of low skill workers push their wages up, decreasing the incentives for low skill workers to become entrepreneurs. Then, because low skill workers still represent the largest share of the population, the overall proportion of entrepreneurs declines. Taken together, the increase in the productivity of high skill workers and the increase in the supply of high skill labor account for 75% of the drop in entrepreneurship implied by the model.

Finally, the decline in the relative price of capital brings the green-squared line in the left plot of figure 11 to the black-starred line. Because of the complementarity between capital and high skill workers, a decrease in the price of capital goods raises

FIGURE 11 – DECOMPOSITION OF THE SHARE OF ENTREPRENEURS



Note: Figure 11 shows the time series of the population share of entrepreneurs implied by the model. The black-starred line shows the share for the baseline case, the red-circled line considers only the evolution of $A_{H,t}$, while the green-squared line considers $A_{H,t}$ and H_t . The center and right panel show similar statistics for high and low skill workers.

the demand for high skill workers, increasing their wages and depressing their incentives to become entrepreneurs. This brings down the share of high skilled individuals that decide to run their own firm while holding steady the share of low skill entrepreneurs in the economy.³³

I find similar results when looking at the transition rate into entrepreneurship and the exit rate of entrepreneurs. Appendix figure 30 displays the time series of the share of workers that start a new firm in the next period under the same decomposition that I consider in this section. Figure 31 shows the corresponding time series for the exit rate of entrepreneurs. Similarly the results on the population share of entrepreneurs, the skill-biased technological change explains about 50% of the decline in the transition rates in and out of entrepreneurship generated by the model. In summary, each of the three trends considered in my quantitative exercise explains an important fraction of the decline in entrepreneurship and implies different responses of high and low skill individuals along the transition. The direct effect of skill-biased technological change explains the lion's share of the overall decline and explains half of the drop in the proportion of entrepreneurs and the entry and exit rate dynamics generated by the model.

³³Varying the order of the shocks in this decomposition does not alter the proportion of the decline in the share of entrepreneurs explained by each of the exogenous trends that I consider. For instance, appendix figure 29 shows a decomposition in which I first let $A_{H,t}$ vary over time, then $p_{k,t}$, and finally, H_t . In such a case, the first two exogenous processes explain three-quarters of the total decline in the share of entrepreneurs implied by the model.

4.3 Wages, Skill Premium, and Productivity

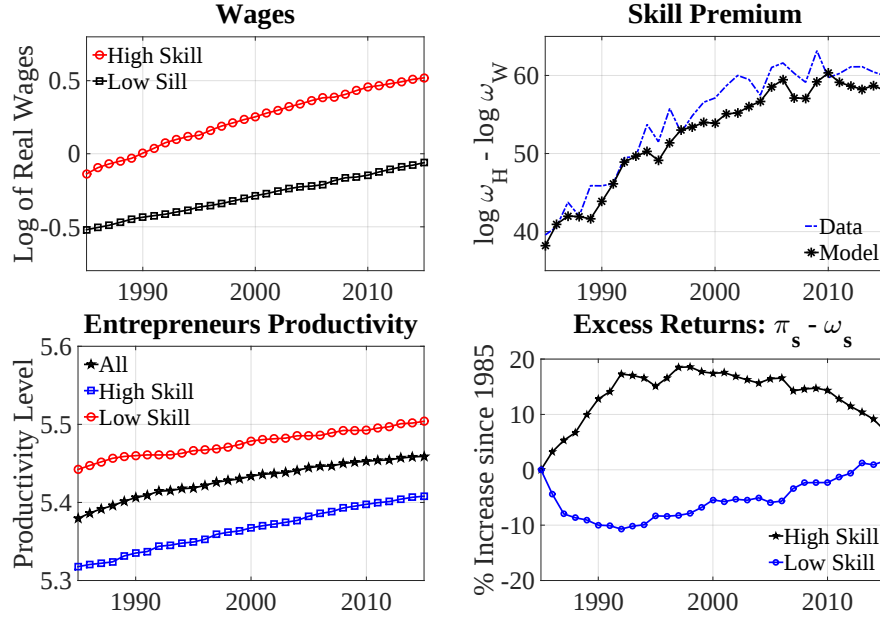
In the model, individuals decide in each period whether to run a firm or work for a wage, comparing the utility value of each of these options. Intuitively, an increase in wages will reduce the incentives to start a firm, more so for those workers whose wage grows faster. Since both the decrease in the price of capital goods and the increase in the productivity of high skill workers increase the marginal productivity of labor, the productivity threshold that makes individuals indifferent between working for someone else or running a firm also increases, shrinking the share of entrepreneurs in the economy. The top left panel of figure 12 shows the log-level of wages of high and low skill workers generated by the model. Both are increasing, reducing the share of high and low skill entrepreneurs. However, since the wages of high skill workers rise faster, generating the increase in the skill premium displayed in the top right panel of figure 12, the share of entrepreneurs declines more within the group of high skill workers. Importantly, only entrepreneurs with high managerial abilities remain active, and the average value of z rises, as shown in the bottom left panel of figure 12. The profits of the remaining entrepreneurs also increase because the workers they hire are more productive.

In my model, the excess return to entrepreneurship, that is, the average profits of the active entrepreneurs relative to the profits they would obtain as workers, also increases. To see this, the bottom right panel of figure 12 shows the percentage increase in the average excess returns with respect to the value in 1985 for high and low skill individuals. Relative to the initial steady state, the excess return increases by 15% for the group of high skill entrepreneurs. This is qualitatively consistent with the evidence presented by Michelacci and Schivardi (2016) that reports a large increase in the excess return, particularly for entrepreneurs with postgraduate studies. Low skill individuals are, on average, less productive, and the excess return decreases relative to the initial steady state as the wages of low skill workers increase during the transition.³⁴

Similar to the evidence shown in figures 4 and 5, my model predicts, first, an increase in the mean labor earnings of individuals that switch from worker to entrepreneur, and second, a stronger increase within high skill individuals. This is shown in figure 13 which displays the average labor earnings of high and low skill individuals before tran-

³⁴Michelacci and Schivardi (2016) define the excess return as the difference between the average entrepreneurs' returns and average labor earnings. In their analysis, entrepreneurs' returns are the sum of labor earnings of self-employment, dividends, and expected capital gains. My model only considers the dividends part of entrepreneurs' returns.

FIGURE 12 – WAGES, SKILL PREMIUM, AND PRODUCTIVITY



Note: The top-left panel of figure 12 shows the evolution of the (log) wages in the model. The top right panel shows the college premium in the data and the skill premium implied by the model. The bottom left panel shows the evolution of the (log) average skill level of active entrepreneurs calculated as $\bar{z}_t = \sum_{s \in \{H,S\}} \int z_{i,t} d_{i,t}^s d\mu_t^s$, whereas the bottom right panel shows the entrepreneurial excess return normalized 1985.

sitioning into entrepreneurship (black-starred line) and the income of those individuals that stayed as workers. My model results are qualitatively consistent with the large increase in labor earnings for individuals that switch from workers to entrepreneurs.

4.4 Robustness

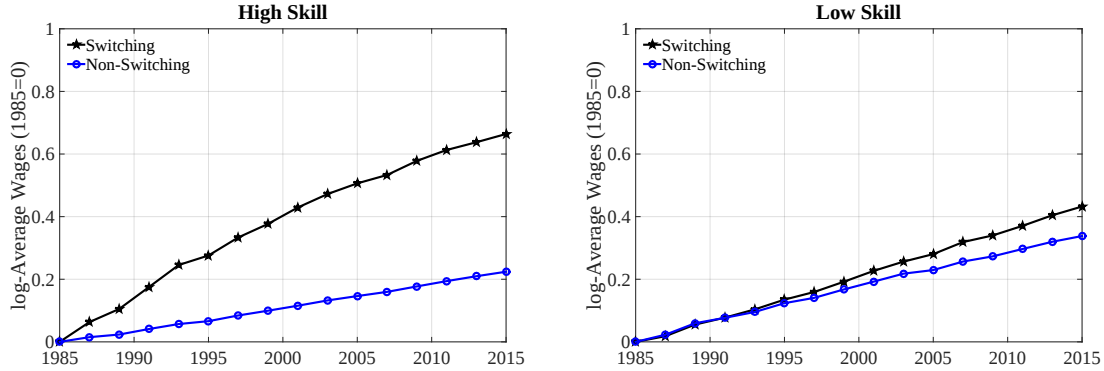
Firm Creation Cost and Borrowing Constraints

A possible explanation for the decrease in new business formation is the increasing cost of regulation in the United States, which affects existing and potential entrepreneurs.³⁵

Arguably, an increase in the regulatory burden would deter firm creation in a similar way to the deterrence effect of an increase in the value of κ , the creation cost in the problem

³⁵The cost of regulation is difficult to measure. One proxy for this cost is the number of restrictions in the administrative code. Al-Ubaydli and McLaughlin (2017) provide an estimate of the number of restrictions and words that indicate that a specific action is prohibited or required for firms. Using this dataset, I find that the average number of restrictions within 2-digit NAICS industries grew 75% from 1985 to 2015.

FIGURE 13 – LABOR EARNINGS FOR SWITCHING AND NON-SWITCHING WORKERS

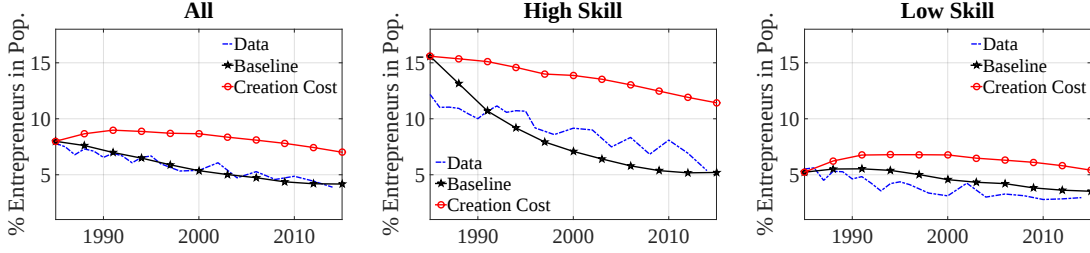


Note: Figure 13 shows the average labor earnings of individuals *prior* switching to entrepreneurship and the average labor earnings of those individuals that stayed as workers.

of the entrepreneurs. Hence, in this section I ask, what is the level of κ that generates the same proportion of entrepreneurs in 2014 conditional on the parameter values of 1985? I find that the value of κ required to reduce the proportion of entrepreneurs to the level observed in 2014 is almost seven times the value of κ in my calibration exercise. Denote this new level of the entry cost by $\tilde{\kappa}$. Next, I study the transition observed in the model generated by a linearly increasing trend of the entry cost. As in my previous exercise, I assume that the economy is at a stationary equilibrium in 1985. Then, the agents learn the entire sequence of κ_t . I assume that κ_t increases between 1985 and 2015 and remains fixed at the value in 2015 for the rest of the transition. For the initial value of κ_t , I take the level used in my baseline calibration, and for the terminal level, I choose $\tilde{\kappa}$.

The left panel of figure 14 shows the evolution of the population share of entrepreneurs resulting from an increase in the cost of firm creation. To facilitate the comparison with my previous results, the figure also displays the evolution of the population share of entrepreneurs for my baseline calibration and the population share of entrepreneurs in the data. First, notice that the decline in the share of entrepreneurs implied by an increase in κ_t is more moderate than the decline observed in the data. This is because, in anticipation of higher future costs, some households decide to transition earlier into entrepreneurship, raising the share of entrepreneurs above the original stationary level. The increase in the share of entrepreneurs is mostly explained by the response of low skill individuals as shown in the right panel of figure 14. Finally, the center panel displays the evolution of the share of high skill entrepreneurs, which is flat-

FIGURE 14 – EFFECTS OF AN INCREASE IN κ



Note: The left panel of figure 14 shows the share of entrepreneurs implied by a linear increase in the cost of creating a firm (κ). The center and right panel show same statistics within the group of low and high skill households.

