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IZA DP No. 12009

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ABSTRACT

Who Creates Stable Jobs? Evidence from Brazil*

Recent research shows that start-ups are important for job creation, but these firms are also inherently volatile. We use linked employer-employee data to examine the relative importance of firm age and firm size for job creation and destruction in Brazil. Firm age is a more important determinant of job creation in Brazil than firm size; young firms and start-ups create a relatively high number of jobs. However, young firms are also more likely to exit the market and have higher levels of employment volatility. We, therefore, condition the job creation analysis on job stability. Young firms and large firms create relatively more stable jobs in Brazil.

JEL Classification: L25, J23, J63
Keywords: job creation, job stability, Brazilian labor market

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1 Introduction

The view that small businesses fuel job creation remains a popular belief among policymakers. Early empirical research found an inverse relationship between firm growth rates and firm size (Birch, 1981). However, more recent research has improved upon previous methods and showed that firm age is a more important determinant of job creation than firm size (Davis, Haltiwanger, & Schuh, 1996b; Davidsson, Lindmark, & Olofsson, 1998). That is, young firms and start-ups contribute more to job creation than small firms in many advanced economies (Haltiwanger, Jarmin, & Miranda, 2013; Decker, Haltiwanger, Jarmin, & Miranda, 2014). However, young firms and firm start-ups are inherently volatile and exhibit relatively high employment turnover rates (Haltiwanger, Hyatt, McEntarfer, & Sousa, 2012). While that volatility is a natural part of business dynamics, it also provides a note of caution about job creation policies. If policies designed to create jobs target young firms, they could increase job turnover in the economy. While job turnover can improve matches between a worker and an employer, it is also costly for both parties (Jacobson, LaLonde, & Sullivan, 1993; Couch & Placzek, 2010; Davis & von Wachter, 2011). Therefore, it is worthwhile to further explore the role of firm age and firm size in employment growth to determine what types of firms create stable jobs.

In this paper, we analyze the relationship between firm characteristics and employment dynamics in the context of an emerging economy, Brazil. We use a linked employer-employee data set for the formal labor market in Brazil for 2004–13 and follow the methodology of Haltiwanger et al. (2013). A linked employer-employee data set is ideal for studying employment dynamics, particularly when conditioned on a measure of job stability, due to the ability to track workers, establishments, and firms across time. We aim to first document the role of firm size and firm age in job creation and job destruction in Brazil. Then, we examine the relationship between firm size, firm age, and employment volatility in Brazil. Last, we condition the job creation analysis on two measures of job stability to identify what types of firms create stable jobs in Brazil.

We extend the literature in two primary ways. First, we document the relative importance of firm age and firm size in employment dynamics in Brazil. Most of the literature uses data from the United States or other developed countries (Davis et al., 1996b; Neumark, Wall, & Zhang, 2011; Haltiwanger et al., 2013; Criscuolo, Gal, & Menon, 2014). Criscuolo et al. (2014) include Brazil in their analysis, but their analysis of the relative importance of firm size and firm age is not country specific. Rather, the authors average across all 18 countries in their data. Second, we extend the job creation analysis to account for the stability of the jobs created. Previous studies on job creation do not account for job stability (Davis et al., 1996b; Neumark et al., 2011; Haltiwanger et al., 2013; Criscuolo et al., 2014) and previous studies on job stability do not focus on firm characteristics (Diebold, Neumark, & Polsky 1997; Marcotte, 1998; Heisz, 2005; Bergmann & Mertens, 2011).

Job creation and stability are especially important in an emerging economy such as Brazil because formal-sector jobs provide a steady source of good income, serve as a primary pathway out of poverty, and provide access to legally mandated rights and benefits for workers (Dix-Carneiro & Kovak, 2017). It is also reasonable to expect that job stability is even more important for workers in emerging economies as these workers often do not have access to generous safety nets and job loss could have serious negative consequences for workers and their families. Employment volatility is also a current policy concern in Brazil. Brazil has several policies aimed at reducing employment turnover, such as severance payment programs and taxes assessed on firms with high turnover rates (Gonzaga, Maloney, & Mizala, 2003; "The 50-year Snooze", 2014). However, Brazil's current policies address employment volatility after the fact. A more thorough understanding of what types of firms create stable jobs will help create better-informed policies that can proactively address high employment volatility.

First, we document the relative importance of firm size and firm age in job creation and destruction in Brazil. Young, small firms play a large role in employment, job creation, and job destruction in Brazil. Firm age is a more important determinant of job creation

in Brazil than firm size, but young firms are also more likely to exit the market. This is consistent with findings for the US (Haltiwanger et al., 2013) and the average across the countries studied in Criscuolo et al. (2014). Next, we analyze the relationship between firm size, firm age, and employment volatility. We find that young firms in Brazil exhibit higher levels of employment turnover relative to older firms. Therefore, we also analyze the relative importance of firm age and firm size in stable empoyment growth in Brazil. Firm age is also an important determinant of stable employment growth. Young firms and large firms have relatively higher stable employment growth rates in comparison to older and smaller firms. While young firms have high levels of employment turnover, they are also an important generator of stable jobs. Together, the results highlight the important role young firms and firm start-ups play in Brazil's economy.

The rest of the paper proceeds as follows. In Section 2, we review the literature on job creation, job destruction, and job stability. Section 3 describes the methodology and Section 4 describes the data. Section 5 presents the main empirical results; Section 5.1 analyzes job creation and destruction in Brazil, Section 5.2 documents employment turnover, and Section 5.3 identifies what types of firms create stable jobs. Finally, Section 6 offers concluding remarks.

2 Literature Review

The common perception that small businesses contribute most to job creation in the United States was initially supported by most empirical work (Birch, 1981; Kirchhoff & Phillips, 1988; Neumark et al., 2011). However, Brown, Hamilton, and Medoff (1990) argued that small firms only appeared important because the fastest growing industries had disproportionately more small firms. Similarly, Davis et al. (1996b) found that research often overestimated the results in favor of small firms.[1] Further, most prominent studies

[1]Regression-to-the-mean bias is inherent to using the base-year size methodology to classify firm size. To overcome this issue, the authors use average size methodology, which averages firm size across years *t* and *t-1*, to average out the serially uncorrelated measurement errors in firm size.

supporting the inverse relationship between employment growth and firm size analyzed only establishment-level or only firm-level data. Davis et al. (1996b) also emphasized the importance of using both establishment- and firm-level data to ensure employment dynamics are accurately captured. We use longitudinal linked employer-employee data that include worker-, establishment-, and firm-level data, which allow us to both properly analyze employment growth and extend the analysis to account for job stability.

More recent research focuses on the effects of both firm age and firm size in employment dynamics, often emphasizing the importance of young firms and start-ups. Haltiwanger et al. (2013) used the Census Bureau's Longitudinal Business Database, which includes both establishment- and firm-level data and convincingly showed that firm age is a more important determinant of job creation in the US than firm size. Their findings echoed the conclusion of Davidsson et al. (1998), who argued that firm age is likely a more important determinant of employment growth, noting that new firms are often relatively small. Decker et al. (2014) analyzed the importance of entrepreneurship in job creation and employment dynamics using both establishment- and firm-level data. They showed start-ups and small businesses are very important contributors to job creation in the US, but their contribution has declined over the past 30 years. While most research focuses on the US or other developed countries, Ayyagari, Demirguc-Kunt, and Maksimovic (2014) investigate what types of establishments create jobs in developing countries. Their results show that small, young establishments ($\leq$ 20 employees and $\leq$ 5 years old) contributed most to job creation in the selected developing countries.

The OECD has undertaken an impressive effort to build a collection of firm-level data on employment dynamics from 18 countries. Brazil is the only country in the collection that is not an OECD member. Criscuolo et al. (2014) used the data to document employment growth and how the Great Recession impacted those dynamics. The report shows that, on average across all 18 countries, firm age is a more important determinant of job creation than firm size. However, the relative contributions of firm age and firm size are not formally

analyzed for each country independently. Since Brazil is the only non-OECD country in the dataset, their findings may mask a heterogenous result for Brazil. We examine this in the first section of our analysis.

The job stability literature often focuses on job stability trends across time within a particular country. Bergmann and Mertens (2011) analyzed job stability trends in West Germany from 1984 to 1997 and found that job stability, measured using the worker's tenure, declined over the sample. Heisz (2005) conducted a similar analysis for job stability in Canada during the 1980s and 1990s, but used retention rates to measure job stability. He determined that retention rates in Canada increased during periods of labor market slack but decreased during periods of labor market boom. Diebold et al. (1997) and Marcotte (1998) both analyzed worker-level job stability in the US during the 1980s. Diebold et al. (1997) found retention rates remained stable over the sample period, but Marcotte (1998) found job stability declined for male head of households.

Another area of the literature emphasizes the importance of business cycle dynamics in employment growth and job stability. Cravo (2011) used establishment-level aggregate job flow data for Brazil and found small establishments are more sensitive to business cycle dynamics than large establishments. Moscarini and Postel-Vinay (2012) found small firms matter most for job creation during times of high unemployment, but large firms matter most during times of low unemployment in the US. However, Haltiwanger, Hyatt, Kahn, and McEntarfer (2017) found no evidence that workers move up the firm size ladder, but rather move up the firm wage ladder in the US. Nagore García and van Soest (2017) analyzed the stability of new job matches in Spain before and during the financial crisis using worker-level data. The authors found a positive relationship between firm size and job stability for new job matches, which was stronger during the 2009 recession than before the crisis in 2005.

The majority of the job stability literature analyzes how job stability varies with worker characteristics or how job stability changes within a country over a given time period or across business cycles. The job creation literature usually examines the relationship between firm

size and employment growth, and later studies often control for firm age. While Kirchhoff and Phillips (1988) found small firms account for over 50% of net new jobs, they also found small firms account for over 50% of jobs lost from firm exit. Davis et al. (1996b) pointed out that almost all analytic studies on the role of small firms in job creation ignore the durability of a job. This is a real policy concern since it is well documented that large firms have lower employment turnover rates (Brown & Medoff, 1989; Brown et al., 1990; Bergmann & Mertens, 2011; Haltiwanger, Hyatt, & McEntarfer, 2015). We attempt to fill this gap in the literature by analyzing firm characteristics and job creation conditioned on a measure of job stability.

3 Methodology

We analyze the relative importance of firm age and firm size in various employment dynamics in Brazil. We follow Haltiwanger et al.'s (2013, hereafter HJM) empirical approach as closely as possible to be consistent with the literature. HJM use eight firm size classes (1–4, 5–9, 10–19, 20–49, 50–99, 100–249, 250–499, and 500+) and nine firm age classes (0, 1–2, 3–4, 5–6, 7–8, 9–10, 11–12, 13–15, and 16+) to estimate one-way and two-way models of job creation and destruction. Their methodology allows each size and age class to have a heterogeneous effect on employment dynamics. First, we estimate a series of one-way models to analyze employment dynamics by firm size class or firm age class only. Then, we estimate a series of two-way models to analyze employment dynamics by firm size class, firm age class, and all possible interactions. All models are employment weighted. A comparison of results from the one-way models with those from the two-way models easily shows the relationship between employment dynamics, firm size, and firm age, as well as the importance of accounting for firm age in the analysis.[2]

The models require one category (size or age class) be omitted as a baseline comparison

[2]We also conduct the analysis using industry and year controls. These results are very similar to our main analysis and are included in the online appendix.

group. Following HJM, we omit the largest firm size class (500+ employees) or the oldest firm age class (16+ years). The result for the omitted category is reported at its unconditional mean for each model. Since the method focuses on the relative differences between size and age classes, the unconditional mean of the omitted group is added to the other estimates for each size and age class to re-scale them.

Given that some areas of the joint firm size and age distribution have relatively few observations, HJM limit the maximum size threshold to 500 employees and the maximum age threshold to 16 years. They also use both base-year and average size to measure firm size in their analysis since the base-year size methodology leads to regression-to-the-mean effects. The base-year size methodology calculates firm size for year t as firm size in year t for new firms and firm size in year *t-1* for all other firms (both continuing and destroyed). The average size methodology calculates firm size for year t as the average of firm size in year t and *t-1* for all firms.[3]

The main dependent variable in the job creation analysis is the employment growth rate, either at the establishment level or at the firm level. An establishment is a single location where business is conducted (for example, a storefront) and a firm is the parent company with ownership over one or more establishments (for example, a retail corporate headquarters). The employment growth rate for establishment i in year t, made popular by Davis, Haltiwanger, and Schuh (1996a), is calculated as follows:

$$G_{it} = \frac{E_{it} - E_{it-1}}{0.5 * (E_{it} + E_{it-1})}, \tag{1}$$

where E_{it} is the level of employment for establishment i in December of year t. The growth rate is symmetric around zero and bounded between -2 (destroyed establishments) and 2 (new establishments). Firm growth rates are then calculated as the employment-weighted average of the establishment growth rates under control of the firm. Thus, firm growth rates

[3]We include formal definitions for all fundamental worker-level, establishment-level, and firm-level concepts used for the project in the online appendix.

share the same properties as establishment growth rates.

The second part of the project analyzes employment volatility by firm size and firm age classes. Analyzing measures of employment volatility helps motivate the need to consider job stability when analyzing employment growth. We use two measures of employment volatility; the worker reallocation rate and the separation rate. The worker reallocation rate is a more comprehensive measure of employment turnover because it accounts for both incoming and outgoing employees. For these measures, we follow the definitions of Abowd et al. (2009) and Abowd and Vilhuber (2011). The worker reallocation rate (WRR) for establishment i in year t is defined as:

$$WRR_{it} = \frac{A_{it} + S_{it}}{0.5 * (E_{it} + E_{it-1})}, \tag{2}$$

where A_{it} is the number of accessions in year t at establishment i, S_{it} is the number of separations from establishment i in year t, and E_{it} is previously defined.

The second measure of employment volatility, the separation rate, accounts only for employees separating from an establishment or firm. The establishment-level separation rate (SR) for establishment i in year t is:

$$SR_{it} = \frac{S_{it}}{0.5 * (E_{it} + E_{it-1})}. \tag{3}$$

Similar to employment growth rates, we take an employment-weighted average of establishment WRR_{it} and SR_{it} to calculate firm-level WRR_{ft} and SR_{ft} for firm f in year t.

Both employment volatility measures are bounded below by zero, with lower numbers indicating lower levels of employment volatility. However, both measures are unbounded above and low employment in the denominator can lead to very large values for these measures. Therefore, we trim the top 1% of observations based on the WRR_{ft} or SR_{ft} when conducting those analyses. We only present and discuss the results for firm WRR_{ft} because the results for SR_{ft} yield similar patterns.

For the third phase of the project, we condition the analysis of job creation on a measure of job stability. We rely on two definitions of job stability to determine if each individual job is stable. The first definition, a current measure, uses the tenure of each worker to determine if each job in the sample is stable. The second definition, which is forward looking, uses worker retention to define a stable job.

We follow the work of Abowd and Vilhuber (2011) and Hyatt and Spletzer (2016) for the following definitions. Stable-worker tenure (SWT) of length k for worker j at firm f at time t is defined as:

$$SWT^k_{jft} = \begin{cases} 1, & \text{if } T_{jft} \geq k \text{ and } e_{jft-g} = 1 \text{ for } g = 0, ..., k \\ 0, & \text{otherwise} \end{cases}, \tag{4}$$

where T_{jft} is the worker's tenure at firm f in year t and e_{jft} is worker j's employment status at firm f in December of year t. We calculate tenure at the firm level to account for the possibility of workers moving between establishments to climb the corporate ladder within a given firm.[4] By construction, using worker tenure to define a stable job does not allow any firm less than k years in age to have any workers with a stable job. We, therefore, also use a second measure of job stability that is forward-looking to allow all firms the possibility to have stable jobs.

The second definition of job stability uses retention to determine whether each job in the sample is stable. A worker j at firm f has stable-worker retention (SWR) of length k at time t if the worker is continuously employed at firm f between year t and $t + k$.

$$SWR^k_{jft} = \begin{cases} 1, & \text{if } e_{jft+g} = 1 \text{ for } g = 0...k \\ 0, & \text{otherwise} \end{cases}, \tag{5}$$

where e is previously defined. As with SWT^k_{jft}, we calculate retention at the firm level to

[4]Calculating tenure at the establishment level does not significantly alter the results.

account for employees switching establishments to move up within a given firm.[5]

We then sum these measures across employees at each firm to get the number of stable workers at each firm. Stable-firm tenure (SFT) of length k for firm f in year t is defined as:

$$SFT^k_{ft} = \sum_j SWT^k_{jft}, \tag{6}$$

and stable-firm retention (SFR) is defined similarly:

$$SFR^k_{ft} = \sum_j SWR^k_{jft}. \tag{7}$$

These measures are counts of the number of workers with stable jobs at each firm f in year t.

To determine what types of firms create stable jobs, we then calculate stable employment growth rates, using both measures of job stability. Stable employment growth rates are augmented from the employment growth rate (equation 1) to account for firm size as well as the number of stable jobs created. It captures how many stable jobs the firm creates relative to that firm's size. The stable employment growth rate using worker tenure of length k (SGT) for firm f in year t is calculated as:

$$SGT^k_{ft} = \frac{SFT^k_{ft} - SFT^k_{ft-1}}{0.5 * (E_{ft} + E_{ft-1})}, \tag{8}$$

where the numerator is the number of stable jobs created (or destroyed) at firm f in year t and E_{ft} is employment at firm f in December of year t. By construction, SFT^k_{ft} is undefined for all firms less than k years of age. However, in order to capture the high number of young firms that exit the market, we set $SFT^k_{ft} = -2$ in the year of destruction (even if the firm is less than k years of age).

We also calculate the stable employment growth rate using retention to allow firms less

[5]Calculating retention at the establishment level does not significantly alter the results.

than k years of age the possibility of creating stable jobs. The stable employment growth rate using worker retention of length k (SGR) for firm f in year t is calculated as:

$$SGR^k_{ft} = \frac{SFR_{ft} - SFR_{ft-1}}{0.5 * (E_{ft} + E_{ft-1})}, \tag{9}$$

where SFR^k_{ft} and E_{ft} are previously defined. Because retention is forward looking, we cannot calculate k-year retention rates for the last k years in the sample. In line with how SFR^k_{ft} is defined for destroyed firms, for firms destroyed in year t, SGR^k_{ft} is undefined in year $t-k+1$ through year t and equal to -2 in year t-k.

