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ABSTRACT

There is growing consensus that a key difference between the U.S. and developing economies is that the latter exhibit slower employment growth over the life cycle of the average business. At the same time, the rapid post entry growth in the U.S. is driven by an "up or out dynamic". We track manufacturing establishments in Colombia vs. the US and find that slower average life cycle growth in Colombia is driven by a less enthusiastic contribution of extraordinary growth plants and less dynamic selection of young underperforming plants. As a consequence, the size distribution of non-micro plants exhibits more concentration in small-old plants in Colombia, both in unweighted and employment-weighted bases. These findings point to a shortage of high-growth entrepreneurship and a relatively high likelihood of long-run survival for small, likely unproductive plants, as two key elements at the heart of the development problem. An extreme concentration of resources in micro plants is the other distinguishing feature of the Colombian manufacturing sector vis a vis the US.

JEL Classification: O47, O14.

Keywords: Entrepreneurship; SMEs; employment growth.

1 Introduction[1]

The finding that employment growth over an average business' life cycle is lower in Mexico and India compared to the US (Hsieh and Klenow, 2014, hereafter HK) suggests the life cycle growth of businesses may be a crucial driver of development. At the same time, employment growth in the U.S. exhibits "up or out" dynamics with most startups exiting but a small fraction of fast growing surviving startups contributing disproportionately to aggregate job growth (Haltiwanger, Jarmin and Miranda, 2013, HJM hereafter).[2] To what extent the differences in life cycle employment dynamics between high- and lower-income countries are also driven by differences in the upper tail and lower tails of the respective distribution, more than median growth?

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[2]HJM focus on "up or out" dynamics for firms. The data for Colombia are at the establishment-level which are more closely aligned with firms than in the U.S. as most activity is at single unit establishment firms in Colombia. In addition, Haltiwanger (2016) shows that "up or out" dynamics are also present for U.S. establishments. Also, as will become clear, we find strong "up or out" patterns for U.S. manufacturing establishments.

We take advantage of data on all non-micro manufacturing establishments in Colombia for a period of 30 years to conduct a full distribution characterization of plant employment growth in that country, compared to the U.S. We characterize, more specifically, the cross size-age distribution of plants, and the sources of overall employment growth in the manufacturing. We define non-micro plants as those with at least 10 employees

We document some broad (and perhaps surprising) similarities between the two countries: highly skewed distributions of employment growth; faster growth in young establishments compared to old ones; negligible median growth at any age; and aggregate employment creation entirely attributable to the entry of new establishments over the course of five years. Still, average life-cycle employment growth is weaker in Colombia.

Among non-micro establishments–to which data availability limits our attention for much of this paper—slower growth vis-a-vis peers in the U.S. is driven by a less dynamic 90th percentile of growth for early ages and by more sluggish job destruction from the exit of weak recent startups. As a consequence, the size distribution of non-micro plants exhibits more concentration in small-old plants in Colombia, both in unweighted and employment-weighted bases. These findings point at the quasi-absence of superstar businesses in less developed countries as a feature likely at the heart of the development problem.[3]

[3]Haltiwanger, Jarmin and Miranda, 2013, show that high average employment growth by young businesses in the US is driven by high-growth young businesses. Decker et al (2016) show that declined business dynamism and entrepreneurship since 2000 in the US is partly attributable to a decline in the emergence of high-growth young businesses. Autor et al. (2017) show that the decline in the labor share in the US is attributable to a shift of employment towards superstar firms, more capital intensive than others, rather than a decline in average labor shares.

While our evidence on micro establishments (those that start and remain micro or exit) is much more limited due to data availability constraints, the much more marked prevalence of micro-establishments in Colombia relative to the US is the other distinctive feature that we illustrate in the data. That is, at any point in time a large fraction of productive resources in Colombia concentrates in a type of businesses typically at the bottom of the productivity distribution. Despite the burden that this imposes on aggregate productivity at any point–and subject to the limits imposed by data constraints–we find that our characterization of the dynamics of average life-cycle growth from non-micro establishments is not much distorted by the inclusion of micro establishments. The reason is two-fold. First, for establishments that start as micro but transit to non-micro we track them accurately in the non-micro data, including the correct year of startup as a micro business, from the point in which they cross the size threshold. Second, while some micro-establishments likely remain as such and thus do not contribute positively to average life cycle growth, there is also little room for contraction, and the well known high turnover of micro-establishments implies a selection effect that, if anything, pushes average growth up.