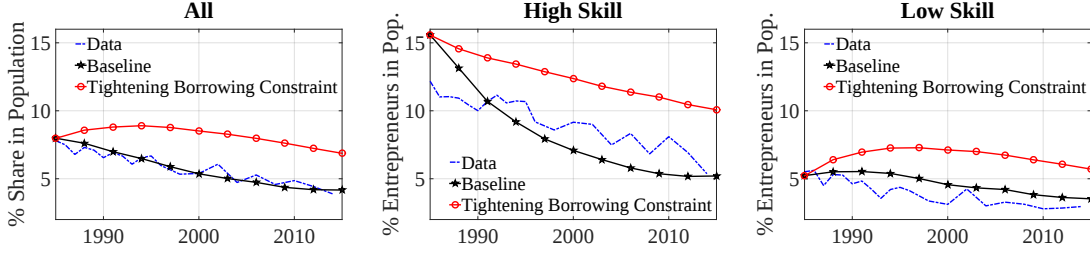
ter than the evolution implied by my baseline exercise. In summary, an increasing cost of regulation, in the form of an increase in the cost of firm creation, generates a small decline in the share of entrepreneurs along the transition and does not seem to account for the rapid decrease in the share of entrepreneurs among high skill individuals.³⁶

A tightening of the borrowing constraint could also generate a decrease in the share of entrepreneurs. There are at least two possible problems for such channel to be quantitatively important. First, given the large increase of house prices observed before the Great Recession, it is unlikely that the borrowing constraints have tightened over time, as many entrepreneurs use their house as a collateral to start a firm. Moreover, if the borrowing constraints have become tighter, then one would expect that the rate at which households and entrepreneurs get rejected by a financial institution when asking for a loan to increase. However, data from the SCF shows that the rate of rejection has decreased, if anything, across the population in general, and for entrepreneurs in particular.³⁷ Second, in the context of my model, a tightening of the borrowing constraint

³⁶These results might overestimate the real effect of the increase in the entry cost in my model. If one takes the entry cost as a proxy for the cost of regulation imposed by the tax code and other mandatory rules that firms need to follow, then the entry cost must have increased only 75% based on my calculations using the data collected by [Al-Ubaydli and McLaughlin \(2017\)](#). In such a case, keeping the rest of the parameters as in 1985, my model would predict a decrease of 0.5 percentage point in the share of entrepreneurs, much less than the drop of 3.9 percentage points observed in the data.

³⁷The share of households whose head is between 22 and 60 years old that asked for a credit but where rejected has remained constant around 25% since 1989. For entrepreneurs, the rate of rejection declined from 25% in 1992 to less than 15% in 2016. Separating the sample in different age groups or considering heads of households more than 60 year old does not change this result. Alternatively, it is possible that individuals do not get rejected because they never asked for a credit in the first place. The SCF provides information on the share of households (entrepreneurs) that did not ask for a credit because they expected to be reject by the financial institution. Similarly to the rejection rate, the share of households that did not ask for a credit because they expected a rejection has remained

FIGURE 15 – EFFECTS OF A DECREASE IN λ



Note: The left panel of figure 15 shows the share of entrepreneurs implied by a linear decrease in the value of λ . The center and right panel show same statistics within the group of low and high skill households.

is inconsistent with the decrease in the share of low skill entrepreneurs observed in the data. In fact, the model predicts an increase in the share of entrepreneurs within this group. Figure 15 shows the time series of the share of entrepreneurs under the assumption that the value of λ decreases by a third between 1985 and 2015, keeping fixed the rest of the parameters as in 1985. In this case, the population share of entrepreneurs declines by half, mostly because of the decrease in the share of high skill entrepreneurs. However, within the group of low skill individuals, the share of entrepreneurs increases over time. This differential response comes from the differences in managerial ability of high and low skill individuals. Because high skill individuals are relatively more productive as entrepreneurs they run larger projects that require more resources. Therefore, a tightening of the borrowing constraint affects them the most, whereas the effect for low skill individuals is weaker because they are less able as managers and run smaller projects.³⁸

Myopic Transition

So far I have assumed that agents have perfect foresight about the future path of the aggregate state of the economy. Alternatively, one could consider that agents are surprised every period about changes in the aggregate variables and expect that the current state of the economy remains fixed for the infinite future. In this sense, agents are perfectly myopic. This assumption does not change the equilibrium definition, but

constant around 15% (12% within entrepreneurs) between 1989 to 2007, increased during the Great Recession, and then declined again in 2016.

³⁸Importantly, these results do not depend on the specific form of the borrowing constraint. The results showed in appendix C.1 consider a more standard borrowing constraint of the form $p_k k \leq \lambda a$. I find a similar decline in the share of entrepreneurs despite the fact that the borrowing constraint is becoming more relaxed over time as the cost of capital declines.

it does modify the information set available for the agents. Hence, one needs to change the solution algorithm accordingly. Appendix B explains in detail the algorithm used to solve the transition path in this case. The upper left panel of figure 16 shows the evolution of the fraction of entrepreneurs in this case, along with the time series for the perfect foresight case and the share of entrepreneurs calculated from the data. Overall, the evolution of the share of entrepreneurs is quite similar, both qualitatively and quantitatively. Relative to the perfect foresight case, the overall fall in the share of entrepreneurs and the speed of decline remain basically unchanged if one assumes that entrepreneurs learn every period about the current aggregate state of the economy. Therefore, I conclude that assuming perfectly myopic agents does not affect the results of my model.

Smooth Transition of Aggregates

How would my results change under an alternative assumption about the evolution of the aggregates after 2015? To answer this question, I assume that the price of capital goods, the relative productivity of high skill workers, and the supply of high skill workers all keep a constant growth rate equal to the average growth rate observed during the period 2005-2015. I assume the growth rate of each trend declines geometrically to reach 0 growth in 2035. The upper right panel of figure 16 shows that the share of entrepreneurs and the decline implied by the model remain basically the same as in my baseline results.

General Equilibrium

In the benchmark results, I have assumed a fixed interest rate. This was with the explicit purpose of highlighting the effects of the change in wages on the decision to become an entrepreneur while muting the general equilibrium effect of the change in the interest rate on the production cost and individuals' savings. In this section, I study how my results change if I solve for the equilibrium interest rate along with the wages of high and low skill workers.³⁹ The bottom left panel of figure 16 shows

³⁹Since this is now a closed economy, one needs to pin down a particular value of capital-to-output ratio at the initial steady state. I do that by choosing value of β to that the capital-to-output ratio is equal to three in the stationary equilibrium at the beginning of my simulation. The corresponding value of β is 0.88, which is what I use in my baseline calibration.

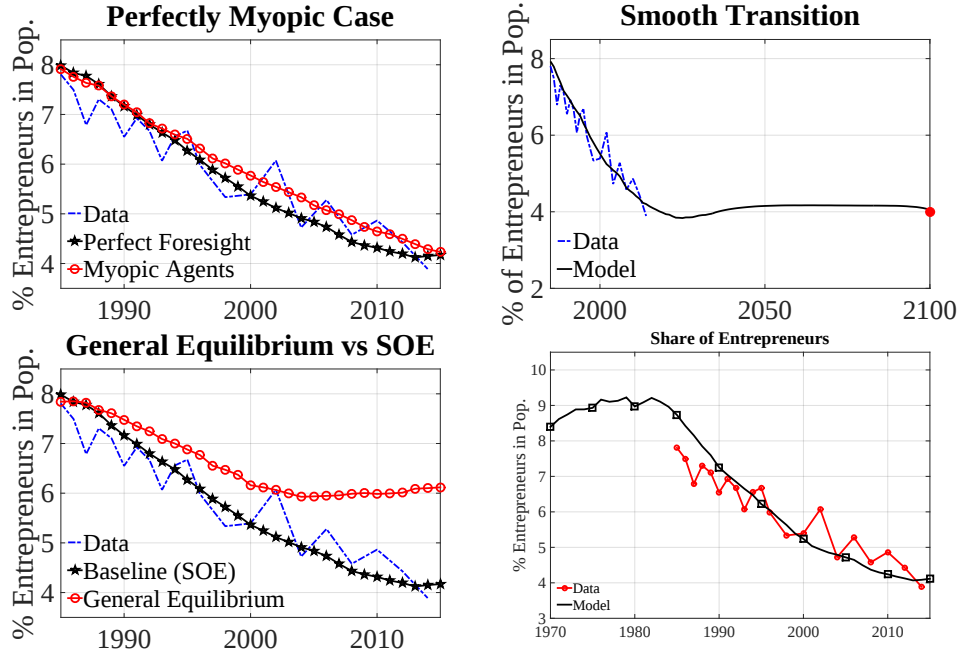
the evolution of the share of entrepreneurs in the data, in the benchmark small open economy case and in the general equilibrium case.⁴⁰ In the latter, the decline in the share of entrepreneurs is half of the decline generated by my benchmark case. This is because the interest rate increases substantially along the transition path, increasing the rate of households's saving. The increase in individuals' savings has two effects on entrepreneurial profits. First, more savings imply more capital for the firms, increasing the profits of entrepreneurs. Second, more wealth relaxes the borrowing constraint, allowing entrepreneurs to operate firms closer to their optimal size. These two effects increase the value of being an entrepreneur. Consequently, the general equilibrium feedback dampens the effects of the changes in the wages on the share of entrepreneurs. Overall, the general equilibrium version of the model predicts a decline of 2.0 percentage points in the share of entrepreneurs, which is about 52% of the decline generated in the fixed interest rate case. Consequently, although considering general equilibrium changes my results quantitatively, the changes in wages and profits induced by the three aggregate trends I consider can account for at least half of the fall in the share of entrepreneurs observed in the data.

A Longer Transition

In my baseline exercise, I have assumed that the economy is in steady state in 1985. Then agents learn about the path of aggregate variables from that year to the infinite future. However, the relative price of investment has shown a declining trend starting several years before 1985, so one might wonder how much my quantitative results depend on the assumption that the economy is at steady state in 1985. To address this concern, here I assume that the economy is at its stationary equilibrium in 1970, and then individuals observe the evolution of the price of capital, the evolution of the productivity of high skill workers, and the supply of high skill labor. As in my previous results, here I take the values of $p_{k,t}$ and H_t directly from the data, and I change the value of $A_{H,t}$ to reproduce the skill premium observed in 1970. Then, I assume that each exogenous process remains constant after 2015. The bottom right panel of figure 16 shows the evolution of the share of entrepreneurs in the data and the model. First, notice that starting the economy in 1970 does not affect the ability of the model to closely follow the decline in the share of entrepreneurs from 1985 on. Second, the

⁴⁰Appendix figure 28 shows the evolution of the skill premium and the interest rate implied by the model.

FIGURE 16 – SHARE OF ENTREPRENEURS FOR DIFFERENT ROBUSTNESS EXERCISES



Note: The upper left panel of figure 16 compares the evolution of the share of entrepreneurs in the baseline perfect foresight case with the share of entrepreneurs in the perfectly myopic case. The upper right panel shows the transition path of the share of entrepreneurs under the assumption that aggregate variables grow at a decreasing rate after 2015. The bottom left panel of figure 16 compares the baseline, fixed interest rate case with the evolution of the share of entrepreneurs in the general equilibrium case. Finally, the bottom right panel displays the share of entrepreneurs implied by the model under the assumption that the economy was in steady state in 1970.

model predicts that the share of entrepreneurs was more or less stable between 1970 and the early 1980s, and started its decline in the mid-1980s. The data necessary to construct my preferred definition of entrepreneurs start in 1984. However, one can look at the evolution of the share of self-employed business owners to get a sense of the evolution of the share of entrepreneurs before 1985. This is shown by the squared-red line in the bottom right plot of figure 16. Between 1970 and 1985, the college premium decreased and then bounced back, explaining why my model predicts a flat rate of entrepreneurs in the first years of the transition. Therefore, I conclude that a longer transition starting from 1970 does not substantially change my baseline, post-1985, results. However, the model cannot account for the increasing trend of entrepreneurs in the early 1980s. Some other factors (such as changes in taxation or changes in the age distribution of the labor force) might explain the increase in the share of entrepreneurs in the late 1970s and early 1980s.