Both SGT^k_{ft} and SGR^k_{ft} are bounded below by -2 and bounded above by 2, with higher numbers indicating a higher growth rate of stable jobs. For our main analysis, we use $k = 2$. For tenure, this means that a worker must have current firm-level tenure of at least 2 years and still be employed at the firm in December to have a stable job. For retention, a worker must continue to be employed at the same firm for the following two years to have a stable job. As a robustness check, we also use $k = 1$ and $k = 3$ and do not find any qualitative change in the results.

4 Data

The data comes from the *Relação Anual de Informações Sociais* (hereafter, RAIS) collected annually by the Brazilian Ministry of Labor (MTE - *Ministerio do Trabalho e Emprego*). The data are collected for all formal establishments in Brazil as part of a program in which qualified workers receive a bonus at the end of the year equal to one month's salary (or a prorated amount if the worker worked < 12 months). This 13th month salary is paid by the employer but facilitated by MTE. Hence, both employers and employees have great interest in ensuring accurate information is reported to MTE.[6] For this project, we use RAIS for years 2004–13. RAIS has unique identifiers for workers, establishments, and firms, resulting

[6]Workers will ensure wages are not underreported, and firms will ensure wages are not overreported.

in a linked employer-employee data set that allows researchers to track firms, establishments, and workers across time. An establishment represents a single location of a business while the firm represents all establishments under common ownership.

The unit of observation in RAIS is the individual worker, each with a unique personal identification number. Each worker-year record in RAIS has an establishment identification number associated with it, and the first eight digits of the establishment identification number identify the parent firm. To compare the job creation results for Brazil with the literature, we restrict our analysis to private, for-profit firms. Further, we drop observations that are unusable for the analysis: those with zero wages, those without a personal or establishment identification number, and those that are not subject to labor regulations.[7]

For the initial job creation analysis, we keep only workers employed in December of each year. This is consistent with HJM's point-in-time measure of employment. In the online appendix, we also consider firms that existed for less than one year. These are firms that have records in our data, but had zero workers employed in December. We do include these short-lived firms in the employment turnover and job stability analysis to capture all of the volatility of job creation and destruction.

The RAIS data do not provide information on establishment age or firm age, but they do contain the date for when each employee was hired. We use this hire date of each worker and the panel structure of the data to construct establishment and firm age variables. To calculate establishment age, we begin with the year the establishment first appears in the panel. We calculate establishment age for the first year as the difference in the first year and the earliest hire year of any employee working at the establishment in that year. For example, if the establishment first appears in the panel in the year 2004, establishment age is calculated as the difference between that year (2004) and the earliest hire year of any employee working at the establishment in 2004 (which may be prior to 2004). For each additional year an establishment appears in the data, we allow the establishment to age

[7] 0.24% of observations are dropped due to no personal or establishment identification number and 1.9% of observations are dropped because they are not subject to labor regulations.

naturally. To calculate firm age, we again start with the first year the firm appears in the panel. For the first year, firm age equals the maximum age of all establishments controlled by the firm. For example, if a firm controls three establishments in 2004, its first year in the panel, with establishment ages of 5, 10, and 2. Then, firm age for 2004 equals 10, the maximum age of the three establishments. For each additional year the firm appears in the data, we allow the firm to age naturally.

However, these constructed measures of establishment and firm age may be measured with error. Establishment age could underestimate true establishment age if all the original workers at the establishment are no longer employed in 2004. Firm age could also be measured with error if the original establishment is no longer a part of the firm. It is also possible that our establishment and firm age variables overestimate true establishment and firm age if the hire date variable is measured with error. For example, establishment identification numbers first appearing in the panel in the year 2005 or later should be new establishments. However, we observe several establishments first entering the panel in 2005 or later with an earliest employee hire year prior to 2005. Therefore, we perform a consistency check on the constructed age variables to determine their accuracy. We calculate observed establishment age for establishments first appearing in the panel in 2005 or later as the difference in the current year and the first year they appear in the data (true establishment age). Then, we compare this to the establishment age previously described, which we calculate using the minimum hire year of all employes (hire date establishment age).

We find that our method for calculating establishment and firm age based on employee hire dates overestimates observed establishment age for approximately 9% of establishments and overestimates observed firm age for approximately 7.2% of firms. Using firm age classes, rather than firm age, helps minimize the issue, only overestimating firm age class for approximately 5.3% of firms. We repeat the age consistency checks for establishments that first appear in the data in 2006 or later. In theory, these are more likely to be truly new establishments because they do not have data for 2004 or 2005. We find very similar, but

Table 1: Summary Statistics

Firm Level	Count	Mean	SD
Num. of Establishments	18,998,490	1.13	6.18
New Firm	18,998,490	0.14	0.34
Continuing Firm	18,998,490	0.75	0.43
Destroyed Firm	18,998,490	0.11	0.32
Employment	18,998,490	12.47	191.62
Base Size	18,998,490	12.06	184.34
Average Size	18,998,490	11.74	185.32
Age	18,998,490	5.84	5.85
Employment Growth Rate	18,998,490	0.06	1.08
Worker Reallocation Rate	19,149,958	1.63	44.97
Separation Rate	19,149,958	0.72	37.19
Stable Employment Growth Rate (Tenure)	14,894,946	-0.24	0.82
Stable Employment Growth Rate (Retention)	11,373,556	-0.08	0.94

Notes: RAIS data, 2005–13. All measures are formally defined in section A of the online appendix.

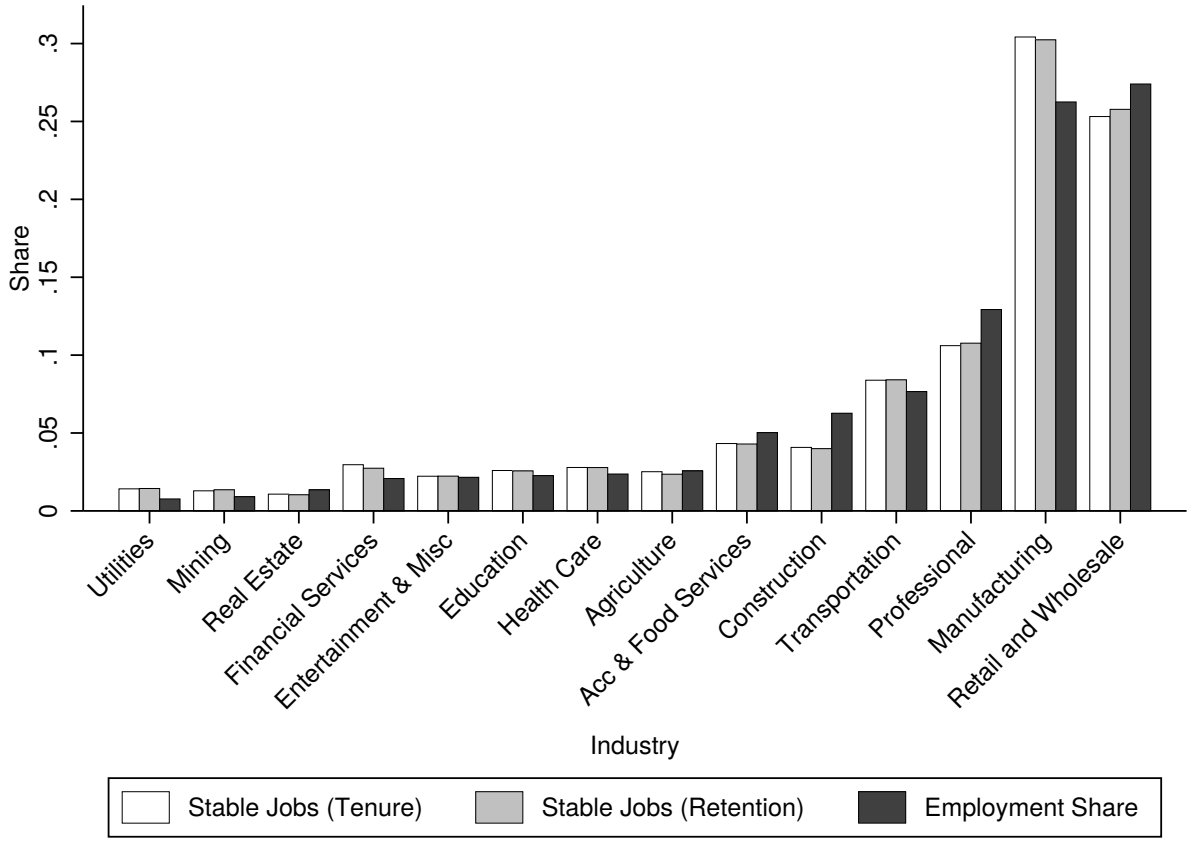
slightly smaller results in comparison to those using 2005 and later. The results for the age consistency checks are shown in Tables S1 and S2 in the online appendix.

Ultimately, we have 260,479,528 worker-year observations with non-zero wages in December working for private, for-profit establishments for the ten-year panel. We aggregate the worker-level data up to the establishment level, keeping one observation per establishment per year – a total of 21,562,744 establishment-year observations. Then, we aggregate the establishment-level data up to the firm level, keeping one observation per firm per year – a total of 18,998,490 observations. Since our data start in 2004, we can begin calculating measures of employment growth only starting in 2005.

Summary statistics for the firm-level data are presented in Table 1.[8] Each firm-year is categorized as new, continuing, or destroyed. A firm is considered new if all establishments under its ownership are new (i.e. they appear in the data in 2005 or later). A firm is considered continuing if at least one establishment under its ownership is continuing. A firm is considered destroyed if all establishments under its control are destroyed. For example,

[8]Summary statistics for the establishment-level data are presented in the online appendix.

Figure 1: Shares of Stable Jobs by Industry: Brazil, 2005–13



Notes: RAIS data, 2005–13. The first bar for each industry shows the share of stable jobs in that industry relative to the total number of stable jobs in all industries using worker tenure. The second bar shows the similar statistic using worker retention to measure stability. The third bar shows the share of employment in that industry relative to overall employment. The industries are sorted by employment shares.

if all establishments controlled by a firm first appear in the data in 2006 and continue to appear in the data in 2007 and 2008, the firm is new in 2006, continuing in 2007 and 2008, and destroyed in 2009. Table 1 shows that approximately 14% of all firms are new, 75% are continuing, and 11% exit the market. Table 1 also reveals that the average firm is relatively small (12.5 employees) and relatively young (just under 6 years in age). Formal definitions of all employment measures are included in Section A of the online appendix.

Figure 1 shows the share of employment and stable jobs by industry using both tenure and retention to measure job stability. The first and second bar for each industry show the share of stable jobs in that industry relative to the total number of stable jobs across

all industries using tenure and retention, respectively. For example, over 30% of all stable jobs are in manufacturing, nearly 27% of all stable jobs are in retail and wholesale, and only 1% of all stable jobs are in real estate. The share of stable jobs dramatically varies by industry but is nearly identical under the two measures of stability. The third bar for each industry shows the share of overall employment in each industry. Comparing the first two bars for each industry with the third bar indicates whether each industry has relatively more or fewer stable jobs than its share of overall employment. For example, manufacturing has relatively more stable jobs and retail has relatively fewer stable jobs than their share of employment. In the online appendix, Figure S1 shows the share of stable jobs within each industry rather than across industries. Mining, financial services, and utilities have the highest percentage, whereas construction and real estate have the lowest percentage of stable jobs within industries.

5 Results

5.1 Job Creation and Destruction

Notes: RAIS data, 2005–13. Shares of employment, job creation, and job destruction are calculated using establishment-level data characterized by three firm base size classes and three firm age classes. Firm births only create jobs and cannot destroy any jobs by definition.

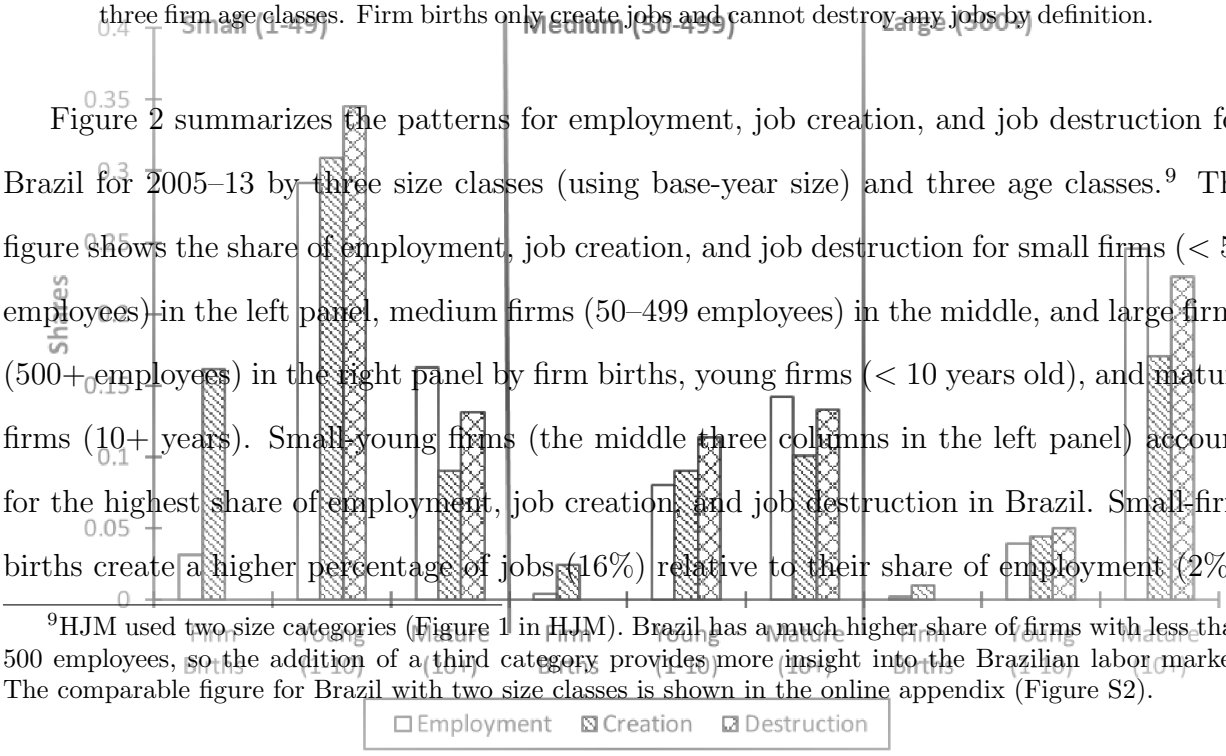


Figure 2 summarizes the patterns for employment, job creation, and job destruction for Brazil for 2005–13 by three size classes (using base-year size) and three age classes.[9] The figure shows the share of employment, job creation, and job destruction for small firms (< 50 employees) in the left panel, medium firms (50–499 employees) in the middle, and large firms (500+ employees) in the right panel by firm births, young firms (< 10 years old), and mature firms (10+ years). Small-young firms (the middle three columns in the left panel) account for the highest share of employment, job creation, and job destruction in Brazil. Small-firm births create a higher percentage of jobs (16%) relative to their share of employment (2%),

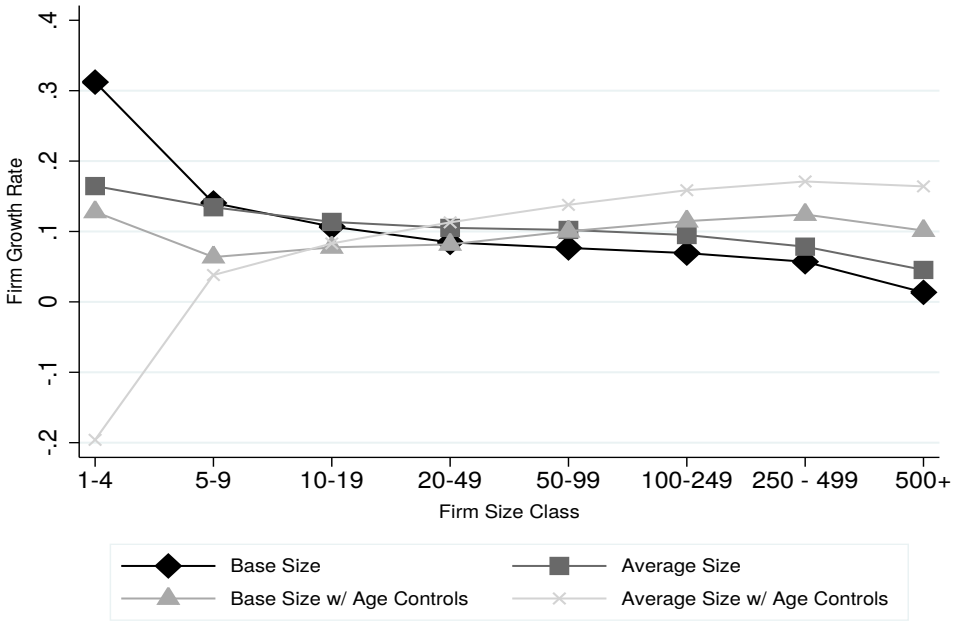
[9]HJM used two size categories (Figure 1 in HJM). Brazil has a much higher share of firms with less than 500 employees, so the addition of a third category provides more insight into the Brazilian labor market. The comparable figure for Brazil with two size classes is shown in the online appendix (Figure S2).

and small-mature firms create a lower percentage of jobs (9%) relative to their share of employment (16%). By construction, firm births cannot destroy jobs. We also see that most firm births and young firms are also small firms. In all size categories, mature firms have lower job creation than their share of employment, suggesting the important role of young firms in job creation.

Comparing these statistics to the US, the most noticeable difference is where employment, job creation, and job destruction are concentrated. For the US, the shares of employment, job creation, and job destruction are concentrated in large-mature firms, 45%, 35%, and 40%, respectively (HJM). For Brazil, small-young firms account for the highest percentages of each category. Criscuolo et al. (2014) show that some OECD countries also have large shares of employment in small firms, such as Spain and Italy. However, young firms play a much larger role in Brazil than in any other country Criscuolo et al. (2014) study. Firms less than five years old in Brazil account for around 65% of all small firms; Spain has the next highest share at 45% (Criscuolo et al., 2014).