The contrast between size and age in terms of employment creation is important in the context of policy-making. Policies targeted at fostering entrepreneurial business activity frequently adopt a size criterion to operationalize their targets: they focus on small businesses.[4] One underlying assumption is that small units are young

[4]The Small Business Administration in the US, and the now extinct Mipymes administration in Colombia are two examples of government agencies aimed at fostering small business growth in the countries that we study. Over 90% of Public Development Banks lend to SMEs, while other segments (e.g. startups, large firms, households) are covered by at most 60% of these banks (Eslava and Freixas, 2017). International organizations such as the World Bank and the Interamerican Development Bank also pay particular attention to the challenges faced by small businesses and

entrepreneurial initiatives that have yet to develop their full potential, but may fail to do so due to external obstacles to small businesses. Starting with Birch (1981) a wide literature seemed to support this approach, by showing that small businesses tend to grow faster than large ones.[5]

But the focus on small businesses is potentially problematic, from both a conceptual and an empirical standpoint. Conceptually, the small size of a business may rather be a reflection of low productivity (as in models of business dynamics like Jovanovic's, 1982, or Hopenhayn's, 1992). Empirically, recent findings—including those in this paper—do not square with the view that small businesses are particularly dynamic. Hurst and Pugsley (2012) show evidence that, despite high average growth rates among small businesses, the median small establishment actually does not grow, and its owners do not even intend to make it grow. Other studies have emphasized the importance of distinguishing between business size and business age. Haltiwanger, Jarmin and Miranda (2013) have shown that the job creating prowess of small businesses in the U.S. is accounted for by the contribution of entrants and young businesses–that are typically small—while size actually correlates negatively with employment growth once age is accounted for. In fact, small mature businesses in the U.S. have on average negative net job creation. The high average employment growth at young businesses compared to older ones has been confirmed for a large set of developing economies by Ayyagari et al. (2014), for Cote d'Ivoire by Klapper and Richmond (2011) and for OECD countries by an OECD (2017) study, though

entrepreneurs.

[5]More recent references are Neumark et al. (2011) for the U.S.; Baldwin and Picot (1995) for Canada; Broersma and Gautier (1997) for the Netherlands; Barnes and Haskel (2002) for the UK; Yasuda (2005) for Japan; and Fariñas and Moreno (2000) for Spain.

these studies do not conduct full distribution accounting.

Our study covers the 30 years between 1982 and 2012 for Colombia and a slightly shorter period for the US. We limit our attention to employer establishments in the manufacturing sector, given data constraints for Colombia. These constraints also imply that, for the most part, we abstract from micro employers, by limiting our study to units of 10 or more employees.[6] In this respect, our study is neither about the businesses without employees or micro employer businesses. However, we do incorporate information on the latter establishments whenever possible, and show that their prevalence is one of the most salient differences between manufacturing in the two countries.

The paper is divided into 5 sections, including this introduction. Section 2 provides a conceptual framework, by placing this study in the context of the literature and of related policy discussions. Section 3 discusses data and measurement issues. Section 4 presents our results, first on establishment growth by age (4.1.); second on the contribution of different cohorts to aggregate growth (4.2); then on how age growth patterns differ from size growth patterns (4.3) and on the evolution of these patterns over time (4.4.), and finally on the size-age distribution of plants (4.5). Conclusions are presented in Section 5.

2 Conceptual Underpinnings and Existing Evidence

Existing evidence shows substantial dispersion in productivity, size, and growth rates across firms within narrowly defined industries (see Syverson 2011 for a survey).

[6] Informal establishments of at least this size, however, are in principle included in the data.

These features of the data are captured by heterogeneous firm dynamic models, and models of creative destruction, which in turn show that job and productivity growth at the aggregate level are connected through ongoing reallocation dynamics.[7] High productivity businesses should be either large or becoming large through expansion, with entry and exit reinforcing these dynamics.

The different sources and consequences of business heterogeneity are likely reinforced for business entry. Young businesses face inherent uncertainty over a number of dimensions: at entry, their productivity, demand, costs and managerial ability are poorly observed by managers and owners. Moreover, uncertainty about demand is likely enhanced by not having yet built up a customer base (as in Foster, Haltiwanger and Syverson, 2016, and Drozd and Nasal, 2012). These factors imply that young businesses are likely to be small and exhibit especially high dispersion in productivity and growth dynamics. At the same time, selection and learning dynamics of young businesses enhance the contribution of overall entry and exit to productivity growth (Jovanovic, 1982, Arkolakis, 2016) and the post-entry dynamics of these businesses are likely crucial determinants of aggregate growth (HK).

Recent evidence from HJM confirms that young businesses are crucial drivers of aggregate employment growth in the data. In addition, HJM also point at particularly marked heterogeneity among young businesses. They find evidence that young businesses exhibit an "up or out" dynamic – that is, they face a high probability of exit but conditional on survival they have higher net growth rates than their more mature counterparts. As a consequence, highly dynamic young businesses are crucial

[7] E.g. Hopenhayn, 1992; Ericson and Pakes, 1994; Caballero and Hammour, 1994; Mortensen and Pissarides, 1994; Aghion and Howitt, 2006; Arkolakis, 2016.

drivers of aggregate growth.