5 Policy Analysis

Several researchers have considered the decline in firm creation to be a negative outcome that should be addressed by policy. In my model, a decline in firm creation is equivalent to a fall in the transition rate of workers into entrepreneurship. In this section I study the aggregate response of the economy to a subsidy that intends to increase the rate of entry of new entrepreneurs to its 1985 level conditional on the parameter values in 2015. Consider now a policy reform that directly relaxes the borrowing constraint of the entrepreneurs. Specifically, I assume that the government gives a subsidy of ι_t to finance the cost of inputs to every entrepreneur in the economy. Hence, entrepreneurs face a new collateral constraint given by

$$(1 - \iota_t) (p_{k,t} k_t + \omega_{H,t} (\Theta_t, \mu_t) n_{H,t} + \omega_{L,t} (\Theta_t, \mu_t) n_{L,t}) \leq \lambda a_t.$$

Although this subsidy affects every entrepreneur, it has a larger impact on small and new entrepreneurs, who typically have less wealth than large, established entrepreneurs. I assume that the government collects revenues using an equal linear tax on workers' and entrepreneurs' income. Denote this tax by τ_g . Then, the government budget constraint is given by

$$\begin{aligned} \sum_{s \in H, L} \int \tau_g (d_t^s (\Omega_t, p_{k,t}, \mu_t) y_t \omega_{s,t} + d_t^s (\Omega_t, p_{k,t}, \mu_t) \pi_{s,t} (a_t, z_t)) \mu_t^s (\Omega_t) = \\ \sum_{s \in H, L} \int d_t^s (\Omega_t, p_{k,t}, \mu_t) ((p_{k,t} k_t^s + \omega_{H,t} (\Theta_t, \mu_t) n_{H,t}^s + \omega_{L,t} (\Theta_t, \mu_t) n_{L,t}^s)) \iota_t d\mu_t^s (\Omega_t). \end{aligned} \quad (10)$$

The equilibrium definition for this case is similar to the definition in section 3.2, with the additional condition that the government must balance the budget in every period. Using this simple policy, I run the following experiment. I start as if the economy is in a stationary equilibrium conditional on the parameter values of 2015, and I compare this economy to a new stationary economy in which the subsidy is such that the entry rate of new entrepreneurs is equal to 2.4%, which is the transition rate from workers into entrepreneurship observed in 1985. Columns (1) and (2) of table V compare aggregate output, total factor productivity (TFP), the tax burden as a percentage of output, and other aggregates at the stationary equilibrium of both economies.⁴¹ To reach an entry

⁴¹TFP is defined as $Y (K^{0.33} L^{0.67})^{-1}$. Here, Y is aggregate output, K is the sum of the capital utilized by all the entrepreneurs and the non-entrepreneurial sector, and L is the size of the labor force,

rate of entrepreneurs as in 1985, the government imposes a tax that generate revenues that are equivalent to 3.16% of aggregate output. The increase in the entry rate induces a rise in the fraction of entrepreneurs in the population of 2.42 percentage points and an increase in aggregate output of 4.0%. TFP increases 9.20% in the new steady state. This happens for two reasons. First, on the extensive margin, some production factors are reallocated from the non-entrepreneurial sector to the new entrepreneurs that are, on average, more productive than the firms in the non-entrepreneurial sector. Second, on the intensive margin, already existing entrepreneurs can run firms closer to their optimal, unrestricted, scale.

The subsidy also induces higher welfare, measured in consumption equivalents. In particular, the average consumption equivalent required to make individuals indifferent between the baseline steady state and the steady state with a subsidy to firms is 0.04; that is, individuals are willing to give up some consumption to live in an economy where the subsidy is in place.⁴² The welfare gains, however, are not distributed equally across the population. High skill individuals experience a larger increase in welfare because they are able to run larger firms. Low skill workers also enjoy an increase in welfare as their wages go up because of the increase in labor demand. Low skill entrepreneurs experience the lowest increase in welfare. This is because, although they receive a subsidy that relaxes their borrowing constraint, the tax is large and pushes down their consumption, and hence welfare, although not enough to reduce it below the level of the unsubsidized economy.

In fact, the subsidy is much more effective in inducing high skill workers to become entrepreneurs than it is for low skill workers. The fraction of high skill individuals that are entrepreneurs increases 1.56 percentage point, from 2.41% to 3.96%, whereas the fraction of low skill entrepreneurs rises 0.88 percentage points from 1.26% to 2.14%. Alternatively, the government could impose a tax that maximizes the welfare of the economy. If the government considers an equally weighted average of utility across the individuals in the economy, the maximum level of utility is reached with a subsidy of 2.58% of GDP, as column (4) in table V shows. Output, productivity, and the share of entrepreneurs also increase in this case. I conclude that a policy that aims

which is normalized to 1.

⁴²The average consumption equivalent is the equally weighted average of the value $\omega(\Omega)$ that solves the equation $(1 + \omega_s(\Omega))^{1-\sigma} V_{s,t}^*(\Omega) = \tilde{V}_{s,t}(\Omega)$ where $V_{s,t}^*(\Omega)$ is the value of an individual in the original stationary equilibrium without subsidies and $\tilde{V}_{s,t}(\Omega)$ is the value at the new stationary equilibrium, both conditional on the same idiosyncratic states, Ω .

TABLE V – STEADY STATE COMPARISON OF A SUBSIDY TO FIRM COSTS

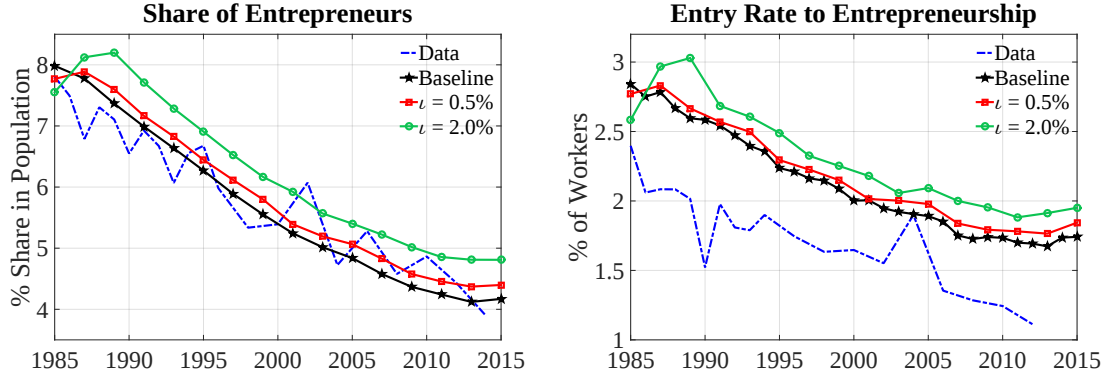
	(1)	(2)	(3)	(4)	(5)
	Baseline	1985-level		Optimal	
		Level	Δ	Level	Δ
Subsidy (% of GDP)	-	3.16		2.58	
Entry Rate (%)	1.55	2.40		2.35	0.80
Aggregate Output	1.50	1.56	4.0%	1.56	4.0%
Total Factor Productivity	0.87	0.95	9.2%	0.94	8.0%
Entrepreneurs All (%)	3.68	6.10	2.42	5.85	2.17
High Skill (%)	2.41	3.96	1.55	3.77	1.36
Low Skill (%)	1.26	2.14	0.88	2.08	1.08
Entrepreneurs W/High Skill (%)	6.34	10.30		9.80	
Entrepreneurs W/Low Skill (%)	2.03	3.48		3.38	

Note: Table V compares the macroeconomic aggregates of different stationary economies. Column (1) shows the results for the baseline stationary economy if the parameters were as in 2015 and remain constant for the infinite future. Column (2) uses the same set of parameters but introduces a subsidy to finance the production costs of the entrepreneurs financed with linear tax for all individuals in the economy. The subsidy level is $\iota_t = 6.5\%$ of the total cost of production. Column (4) shows the same statistics under the assumption that the government implements the subsidy that maximizes the average welfare of the stationary economy given the parameter values in 2015. The value of the subsidy is $\iota_t = 5.73\%$.

to subsidize firms through a credit line that relaxes the borrowing constraint with the goal of increasing the entry rate of entrepreneurs to its level in 1985 would generate substantial benefits to the economy.

The previous exercise shows that the decline of entrepreneurship can be alleviated by a subsidy to entrepreneurs' cost. What would the transition of the economy looked like if such policy had been implemented in 1985? Figure 17 shows the time series of the share of entrepreneurs both in the data, for my baseline results, and for different levels of the subsidy. As in the steady state comparison, a positive subsidy generates an increase in the level of the share of entrepreneurs in each year of the transition, however, it does not change the slope of the time series. In other words, although a fixed subsidy is effective in generating a larger share of entrepreneurs, it is unable to undo the impacts of the technological changes affecting the economy that have led to an equilibrium decline in the share of entrepreneurs and the entry rate to entrepreneurship.

FIGURE 17 – ENTREPRENEURS AND TRANSITION FOR DIFFERENT SUBSIDIES



Note: The left panel of figure 17 shows the time series of the share of entrepreneurs in the data for four different levels of input subsidies to entrepreneurs. The right panel shows the transition rates into entrepreneurship.

6 Conclusion

In this paper, I have studied the causes of the decline in the share of entrepreneurs in the US population, and I have linked such decline to technological changes experienced by the US economy in recent decades. In doing that, I have argued that the same technological changes that have given rise to the increase of returns to high skill workers are responsible for the decline in the share of entrepreneurs observed in the United States over the last three decades.

I provide new evidence on the fall in the share of households participating in entrepreneurial activities and on the share of households transitioning into entrepreneurship. Moreover, I show that the decline in the proportion of entrepreneurs has been concentrated among individuals with high levels of educational attainment. Additional empirical evidence suggests that the skill level of new entrepreneurs has increased over time, which is consistent with an increase in the selection of individuals with higher managerial abilities.

Building on this evidence, I study an entrepreneurial choice model where the increase in the wage of high skill workers is the equilibrium outcome of the interplay of three exogenous trends, namely, the decrease in the price of capital goods, the increase in the supply of skilled labor, and the increase in the productivity of high skill workers. My model is able to account for the level and the speed of the decline in the share of entrepreneurs. In my baseline exercise, the model generates a decline of 3.8 percentage points in the share of entrepreneurs, which is almost all of the decline of 3.9 percent-

age points experienced in the United States over the last 30 years. My model is also consistent with the differential decrease in the share of entrepreneurs among high and low skill individuals and the observed decline in the transition rate into entrepreneurship. Moreover, I find that each of the exogenous trends is quantitatively important in explaining the drop in the fraction of entrepreneurs in the economy. The increase in the productivity of high skill workers accounts for half of the decrease in the share of entrepreneurs, whereas the other half is equally explained by the decrease in the price of capital goods and by the increase in the supply of high skill workers.

Taken together, my results indicate that a large fraction of the decline in the pace of firm creation and entrepreneurship is the result of the same technological improvements that have increased the returns to high skill workers over the last 30 years. Such changes have naturally led to a reduction in entrepreneurship and entrepreneurial dynamism. However, viewed through the lens of my model, the decline in entrepreneurship, firm creation, and overall dynamism of the US economy should not be cause for concern. This does not imply, there is no role for government intervention. To the extent that the government can ease the borrowing constraint faced by entrepreneurs—the only source of inefficiencies in my model—the share of entrepreneurs would increase, as well as output and productivity.

References

- ACEMOGLU, D. (2002). Technical change, inequality, and the labor market. *Journal of economic literature*, **40** (1), 7–72.
- and AUTOR, D. (2011). Skills, tasks and technologies: Implications for employment and earnings. *Handbook of labor economics*, **4**, 1043–1171.
- AL-UBAYDLI, O. and MCCLAUGHLIN, P. A. (2017). Regdata: A numerical database on industry-specific regulations for all united states industries and federal regulations, 1997–2012. *Regulation & Governance*, **11** (1), 109–123.
- AUTOR, D. H., KATZ, L. F. and KEARNEY, M. S. (2008). Trends in us wage inequality: Revising the revisionists. *The Review of economics and statistics*, **90** (2), 300–323.
- BRICKER, J., HENRIQUES, A., KRIMMEL, J. and SABELHAUS, J. (2016). Measuring income and wealth at the top using administrative and survey data. *Brookings Papers on Economic Activity*, **2016** (1), 261–331.
- BUERA, F. J. (2009). A dynamic model of entrepreneurship with borrowing constraints: theory and evidence. *Annals of finance*, **5** (3), 443–464.
- , KABOSKI, J. P. and SHIN, Y. (2015). Entrepreneurship and financial frictions: A macrodevelopment perspective. *economics*, **7** (1), 409–436.
- and SHIN, Y. (2013). Financial frictions and the persistence of history: A quantitative exploration. *Journal of Political Economy*, **121** (2), 221–272.
- CAGETTI, M. and DE NARDI, M. (2006). Entrepreneurship, frictions, and wealth. *Journal of political Economy*, **114** (5), 835–870.
- CUMMINS, J. G. and VIOLANTE, G. L. (2002). Investment-specific technical change in the united states (1947–2000): Measurement and macroeconomic consequences. *Review of Economic dynamics*, **5** (2), 243–284.
- DAVIS, S. J. and HALTIWANGER, J. (2014). *Labor market fluidity and economic performance*. Tech. rep., National Bureau of Economic Research.