Figure 3 shows the relationship between employment growth rates and firm size. It plots the estimated coefficients for models of employment growth rates by firm size, using both base size and average size, with and without age controls. Standard errors are extremely small in all our analyses because the data have around 20 million observations and therefore are not shown on the figures. The plotted estimates for the one-way model using firm base size (diamond markers) show an inverse relationship between firm size and employment growth. The average employment growth rate for the smallest firms (base size 1–4) is about 30 percentage points higher than that for the largest firms (base size 500+). The growth rate monotonically declines with firm base size class. The plotted estimates for the one-way model using firm average size (square markers) show a mildly decreasing relationship between firm size and employment growth. The employment growth rate of the smallest size class (average size 1–4) is approximately 12 percentage points higher on average than that for the largest firms (average size 500+). Including controls for firm age changes the

Figure 3: Employment Growth Rate and Firm Size

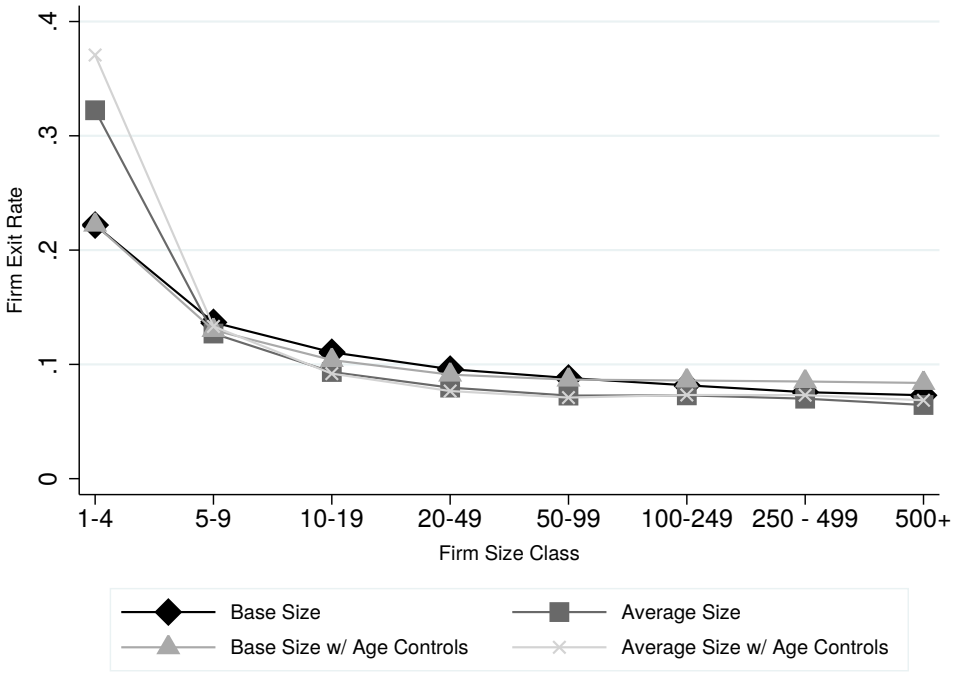


Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of employment growth by firm size class and estimates for two-way models of employment growth by firm size class controlling for firm age class (using both base size and average size). A higher value indicates that a particular firm size class has a higher firm growth rate relative to other firm size classes.

relationship between employment growth and firm size. The plotted curves of the two-way models show an increasing relationship between employment growth and both size measures (the base size curve has a slight decrease initially). Once age controls are included, small firms no longer have the highest employment growth rates.

Next, we look at the relationship between firm size and firm exit. Figure 4 plots estimated coefficients for models of job destruction due to firm exit by firm size, without and with age controls, respectively. As HJM note, "Job destruction from firm exit is directly interpreted as an employment-weighted firm exit rate" (p. 356). Firm exit rates decrease monotonically with firm base size and firm average size, with and without age controls. Small firms are more likely to shut down and exit, regardless of whether age controls are included. Relative to the largest firm size class, the smallest firms have average exit rates approximately 15 percentage points higher using base size and around 25 percentage points higher using average size, with

Figure 4: Firm Exit by Firm Size



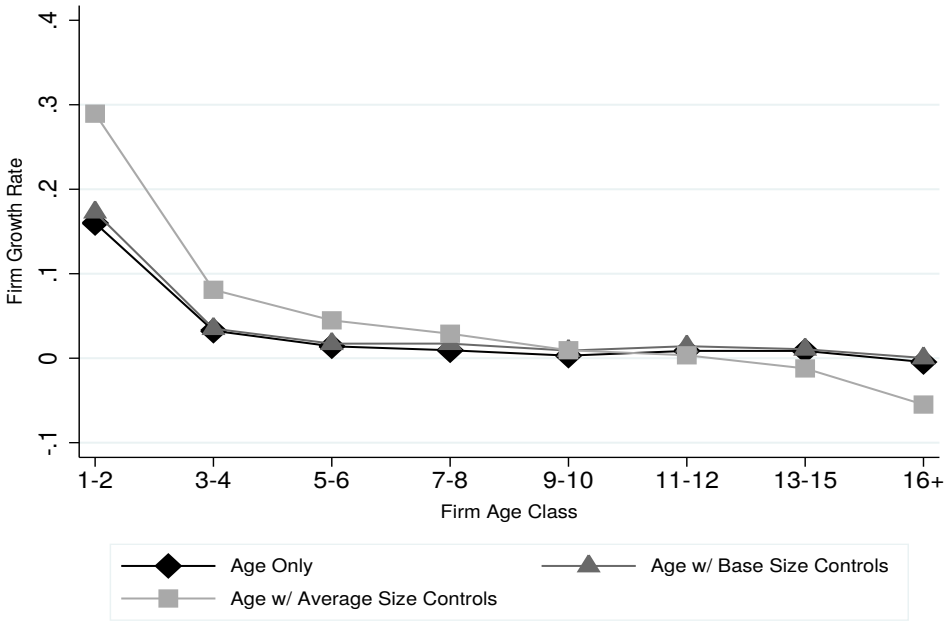
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of firm exit by firm size class and for two-way models of firm exit by firm size class controlling for firm age class. A higher value indicates that a particular firm size class has a higher firm exit rate relative to other firm size classes.

and without age controls. To further analyze the relative importance of firm age and size, we next estimate the relationship between firm growth rates and firm age.

Figure 5 plots estimated coefficients for models of employment growth rates by firm age, without and with firm size controls, respectively.[10] First, we look at coefficients for the one-way model of employment growth rates by firm age (diamond markers). Without firm size controls, the youngest firms (age 1–2) have the highest employment growth rates. The relationship is initially decreasing, but eventually stabilizes. This result differs from HJM, who found an increasing relationship (Figure 4a in their paper). However, the difference is likely explained by the different size-age distributions of firms between the two countries. As previously shown in Figure 2, Brazil has a large concentration of small-young firms. So

[10]The estimated coefficients for firm start-ups are not displayed in the figure since the coefficients are equal to two (by definition of the growth measure).

Figure 5: Employment Growth Rate and Firm Age

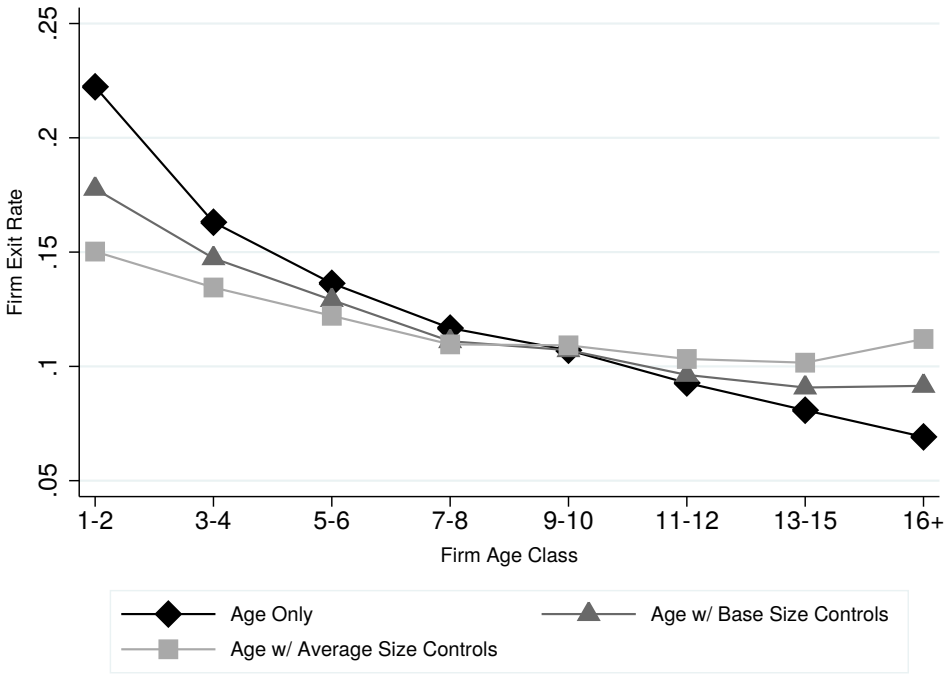


Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of employment growth by firm age class and estimates for two-way models of employment growth by firm age class controlling for firm size class (using both base size and average size). A higher value indicates that a particular firm age class has a higher firm growth rate relative to other firm age classes. Results for new firms are not displayed.

even when not controlling for firm size, most of the young firms are also small. The plotted coefficients for the two-way models, which control for firm age and either firm base size (triangle markers) or firm average size (square markers), indicate the youngest firms still have the highest employment growth rates. The relationship between employment growth and firm age is initially decreasing, but eventually stabilizes using firm base size. We also perform this analysis on the set of continuing firms only but do not present those results to conserve space. Those results show a similar pattern, but that young surviving firms have even higher growth rates than the sample of all firms.

Figure 6 plots estimated coefficients for one-way and two-way models of job destruction from firm exit by firm age. The coefficients for all models of firm exit by firm age show similar relationships. Without firm size controls, firm exit rates decrease monotonically with firm age. With firm size controls, firm exit rates initially decrease with firm age and eventually

Figure 6: Firm Exit by Firm Age



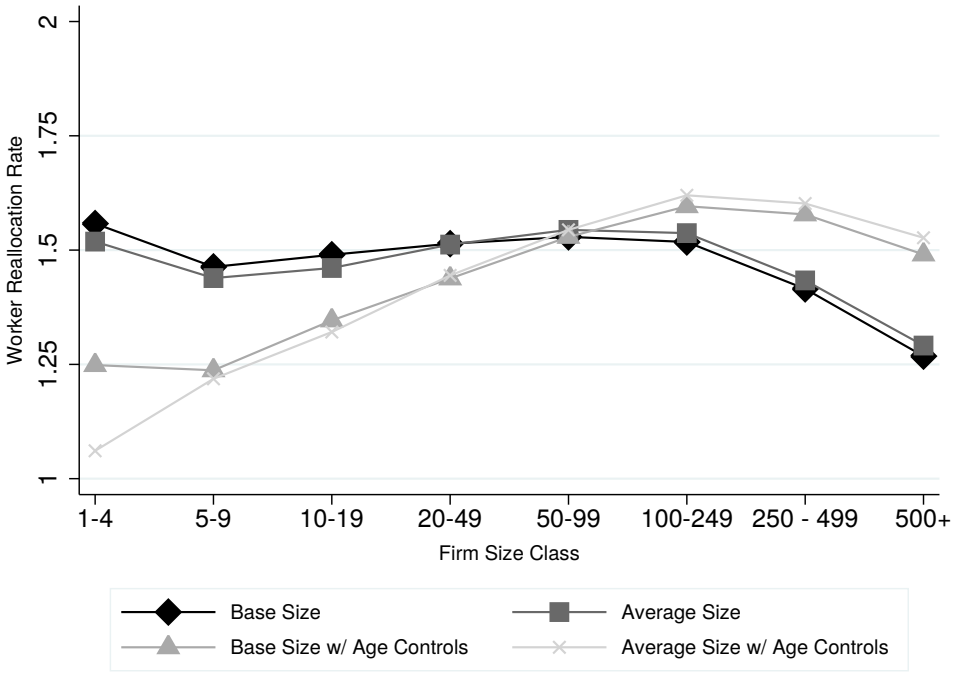
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of firm exit by firm age class and for two-way models of firm exit by firm age class controlling for firm size class (using both base size and average size). A higher value indicates that a particular firm age class has a higher firm exit rate relative to other firm age classes. New firms are excluded from the figure because they cannot destroy any jobs by construction.

stabilize (with a slight increase for the oldest firms using average size controls). Together, Figures 5 and 6 show young firms have higher employment growth rates, but they are also more likely to shut down and exit the market than more mature firms.[11]

These patterns for job creation and destruction by firm age for Brazil are similar to HJM's results for the US and Criscuolo et al.'s results averaging across Brazil and 17 OECD countries. That is, firm age is a more important determinant of job creation and destruction than is firm size. The results also highlight the importance of the "up-or-out pattern", summarized by HJM, "Each wave of firm start-ups create a substantial number of new jobs. In the first years following entry, many start-ups fail, but the surviving young businesses grow very fast" (p. 358). This pattern is potentially more relevant for Brazil, due to the

[11]In the online appendix, Figure S5 shows these results by broad sectors and shows that results are similar across sectors.

Figure 7: Worker Reallocation Rate by Firm Size



Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of worker reallocation rates by firm size class and estimates for two-way models of worker reallocation rates by firm size class controlling for firm age class (using both base size and average size). A higher value indicates that a particular firm size class has a higher worker reallocation rate relative to other firm size classes.

greater presence of young firms in Brazil relative to the other countries studied by Criscuolo et al. (2014).

5.2 Young Firms and Employment Volatility

Thus far, the results highlight the significant role firm start-ups and young firms play in the Brazilian economy. However, young firms may not provide very stable jobs, partly due to higher exit rates (Figure 6), but also due to new firms searching for the right workers. To explore the volatility of jobs in Brazil, we analyze worker reallocation rates (WRR) by firm size and firm age. A higher WRR indicates higher levels of employment volatility.

We continue to follow HJM's methodology and present the results in figures. Figure 7 shows coefficients from the analysis of WRR by firm size, with and without age controls.

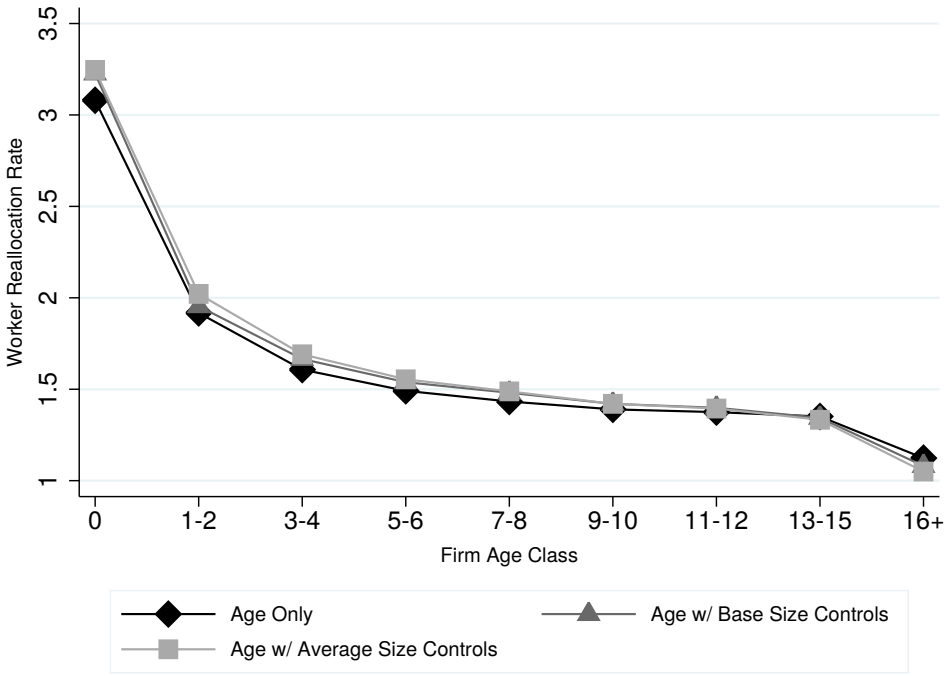
The results for the one-way models show that WRR is relatively flat for firms with less than 250 employees. The relationship between WRR and firm size begins to decrease for firms with 250+ employees. The estimates for models with firm age controls show volatility increasing with firm size for firms between 5 and 250 employees, but it eventually becomes a decreasing relationship for the largest firms. The results are similar regardless of which size measure is used.

With age controls, firms size 100–249 have the largest worker reallocation rates (1.60 and 1.62 on average), while firm sizes 5–9 and 1–4 have the smallest (1.23 and 1.06 on average), using base size and average size, respectively. This translates to a 30% or 52.8% higher worker reallocation rate for the larger firms using base and average size, respectively. Using a back-of-the-envelope calculation, we see that the average firm size 100–249 would have approximately 100 fewer workers reallocate if their WRR was equal to that of the smallest firms. Therefore, even with firm age controls, we see economically significant differences between worker reallocation rates for small and large firms.

The analysis of WRR by firm age is of more interest for exploring the volatility of firm start-ups and young firms. Figure 8 shows the results for the analysis of WRR by firm age, without and with firm size controls, respectively. The estimates for the one-way models indicate that WRR is decreasing with firm age. With firm size controls, WRR continues to decrease with firm age. The figure indicates that employment volatility is relatively high for firm start-ups and young firms in Brazil. With firm size controls, firm start-ups have an average WRR of 3.24 and the oldest firms (age 16+) have an average WRR of 1.05, using average size. Using a back-of-the-envelope calculation, if the oldest firms had WRR equal to the WRR for firm start-ups, this would translate to approximately 150 more workers reallocating.