The work by HJM further suggests that the job creating prowess of small businesses in the U.S. that is widely cited by U.S. policymakers is best interpreted as reflecting the dynamics of small startups and young businesses. Small businesses do exhibit higher net growth rates as a proportion of initial size than larger businesses (consistent with for example, Neumark et al. 2011; Arkolakis, 2016; and Arkolakis et al. 2018), but this is partly accounted for by transitory dynamics and associated regression to the mean effects. To mitigate such effects, HJM concentrate on growth rates as a proportion of average (current and prior period) size. While under this metric small businesses still exhibit higher growth, this is being driven by the contribution of young businesses, which tend to be small.[8]

The finding that high growth among small businesses is actually driven by a few of them (the young) is also consistent with findings by Hurst and Pugsley (2012) showing that the median young or small business in the US does not grow, does not invest in innovation, and in fact does not even pursue growth; its owners frequently started it for non-pecuniary reasons. As far as businesses without employees, Schoar (2010) highlights that most self-employed individuals in developing economies are "subsistence" entrepreneurs that are inherently small-scale and informal (and as such unlikely to hire few if any workers). The characterization of small businesses that emerges is one where units that are both small and young are businesses yet to

[8] Arkolakis' (2016) integrated model of firm growth delivers the prediction that growth rates decline with size both unconditionally and conditionally when growth is measured as a proportion of initial size, but not when measured as a proportion of average size. The mechanism behind the size-growth relationship relies on a marginal cost of adding costumers that increases with initial size.

grow that exhibit healthy growth on average but also a high probability of failure or stagnation. The fast growing among them will drive aggregate employment growth and many will die, while the rest of the small—especially the old ones– are typically not growing or even contracting.

This discussion helps provide perspective for how and why distortions that impact startups and post-entry growth dynamics may impact job and productivity growth. At the core is the idea that such distortions impact allocative efficiency (see, e.g., Hopenhayn and Rogerson (1993), Banerjee and Duflo (2003), Restuccia and Rogerson (2008), Hsieh and Klenow (2009, 2014) and Bartelsman et. al. (2013)), and also the incentives to invest in future growth at the firm level (HK, 2014). For present purposes, distortions of particular interest and relevance are those that impinge on the startup and post-entry growth dynamic margins. Hsieh and Klenow (2014) estimate that distortions to profitability in Mexico and India may explain the flatter patterns of growth over the life cycle that the manufacturing industries of these countries exhibit relative to those of the U.S.

We contribute to this growing literature by characterizing the contribution of high- and low-growth young businesses to overall job growth for the manufacturing industry in a middle-income economy, and contrasting such patterns for those for the United States. We take advantage of the highly detailed data available for Colombia to analyze the connection between age, size, and growth at the micro level, characterizing the full distribution of growth and not only its mean.

3 Data and measurement

For Colombia, we use mostly data on plant employment and employment growth from the Colombian Annual Manufacturing Survey. The survey covers all manufacturing establishments belonging to firms that own at least one plant with 10 or more employees, or those with production above a level close to US$100,000. The unit of observation in the survey is the establishment (denominated plant or establishment interchangeably). An establishment is a specific physical location where production occurs. Establishments have a unique ID that allows us to follow them over time.[9] Since a plant's ID is not modified with changes in ownership, such changes are not mistakenly labeled as births and deaths. We have contrasted some of our results against those obtained at the firm—rather than establishment—level, taking advantage of firm tax identifiers for the different establishments. Results show very little variation at this level for Colombia, as a result of the fact that the overwhelming majority (over 90%) of establishments are associated to single-establishment firm tax IDs.

Importantly for this study, plants report their initial year of operation. We use that information to calculate an establishment's age in each year of our sample.[10] We note that having this direct measure of the initial year of operation overcomes the problems that would arise if we used the first period of in-sample presence to

[9] There have been some changes in the coding of plant IDs over time. The last of those changes occurred in 1992-1993. As a result, we are unable to follow some plants over the 1991-1993 period, and may overestimate the impact of exit in that period. However, our results for the pooled data are generally robust to restricting the analysis to 1993-2012.

[10] The reported initial year is in general consistent over time for any given plant. In the few cases in which we do observe jumps in this report, or missing values, we fix the initial year of operation of the plant at the smallest non-missing value reported by the plant over our sample years.

characterize birth, given the minimum size threshold. From here on when we talk about an establishment's age at a given year t we refer to the difference between that year t and the establishment's initial year of operation.

This source of data offers great advantages to study growth over the life cycle of a manufacturing plant, the most important being the possibility of following each individual plant over time, and for a long period. This is in contrast to studies characterizing the life cycle of plants from cross sectional data, where cross sectional size differences between establishments at different ages, or at best short term growth differences for different cohorts, must be used to infer true life cycle growth (e.g. Hsieh and Klenow, 2014; Ayagari et al. 2017). Cross-sectional estimates implies biases from selection and from the relatively weight that large establishments have in the most recent cohort of plants, as discussed in detail below.

However, it is clearly the case that, given the exclusion of micro businesses from this baseline dataset, we are only looking at a fraction of the economy: micro businesses (i.e. those with less than 10 employees and production below a given level) represent more than half the employment in the country across sectors and in manufacturing. We use complementary information to provide a more complete picture of the manufacturing sector. In particular, we use data from the Colombian Survey of Microestablishments from 2000 to 2007 to estimate cross-sectional life cycle growth including establishments of all sizes. The Survey of Microestablishments is a sample of establishments intended to be representative of these establishments in the country. Among other dimensions, it records employment by broad establishment age categories. We also use data from the 2005 Colombian Census to provide a full

characterization of the size distribution.