- DECKER, R., HALTIWANGER, J., JARMIN, R. and MIRANDA, J. (2014). The role of entrepreneurship in us job creation and economic dynamism. *The Journal of Economic Perspectives*, **28** (3), 3–24.
- , —, — and — (2015). Where has all the skewness gone? the decline in highgrowth (young) firms in the u.s. *Working Paper*.
- DECKER, R. A., HALTIWANGER, J., JARMIN, R. S. and MIRANDA, J. (2016). Declining business dynamism: Implications for productivity. *Brookings Institution Hutchins Center Working Paper No*, **23**.
- DiCECIO, R. (2009). Sticky wages and sectoral labor comovement. *Journal of Economic Dynamics and Control*, **33** (3), 538–553.
- EVANS, D. S. and JOVANOVIC, B. (1989). An estimated model of entrepreneurial choice under liquidity constraints. *Journal of political economy*, **97** (4), 808–827.
- and LEIGHTON, L. S. (1989). Some empirical aspects of entrepreneurship. *The American Economic Review*, **79** (3), 519–535.
- GENTRY, W. M. and HUBBARD, R. G. (2004). Entrepreneurship and household saving. *Advances in economic analysis & policy*, **4** (1).
- GORDON, R. J. (2007). *The measurement of durable goods prices*. University of Chicago Press.
- GOURIO, F., MESSER, T. and SIEMER, M. (2016). Firm entry and macroeconomic dynamics: A state-level analysis. *The American Economic Review*, **106** (5), 214–218.
- GREENWOOD, J., HERCOWITZ, Z. and KRUSELL, P. (1997). Long-run implications of investment-specific technological change. *The American Economic Review*, pp. 342–362.
- GUVENEN, F., KAMBOUROV, G., KURUSCU, B., OCAMPO, S. and CHEN, D. (2015). *Use it or lose it: Efficiency gains from wealth taxation*. Tech. rep., Working paper.
- HALTIWANGER, J., DECKER, R. and JARMIN, R. (2015). Top ten signs of declining business dynamism and entrepreneurship in the us. In *Kauffman Foundation New Entrepreneurial Growth Conference*.

- HATHAWAY, I. and LITAN, R. E. (2014a). Declining business dynamism in the united states: A look at states and metros. *Brookings Institution*.
- and — (2014b). What’s driving the decline in the firm formation rate? a partial explanation. *The Brookings Institution*.
- HURST, E. and LUSARDI, A. (2004). Liquidity constraints, household wealth, and entrepreneurship. *Journal of political Economy*, **112** (2), 319–347.
- HYATT, H. R. and SPLETZER, J. R. (2013). The recent decline in employment dynamics. *IZA Journal of Labor Economics*, **2** (1), 5.
- JERMANN, U. and QUADRINI, V. (2012). Macroeconomic effects of financial shocks. *The American Economic Review*, **102** (1), 238–271.
- JIAN, H. and SOHAIL, F. (2017). *Skill Biased Entrepreneurial Decline*. Mimeo, Washington University in St. Louis.
- KARAHAN, F., PUGSLEY, B. and SAHIN, A. (2016). *Demographic Origins of the Startup Deficit*. Tech. rep., NY Fed mimeo.
- KATZ, L. F. and KRUEGER, A. B. (2016). *The rise and nature of alternative work arrangements in the United States, 1995-2015*. Tech. rep., National Bureau of Economic Research.
- KRUEGER, A. B. (1993). How computers have changed the wage structure: evidence from microdata, 1984–1989. *The Quarterly Journal of Economics*, **108** (1), 33–60.
- KRUSELL, P., OHANIAN, L. E., RÍOS-RULL, J.-V. and VIOLANTE, G. L. (2000). Capital-skill complementarity and inequality: A macroeconomic analysis. *Econometrica*, **68** (5), 1029–1053.
- LIANG, J., WANG, H. and LAZEAR, E. P. (2014). *Demographics and entrepreneurship*. Tech. rep., National Bureau of Economic Research.
- LUCAS, R. E. (1978). On the size distribution of business firms. *The Bell Journal of Economics*, pp. 508–523.
- MICHELACCI, C. and SCHIVARDI, F. (2016). *Are They All Like Bill, Mark, and Steve? The Education Premium for Entrepreneurs*. Tech. rep., Einaudi Institute for Economics and Finance (EIEF).

- MOLL, B. (2014). Productivity losses from financial frictions: can self-financing undo capital misallocation? *The American Economic Review*, **104** (10), 3186–3221.
- MONDRAGÓN-VÉLEZ, C. (2009). The probability of transition to entrepreneurship revisited: Wealth, education and age. *Annals of Finance*, **5** (3), 421–441.
- PUGSLEY, B. and SAHIN, A. (2014). Grown-up business cycles. *Federal Reserve Bank of New York Staff Reports*.
- QUADRINI, V. (2000). Entrepreneurship, saving, and social mobility. *Review of Economic Dynamics*, **3** (1), 1–40.
- (2011). Financial frictions in macroeconomic fluctuations. *Economic Quarterly*, **97** (3Q), 209–254.
- REEDY, E. and STROM, R. J. (2012). Starting smaller; staying smaller: America’s slow leak in job creation. In *Small Businesses in the Aftermath of the Crisis*, Springer, pp. 71–85.
- TAUCHEN, G. (1986). Finite state markov-chain approximations to univariate and vector autoregressions. *Economic Letters*.
- YELLEN, J. L. (2016). Perspectives on inequality and opportunity from the survey of consumer finances. *RSF*.

A Data Appendix

A.1 The PSID Sample

The PSID sample used for studying the time series of the share of entrepreneurs and other statistics used in this study was constructed as follows. From the raw data, I extract a sample of heads of household from the SRC sample (I do not consider information of the SEO, Immigrants, or Latino Sample) from the waves going from 1970 and 2015. Some individuals have missing observations in employment status or were registered as “refusing to answer”. In those cases I replace the employment status variable by the code corresponding to “no working for money” (code 3). Only 107 observations were replaced in this way. The variable defining the age of the head of the household has several inconsistencies that are necessary to fix. In particular, for those individuals whose age jumps up for more than 3 years, or jumps down, I imputed an increase in age based on the first reliable age. Similar to age, the education variables has many inconsistencies. Because in this paper I focus on the education as a measure of skill, I create a new variable that considers the highest educational attainment of the individual as a measure of education. All monetary variables (income, wealth, etc.) were deflated using the Personal Consumption Expenditure index from the Bureau of Economic Analysis. The baseline sample considers households whose head is between 22 and 60 years old, both ends included. This yields a sample of 112,283 year-household observations with an average of 3,118 observations per year. For the period in which I focus my study, that is 1985 to 2015, the number of observations is 75,031 with an average of 5,573 observations per year. All statistics were calculated using PSID sample weights.

To calculate the parameters of the income process of equation (9) I measure earnings as the real value of total labor income of individual i in period t . Total labor includes wages and salaries, tips, commissions, and bonuses. However, the results are quite similar if one uses wages and salaries as measure of labor income. Then, I drop all observations of individuals that are self-employed business owners in either period t or $t - 1$. Given these restrictions, the parameters of equation (9) are calculated on a sample of 6,303 individuals and 58,094 observations. The value of ρ_w is 0.73 with standard error of .0028. The adjusted R^2 of the regression is 0.55. The standard error of the residuals 0.53 so I set σ_y to this value. Estimating equation (9) only for

individuals with college or more generates a slightly lower value for ρ_w equal to 0.70 (0.72 for individuals with high school or less). Nevertheless, the standard error of the residuals is quite similar and equal to 0.53.

A.2 CPS Data, Supply of Skills and College Premium

In this section, I describe how I constructed the share of college graduates (which is equated to the share of high skill workers in the model) and the college premium (which is the skill premium in the model). To calculate both time series I draw a sample of individuals from the March CPS data (accessed through IPUMS) from 1970 to 2015. To keep the sample selection as close as possible to the PSID, I keep individuals that are head of the household aged between 22 and 60 years (both ends included) which are in the labor force and have valid education information. Individuals in the armed force or with negative weights are also excluded from the sample. The baseline sample consists of 1.7 million individual-year observations.

The share of high skill workers is the weighted proportion of individuals with a college degree or more. The center panel of figure 8 shows the corresponding time series from 1980 to 2015. The skill premium, on the other hand, is calculated over a subsample of wage workers only. This is because both in the model and in the literature, the skill premium is the relative wage of high skill workers to low skill workers. To avoid issues related to the differences in labor supply of college graduates versus non-college graduated, here I consider a sample of individuals wage workers (not self-employed) that worked more than 40 weeks, and more than 35 hours per week (which is the definition of full time workers in [Acemoglu and Autor \(2011\)](#)). This leave yields a sample of 1.2 million observations. Then, the college premium is the difference between the weighted average of log-real wage for college graduates and the weighted average of log-real wage for high school graduates. The right panel of figure 8 shows the corresponding time series from 1985 to 2015.

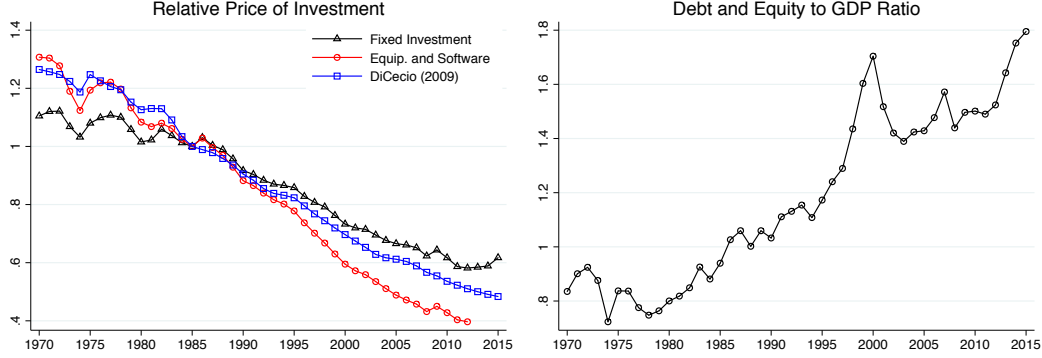
A.3 Aggregates

In this section, I show some additional details on the construction of the relative price of capital goods used in my quantitative exercise and the measure of debt and equity relative to non-financial private sector GDP.

I take the measure of the relative price of investment directly from [DiCecio \(2009\)](#) estimates available in the Federal Reserve Bank of St. Louis website (FRED time series PIRIC). Alternatively, one could calculate the relative price of investment as the ratio of the price index of non residential investment calculated by the BEA (FRED time series A008RD3Q086SBEA) divided by the price index of non durable consumption (FRED series CUUR0000SAN). A third alternative is to use a more refined measure of investment that only considers equipment and software (FRED time series A010RD3A086NBEA) relative to the price index of non durable consumption. The left panel of figure 18 shows the evolution of each of these series re scaled to 1985. The three time series show a similar declining pattern although measure of the price of investment that considers equipment and software only shows a sharper decline: relative to 1985 the measure that considers all investment declined 40%, [DiCecio \(2009\)](#) measure declined a 55%, and the measure that considers equipment and software declined 60%. This makes the choice of the quality adjusted time series calculated by [DiCecio \(2009\)](#)'s a conservative option, right in the middle of these different measures.

To the ratio of debt and equity to business GDP that serves as one of the targets in my quantitative exercise I consider four different time series. From the Flow of Funds I consider the Non Financial Non Corporate Businesses Total Liabilities (FRED time series NNBTLQ027S) and the Non Financial Corporate Businesses Total Liabilities and Equity (FRED time series NCBLEYQ027S). Both series are aggregated averaging the quarterly data to annual levels. Then I add these annual series to have a measure of the total liabilities of the non financial business sector. The measure of GDP comes from BEA sectoral measures of GDP from which I add up the annual nominal GDP across all private industries with the exception of Finance and Insurance. The right panel of figure 18 shows the resulting time series.

FIGURE 18 – PRICE OF INVESTMENT AND DEBT-TO-GDP RATIO



Note: The left panel of figure 18 shows the time series of the relative price of investment for three different measures. The right panel shows the debt and equity of non financial businesses to non financial businesses GDP ratio.

B The Algorithm

The solution of the model implies calculating an initial and final steady states, and the complete transition path of aggregate states and factor prices, given the exogenous sequences of $p_{k,t}$, H_t , and $A_{H,t}$. On top of the well known complications of solving heterogenous agents models, the present model requires finding a combination of three prices that simultaneously clear the markets for capital, high skill labor, and low skill labor.

To solve the steady states of the economy I proceed as follows. Consider that the economy is at the steady state in $t = 0$ and $p_{k,t} = p_{ss,0} = 1$, $H_t = \bar{H}$, and $A_{H,t} = 1$. Individuals expect this vector of aggregate states variables to remain constant forever. Then, given this aggregate vector, the algorithm to find the stationary equilibrium is as follows,

- S0: Guess a vector of prices $\{\tilde{\omega}_H, \tilde{\omega}_L, \tilde{r}\}$ and solve the problem of the households in 2, that is, solve the profit maximization problem of the entrepreneurs, and get the corresponding policy rules and factor demands for the households. To solve the problem of the households I use Value Function Iteration searchings continuously over the asset space.
- S1: Given an initial distribution of individuals over idiosyncratic states, μ_t , iterate until convergence and calculate the aggregate demand of capital, high skill

labor, and low skill skilled labor coming from the entrepreneurs. Denote these by $K^{D,e}$, $N_H^{D,e}$, and $N_L^{D,e}$ respectively. Calculate also the aggregate supplies of capital, and each type of labor, K^S , N_H^S , and N_L^S .