We also conducted the analysis for worker reallocation rates by firm size and firm age for continuing firms only. The results are shown in Figure S6 in the online appendix and are nearly identical to those for all firms. Last, to ensure the relatively high levels of employment

Figure 8: Worker Reallocation Rate by Firm Age

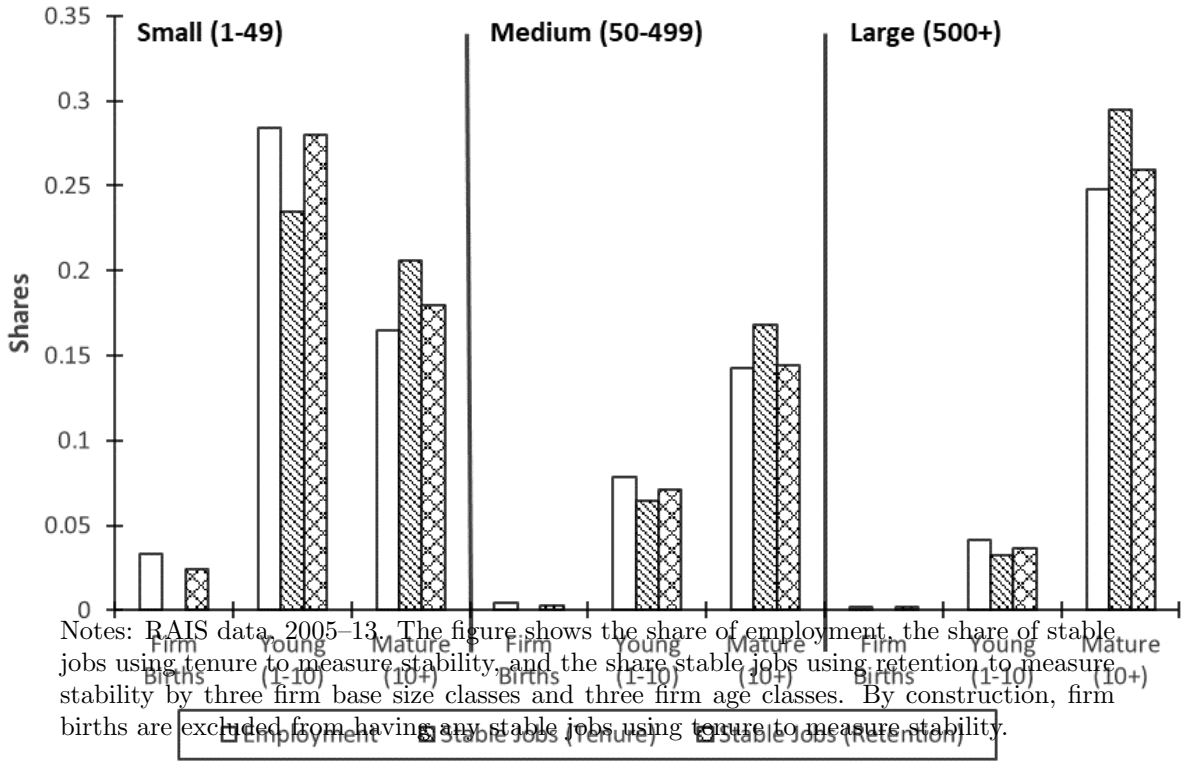


Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of worker reallocation rates by firm age class and estimates for two-way models of worker reallocation rates by firm age class controlling for firm size class (using both base size and average size). A higher value indicates that a particular firm age class has a higher worker reallocation rate relative to other firm age classes.

volatility are not driven by a high number of accessions, we also analyze firm separation rates (SR), an alternative measure of employment volatility. We find very similar results and therefore do not include them.

5.3 Job Stability and Job Creation in Brazil

The analysis thus far indicates that firm start-ups and young firms have higher employment growth rates relative to more mature firms in Brazil, but they also have higher levels of firm exit and employment volatility. Therefore, we now condition the job creation analysis on job stability to determine what types of firms create stable jobs in Brazil. Figure 9 summarizes the share of employment and the share of stable jobs by broad firm size and firm age classes in Brazil. The figure shows the share of employment, share of stable jobs using

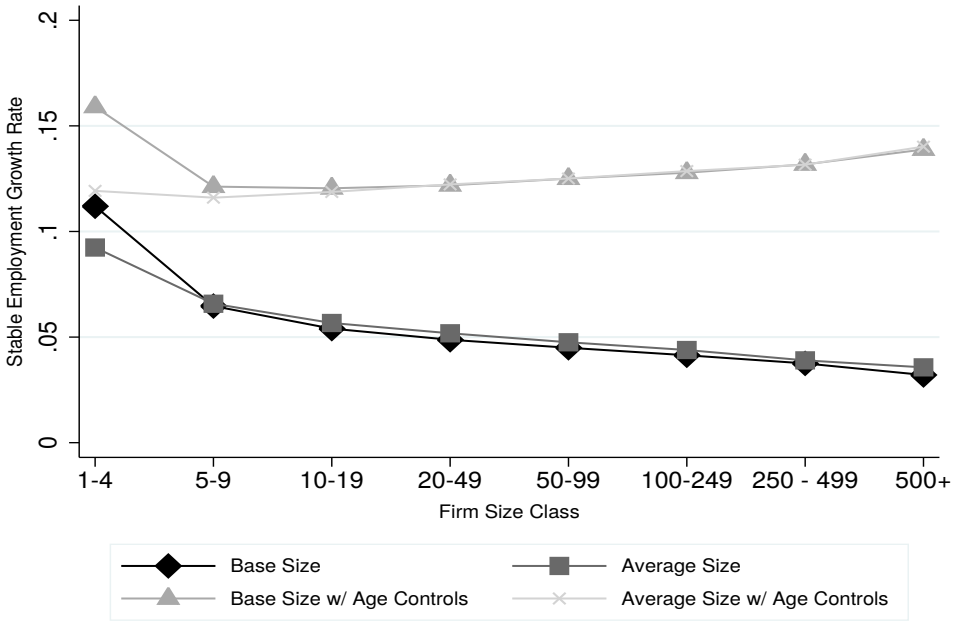


Notes: RAIS data, 2005–13. The figure shows the share of employment, the share of stable jobs using tenure to measure stability, and the share stable jobs using retention to measure stability by three firm base size classes and three firm age classes. By construction, firm births are excluded from having any stable jobs using tenure to measure stability.

tenure, and the share of stable jobs using retention for small firms (< 50 employees) in the left panel, medium firms (50–499 employees) in the middle, and large firms (500+ employees) in the right panel by firm births, young firms (< 10 years old), and mature firms (10+ years). Figure 9 shows small-young firms account for over 28% of employment, 23% of stable jobs using tenure to define stability, and 28% of stable jobs using retention to define stability. While Figure 2 shows that employment, job creation, and job destruction are concentrated in small-young firms, Figure 9 shows that stable jobs are concentrated in both small-young firms and large-mature firms. Large-mature firms have the highest share of stable jobs using tenure (29%) and small-young firms have the highest share of stable jobs using retention (28%). Large-mature firms also have a higher share of stable jobs relative to their share of employment.

Figure 10 plots estimated coefficients for one-way and two-way models of stable employment growth rates using tenure to define stability (SGT) by firm size. The estimates for one-way models of SGT show that stable growth rates monotonically decrease with firm size (diamond and square markers). Without age controls, the smallest firms have SGT ap-

Figure 10: Stable Employment Growth by Firm Size (Tenure)

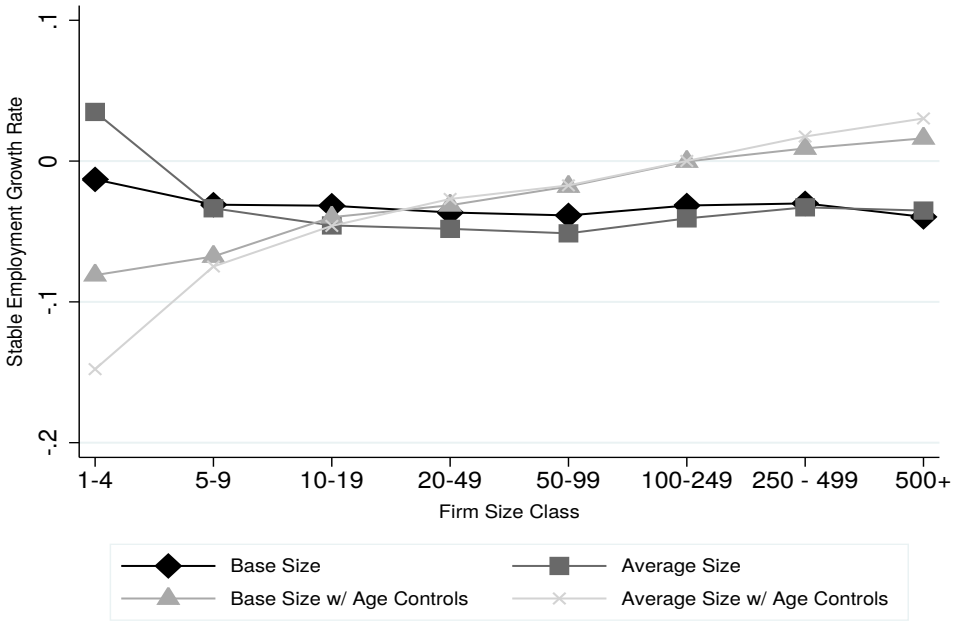


Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of stable employment growth (tenure) by firm size class and estimates for two-way models of stable employment growth (tenure) by firm size class controlling for firm age class (using both base size and average size). A higher value indicates that a particular firm size class has a higher stable growth rate relative to other firm size classes.

proximately 8 and 6 percentage points higher than the largest firms using base and average size, respectively. When firm age controls are included, the relationship between SGT and firm size becomes relatively constant or mildly increasing (triangle and X markers). The largest firms have SGT approximately 2 percentage points higher than firms size 5–9 when age controls are included.

Figure 11 also plots the coefficients for one-way and two-way models for stable employment growth rates by firm size but uses retention to measure job stability. The one-way models show that stable employment growth rates using retention (SGR) initially decrease with firm size without age controls for firms smaller than 100 employees. But, the relationship becomes strictly positive when age controls are included. The largest firms have SGR approximately 9 and 17 percentage points higher than the smallest firms. Across Figures 10 and 11, the relationship between stable growth rates and firm size changes when age controls

Figure 11: Stable Employment Growth by Firm Size (Retention)



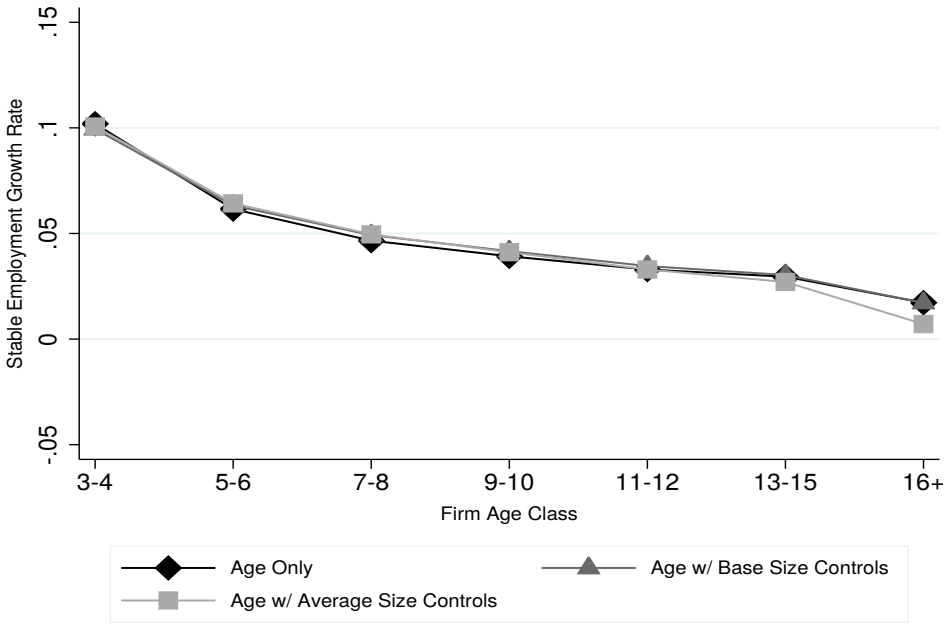
Notes: RAIS data, 2005–13. The figure shows estimates from one-way models of stable employment growth (retention) by firm size class and estimates for two-way models of stable employment growth (retention) by firm size class controlling for firm age class (using both base size and average size). A higher value indicates that a particular firm size class has a higher stable growth rate relative to other firm size classes.

are included using both tenure and retention to measure job stability. This highlights the important role firm age plays in the analysis. With age controls, large firms have relatively higher stable employment growth rates than small firms.

We also analyze stable employment growth rates by firm age. Figures 12 and 13 show results for one-way and two-way models of stable employment growth using tenure (SGT) and retention (SGR), respectively, by firm age. Figure 12 shows that SGT decreases with firm age for both the one-way and two-way models. The results are very robust to including firm size controls. For all models, firms age 3–4 have SGT approximately 10 percentage points higher than the oldest firms (age 16+). Figure 12 excludes estimates for firms age 0–2 because only firms at least two years in age can create stable jobs by the tenure definition of a stable job.

Figure 13 shows coefficients for the one-way and two-way models for stable employment

Figure 12: Stable Employment Growth by Firm Age (Tenure)

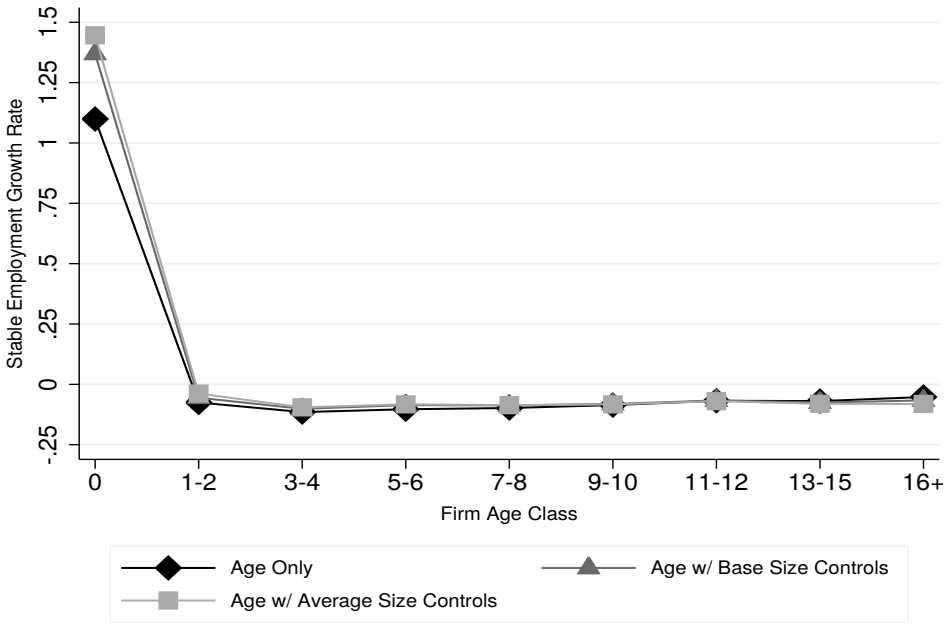


Notes: RAIS data, 2005–13. The figure shows estimates from one-way models of stable employment growth (tenure) by firm age class and estimates for two-way models of stable employment growth (tenure) by firm age class controlling for firm size class (using both base size and average size). A higher value indicates that a particular firm age class has a higher stable growth rate relative to other firm age classes.

growth rates using retention to measure stability (SGR) and firm age. SGR initially decreases with firm age, but quickly stabilizes, regardless of firm size controls. Firm start-ups create the most stable jobs in Brazil relative to all other age classes using retention to measure stability.

The analysis of stable employment growth rates shows that firm age is also a key determinant of stable employment growth in Brazil. We find that larger firms and younger firms create relatively more stable jobs in Brazil, seen through higher estimated stable employment growth rates.

Figure 13: Stable Employment Growth by Firm Age (Retention)



Notes: RAIS data, 2005–13. The figure shows estimates from one-way models of stable employment growth (retention) by firm age class and estimates for two-way models of stable employment growth (retention) by firm age class controlling for firm size class (using both base size and average size). A higher value indicates that a particular firm age class has a higher stable growth rate relative to other firm age classes.

6 Conclusion

This project uses RAIS (*Relação Anual de Informações Sociais*) data from Brazil to first analyze job creation and destruction patterns by firm size and firm age. The project then examines employment volatility by firm age and firm size. Last, we condition the job creation analysis on two measures of job stability to determine what types of firms create stable jobs in Brazil.

The first glimpse at the data show that employment, job creation, and job destruction are most concentrated in small-young firms. Our results also show firm age is a more important determinant of employment growth than firm size. Firm start-ups and young firms create a disproportionately high number of jobs in Brazil. However, young firms also experience much higher exit rates relative to more mature firms. The "up-or-out" dynamic of young

firms in the US described by HJM is also present in Brazil. The fact that young firms exit the market at a disproportionately high rate suggests that young firms are inherently volatile. Therefore, we analyze a measure of employment volatility, the worker reallocation rate, by firm size and firm age. The results indicate that younger firms have higher levels of volatility, even after conditioning on survival.

To account for young firms' high levels of employment volatility, we condition the employment growth analysis on two measures of job stability, one using worker tenure and one using worker retention. Using tenure, we define a job as stable if the worker has been employed at the firm for at least two years. We use a second measure of stability, retention, and define a job as stable if the worker is continuously employed at the same firm for two additional years. Firm age is also an important determinant of stable employment growth in Brazil. Not only are young firms creating a relatively higher number of jobs in Brazil, but young firms also have relatively higher stable employment growth rates. Large firms also have relatively higher stable employment growth rates. These results are consistent under both measures of stability.

Overall, using RAIS data for 2004–13, our analysis confirms the important role firm age plays in employment dynamics in Brazil. Young firms and firm start-ups contribute to job creation and destruction at a disproportionately high rate. Further, we find that firm age is also an important determinant of stable employment growth in Brazil. The results show why it is important for researchers and policymakers to consider firm size, firm age, and job stability when analyzing employment growth. Policymakers simply cannot afford to focus on only firm size or firm age when creating policies to promote employment growth, particularly when promoting the creation of stable jobs. Policies promoting dominantly small firms ignore firm age, a crucial determinant of employment growth and stable employment growth. But, policies promoting primarily new firms ignore the volatility inherent to new and young firms.

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Appendix: for online publication only

A Worker, Establishment, and Firm Concepts and Definitions

A.1 Worker-Level Concepts

We calculate all worker-level concepts for the years $t = 2004, ..., 2013$.

December Employment (e): A worker j employed at establishment i in December of year t.

$$e_{jit} = \begin{cases} 1, & \text{if } j \text{ has positive earnings at establishment } i \text{ in December of year } t \\ 0, & \text{otherwise.} \end{cases} \tag{10}$$

Replacing subscript i with f gives a worker j's employment at firm f in December of year t.

Accession (a): A worker j was hired or recalled for employment at establishment i during year t.

$$a_{jit} = \begin{cases} 1, & \text{if } hire\_year_{jit} = t \\ 0, & \text{otherwise,} \end{cases} \tag{11}$$

where $hire\_year_{jit}$ is the year t worker j was hired at establishment i, which is provided in the data.