A related issue is the fact that the exclusion of micro-establishments in most of our analysis may lead to an exclusion of informality, which is a prevalent phenomenon in Colombia–as in the rest of Latin America–. But it need not be the case that we exclude informality. On the one hand, informal employment in Colombia and many countries is present not only in micro establishments but also in firms of much larger sizes, including some that pay taxes and contributions for a fraction of their revenue and employees (Ulyssea, forth; Eslava, Haltiwanger, Kugler and Kugler,2013). On the other hand, even "business informality", where a business as a whole is classified as either formal or informal based, for instance, on formal registration, may be partly captured in our data. This is so because the sample frame used to include plants in the Manufacturing Survey is not a formal business registry, but a combination of such registries with previous censuses and other sources, from the phone book to in-person inspections. We assess the presence of unregistered firms in our sample by calculating the fraction of firms in it that are not present in the merchants registry. Registration in the merchants registry is mandatory–though the mandate is only partially enforced–, and necessary, for instance, to get into contracts with government. We focus on the most recent part of our sample, starting on 2004, to minimize potential biases from low quality recording in years where systems were less reliable and extended.[11] We find that 20% of plants in our sample belong to firms that are not tied to the merchants registry. These are smaller and less productive than those registered. The non-negligible presence of unregistered firms in

[11] We conduct this check only up to 2009, as we do not have access to the common identifiers for later years.

our sample suggests that we do partially capture business informality. We also note that, although informality is clearly a non-negligible phenomenon in Colombia, it has not increased markedly over our period of study (Mondragón and Peña, 2010), and actually started to decrease in the 2010s.

Our imposed exclusion of micro-establishments that remain micro throughout their life cycle, by leaving out of the picture survival entrepreneurship, arguably also brings the advantage—in light of the objective of characterizing sources of growth–of focusing attention on businesses that have growth potential. The literature surveyed above has documented that micro establishments are typically neither high growers nor high contributors to aggregate growth, and exhibit extremely high exit rates. We also note that establishments born micro, but that eventually cross the 10-employee threshold, make it into our baseline sample starting at the time when they reach that milestone. And, we do know their correct age at each point in which we do observe them. As a result, the contribution of those micro establishments that end up constituting a source of growth is captured by our calculations as soon as they cross the 10 employee threshold (or the revenue threshold).

To produce statistics for the U.S. we rely on publicly available tabulations of employment by sector, size, and age, from the Business Dynamic Statistics (BDS). The BDS covers all employer businesses in the US' business registry. When comparing with statistics for Colombia, we either make an effort to include micro-establishments for both countries or, when this is not possible, restrict calculations to establishments with 10 or more employees. Notice that the BDS only covers formal businesses, but this is much less of a problem for the US than it would be for Colombia given the

low prevalence of informality in the former.

4 Growth over the life cycle

4.1 Micro-level patterns of growth for different ages

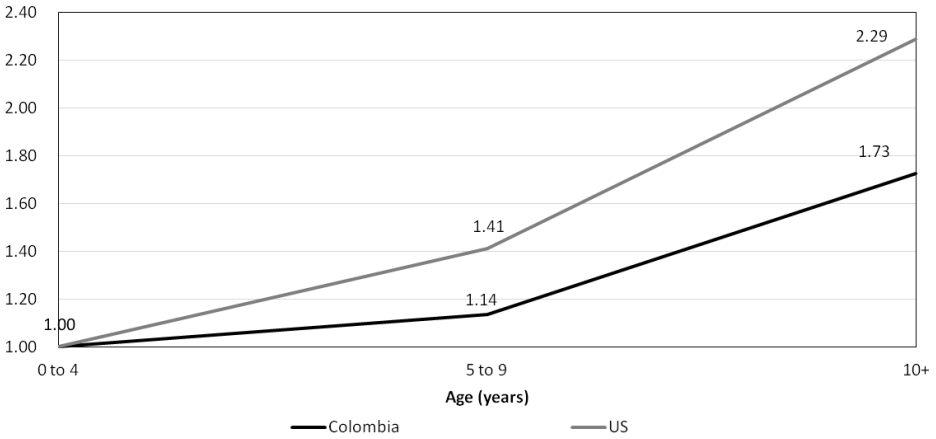
We begin our empirical analysis by characterizing employment by age in the cross section (as in HK, 2014, Figure 1). Figure 1 shows the ratio of average employment at a given age and average employment at birth, for different ages, for Colombian and U.S. plants ("birth" size is average size at the first age category). The U.S. figures are obtained from the Business Dynamic Statistics (BDS). For Colombia, average size for a size category is the weighted average between average size for establishments of 10+ employees, from the Annual Manufacturing Survey, and average size for establishments below that threshold, from the Survey of Microestablishments. The weight for each category is the corresponding weight in the establishment size distribution from the 2005 Census.[12]

The first, perhaps not surprising fact, that emerges is that younger establishments are smaller on average than older ones. This is consistent with patterns of learning and selection (as in Jovanovic's 1982 model). Of greater interest is the finding that Colombian plants grow at a slower pace than U.S. plants. We find that the ratio of average employment at age 10+ compared to average employment at birth is about 2.3 for the U.S. and 1.7 for Colombia. This is clearly reminiscent of HK's finding that