- S2: Calculate the demands of high and low skilled labor of the non-entrepreneurial sector as the residual supply after subtracting the demands for the entrepreneurial sector, that is $N_H = N_H^S - N_H^{D,e}$ and $N_L = N_L^S - N_L^{D,e}$. If these result in negative supplies, go to S0 and guess a new set of prices with a larger value of the wages.
- S3: If the residuals demands of labor are positive in S2, use the first order condition of the problem of the non-entrepreneurial sector to find K , that is, solve the nonlinear expression, $p_{ss,0}(\tilde{r} + \delta) - F_K(N_H, N_L, K^C) = 0$.
- S4: Using N_H and N_L from S2 and K^C from S3, check the three following conditions,

$$\begin{aligned} & - \tilde{\omega}_H - F_H(N_H, N_L, K), \\ & - \tilde{\omega}_L - F_L(N_H, N_L, K), \\ & - K^S - K^C + K^{D,e} \end{aligned}$$

If the sum of the last three expressions is greater than 10^{-6} , go to S0 using a new guess of prices. If not, the equilibrium set of policy functions, value functions, prices, and stationary distribution of individuals over idiosyncratic states has been found.

Notice that we could calculate in S2 the residual demand of capital for the corporate sector, and go directly to S4 to check $\tilde{r} = F_K(N_H, N_L, K^C) - \delta$. In practice, I have found that the previous algorithm is much more stable since it avoids iterating over the interest rate. I repeat these same steps both for the initial and final steady states, changing only the value of the aggregates, $p_{k,t}$, $A_{H,t}$, and H_t .

To calculate the transition path of the economy between the initial and final steady states requires taking a stand of what do the household know about the evolution of the economy from period 0 to the infinite future. Here, we can take two extremes cases. One can assume that individuals have perfect foresight about the full equilibrium path of prices and aggregate states, or one can assume that individuals are myopic in the sense that they are surprised by the change of the relative price of investment goods

and perceive that such price will remain fixed forever. Here I describe both algorithms in detail.

Perfect Foresight Case. Given a sequence of aggregate states $\Theta_t = \{p_{k,t}, A_{H,t}, H_t\}_{t=0}^T$ and a fixed value of the vector after T periods, $\Theta_T = \{p_{k,T}, A_{H,T}, H_T\}$ for all $t > T$, I proceed as follows,

- P0: take $\Theta_t = \Theta_0$ and $\Theta_t = \Theta_T$ and calculate the corresponding stationary equilibrium recording the equilibrium prices, and value functions. Denote the stationary distribution of the first steady state as $\mu_{ss,1}$.
- P1: Guess a path of prices $\{\tilde{\omega}_{H,t}, \tilde{\omega}_{L,t}, \tilde{r}_t\}_{t=1}^{t=T}$ which is fully observed by the agents at the end of period $t = 0$,
- P2: Starting in period $T - 1$, take the continuation values of the problem of the households as given and solve

$$V_{T-1}^s(a_{T-1}, z_{T-1}, y_{T-1}, d_{T-2}) = \max_{c_{T-1}, a_T} \left\{ \frac{c_{T-1}^{1-\sigma}}{1-\sigma} + \beta \left[\chi \mathbb{E}_{z'|z, y'|y} V_T^s(a_T, z_T, y_T, e_T) + (1-\chi) \sum_{j \in \{H, T\}} \zeta_{s,j} \mathbb{E} V_T^s(a_T, z_T, y_T, e_T) \right] \right\}$$

$$c_{T-1} + a_{T-1} \leq (1 + \tilde{r}_{T-1}) a_{T-1} + \pi_s(z_{T-1}, a_{T-1}) - \mathbb{I}(d_{T-2} = w) \kappa,$$

on a grid of $a's, z's$, and $y'z$. Do the same for workers, and record the value functions, V_{T-1}^s .

- P3: Go to period $T - 2$, take V_{T-1}^s as given, and solve the problem entrepreneurs and workers in $T - 2$ recording the continuation values. Continue until $t = 1$.

This generates a path of value functions that are consistent with $\{\tilde{\omega}_{H,t}, \tilde{\omega}_{L,t}, \tilde{r}_t\}_{t=1}^{t=T}$. Notice, however, that *these are not the equilibrium prices*. To find the equilibrium prices now we need to iterate forward, taking the initial distribution as given, and solving for the equilibrium prices in every period. Notice that in going forward, we shall not use the guessed set of prices. To iterate forward, I proceed as follows.

- F1: Given $\mu_0 = \mu_{ss,1}$ and the continuation values, V_1^s for $s = \{H, L\}$, solve for a new set of prices $\{\omega_{1,H}, \omega_{1,L}, r_1\}$ that clears the markets and record the resulting μ_1 *without using the guessed sequence of prices*
- F2: To solve the equilibrium in a given period
 - (A) Guess $\{\hat{\omega}_{1,H}, \hat{\omega}_{1,L}, \hat{r}_1\}$ and solve the problem of the agents
 - (B) Given μ_0 and the policy functions, calculate the excess demand and check market clearing as in S4
 - (C) If prices clear the markets (tolerance 10^{-5}) stop, record the new equilibrium prices and the results distribution, μ_2 and go to the next period,
 - (D) Otherwise, guess a new set of prices and go to (A)
- F3: Proceed in the same way until period T to generate a new path of *equilibrium prices*, $\{\omega_{t,H}, \omega_{t,L}, r_t\}_{t=1}^{t=T}$. Compare them with $\{\tilde{\omega}_{t,H}, \tilde{\omega}_{t,L}, \tilde{r}_t\}_{t=1}^{t=T}$ if the maximum distance is greater than 10^{-4} , take a weighted average of the series as a new guess and go to S1, stop other wise

Upon completion, we have found a path of prices, continuation values, policy function, and distributions that are consistent with the equilibrium along the time series of $\{\Theta_t\}_{t=0}^T$. Given that the algorithm needs to find a vector of three prices in each period which is consistent with market clearing it requires very good initial conditions. I have found that the standard method of starting with a linear trend of prices between the initial and last steady states works quite poorly. Instead, calculating the stationary equilibrium for several points on the path of $\{\Theta_t\}_{t=0}^T$ and using a linear path between these points ensure a faster, more accurate, solution.

Myopic Case. Alternatively, we can assume that individuals are surprised every period by the changes of the exogenous process of Θ_t and every time they see a new aggregate vector, they perceive this as remain fixed for the infinite future. To solve the transition in this case I proceed as follows.

- M1: Solve the initial steady state of the economy with $\Theta_t = \Theta_0$ and save the steady state distribution, μ_0

- M2: Go to period $t = 1$ with Θ_1 and assume that individuals think that $\Theta_t = \Theta_1$ for all t , and solve for the equilibrium prices as follows,
 - Guess a vector of $\{\hat{\omega}_{1,H}, \hat{\omega}_{1,L}, \hat{r}_1\}$, solve the household’s problem, and record the policy functions. Here we can use value function iteration because future is perceived as “the same” by the agents.
 - Taking μ_0 and given and the policy functions, check the equilibrium conditions for capital and labor as in S4 above. If they hold, then we have found the equilibrium prices. If not, guess a new set of prices.
- M3: When the prices have been found, update μ_0 to μ_1 and
- M4: Go to period $t = 2$ and start again in point M2, and proceed until the entire transition path is completed.

This generates a new path of equilibrium prices and a distribution of agents over idiosyncratic states.

Some additional details on the numerical implementation of the model are important. The problem of the households is large and contains several state variables that one needs to keep track of. To maintain tractability I choose a coarse grid of 7 points in the labor productivity, y , and a denser grid of 11 points for the entrepreneurial ability, z . Both stochastic processes are discretized using a modified version of the [Tauchen \(1986\)](#) method. In the particular case of z , since most of the action in terms of switching between occupations happen at the upper end of the distribution of z , I place more point in that area of the grid. In other words, I do not choose a equally spaced grid for the z process. Finally, for the grid of assets, I choose a coarse grid of 205 points. Because the Value Function has kinks at the points of occupational switching, I solve the problem using Value Function Iteration to ensure the accuracy of the solution. For the same reason, I solve the equilibrium of the model simulating the PDF of the distribution of individuals over the idiosyncratic distribution. The main challenge of solving the model is finding the vector of prices that clear the labor and capital markets. There is no clear guidance to solve such non linear system of equations that involves aggregating the individuals’ decisions. Consequently, I trade accuracy for speed. I found that solving first the steady state in each of the transition gives excellent initial conditions for solving the problem along the transition path.

C Model extensions

In this section I consider several extensions and modifications of the baseline version of the model.

C.1 Collateral constraint

In the baseline version of my model entrepreneurs require working capital to run their firms and they can borrow resources up to a fraction $\lambda > 1$ of their own wealth, a . This assumption was made to have an interesting policy comparison. In this section I consider a more standard assumption. Entrepreneurs are not required to pay workers in advance and can borrow capital up to λa . The problem of the workers does not change, but the problem of the entrepreneurs changes to

$$V_{s,t}^e(\Omega_t, \Theta_t, \mu_t) = \max_{c_t, a_{t+1}} \left\{ \frac{c_t^{1-\sigma}}{1-\sigma} + \beta \left[\chi \mathbb{E}_{z_{t+1}|z_t, y_{t+1}|y_t} V_{s,t+1}(\Omega_{t+1}, \Theta_{t+1}, \mu_{t+1}) + \right. \right. \\ \left. \left. (1-\chi) \eta \sum_{j \in \{H,L\}} \zeta_{s,j} \mathbb{E} V_{s,t+1}(\Omega_{t+1}, \Theta_{t+1}, \mu_{t+1}) \right] \right\}, \quad (11)$$

$$\pi_{s,t}(z_t, a_t) = \max_{n_{H,t}, n_{L,t}, k_t} \left\{ z_t \theta_s [f(n_{H,t}, n_{L,t}, k_t)]^\gamma - p_{k,t} (r + \delta) k_t - \right. \\ \left. \omega_{H,t}(\Theta_t, \mu_t) n_{H,t} - \omega_{L,t}(\Theta_t, \mu_t) n_{L,t} \right\},$$

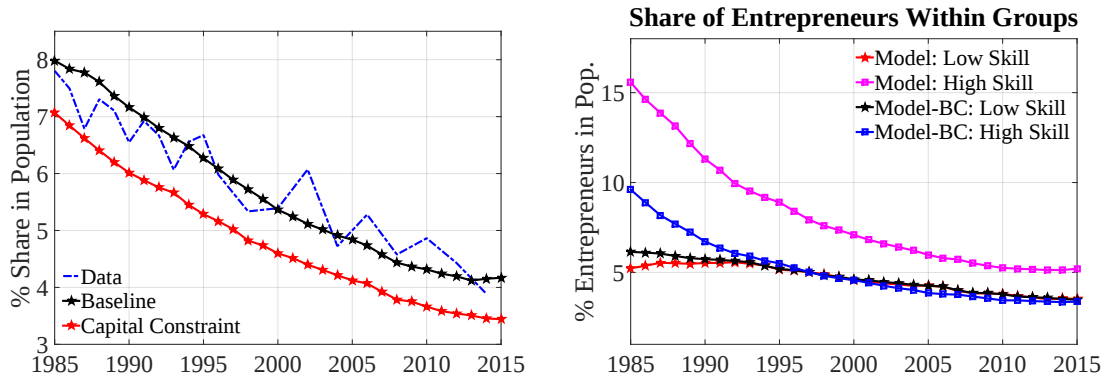
$$c_t + a_{t+1} \leq (1 + r(\Theta_t, \mu_t)) a_t + \pi_{s,t}(z_t, a_t) - \mathbb{I}(d_{t-1} = w_{t-1}) \kappa, \\ p_{k,t} k_t \leq \lambda a_t, a_{t+1} \geq 0.$$

The first thing to notice is that written in this, the equilibrium of this economy is constrained efficient. Notice this is not the case of the original problem because wages appear in the borrowing constraint. In such case the decentralized equilibrium does

not necessarily coincide with planner's solution as the latter internalized the fact that choosing a different allocation, it relaxes the borrowing constraint, moving the economy closer to the efficient optimum. This is not the case with the problem in equation 11 as the value of $p_{k,t}$ is assumed to be exogenous and therefore is not part of the choice of the planner.