Separation (s): A worker j separated from establishment i during year t.

$$s_{jit} = \begin{cases} 1, & \text{if } sep\_year_{jit} = t \\ 0, & \text{otherwise,} \end{cases} \tag{12}$$

where sep_year_{jit} is the year t worker j separated from establishment i, which is provided in the data.

Tenure (T): A worker j has tenure, measured in years, at establishment i in December of year t.

$$T_{jit} = \frac{time\_of\_employment_{jit}}{12}, \tag{13}$$

where $time\_of\_employment_{jit}$, which is given in the data, is the amount of time (measured in months) that worker j has been employed at establishment i in December of year t.

We also calculate tenure for worker j at firm f in December of year t. We first define the worker's tenure at establishment i (owned by firm f) for the first year the worker-firm pair appears in the data, $first\_year\_tenure_{jif}$. Then, for each additional year n worker j works

at any estabishment owned by firm f, we calculate worker j's tenure at firm f as follows:

$$T_{jfn} = first\_year\_tenure_{jif} + (n - t) \text{ where } n > t \text{ and } e_{jft} = 1 \text{ for all } t = t, ..., n. \quad (14)$$

Retention (retention): A worker j has retention of k years at establishment i in December of year t.

$$r^k_{jit} = \begin{cases} 1, & \text{if } e_{ji\tau} = 1 \text{ for all } \tau = t, ..., t + k \\ 0, & \text{otherwise.} \end{cases} \quad (15)$$

Replacing the i subscript with f gives worker j's k-year retention at firm f at time t.

A.2 Establishment-Level Concepts

We calculate the first four establishment-level concepts for the years $t = 2004, ..., 2013$.

Employment (E): Employment at establishment i in December of year t.

$$E_{it} = \sum_j e_{jit}. \quad (16)$$

Accessions (A): accessions at establishment i during year t.

$$A_{it} = \sum_j a_{jit}. \quad (17)$$

Separations (S): separations from establishment i during year t.

$$S_{it} = \sum_j s_{jit}. \quad (18)$$

Establishment Age (estab_age): Establishment i's age (measured in years) in year t.

$$estab\_age_{it} = t - min(hire\_year_{jit}) \text{ for all } j \text{ employed at } i \text{ in year } t \text{ if } t = first\_year_i, \quad (19)$$

where $first\_year_i$ is the first year an establishment i appears in the data.

For each additional year n the establishment appears in the data, we allow the establishment to age naturally as follows:

$$estab\_age_{in} = estab\_age_{it} + (n - t) \text{ where } t = first\_year_i \text{ and } n > t. \quad (20)$$

We calculate the remaining establishment-level concepts for the years $t = 2005, ..., 2013$.

Job Creation (JC): Job creation for establishment i in year t.

$$JC_{it} = max(G_{it}, 0), \tag{21}$$

where G_{it} is the establishment level employment growth rate defined in the paper in equation (1).

Job Destruction (JD): Job destruction for establishment i in year t.

$$JD_{it} = min(G_{it}, 0), \tag{22}$$

where G_{it} is the establishment level employment growth rate defined in the paper in equation (1).

Job Destruction from Establishment Exit (JD_Exit): Job destruction from establishment i's exit in year t.

$$JD\_Exit_{it} = max(-G_{it}, 0) * I(-G_{it} = 2). \tag{23}$$

New Establishment (estab_new): An indicator variable to identify whether an establishment i is considered new in year t.

$$estab\_new_{it} = \begin{cases} 1, & first\_year_i = t \text{ for } t > 2004 \\ 0, & \text{otherwise.} \end{cases} \tag{24}$$

Continuing Establishment (estab_cont): An indicator variable to identify whether establishment i is continuing in year t.

$$estab\_cont_{it} = \begin{cases} 1, & t > first\_year_i \text{ and } E_{it} > 0 \text{ for } t > 2004 \\ 0, & \text{otherwise.} \end{cases} \tag{25}$$

Destroyed Establishment (estab_dest): An indicator variable to identify whether establishment i is destroyed in year t.

$$estab\_dest_{it} = \begin{cases} 1, & E_{it-1} > 0 \text{ and } E_{it} = 0 \text{ for } t > 2004 \\ 0, & \text{otherwise.} \end{cases} \tag{26}$$

Base Size (base_size): Base size for establishment i in year t.

$$base\_size_{it} = \begin{cases} E_{it}, & \text{if } estab\_new_{it} = 1 \\ E_{it-1}, & \text{otherwise.} \end{cases} \tag{27}$$

Average Size (average_size): Average size for establishment i in year t.

$$average\_size_{it} = \frac{E_{it} + E_{it-1}}{2}. \tag{28}$$

A.3 Firm-Level Concepts

We calculate the first three firm-level concepts for the years $t = 2004, ..., 2013$.

Employment (E): Employment at firm f in December of year t.

$$E_{ft} = \sum_i E_{it}. \tag{29}$$

Firm Age (firm_age): Firm f's age (measured in years) in year t.

$$firm\_age_{ft} = max(estab\_age_{it}) \text{ for all } i \text{ owned by } f \text{ in } t \text{ if } first\_year_f = t, \tag{30}$$

where $first\_year_f$ is the first year the firm appears in the data.

For each additional year n the firm appears in the data we allow the firm to age naturally as follows:

$$firm\_age_{fn} = firm\_age_{ft} + (n - t) \text{ where } t = first\_year_f \text{ and } n > t. \tag{31}$$

Firm Age Class (firm_age_class): Firm f's age class in year t.

$$firm\_age\_class_{ft} = \begin{cases} 1, & \text{if } firm\_age_{ft} = 0 \\ 2, & \text{if } 1 \leq firm\_age_{ft} \leq 2 \\ 3, & \text{if } 3 \leq firm\_age_{ft} \leq 4 \\ 4, & \text{if } 5 \leq firm\_age_{ft} \leq 6 \\ 5, & \text{if } 7 \leq firm\_age_{ft} \leq 8 \\ 6, & \text{if } 9 \leq firm\_age_{ft} \leq 10 \\ 7, & \text{if } 11 \leq firm\_age_{ft} \leq 12 \\ 8, & \text{if } 13 \leq firm\_age_{ft} \leq 15 \\ 9, & \text{if } firm\_age_{ft} \geq 16. \end{cases} \tag{32}$$

We calculate the remaining firm-level concepts for the years $t = 2005, ..., 2013$.

Firm Growth Rate (G): Firm growth rate for firm f in year t.

$$G_{ft} = \sum_i \frac{estab\_average\_size_{it}}{firm\_average\_size_{ft}} G_{it}, \text{ for all } i \text{ under control of } f. \tag{33}$$

Job Creation (JC): Job creation for firm f in year t.

$$JC_{ft} = \sum_i \frac{E_{it}}{E_{ft}} max(G_{it}, 0), \text{ for all } i \text{ under control of } f. \tag{34}$$

where G_{it} is the establishment level employment growth rate defined in the paper in euqation (1).

Job Destruction (JD): Job destruction for firm f in year t.

$$JD_{it} = \sum_i \frac{E_{it}}{E_{ft}} min(G_{it}, 0), \text{ for all } i \text{ under control of } f. \tag{35}$$

where G_{it} is the establishment level employment growth rate defined in the paper in equation (1).

Job Destruction from Firm Exit (JD_Exit): Job destruction from firm f's exit in year t.

$$JD\_Exit_{ft} = \sum_i \frac{estab\_average\_size_{it}}{firm\_average\_size_{ft}} I(G_{it} = -2) * max(-G_{it}, 0). \tag{36}$$

Worker Reallocation Rate (WRR): Worker reallocation rate for firm f in year t.

$$WRR_{ft} = \sum_i \frac{estab\_average\_size_{it}}{firm\_average\_size_{ft}} WRR_{it} \text{ for all } i \text{ under control of } f. \tag{37}$$

Separation Rate (SR): Separation rate for firm f in year t.

$$SR_{ft} = \sum_i \frac{estab\_average\_size_{it}}{firm\_average\_size_{ft}} SR_{it} \text{ for all } i \text{ under control of } f. \tag{38}$$

New Firm (firm_new): A firm f is considered new in year t if all establishments i under the firm's control are new.

$$firm\_new_{ft} = \begin{cases} 1, & min(estab\_new_{it}) = 1 \text{ for all } i \text{ under control of } f \\ 0, & \text{otherwise.} \end{cases} \tag{39}$$

Continuing Firm (firm_cont): A firm f is considered continuing in year t if at least one

establishment under its control is continuing in year t.

$$firm\_cont_{ft} = \begin{cases} 1, & min(estab\_cont_{it}) = 1 \text{ for at least one } i \text{ under control of } f \\ 0, & \text{otherwise.} \end{cases} \tag{40}$$

Destroyed Firm (firm_dest): A firm f is considered destroyed in year t if all establishment's under its control are destroyed.

$$firm\_dest_{ft} = \begin{cases} 1, & min(estab\_dest_{it}) = 1 \text{ for all } i \text{ under control of } f \\ 0, & \text{otherwise.} \end{cases} \tag{41}$$

Base Size (base_size): Base size for firm f in year t.

$$base\_size_{ft} = \begin{cases} E_{ft}, & \text{if } firm\_new = 1 \\ E_{ft-1}, & \text{otherwise.} \end{cases} \tag{42}$$

Average Size (average_size): Average size for firm f in year t.

$$average\_size_{ft} = \frac{E_{ft} + E_{ft-1}}{2}. \tag{43}$$

Firm Base Size Class (firm_base_class): Base size class for firm f in year t.

$$firm\_base\_class_{ft} = \begin{cases} 1, & \text{if } 1 \leq firm\_base\_size_{ft} \leq 4 \\ 2, & \text{if } 5 \leq firm\_base\_size_{ft} \leq 9 \\ 3, & \text{if } 10 \leq firm\_base\_size_{ft} \leq 19 \\ 4, & \text{if } 20 \leq firm\_base\_size_{ft} \leq 49 \\ 5, & \text{if } 50 \leq firm\_base\_size_{ft} \leq 99 \\ 6, & \text{if } 100 \leq firm\_base\_size_{ft} \leq 249 \\ 7, & \text{if } 250 \leq firm\_base\_size_{ft} \leq 499 \\ 8, & \text{if } firm\_base\_size_{ft} \geq 500. \end{cases} \tag{44}$$

Firm Average Size Class (firm_average_class): Average size class for firm f in year t.

$$firm\_average\_class_{ft} = \begin{cases} 1, & \text{if } 1 \leq firm\_average\_size_{ft} \leq 4 \\ 2, & \text{if } 5 \leq firm\_average\_size_{ft} \leq 9 \\ 3, & \text{if } 10 \leq firm\_average\_size_{ft} \leq 19 \\ 4, & \text{if } 20 \leq firm\_average\_size_{ft} \leq 49 \\ 5, & \text{if } 50 \leq firm\_average\_size_{ft} \leq 99 \\ 6, & \text{if } 100 \leq firm\_average\_size_{ft} \leq 249 \\ 7, & \text{if } 250 \leq firm\_average\_size_{ft} \leq 499 \\ 8, & \text{if } firm\_average\_size_{ft} \geq 500. \end{cases} \tag{45}$$

B Age Consistency Checks

Table S1: Establishment and Firm Age Consistency Check, 2005 and Later

Establishment Age	Count	Mean	Median	SD
Age (Hire Date)	10,877,478	2.43	2.00	2.98
Age (True)	10,877,478	2.02	1.00	1.99
Age Difference	1,022,112	4.27	2.00	5.81
Percent Overestimated	(9.40%)			
Firm Age	**Count**	**Mean**	**Median**	**SD**
Age (Hire Date)	9,336,277	2.31	2.00	2.62
Age (True)	9,336,277	2.06	1.00	2.02
Age Difference	674,537	3.49	1.00	5.06
Percent Overestimated	(7.22%)			
Firm Age Class	**Count**	**Mean**	**Median**	**SD**
Age Class (Hire Date)	9,336,277	2.36	2.00	1.25
Age Class (True)	9,336,277	2.24	2.00	1.08
Age Class Difference	525,983	2.07	1.00	1.69
Percent Overestimated	(5.63%)			

Notes: RAIS data, 2005–13. Age consistency checks for establishment age in the top panel, firm age in the middle panel, and firm age class in the lower panel.

Table S2: Establishment and Firm Age Consistency Check, 2006 and Later

Establishment Age	Count	Mean	Median	SD
Age (Hire Date)	8,850,409	2.12	1.00	2.74
Age (True)	8,850,409	1.77	1.00	1.76
Age Difference	751,409	4.10	2.00	5.94
Percent Overestimated	(8.50%)			

Firm Age	Count	Mean	Median	SD
Age (Hire Date)	7,555,307	1.99	1.00	2.34
Age (True)	7,555,307	1.79	1.00	1.77
Age Difference	480,304	3.18	1.00	5.13
Percent Overestimated	(6.36%)			

Firm Age Class	Count	Mean	Median	SD
Age Class (Hire Date)	7,555,307	2.20	2.00	1.12
Age Class (True)	7,555,307	2.11	2.00	0.97
Age Class Difference	360,417	1.98	1.00	1.71
Percent Overestimated	(4.77%)			

Notes: RAIS data, 2006–13. Age consistency checks for establishment age in the top panel, firm age in the middle panel, and firm age class in the lower panel.

C Additional Descriptive Statistics

In this section we present more tables and figures describing the RAIS data. First, we present the summary statistics at the establishment level.

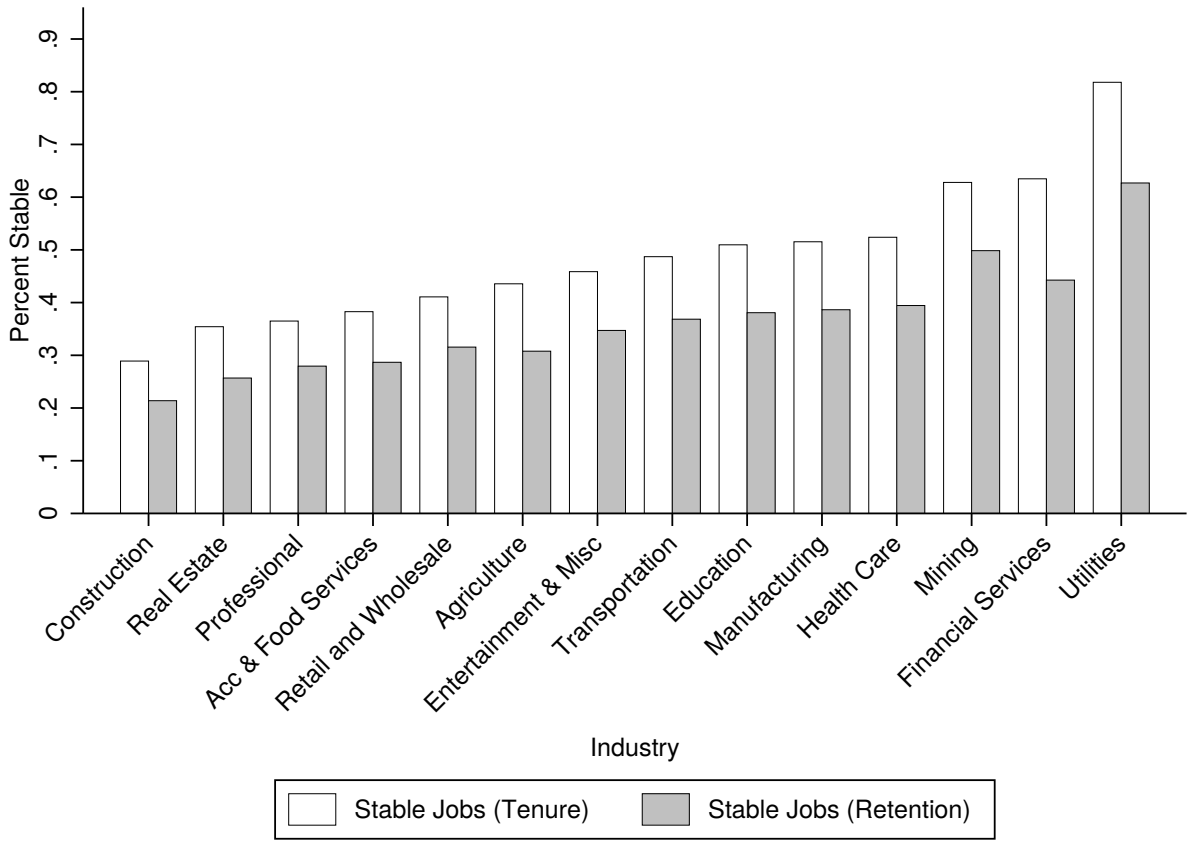
Table S3: Establishment Summary Statistics

Establishment Level	Count	Mean	SD
New Establishment	21,562,744	0.14	0.35
Continuing Establishment	21,562,744	0.74	0.44
Destroyed Establishment	21,562,744	0.12	0.32
Employment	21,562,744	10.99	78.46
Base Size	21,562,744	10.84	76.90
Average Size	21,562,744	10.28	75.07
Age	21,562,744	5.97	6.24
Employment Growth Rate	21,562,744	0.06	1.09
Worker Reallocation Rate	19,208,997	1.81	13.52
Separation Rate	19,208,997	0.76	7.98
Stable Employment Growth Rate (Tenure)	21,752,527	0.59	1.29
Stable Employment Growth Rate (Retention)	13,399,601	-0.15	0.99

Notes: RAIS data, 2005–13. All measures are formally defined in section A of the online appendix.

Next, we present the share of stable jobs within each industry for the years 2005 to 2013. Figure S1 is similar to Figure 1 in the paper, but shows the share of stable jobs within each industry rather than the share of stable jobs across all industries. The figure shows that mining, financial services, and utilities have the highest percentage of stable jobs, whereas construction and real estate have the lowest percentage.

Figure S1: Shares of Stable Jobs Within Industries: Brazil, 2005–13



Notes: RAIS data, 2005–13. The first bar for each industry shows the share of stable jobs within that industry using worker tenure. The second bar shows the similar statistic using worker retention to measure stability. The industries are sorted by percent stable (Tenure).