[12] 87% for 0-9 employees, 13% for 10+, see Table 3. In calculating average employment at establishments of 10+ employees we exclude from the AMS establishments that enter the survey with less than 10 employees because they reach the alternative revenue threshold.

the growth of plants in Mexico and India is slower than that for their counterparts in the U.S., though the difference with respect to the U.S. is much less marked for Colombia than for India, and even a little less intense that for Mexico. [13]

Figure 1: Employment over the life cycle of manufacturing plants
Colombia vs. USA, 2002-2012
Average employment for plants of a given age over average employment for plants aged 0-4



Source: Own calculations from AMS and Survey of Microestablishments for Colombia, and BDS for the U.S. The figure presentes the ratio of the average employment at a given age category and the average at "0-4 years" category. For Colombia average employment at a given age is the weighted average between the corresponding figures for plants with 10+ employees in the AMS and plants with less than 10 employees in the Survey of Microestablishments. Each category (10- or 10+ employees) is weighted by its corresponding weight in the total number of establishments from the 2005 Colombian Census (Table 3, Panel A). For US, age category "5 to 9" and "10+" are actually "5 to 10" and "11+"

Cross sectional life cycle growth rates, such as those in Figure 1, are a biased estimate of actual growth over a single business' life cycle, given selection of better businesses into older ages. In particular, employment at age a is normalized by average employment at birth, which includes employment by businesses which will not

[13] A key figure from Hsieh-Klenow is that the average 40 year-old plant in the U.S. is eight times as large as a startup, while the corresponding ratio is two for Mexico and zero for India. The Hsieh-Klenow statistic is based on the economic census for U.S. manufacturing while our statistics from the U.S. are from the BDS.

survive to age a. In the remaining of this paper we focus on plant-level longitudinal estimates of growth.

Figure 2 depicts average actual plant life cycle growth for Colombia (grey line), where a plant's growth is calculated by dividing its employment at a given age by its own employment at birth (0-5), and contrasts it with cross sectional growth.[14] Figure 2 is based solely on Annual Manufacturing Survey data (and therefore excludes micro-establishments), since it is in this database that we can follow longitudinally a plant over its life cycle. Longitudinal growth for U.S. is not available. Figure 2 displays more detailed age categories to take greater advantage of the richness of the data, since in Figure 2 we are no longer constrained to categories dictated by the comparison with the U.S. or the Colombian Survey of Microestablishments.

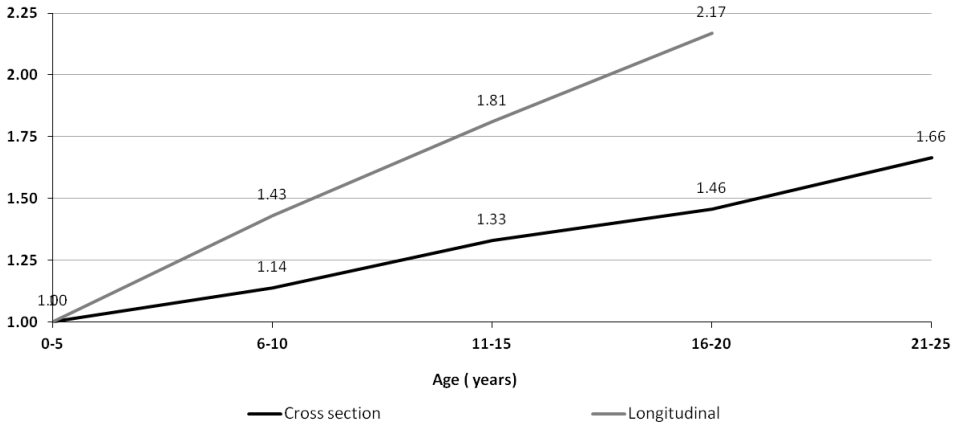
In comparing Figure 1 and 2, it is striking that the cross-sectional life cycle patterns are so similar with (Figure 1) or without (Figure 2) the inclusion of micro businesses. It is important to remember that the reported ratios at a given age are conditional of survival to that age. We draw the inference that micro businesses exhibit low survival rates and those that do survive for an extended period are likely to transit to non-micro businesses (and hence we capture them in both Figure 1 and 2). High turnover by microbusinesses in countries similar to Colombia is documented, for example, by Levy (2018) for Mexico.

Longitudinal growth is faster than that estimated from cross-sectional data: the

[14] For plants which we do not observe from birth, we calculate life cycle growth to age t as $\frac{L_{it}}{L_{iB}} * \overline{\left(\frac{L_{jB}}{L_{j0}}\right)}$, where B is the age at which we first observe plant i and the adjustment factor $\overline{\left(\frac{L_{jB}}{L_{j0}}\right)}$ is average growth from actual birth to age B for the sample of plants we do observe from birth. If we constrain ourselves to that sample we can only estimate growth up to age 15, but the finding that this growth is faster than in the cross section holds.

average plant has doubled its own size by age 16, while in the cross section average employment at age 16 is only 1.5 times that observed at birth. The differences between the two approaches reflect the larger weight that cross-sectional comparisons give to plants born larger, which results in the dampened cross-sectional dynamics relative to the longitudinal analogue, counteracting the selection bias that could work in the opposite direction.[15]

Figure 2: Employment over the life cycle of non-micro manufacturing plants: longitudinal vs. cross-sectional Colombia 2002-2012



Source: Own calculations from AMS. Cross section *current to initial employment* (black line) is calculated as the ratio of the average employment at a given age category and the average at the "0-5 years" category (analogous to the Colombia line in Figure 1). Longitudinal *current to initial employment* (grey line) is calculated as the average of the ratio of a plant's employment at a given age category and the plant's own employment at birth.