The second thing to notice is that the borrowing constraint relaxes over time as $p_{k,t}$ decreases. Everything else equal, a decrease in the relative price of capital would induce more individuals to start a firm, increasing the share of entrepreneurs in the economy. Still, because of the general equilibrium effects and the effects of $A_{H,t}$ and H_t , the decrease in the share of entrepreneurs is quite similar to my baseline results in section 4. The left panel of figure 19 shows decline almost does not change in this case relative to the data and the baseline results. However, because I am using the same set of parameters used in my baseline exercise, the level of the share of entrepreneurs is lower in this case. The right panel shows that the distribution within skill groups changes substantially. Notice also that the share of entrepreneurs declines in this case. This is because, with a more relaxed borrowing constraint, entrepreneurs can operate even closer to their optimal level. General equilibrium will increase even more the wages, reducing the share of entrepreneurs in the economy.

FIGURE 19 – EVOLUTION OF THE SHARE OF ENTREPRENEURS



Note: The left panel of figure 19 shows the evolution of the share of entrepreneurs as calculated from the PSID data (blue dashed line) and the share of entrepreneurs implied by the baseline model (black-starred line) and by the model with a more standard borrowing constraint $p_{k,t}k_t \leq \lambda a_t$. The right panel shows the share of entrepreneurs within skill group implied by the model. Lines labeled as Baseline correspond to the basic results. Lines labelled as Model-BC consider the modified borrowing constraint.

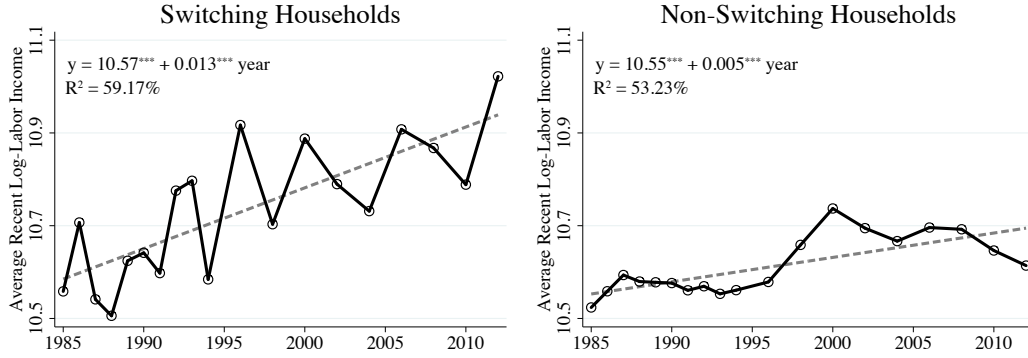
D Appendix Figures

TABLE VI – SAMPLE CHARACTERISTICS

	Wage Workers	Bus. Owners	Active Bus. Owners	Self-Emp. Bus. Owners	Entrepreneurs
Num. obs. per year	2,922	609	526	372	203
Fam. Income (M)	69.2	123.3	124.4	134.8	161.2
Age (mean)	39.8	43.1	43.2	44.0	44.3
Males (%)	70.7	89.7	90.0	91.7	92.9
Drop Outs (%)	7.4	2.8	2.8	2.8	1.4
High School (%)	31.1	24.3	25.0	25.9	18.3
Some College (%)	26.4	25.4	25.9	25.5	22.4
College and More (%)	35.2	47.5	46.4	45.8	57.9
White (%)	87.2	95.5	95.6	96.0	96.3
10th Pct. Wealth (M)	-7.8	5.5	6,252	15249	39.2
50th Pct. Wealth (M)	39.0	267.0	278.9	358,9	493.0
90th Pct. Wealth (M)	414.2	1,605.0	1,729.2	2,068.5	2,601.3
95th Pct. Wealth (M)	684.9	2,750.0	2,959.4	3,497.8	4,326.6

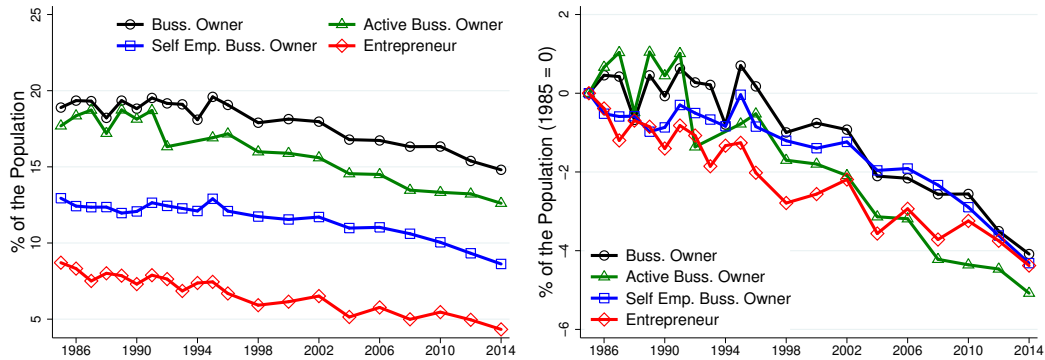
Note: Table VI reports statics of a sample of heads of households ages between 22 and 60 years old. See appendix A.1 for additional details on the sample selection. Each statistics is the sample average across the waves of 1985 to 2015. Business owners are individuals that declare owning a business. Active business owners declares have a business and have worked for it in a given year. Are active business owners that declare be self-employed. Entrepreneurs are the subset of the previous group that declare to have a managerial or professional occupation. All monetary values are deflated by the PCE index and expressed in 2012 US dollars. Household wealth is defined as the sum if savings checking accounts, bonds, stocks, IRA, housing equity, other real state, and vehicles, minus total debt. All statistics, with the exception of the number of observation, were calculated using sample weights.

FIGURE 20 – AVERAGE OF RECENT LABOR INCOME



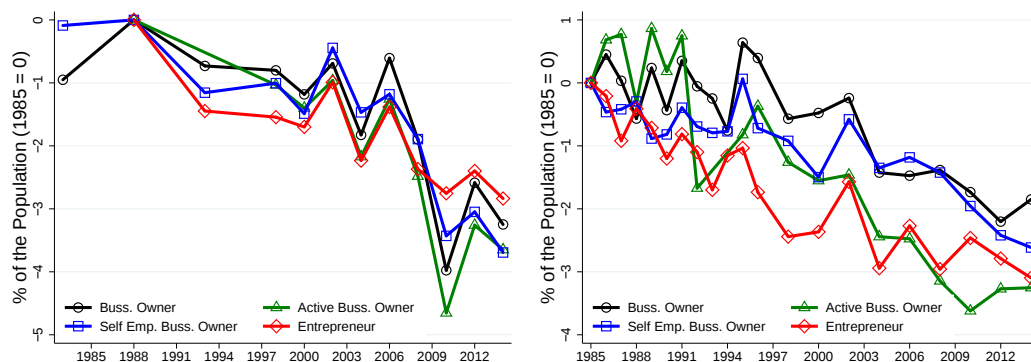
Note: Figure 20 shows the average (log of) recent labor earnings for a sample of men, heads of household, who are neither a business owner nor self-employed in year t . Recent earnings are defined as the average of the real labor income in periods t , $t-1$, and $t-2$ for years prior 1997 and the average labor income in periods t and $t-2$ after 1997. The left panel shows the average recent earnings within the group of households that become *business owners* in year $t+2$ while the right panel shows the same statistic for individuals that remain as workers in period $t+2$. The difference in the slope in the left and right panels is statistically significant at 1%.

FIGURE 21 – PROPORTION OF ENTREPRENEURS



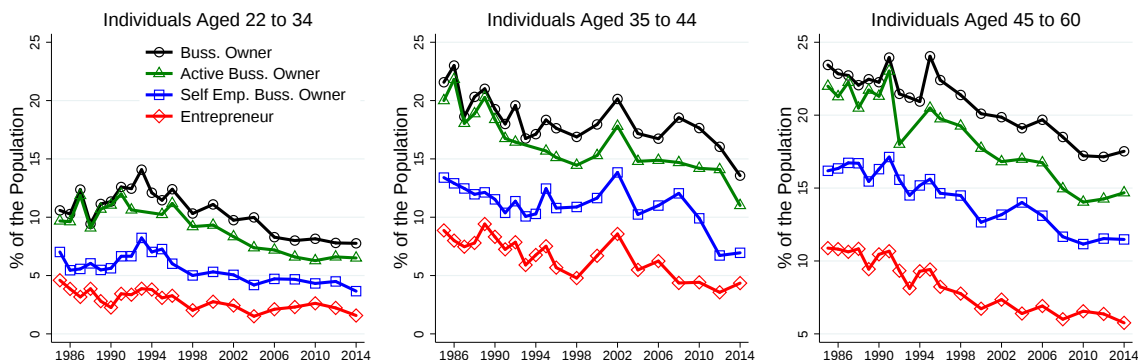
Note: Figure 21 shows the share of entrepreneurs for different definitions calculated over a sample of employed heads of households. See the note in table I for more details on the classification of entrepreneurial households.

FIGURE 22 – PROPORTION OF ENTREPRENEURS – ADDITIONAL DEFINITIONS



Note: Figure 22 shows the proportion of households that are neither business owners nor self-employed in period t that are classified as entrepreneurs in period $t+2$ for different definitions of entrepreneurship. The right panel shows the same statistics rescaled to the corresponding value in 1985.

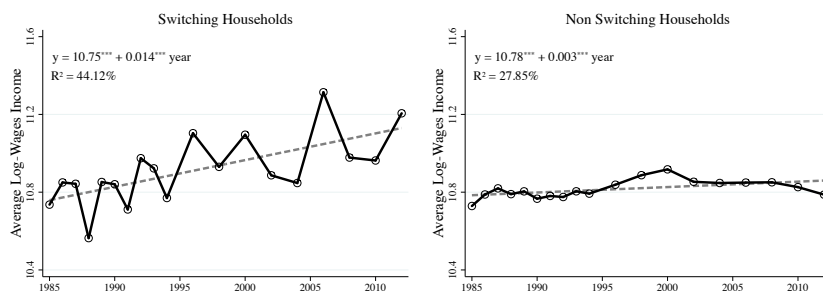
FIGURE 23 – SHARE OF ENTREPRENEURS WITHIN DIFFERENT AGE GROUPS



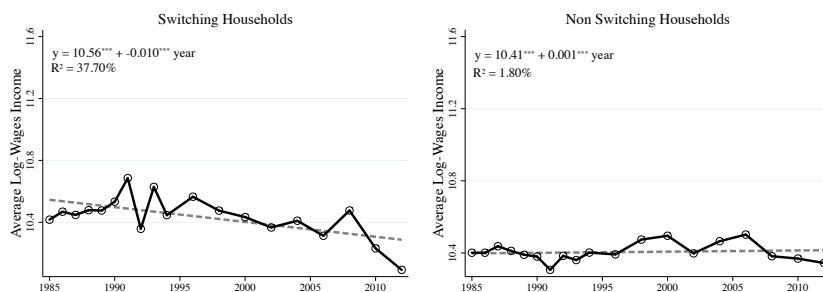
Note: Figure 23 shows the fraction of entrepreneurs within three different age groups. See notes in table I for additional details.

FIGURE 24 – AVERAGE WAGES AND SALARIES INCOME FOR WORKERS

(A) SOME COLLEGE OR MORE



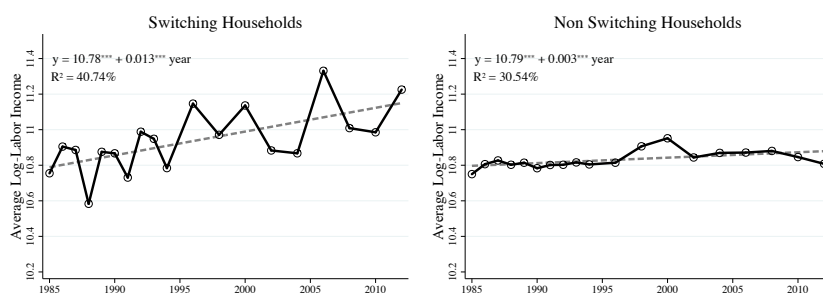
(B) HIGH SCHOOL GRADUATES OR LESS



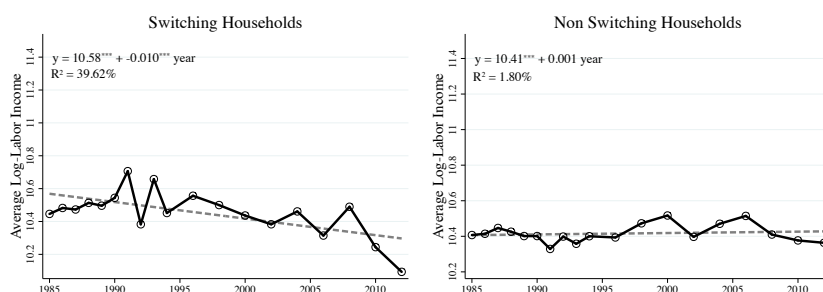
Note: Figure 24 shows the average log of wages and salaries income of men head household who are neither a business owner nor self-employed in year t from PSID. Top panels show the statistics for college graduates. Bottom panel shows the statistics for workers with some college or less. The left panel shows the average wage within the group of households that become *self-employed business owners* in year $t + 2$ while the right panel shows the same statistic for individuals that remain as workers in period $t + 2$.