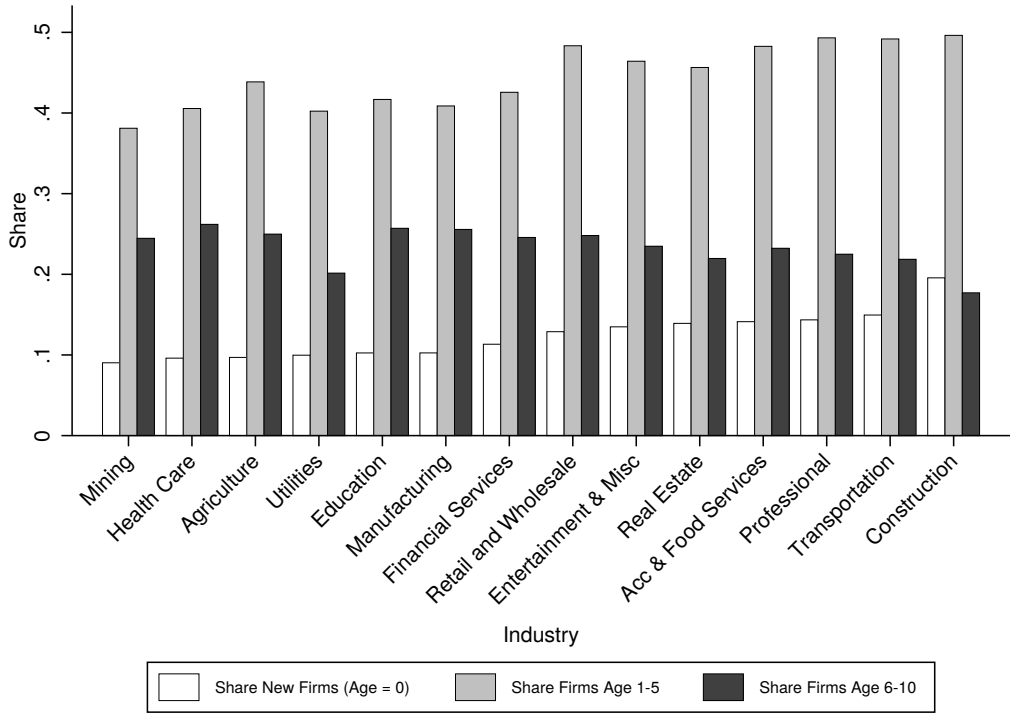
Next, we present results for the shares of employment, job creation, and destruction, using the same two categories for firm size as Haltiwanger et al. (2013). HJM split the sample into two size categories, small firms with up to 500 employees and large firms with over 500 employees. However, Brazil, has many more small firms than the United States. So, for the main analysis we included an additional category for medium sized firms, with employment between 50 and 500. Here, we use the same size categories as HJM. Compared to Figure 2 in the text, Figure S2 shows that when combining small and medium sized mature firms into one category, it now has larger shares of employment, job creation, and job destruction, than do large-mature firms. Both figures show the importance of small-young firms in the Brazilian labor market.

Figure S2: Shares of Employment, Job Creation, and Destruction by HJM's Firm Size and Age Classes: Brazil, 2005–13

Notes: RAIS data, 2005–13. Shares of employment, job creation, and job destruction are calculated using establishment-level data characterized by two firm base size classes and three firm age classes. Firm births only create jobs and cannot destroy any jobs by definition.

We next show the intensity of young firms by industry in Brazil. Figure S3 shows the share of firms in three different age categories for each industry in Brazil. The first bar for each industry shows the share of new firms. The second bar shows the share of firms between 1 and 5 years old. The third bar shows the share of firms between 6 and 10 years old. Note the bars for each industry do not sum to one as mature firms are excluded from this figure. However, given the prevalence of young firms in Brazil, it is worthwhile to investigate the intensity of young firms across sectors. The construction industry has the most new firms and the fewest firms between 6 and 10 years old. The mining and health care industries have the lowest share of new firms and have among the lowest shares of firms between 6 and 10 years old. Over all industries, we see a consistent pattern that the highest share of firms within all industries are age 1 to 5.

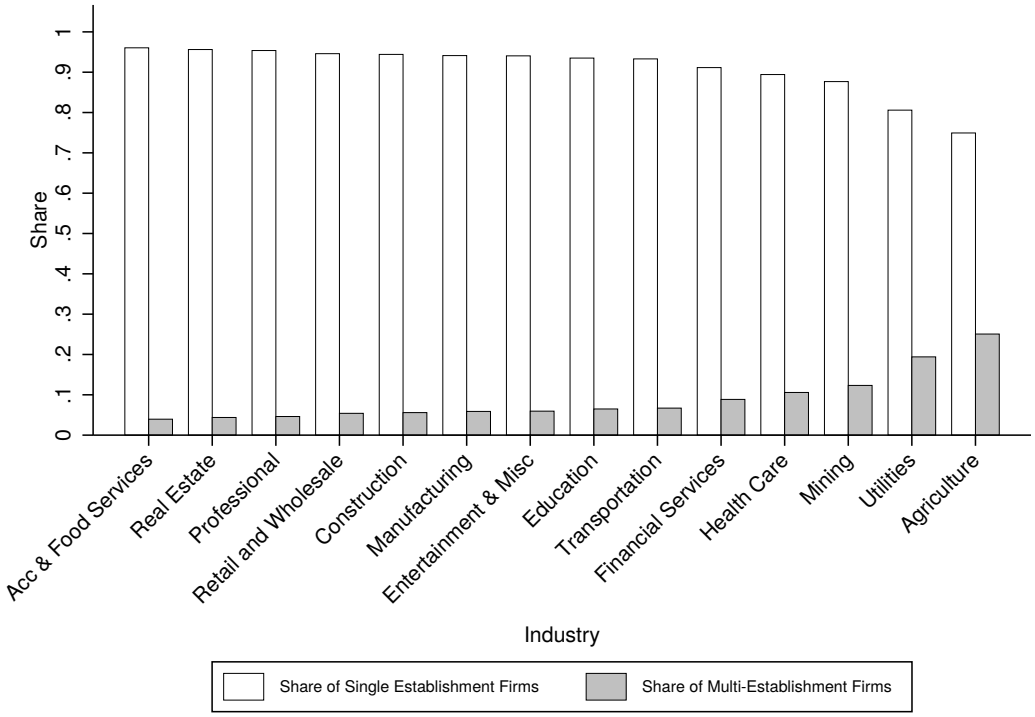
Figure S3: Intensity of Young Firms by Industry: Brazil, 2005–13



Notes: RAIS data, 2005–13. Share of young firms in each industry in three different age categories. Industries are sorted by the share of new firms.

Figure S4 shows the share of single-establishment firms and multi-establishment firms for each industry in Brazil. The first bar for each figure shows the share of single-establishment firms and the second bar shows the share of multi-establishment firms. Agriculture and utilities have the highest share of multi-establishment firms, whereas the accommodation and food services sector has the lowest share of multi-establishment firms. Across all sectors, the overwhelming majority of firms only own a single establishment.

Figure S4: Share of Single-Establishment and Multi-Establishment Firms by Industry: Brazil, 2005–13

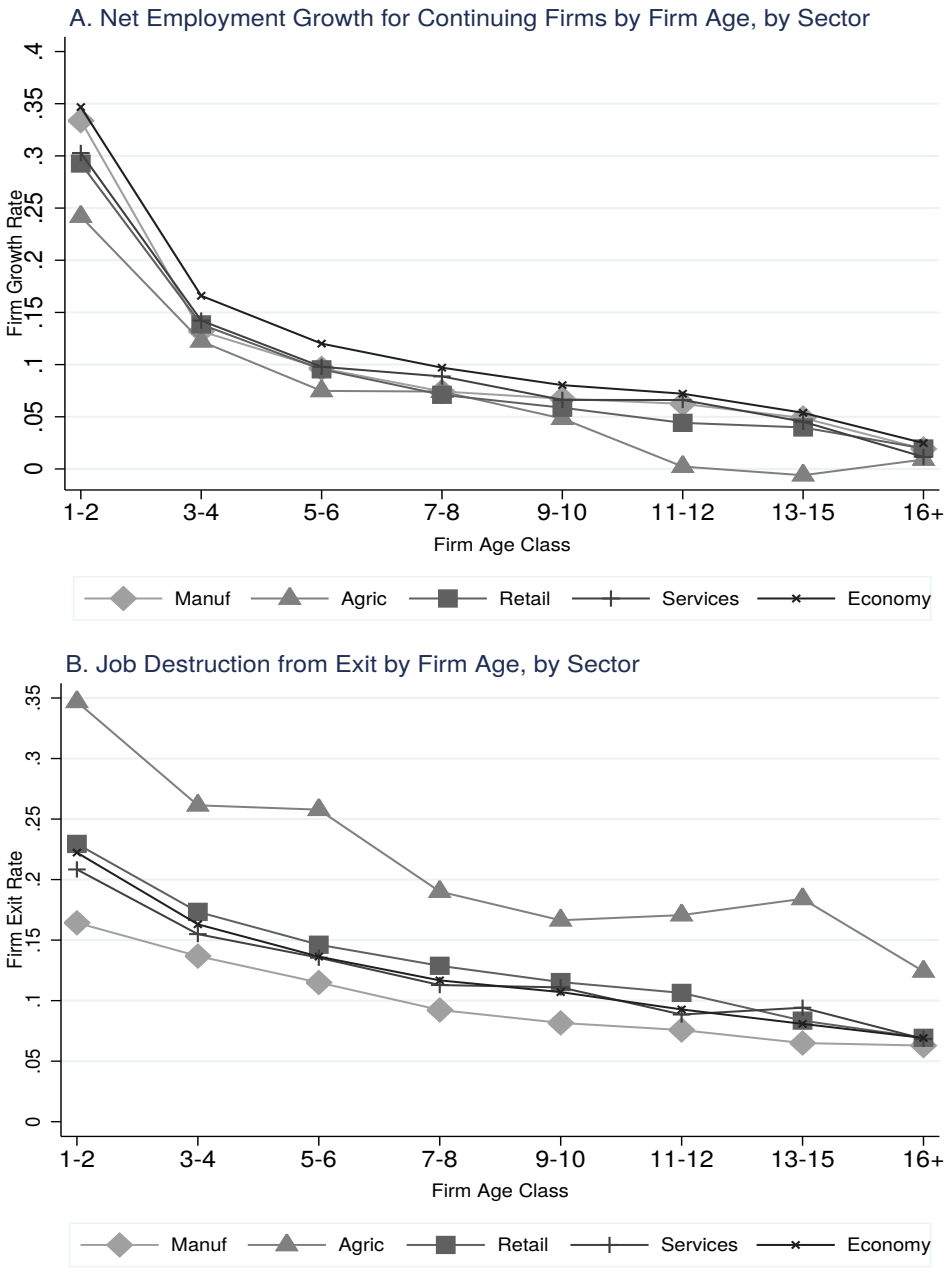


Notes: RAIS data, 2005–13. Percentage of single-establishment and multi-establishment firms by industry. Industries are sorted by share of multi-establishment firms.

D Up-or-Out Dynamics by Sector

The main analysis shows the importance of the up-or-out dynamic of employment for the Brazilian labor market. Here, we repeat that analysis by broad sectors to see if any one sector in the Brazilian economy is driving our result. Figure S5 shows the pattern to be consistent across sectors in Brazil. That is, firm start-ups create a lot of jobs, but many start-ups fail. However, the firms that survive, grow very fast.

Figure S5: Up-or-Out Patterns by Sector



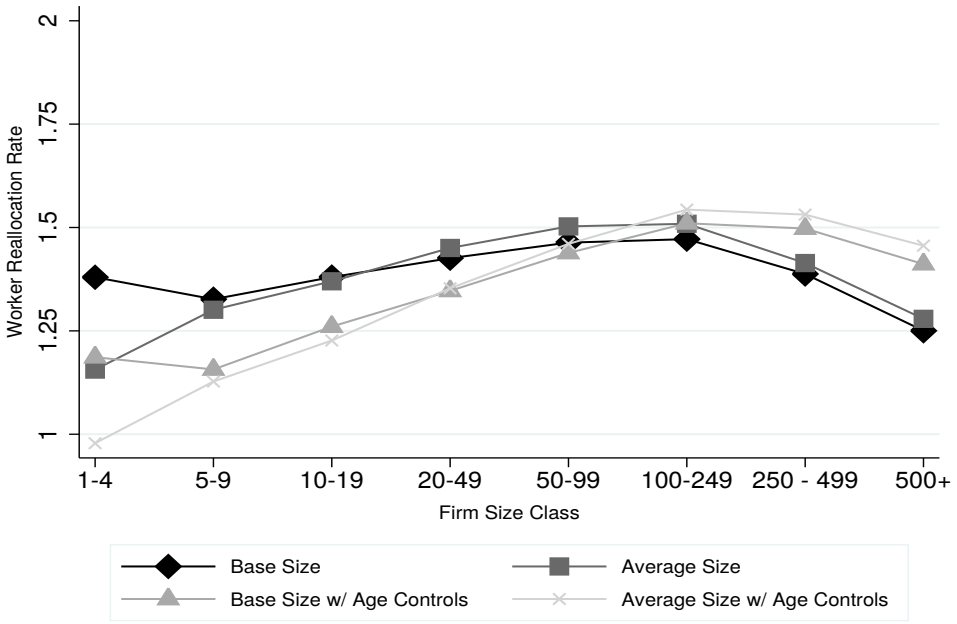
Notes: RAIS data, 2005–13. In the top panel, the figure shows estimates for one-way models of firm growth rates by firm age class and firm growth rates by firm age class and firm size class (using both base size and average size) for continuing firms only. A higher value in the top panel indicates that a particular firm age class has a higher employment growth rate relative to other firm age classes. In the bottom panel, the figure shows the estimates for one-way models of firm exit by firm age class and estimates for two-way models of firm exit by firm age class and firm size class (using both base size and average size). A higher value in the bottom panel indicates that a particular firm age class has a higher firm exit rate relative to other firm age classes.

E Employment Volatility for Continuing Firms Only

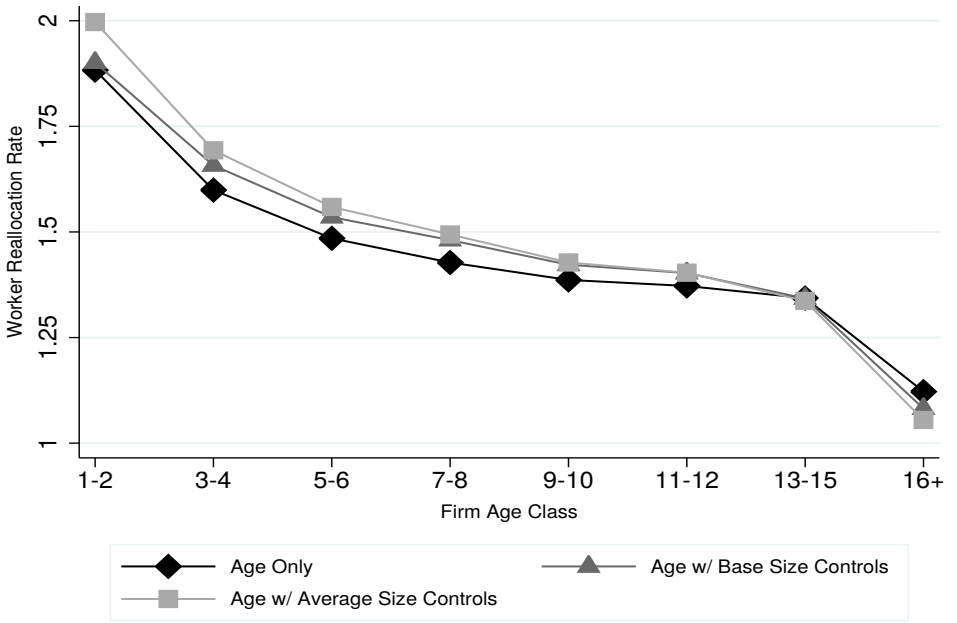
In this section, we present the results for employment volatility by firm size and firm age for the subset of continuing firms only. We use the worker reallocation rate to measure employment volatility.

Figure S6: Worker Reallocation Rates by Firm Size and Firm Age, Continuing Firms Only

(a) By Firm Size



(b) By Firm Age



Notes: RAIS data, 2005–13. In the top panel, the figure shows estimates for one-way models of firm worker reallocation rates by firm size class and worker reallocation rates by firm size class and firm age class (using both base size and average size) for continuing firms only. In the bottom panel, the figure shows the estimates for one-way models of worker reallocation rates by firm age class and estimates for two-way models of worker reallocation rates by firm age class and firm size class (using both base size and average size) for continuing firms only. A higher value indicates that a particular firm size or age class has a higher worker reallocation rate relative to other firm size or age classes.

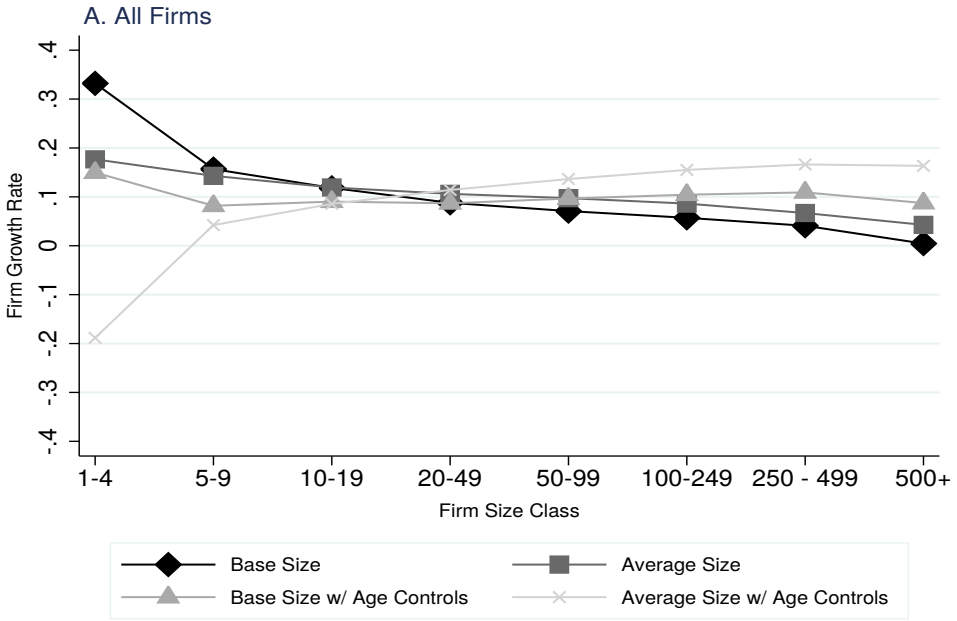
F Robustness Checks

In this section we consider the robustness of our results along two dimensions. First, we include controls for industry and year effects in the analysis. Second, we include establishments that lasted less than one year. The main replication analysis excluded these establishments to make the results comparable with HJM.