[15]

$$\frac{\overline{L_{age}}}{\overline{L_0}} = \frac{\sum_{i=1}^{N_{age}} L_{i,age}}{\sum_{i=1}^{N_0} L_{i,0}} = \frac{\sum_{i=1}^{N_{age}} \frac{L_{i,age}}{L_{i,0}} * L_{i,0}}{\sum_{i=1}^{N_0} L_{i,0}} = \sum_{i=1}^{N_{age}} \frac{L_{i,age}}{L_{i,0}} \frac{L_{i,0}}{\sum_{i=1}^{N_0} L_{i,0}}$$

The higher weight to establishments born larger counteracts the upward bias in cross sectional estimates of life cycle growth that emerge from dividing average survivor size at age t by average size at birth including just-born plants that will not survive to age t.

To deepen our understanding of growth over the life cycle, we document growth-age and growth-size relationships in Figure 3. From this point onwards, and unless explicitly noted, we focus attention for Colombia on data from the AMS, with the implication that we look exclusively at non-micro establishments. When comparing to U.S. data we constraint both datasets to be comparable when this is possible.

Growth rates in Figure 3 are calculated using the average employment between t and t-1 as a denominator (as in HJM), and deviated from the overall mean.[16] Following Colombian legal standards, slightly adjusted to obtain size categories comparable with those available for the US, small plants are defined as those with 10 to 49 employees, medium ones have between 50 and 249 employees, and large plants have 250 or more employees. The figure classifies plants into size classes based on average employment at the plant between t and t-1.

Focusing first on patterns pooling over plant sizes, shown in the left-most set of bars of each panel of Figure 3, average annual net growth rates for surviving plants fall markedly over the life cycle. This is the case independently of whether

[16] Davis, Haltiwanger and Schuh (1996) explain the advantages of these symmetric growth rates. An important one is that growth rates calculated as fraction of initial size are mechanically larger for initially small establishments. The use of this traditional approach partly explains why an early literature starting with Birch, 1981, consistently found that small businesses exhibited high growth over a range of countries (see Neumark et al., 2011; Baldwin and Picot, 1995; Broersma and Gautier, 1997; Barnes and Haskel, 2002; Yasuda, 2005; Fariñas and Moreno, 2000). Arkolakis (2016) and Arkolakis et al (2018) develop models that imply that small businesses indeed grow faster in relation to their initial size, but not necessarily in relation to average initial-final size. In Arkolakis (2016) model of firms reaching an increasingly large costumer base, growth rates decrease with initial size because the marginal cost of adding a costumer is increasing in initial size, so that any percentage change in underlying productivity has a greater impact on the costumer base of initially smaller firms. His calibrations yield an increase relationship between growth and average (initial-final) size. Arkolakis et al (2018) show that a negative relationship of growth to initial size may emerge in the context of learning, because smaller firms are also closer to the exit threshold and therefore benefit more from growth when there is uncertainty.

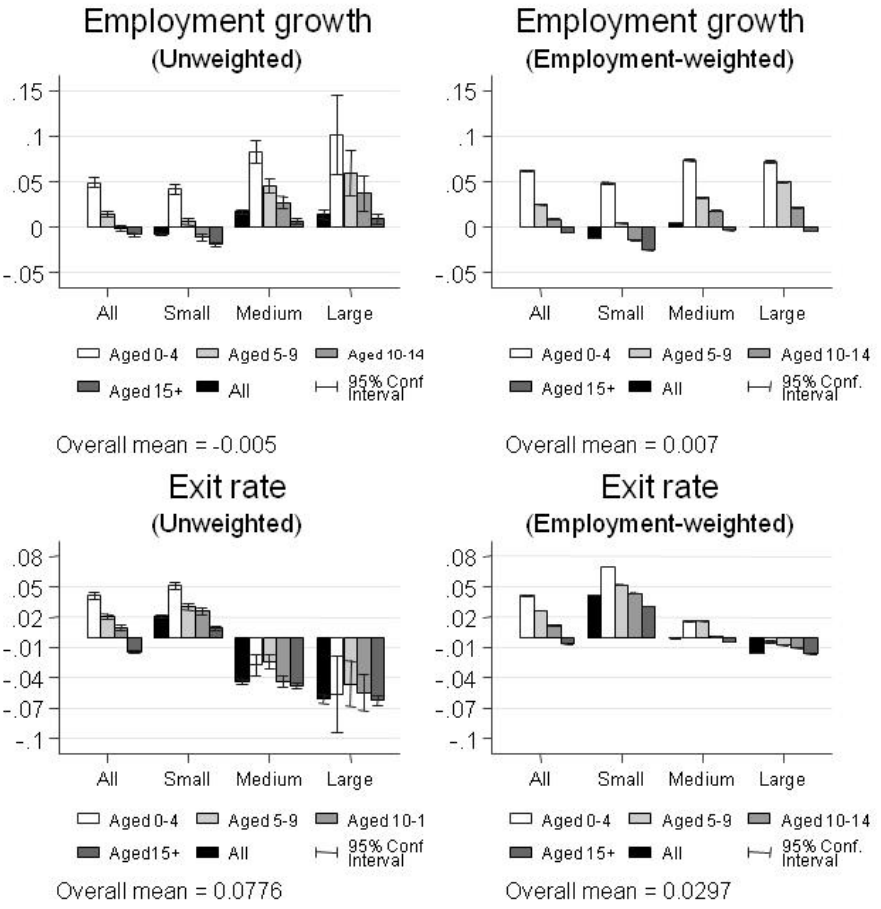
unweighted or weighted figures are considered. On a weighted basis, employment in the category of plants aged 0-4 grows at a mean rate 6 percentage point above the overall mean rate, while plants aged 15 years or older grow below average. A main inference, recurrent in our exercises, is that net growth is highest among the youngest establishments.