FIGURE 25 – AVERAGE TOTAL LABOR EARNINGS FOR WORKERS

(A) SOME COLLEGE OR MORE

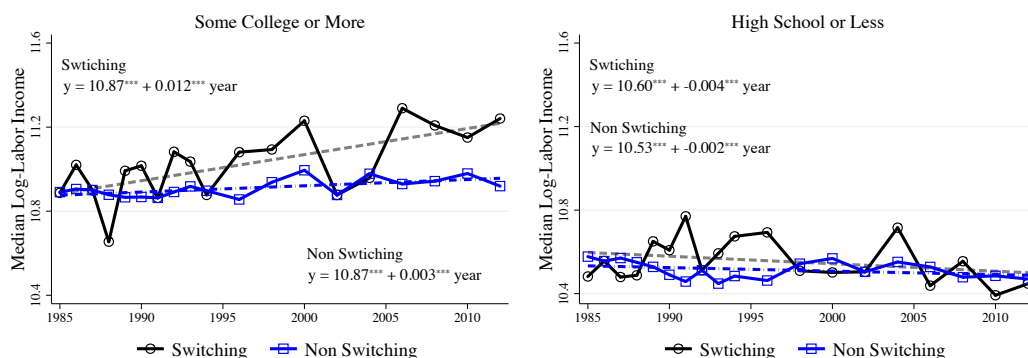


(B) HIGH SCHOOL GRADUATES OR LESS



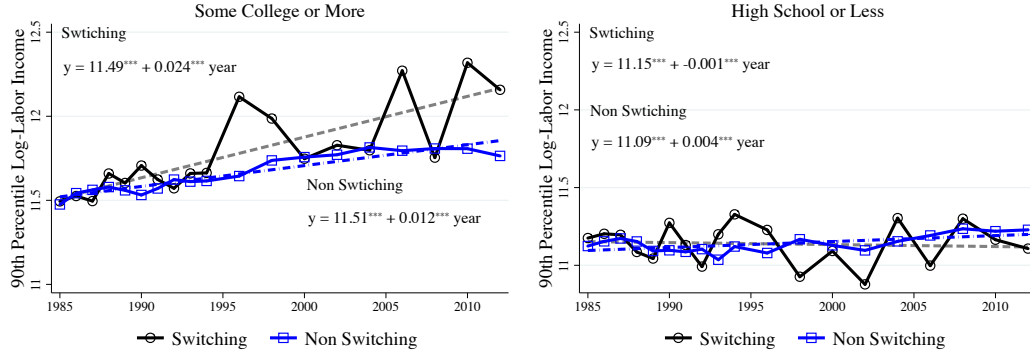
Note: Figure 25 shows the average of log labor earnings of men, head household who are neither a business owner nor self-employed in year t from PSID. Recent earnings are defined as the average labor income in periods t , $t - 1$, and $t - 2$ for years prior 1997 and the average labor income in periods t and $t - 2$ after 1997. Top panels show the statistics for college graduates. Bottom panel shows the statistics for workers with some college or less. The left panel shows the average wage within the group of households that become *self-employed business owners* in year $t + 2$ while the right panel shows the same statistic for individuals that remain as workers in period $t + 2$.

FIGURE 26 – 50TH PERCENTILE OF THE LABOR INCOME FOR WORKERS



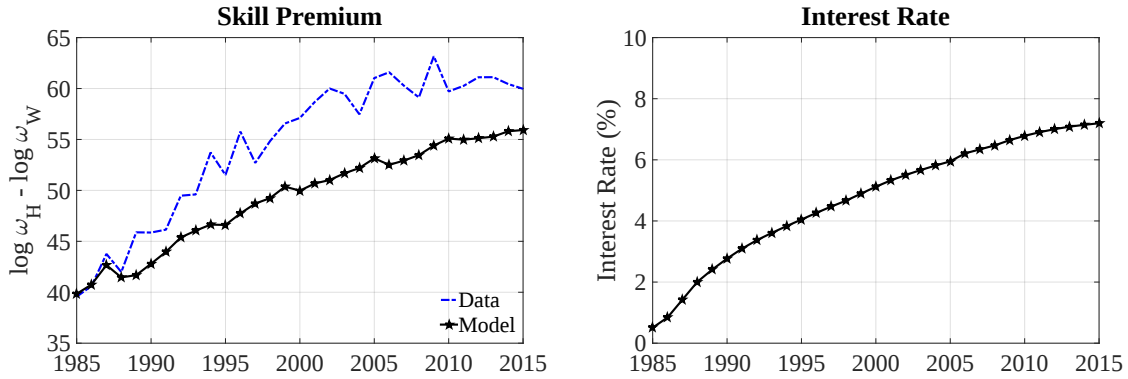
Note: Figure 26

FIGURE 27 – 90TH PERCENTILE OF THE LABOR INCOME FOR WORKERS



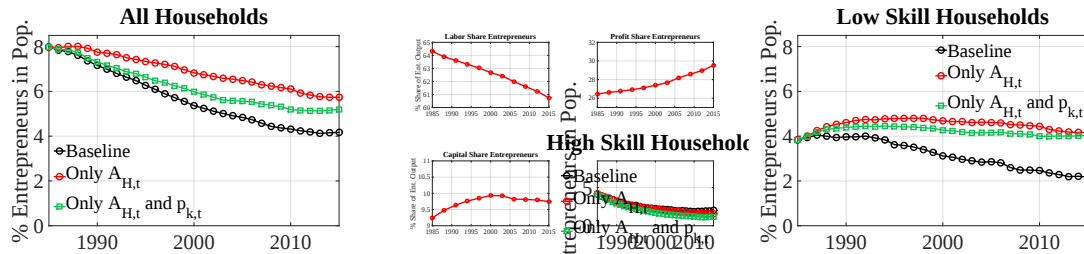
Note: Figure 27

FIGURE 28 – COLLEGE PREMIUM AND INTEREST RATE IN GE



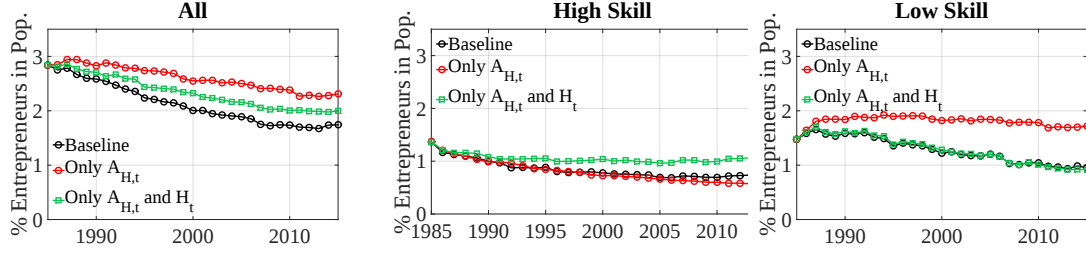
Note: Figure 28 shows the evolution of the skill premium and interest rate implied by the mode in the general equilibrium case.

FIGURE 29 – ALTERNATIVE DECOMPOSITION OF THE DECLINE IN ENTREPRENEURSHIP



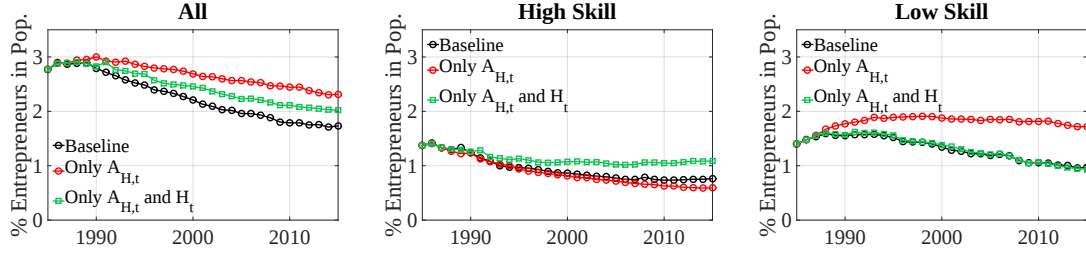
Note: Figure 29 shows the share of entrepreneurs implied by the model. The black starred line shows the share of entrepreneurs for the baseline case, the red circled line considers only the evolution of $A_{H,t}$, while the green squared line considers $A_{H,t}$ and $p_{k,t}$. The center and right panel show similar statistics for high and low skill workers.

FIGURE 30 – DECOMPOSITION OF THE TRANSITION RATE



Note: Figure 30 shows the time series of the transition rate into entrepreneurship implied by the model. The black starred line shows the baseline case, the red circled line considers only the evolution of $A_{H,t}$, while the green squared line considers $A_{H,t}$ and H_t . The center and right panel show similar statistics for high and low skill workers.

FIGURE 31 – DECOMPOSITION OF THE EXIT RATE



Note: Figure 31 shows the time series of the transition rate out from entrepreneurship implied by the model. The black starred line shows the baseline case, the red circled line considers only the evolution of $A_{H,t}$, while the green squared line considers $A_{H,t}$ and H_t . The center and right panel show similar statistics for high and low skill workers.

E SFC Sample

In this section, I describe in more detail the sample selection the variable construction for the results using the Survey of Consumer Finances (SCF). The SCF is a nationally representative survey conducted every three years by the Federal Reserve Board of Governors. Importantly, the SCF oversample rich individuals which are more likely to be entrepreneurs. I take data from over the period 1989 to 2016. The raw sample contains 238,880 individual-year observations. For comparability to the results on the PSID, I consider a sample of heads of households between 22 and 60 which are in the labor force with valid information on education. Following [Cagetti and De Nardi \(2006\)](#) and [Michelacci and Schivardi \(2016\)](#) I classify an individual as an entrepreneur if she is self-employed in his primary job (variable X4106 in the SCF) and she has an active management role in at least one privately owned business (variable X3104 in the SCF).

I further divide the sample on individuals with a high school degree or less and those with some college studies or more (variable X5901 in the SCF for the period 1989 to 2013 and X5931 for 2016). Finally, I drop all those individuals that do not work for a pay (variable X4106 in SCF). This leave us with a sample of 173,066 individual-year observations. For all the calculations I use the sample weights (variable X42001).

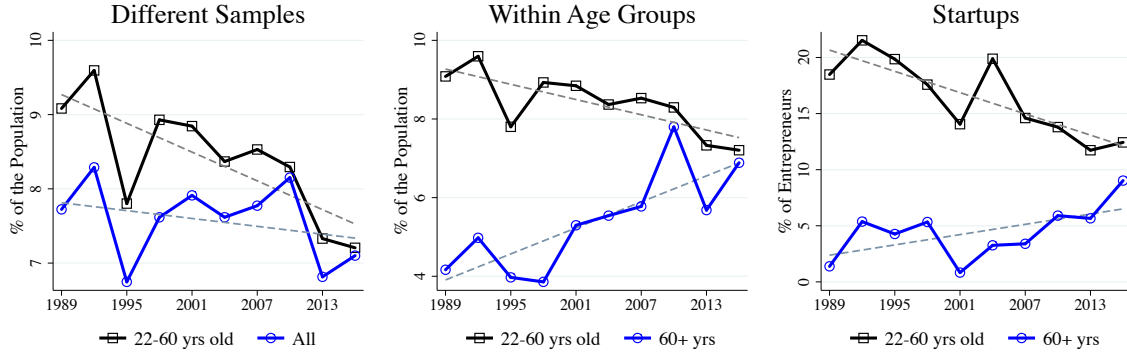
The main body of the text presented the share of entrepreneurs in the age group of 22 and 60 years old and within education groups (6). Here I discuss two additional issues. First, [Michelacci and Schivardi \(2016\)](#) use the SCF to study the returns to entrepreneurs and he suggests that the share of entrepreneurs has been stable from 1989 to 2013. The difference between my conclusions and theirs steams from the sample selection. Given their focus on entrepreneurial returns [Michelacci and Schivardi \(2016\)](#) consider the entire population sample while I focus on 22 to 60 years old individuals which are more likely to switch occupations between workers and entrepreneurs. The left panel of figure 32 shows the share of entrepreneurs in the SCF with and without the group of individuals that are over 60 years old. In the second case, the share of entrepreneurs is more or less stable over the sample period. This is because within the group of over 60 years old, the share of entrepreneurs is either flat or increasing as it is shown in the center panel of figure 32. This, coupled with an increasing share of this group in the US population, pushes the share of entrepreneurs up, keep the share more or less constant. In contrast to [Michelacci and Schivardi \(2016\)](#), I focus on individuals that might transit into entrepreneurship and weigh the costs and benefits of starting a new firm. Importantly, for the group of entrepreneurs that are between 22 and 60 years old, the share of startups entrepreneurs, that is, the fraction of entrepreneurs whose primary firm is one year old or less, shows an step decline during the sample period while this share is smaller and increasing within the group of entrepreneurs older than 60 years (right panel of figure 32).