F.1 Inclusion of industry and year effects

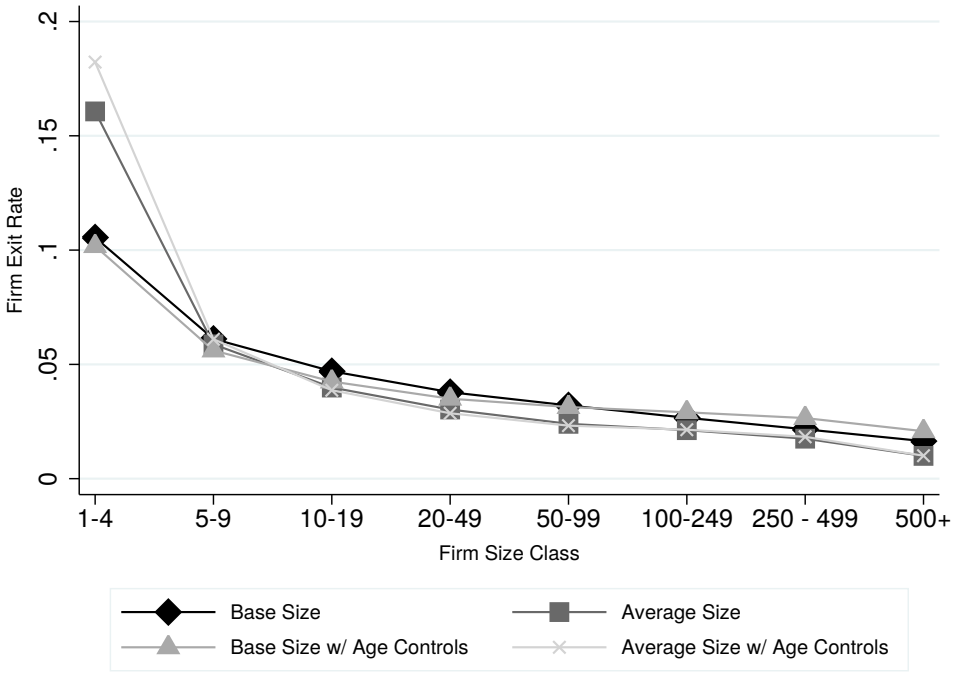
In this section, we repeat our main analyses but now include both year and industry effects. The reference category is then constructed to account for the share of the data in each year and industry. Figures S7 – S16 show very similar results to those in Figures 3 – 13 in the text.

Figure S7: Employment Growth Rate and Firm Size, with Year and Industry Effects



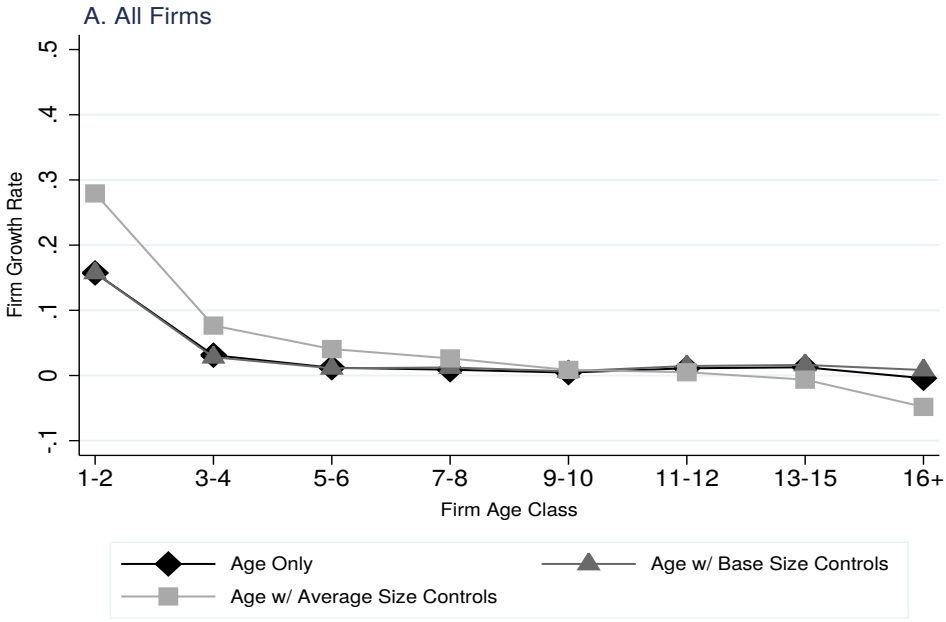
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of employment growth by firm size class and estimates for two-way models of employment growth by firm size class controlling for firm age class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm size class has a higher firm growth rate relative to other firm size classes.

Figure S8: Firm Exit by Firm Size, with Year and Industry Effects



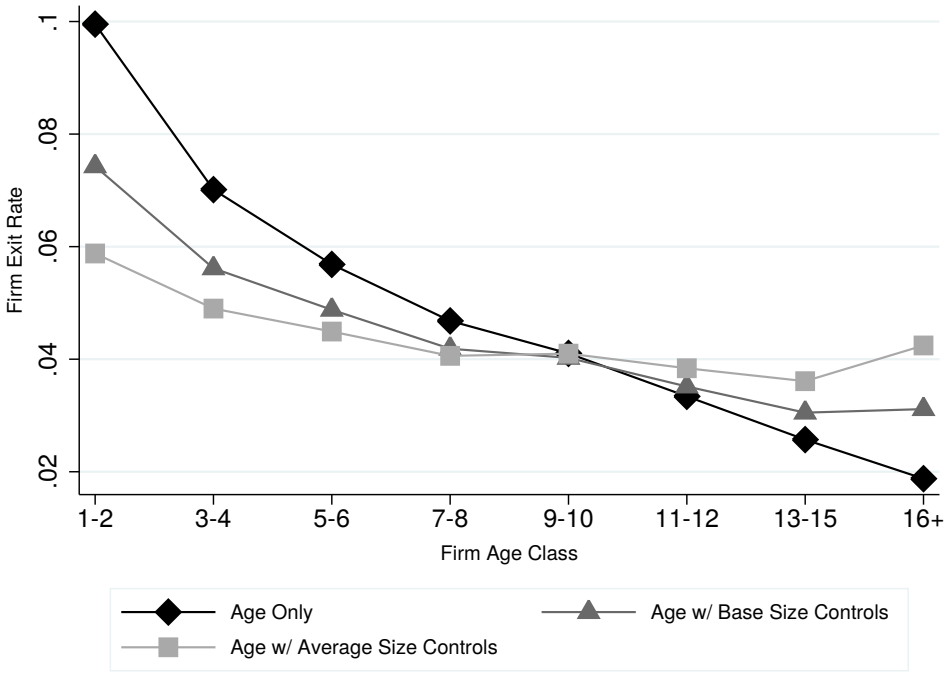
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of job destruction due to firm exit by firm size class and for two-way models of job destruction due to firm exit by firm size class controlling for firm age class. All models include industry and year controls. A higher value indicates that a particular firm size class has a higher firm exit rate relative to other firm size classes.

Figure S9: Employment Growth Rate and Firm Age, with Year and Industry Effects



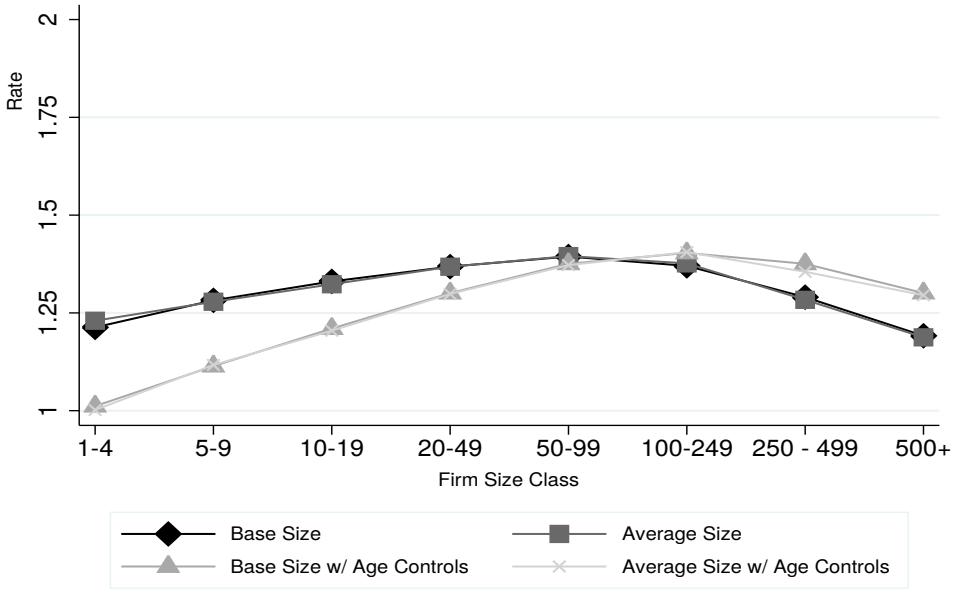
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of employment growth by firm age class and estimates for two-way models of employment growth by firm age class controlling for firm size class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm age class has a higher firm growth rate relative to other firm age classes. Results for new firms are not displayed.

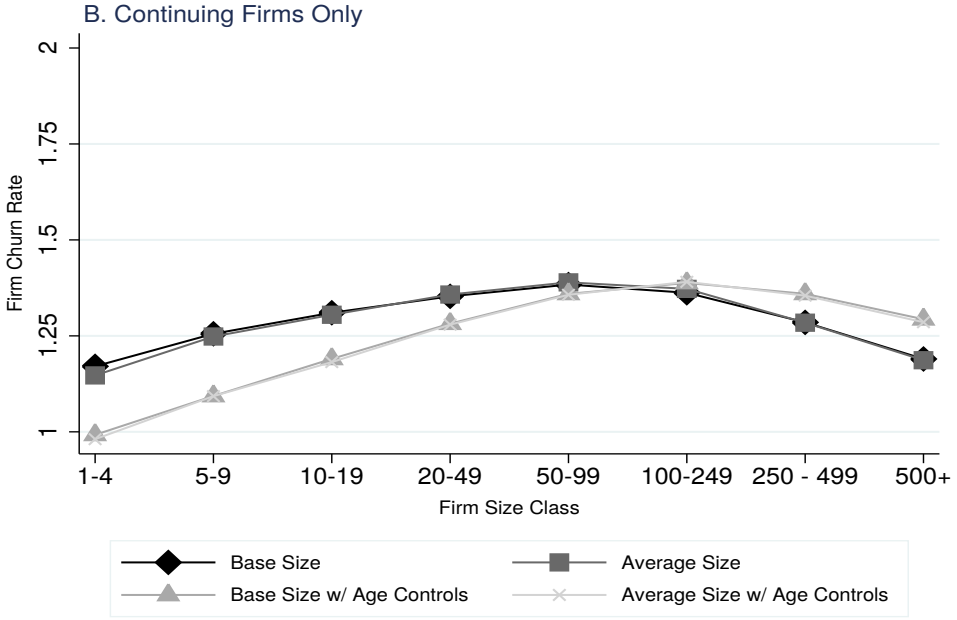
Figure S10: Firm Exit by Firm Age, with Year and Industry Effects



Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of jon destruction due to firm exit by firm age class and for two-way models of job destruction due to firm exit by firm age class controlling for firm size class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm age class has a higher firm exit rate relative to other firm age classes. New firms are excluded from the figure because they cannot destroy any jobs by construction.

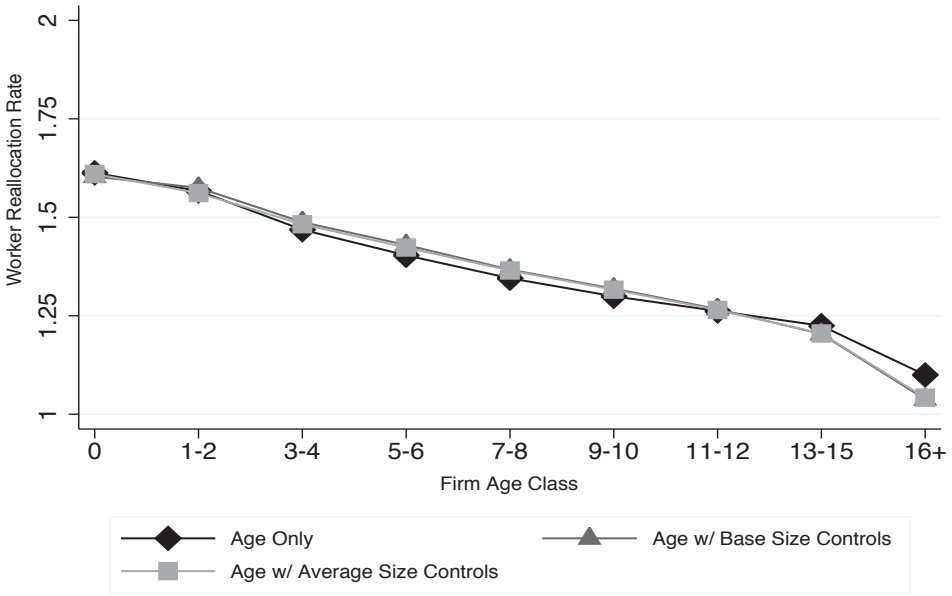
Figure S11: Worker Reallocation Rate by Firm Size, with Year and Industry Effects



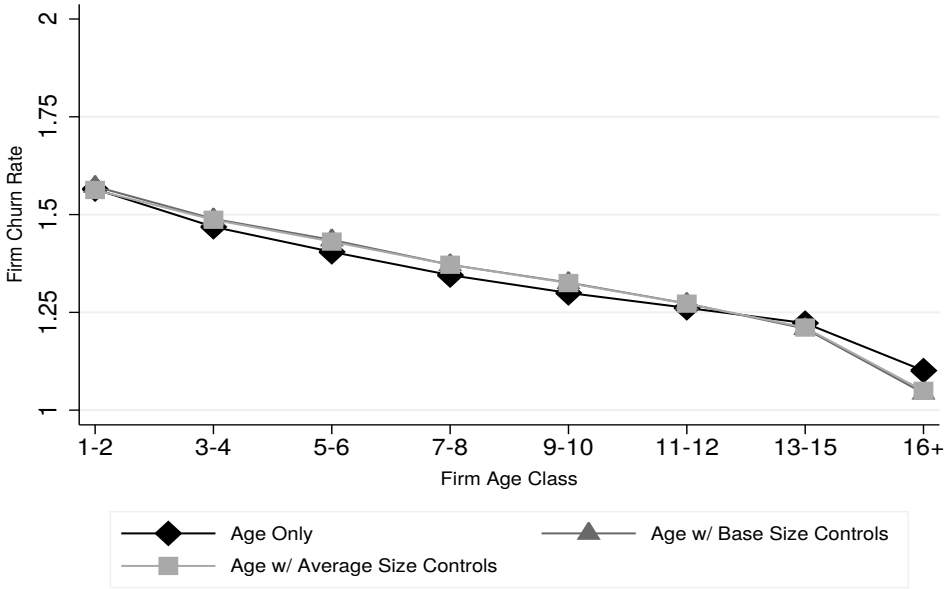


Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of worker reallocation rates by firm size class and estimates for two-way models of worker reallocation rates by firm size class controlling for firm age class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm size class has a higher firm worker reallocation rate relative to other firm size classes.

Figure S12: Worker Reallocation Rate by Firm Age, with Year and Industry Effects

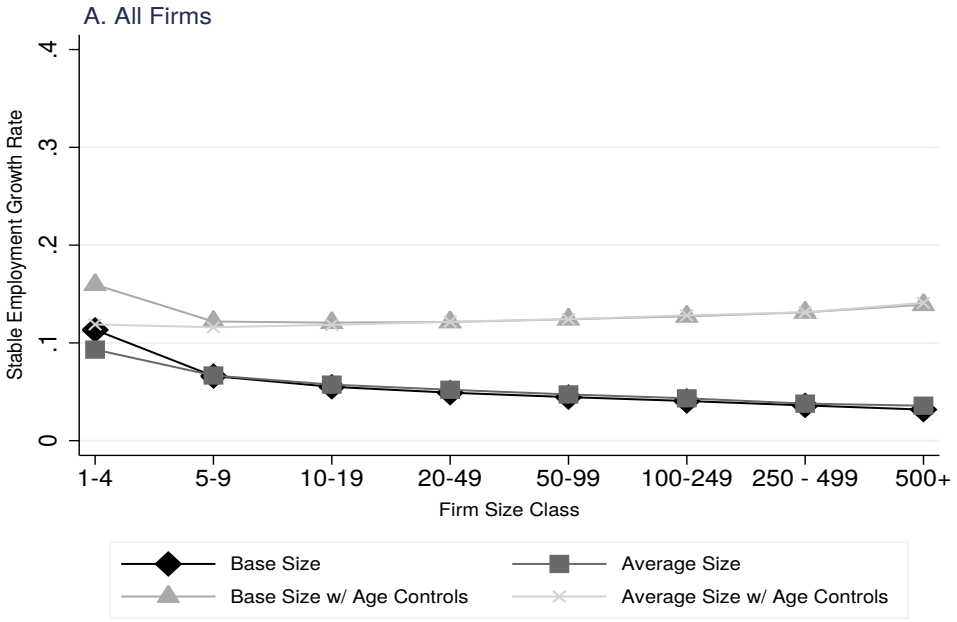


B. Continuing Firms Only



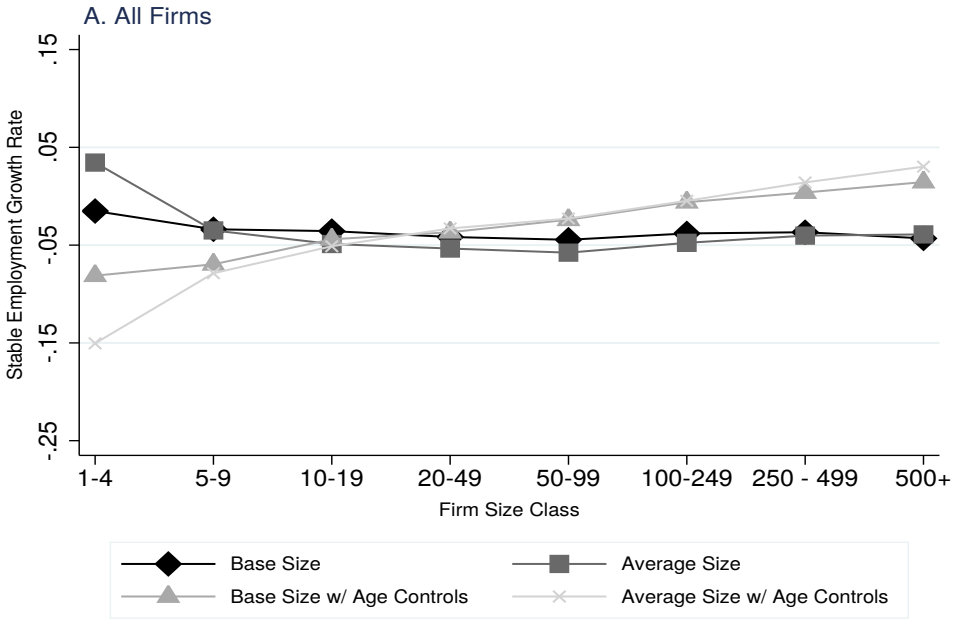
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of worker reallocation rates by firm age class and estimates for two-way models of worker reallocation rates by firm age class controlling for firm size class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm age class has a higher firm worker reallocation rate relative to other firm age classes.