Figure 4 compares the employment-weighted growth rates and exit rates for different ages against those for comparable U.S. data. The latter are constructed from the public domain Business Dynamic Statistics (BDS) from the U.S. Census Bureau. For comparability between the two sources, we use data only for manufacturing plants with 10 or more employees in both cases, and limit the period of analysis to 1992-2012 (which explains the slight changes for Colombia with respect to Figure 3). The numbers displayed correspond to differences with respect to the respective mean growth rate, which is also shown, below each picture.

Younger continuing U.S. plants grow at a larger mean rate than older ones, as previously documented by HJM, and as Figure 2 had already documented for Colombia. Cross-age differences, however, are more marked for the US. While in Colombia only plants above 15 years grow below average, in the US below-mean growth is observed for all plants older than ten. Moreover, the range between the youngest and oldest categories is about 8 percentage points in Colombia but 9 percentage points in the US.

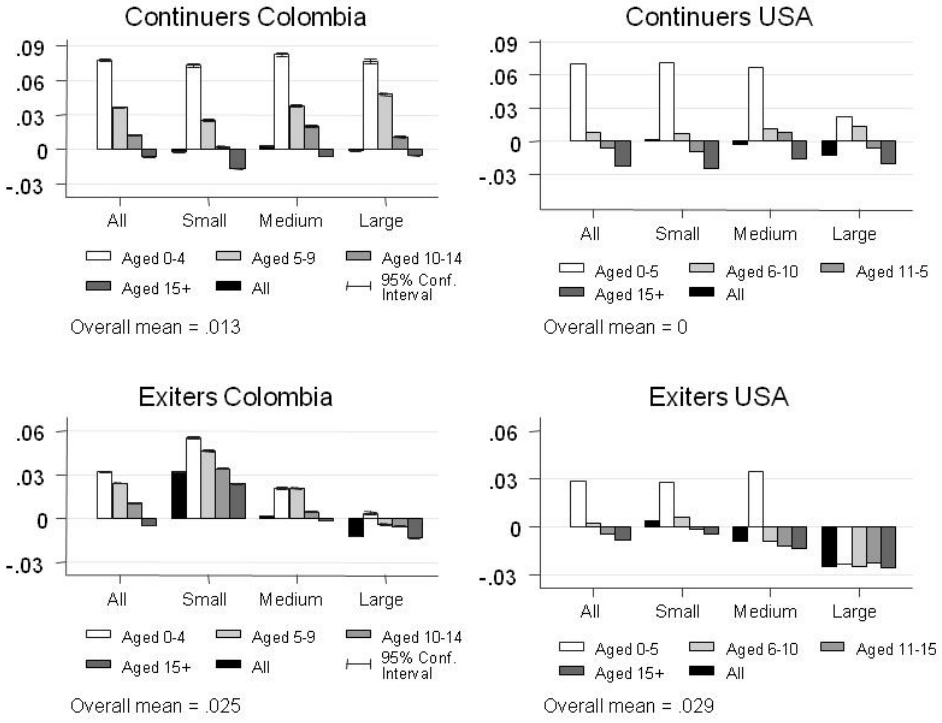
The less decreasing pattern of growth over the life cycle in Colombia is not driven by the typical plant (i.e. the plant at the median). Rather, evidence suggests it reflects a relative deficit of high-growth entrepreneurship and more generally a less

Figure 3: Employment growth rates for continuers and exit rate by age and size (1982-2012)
Deviated from mean