TABLE VII – DISTRIBUTION OF ENTREPRENEURS ACROSS INDUSTRIES

Industry	Less than College	College Graduate	All
Agro, Fish, and Forestry	14.70	3.1	7.3
Construction	25.04	7.39	13.53
Manufacturing	7.71	6.86	7.16
Retails and Wholesale Trade	17.26	11.53	13.53
Professional Services	14.39	25.54	21.66
Transportation, Comm. and Utilities	19.98	43.74	35.47
Others	0.92	1.85	1.53

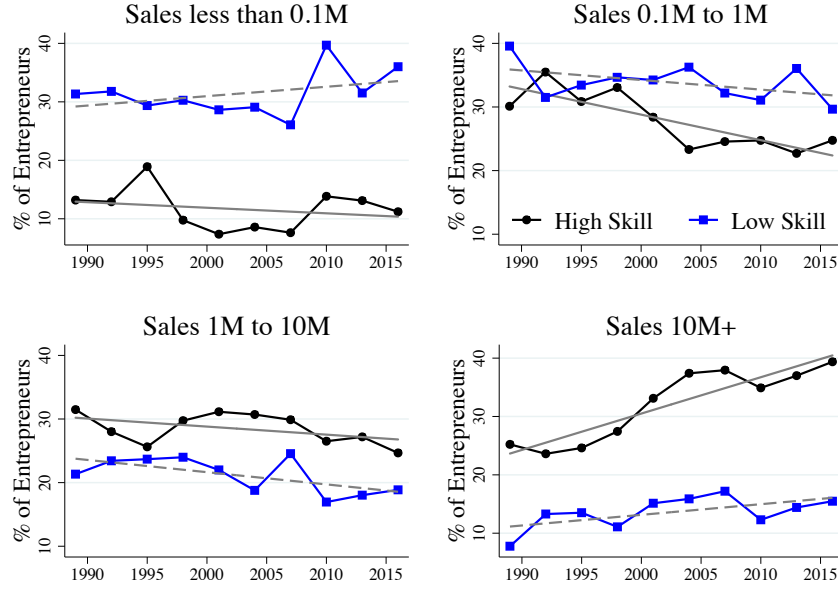
Note: table VII shows the distribution of entrepreneurs across 1-digit SIC sectors in the SCF. Entrepreneurs are defined as heads of household that own a businesses and declare to have an active management role in the business. SIC sectors are defined using the first main business owner by the household.

FIGURE 32 – SHARE OF ENTREPRENEURS AND STARTUPS IN THE SCF



Note: Figure 32 shows the share of entrepreneurs within different population groups and for different definitions of entrepreneurs. The left panel shows the share of entrepreneurs in the baseline sample (individuals between 22 and 60 years old) and considering the entire sample (individuals of 22 years or more). The center panel shows the share of entrepreneurs within age groups. The right panel shows the share of startups entrepreneurs within age groups. Startup entrepreneurs are entrepreneurs that actively manage at most two firms and one of them has at most 1 year old.

FIGURE 33 – SIZE DISTRIBUTION: HIGH AND LOW SKILL ENTREPRENEURS



Note: The figure 33 shows the evolution of the share of entrepreneurs for different size classifications within high and low skill entrepreneurs. All monetary values were deflated using the PCE and expressed in 2012 dollars.

F Evidence from CPS

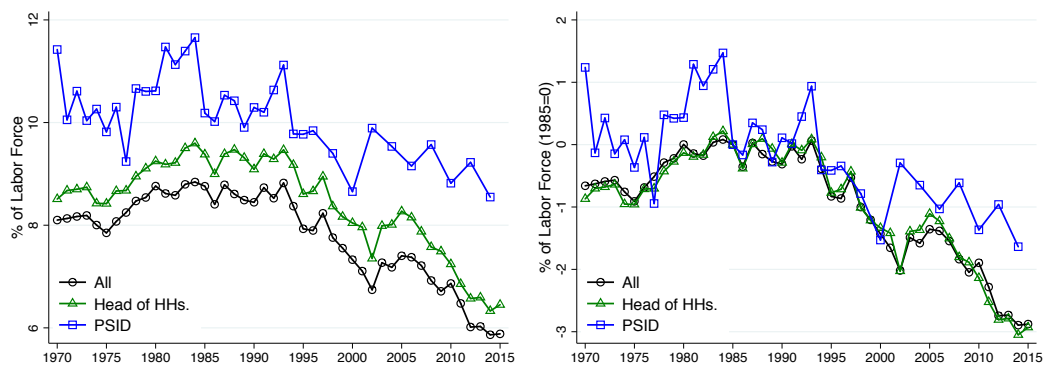
The decline in the share of entrepreneurs documented in section 2 comes from a small, although nationally representative, sample of household. Hence, one might wonder whether the results presented here using the PSID can also be observed in other data sets. For this reason, in this appendix I draw a sample of household from the CPS from 1970 to 2015. The CPS is a nationally representative survey collected by the US Census Bureau. Here, I use the March supplement that collects information on employment status, income, industry, and occupation, to analyze if the patterns found in the PSID are also present using a much larger data set. As much as possible, I keep the same sample selection used in the previous section. The main drawback of using the CPS is that the definition of what constitutes an entrepreneur can be based only on few questions that mostly refer to whether or not the individual is self-employed, and therefore, the sample could be skewed to individuals that work for themselves and do not hire any other employees. This is important for two reasons. First, most of the evidence presented by Haltiwanger *et al.* (2015), Decker *et al.* (2016), and others

refer to employee firms and therefore self-employed individuals that do not hire other workers are not considered. Secondly, new empirical evidence suggests that alternative works agreements (contractors, part time workers, etc.) are in a rise in the US economy (Katz and Krueger (2016)). To the extent that there is overlap between self-employed individuals and workers in alternative work agreements overlap, analysis trends of the share of self-employed might be misleading. With these caveats in mind, I consider two measures of entrepreneurship. The first is the proportion of individuals that are self-employed over the entire population, and second, to have a closer definition to the one used in PSID, I consider the fraction of self-employed head of households.

The left panel of figure 34 shows that the share of self-employed in the population has steadily declined since the early 1980s and such decline has accelerated since the mid 1990s. For better comparison with my previous results, here I also show the proportion of self-employed head of households from the PSID. The levels are somewhat different, with a larger proportion of self-employed in the PSID, but the decline is similar in both data set, as it is shown in the right panel of 34. Figures 35 and 36 complement these results showing the decline in the share of self-employed within education and age groups.

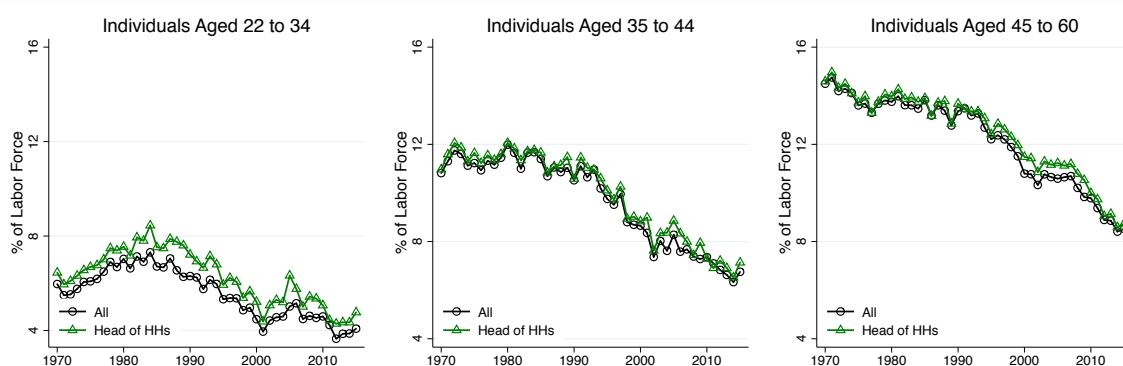
Because the CPS is a much larger sample, we can go one step further and study in which which sectors the decline in the share of self-employed is more evident. For doing that, I calculate the share of self-employed individuals within 14 different sectors. The employment share accounted for self-employed is quite different across industries, as one can expect from the large disparities in the scale of production. For instance, the share of total employment account for by self-employed workers in services is around 15%, while in manufacturing it is 1.5%. To have a better comparison across sectors, figure 37 shows the share of self-employed workers within each industry rescaled to its value in 1985. With the exception of manufacturing, the decline in the share of self-employed is quite evident in almost all sectors. Interestingly, the decline in self employment is not circumscribed to sectors such as retail and whole sale trade (see upper right panel) which has been increasingly dominated by big retail stores, but it is also present in construction or even within growing sectors , such as Services (see the upper left panel).

FIGURE 34 – SHARE OF SELF-EMPLOYED IN THE POPULATION



Note: Figure 34 shows the proportion of self-employed individuals aged between 22 and 60 years old. Individuals which are not in the labor force (students, disabled) or are in the military are excluded. The share of self-employed head of households is the ratio to all the head of households that are self-employed over the population of head of households.

FIGURE 35 – PROPORTION OF SELF-EMPLOYED BY AGE – CPS



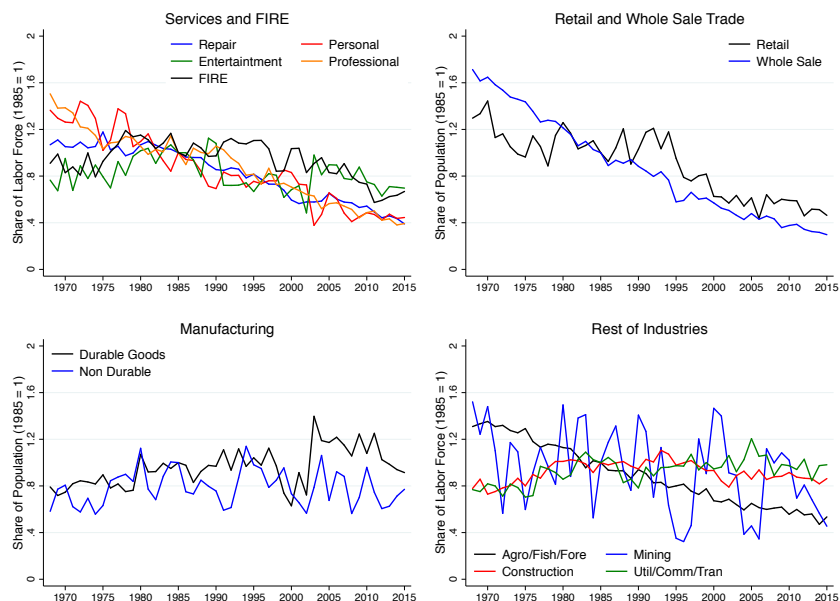
Note: Figure 35 shows the proportion of self-employed individuals within age groups. Individuals which are not in the labor force (students, disabled) or are in the military are excluded. The share of self-employed head of households is the ratio to all the head of households that are self-employed over the population of head of households within each age group.

FIGURE 36 – PROPORTION OF ENTREPRENEURS BY EDUCATION – CPS DATA



Note: Figure 36 shows the proportion of self-employed individuals within education groups. Individuals which are not in the labor force (students, disabled) or are in the military are excluded. The share of self-employed head of households is the ratio to all the head of households that are self-employed over the population of head of households within each education group.

FIGURE 37 – PROPORTION OF SELF-EMPLOYED BY INDUSTRY – CPS DATA



Note: Figure 37 shows the proportion of self-employed individuals within industry sectors. Individuals which are not in the labor force (students, disabled) or are in the military are excluded. The share of self-employed head of households is the ratio to all the head of households that are self-employed over the population of head of households within each industry.