Figure S13: Stable Employment Growth by Firm Size (Tenure), with Year and Industry Effects



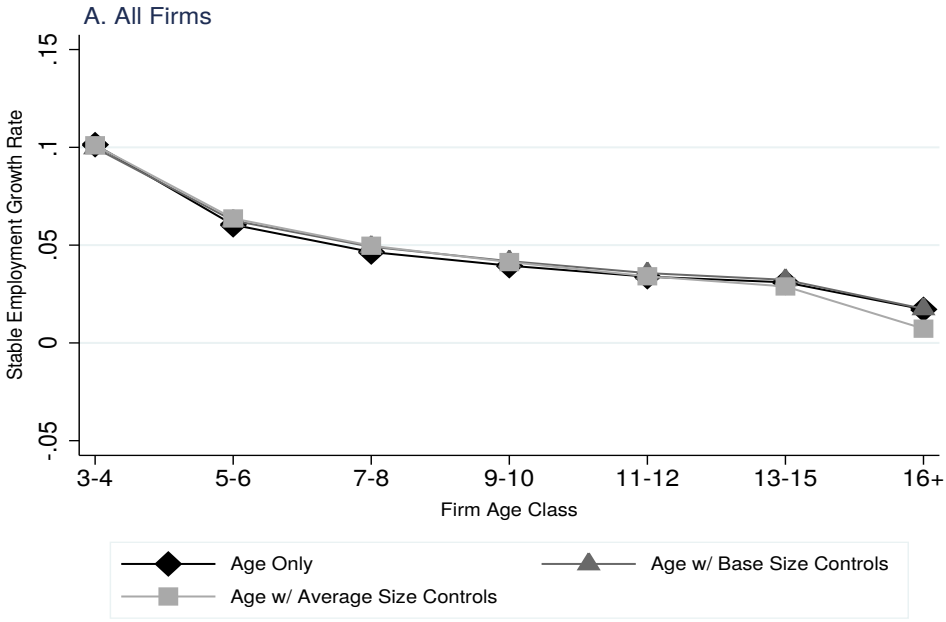
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of stable employment growth (tenure) by firm size class and estimates for two-way models of stable employment growth (tenure) by firm size class controlling for firm age class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm size class has a higher stable growth rate relative to other firm size classes.

Figure S14: Stable Employment Growth by Firm Size (Retention), with Year and Industry Effects



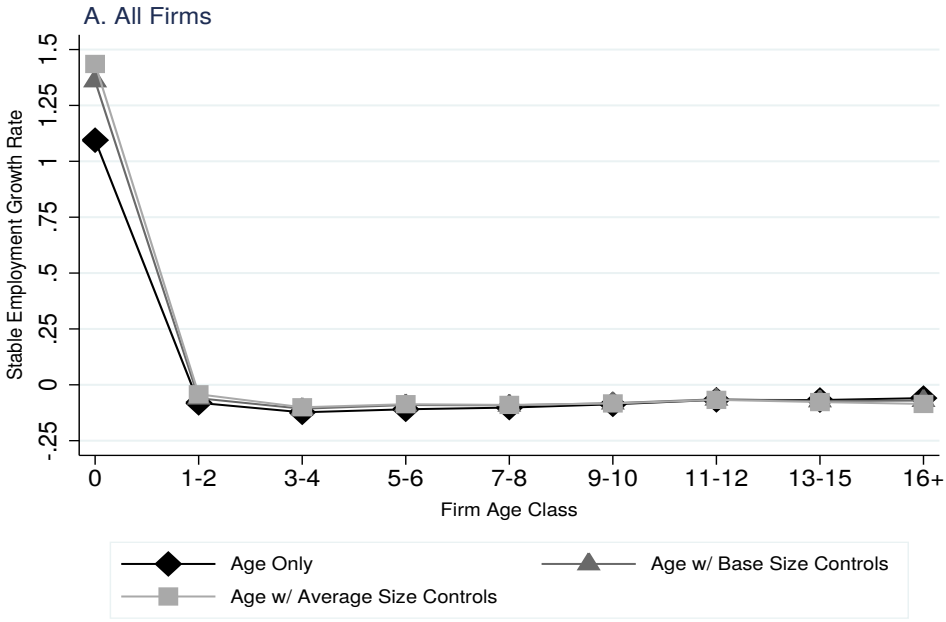
Notes: RAIS data, 2005–13. The figure shows estimates from one-way models of stable employment growth (retention) by firm size class and estimates for two-way models of stable employment growth (retention) by firm size class controlling for firm age class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm size class has a higher stable growth rate relative to other firm size classes.

Figure S15: Stable Employment Growth by Firm Age (Tenure), with Year and Industry Effects



Notes: RAIS data, 2005–13. The figure shows estimates from one-way models of stable employment growth (tenure) by firm age class and estimates for two-way models of stable employment growth (tenure) by firm age class controlling for firm size class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm age class has a higher stable growth rate relative to other firm age classes.

Figure S16: Stable Employment Growth by Firm Age (Retention), with Year and Industry Effects



Notes: RAIS data, 2005–13. The figure shows estimates from one-way models of stable employment growth (retention) by firm age class and estimates for two-way models of stable employment growth (retention) by firm age class controlling for firm size class (using both base size and average size). All models include industry and year controls. A higher value indicates that a particular firm age class has a higher stable growth rate relative to other firm age classes.

F.2 Inclusion of short-lived firms

In this section, we repeat the job creation and job destruction analysis of Section 5.1 above, but now include short-lived firms. The data used by HJM does not capture firms that exist for less than 1 year, so our main analysis excluded these firms for consistency. These short-lived firms are firms which appear in our data but did not have any workers with non-zero wages in December. Table S4 corresponds to Table 1 in the text and Figures S17 – S20 correspond to Figures 3 – 6 in the text. We find very similar results to those for our main analysis. We only repeat the analysis for Section 5.1 because the employment volatility and job stability analysis in the text already include short-lived firms in the analysis.

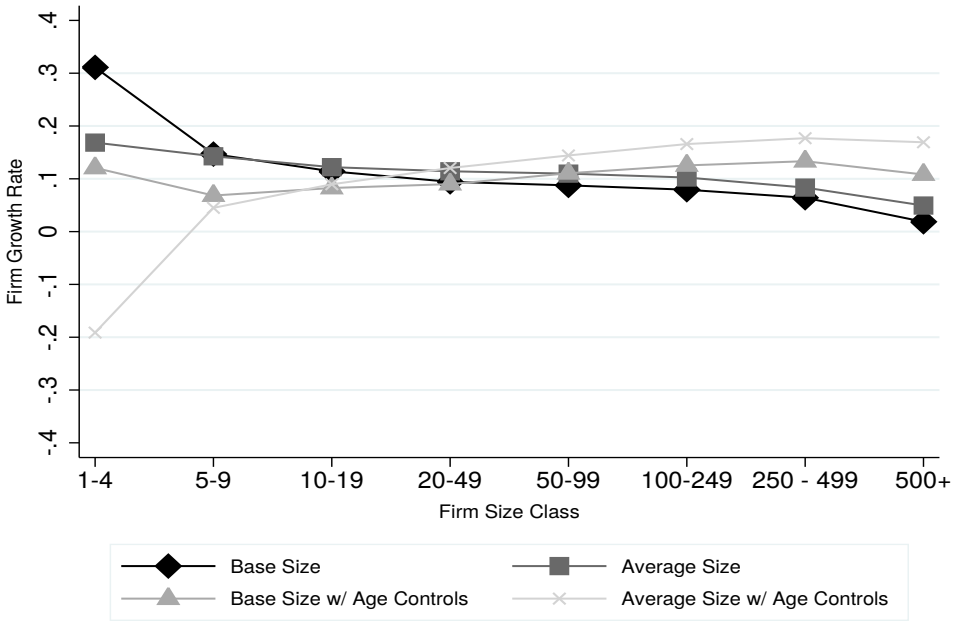
Table S4: Summary Statistics including Short-Lived Firms

Establishment Level	Count	Mean	SD
New Establishment	21,907,534	0.14	0.35
Continuing Establishment	21,907,534	0.75	0.44
Destroyed Establishment	21,907,534	0.12	0.32
Employment	21,907,534	11.02	79.55
Base Size	21,907,534	10.90	78.06
Average Size	21,907,534	10.35	76.22
Age	21,907,534	5.98	6.23
Employment Growth Rate	21,907,534	0.06	1.08
Worker Reallocation Rate	19,208,937	1.81	13.52
Separation Rate	19,208,937	0.76	7.98
Stable Employment Growth Rate (Tenure)	21,752,475	0.59	1.29
Stable Employment Growth Rate (Retention)	13,399,544	-0.15	0.99

Firm Level	Count	Mean	SD
Num. of Establishments	19,302,806	1.13	6.14
New Firm	19,302,806	0.14	0.34
Continuing Firm	19,302,806	0.75	0.43
Destroyed Firm	19,302,806	0.11	0.31
Employment	19,302,806	12.50	194.45
Base Size	19,302,806	12.13	187.51
Average Size	19,302,806	11.82	188.36
Age	19,302,806	5.85	5.84
Employment Growth Rate	19,302,806	0.06	1.07
Worker Reallocation Rate	19,149,889	1.61	8.15
Separation Rate	19,149,889	0.72	4.54
Stable Employment Growth Rate (Tenure)	14,894,950	-0.24	0.82
Stable Employment Growth Rate (Retention)	11,373,559	-0.08	0.94

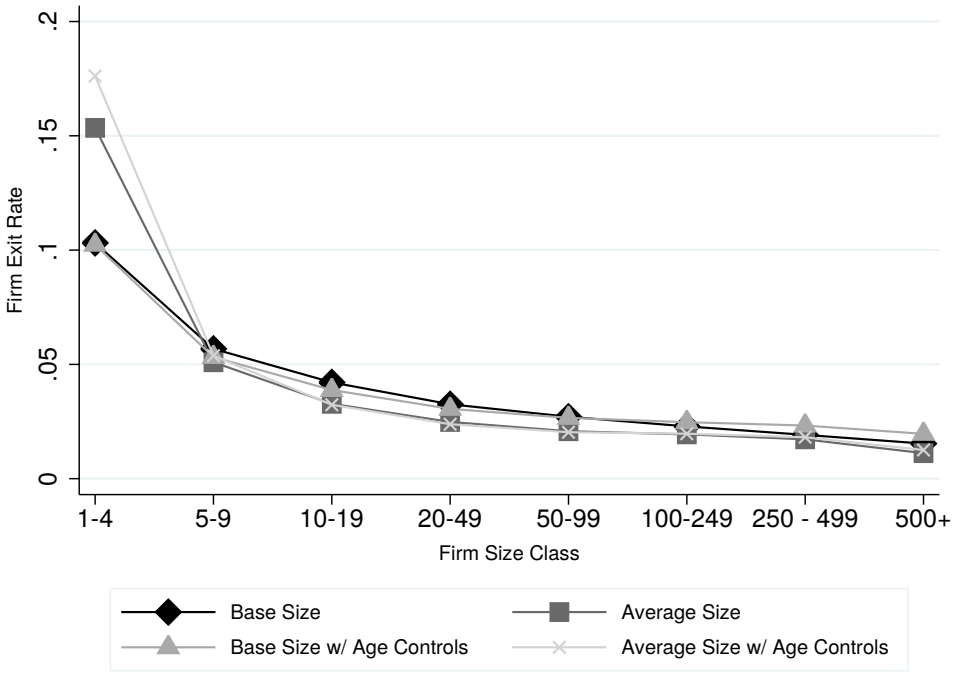
Notes: RAIS data, 2005–13. Summary statistics for the establishment-level data in the upper panel and for the firm-level data in the lower panel.

Figure S17: Employment Growth Rate and Firm Size including Short-Lived Firms



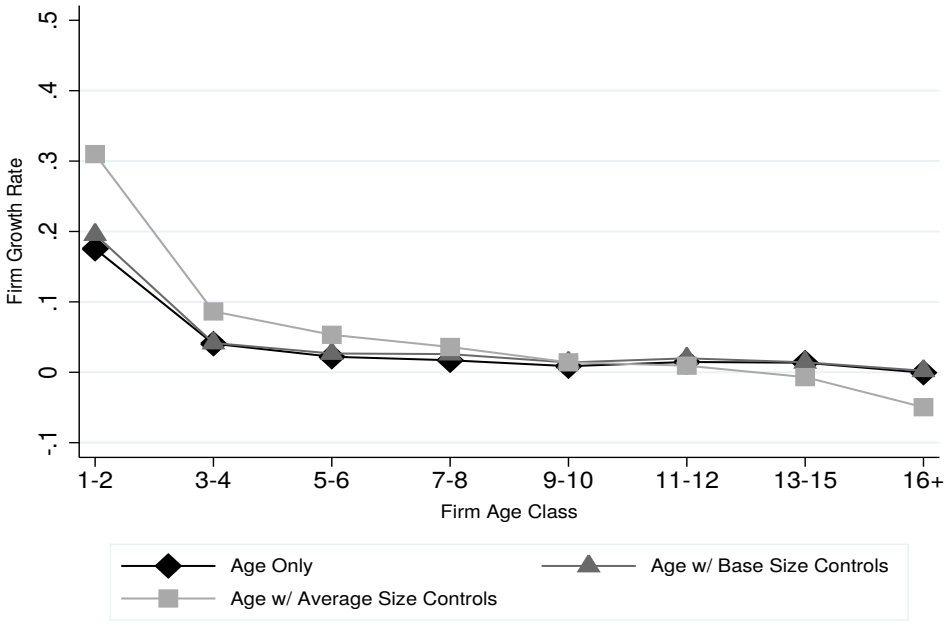
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of employment growth by firm size class and estimates for two-way models of employment growth by firm size class controlling for firm age class (using both base size and average size). A higher value indicates that a particular firm size class has a higher firm growth rate relative to other firm size classes.

Figure S18: Firm Exit by Firm Size including Short-Lived Firms



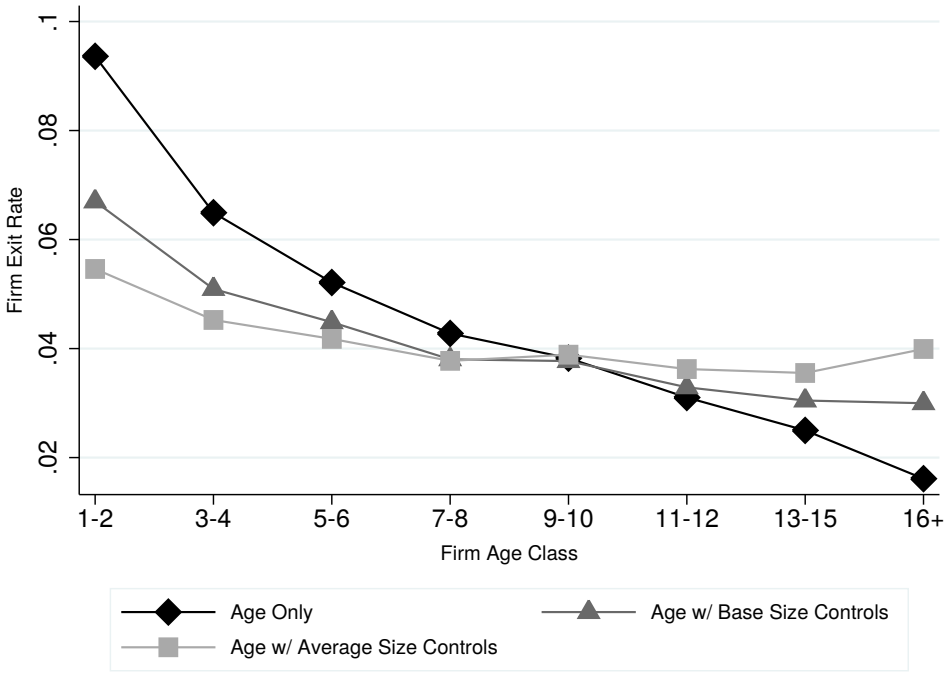
Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of firm exit by firm size class and for two-way models of firm exit by firm size class controlling for firm age class. A higher value indicates that a particular firm size class has a higher firm exit rate relative to other firm size classes.

Figure S19: Employment Growth Rate and Firm Age including Short-Lived Firms



Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of employment growth by firm age class and estimates for two-way models of employment growth by firm age class controlling for firm size class (using both base size and average size). A higher value indicates that a particular firm age class has a higher firm growth rate relative to other firm age classes. Results for firm-births are not displayed because their growth rates are equal to exactly 2 by construction.

Figure S20: Firm Exit by Firm Age including Short-Lived Firms



Notes: RAIS data, 2005–13. The figure shows estimates for one-way models of firm exit by firm age class and for two-way models of firm exit by firm age class controlling for firm size class (using both base size and average size). A higher value indicates that a particular firm age class has a higher firm exit rate relative to other firm age classes. New firms are excluded from the figure because they cannot destroy any jobs by construction.