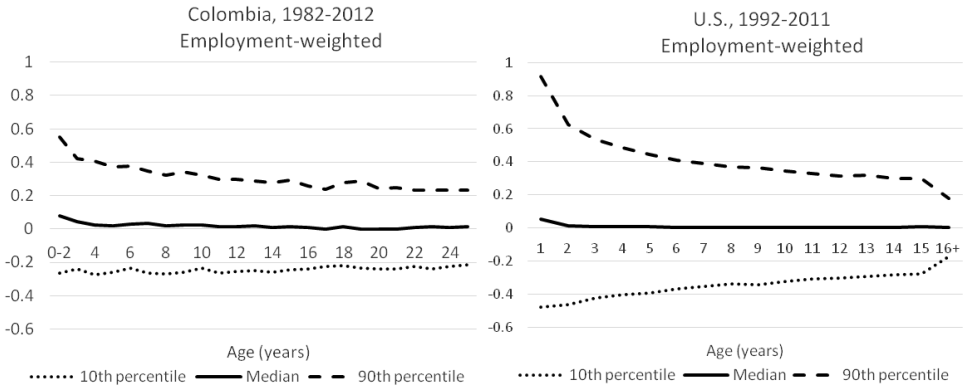
Upper panel: employment-weighted average of $2(L_{it}-L_{it-1})/(L_{it}+L_{it-1})$. Lower panel: employment-weighted average of exit rates. All bars are deviated from overall mean. CI calculated in a linear regression environment. Size categories: Small: L<50; Medium: 50≤L<250; Large: L≥250. Own calculations from AMS.

Figure 4: Employment growth rates for continuers and exit rate
by age and size, Colombia vs. USA
1992-2012 – Employment-weighted – Deviated from mean



Upper panel: employment-weighted average of $2(L_{it}-L_{it-1})/(L_{it}+L_{it-1})$. Lower panel: employment-weighted average of exit rates. All bars are deviated from overall mean. CI calculated in a linear regression environment for Colombia. Size categories: Small: L<50; Medium: 50≤L<250; Large: L≥250. Own calculations from AMS for Colombia, and BDS for the U.S. No microdata available for U.S.. Sizes categories: For comparability, plants with less than 10 employees are not included.

Figure 5: Distribution of employment growth rates for continuers
Colombia 1982-2012 vs. U.S. 1992-2012



Source: U.S.: tabulations from Figure 2 of Decker et al. (2014). Colombia: own calculation from AMS. Appropriate caution is need in comparing left and right panels since figure for Colombia is for continuing manufacturing establishments while for the U.S. is for continuing firms (any sector).

skewed growth distribution for recent entries (Figure 5, which must be taken with caution because we are depicting the US distribution, from Decker et al. (2014), only for firms, rather than plants, and in all sectors). Though in both countries a young business in the 90th percentile of the employment growth distribution is much faster-growing than the median and that one in the 10th percentile, the Colombian 90th percentile business does not exhibit the spectacular growth that young superstars display in the U.S. The 90th-50th and 90th-10th ranges in the U.S. almost double those in Colombia for ages one to five.[17]

Back to Figure 4, exit rates also decline markedly with age in both the Colombian and the US data, but differences between young and older establishments are, once again, more marked in the U.S. Most noticeable, despite average exit rates being

[17]Appropriate caution is needed in comparing Colombia and U.S. patterns in Figure 5. Figure for the U.S. is for continuing firms in the private sector (drawn from Figure 2 of Decker et. al. (2014)) while Figure for Colombia is for continuing manufacturing establishments. All of the other comparisons in the paper are from comparable establishment-level data in the two countries.

similar, in the U.S. only establishments younger than five years exhibit job destruction from exit clearly above the mean, while in Colombia it is only establishments older than 15 years that are below the mean, and only slightly. The fact that a much higher proportion of job destruction concentrates among startups in the US than in Colombia implies more selection in the former. A related fact is the much flatter profile of the 10th percentile of employment growth over age in Colombia than in the U.S. (Figure 5).

As mentioned, growth is also particularly heterogeneous among young plants, by contrast to old ones (Figure 5). The bulk of the aggregate and average growth difference between young and old plants is concentrated in the highest percentiles. That is, it is the fastest growers among the young that drive most of the more rapid aggregate growth in plants' early ages. The 90th percentile decreases rapidly with age, while the 10th one is not that different across age categories. This is true for both countries. The decreasing 90th-10th gap over the life cycle compared to a relatively flat 50th percentile highlights that young businesses exhibit both more disperse and more skewed growth that older ones.

Taken together these findings indicate that, while U.S. young manufacturing plants display a very marked pattern of what HJM (2013) denominate an "up or out" dynamic, Colombian young manufacturing plants show the same qualitative pattern but a more muted difference with respect to older businesses. There seems to be both a shortage of truly high growth entrepreneurship and less cleansing selection at early ages in Colombia as compared to the U.S.

Interestingly, despite the potential greater presence of barriers to the growth of

young businesses in the Colombian economy, in many respects the growth patterns we have illustrated are similar between the two countries. Similarities include higher growth among young continuing business than for their older counterparts, but with high heterogeneity especially in the young age categories, and the fact that the fastest growing ones among the young plants are main drivers of employment growth in that age category.

HJM have shown that in the U.S. patterns of growth over the life cycle and across size categories vary widely if computed at the firm rather than the establishment level, as firms replace underperforming plants by new establishments. We note that in the Colombian data, by contrast, our results are virtually identical if we focus on firms rather than plants. This likely stems from the fact that only about 7 percent of establishments and 16 percent of employment in the Colombian data are accounted for by multi-plant firms. In the U.S. manufacturing sector, meanwhile, multi-units are about 80 percent of employment.[18]

[18] Establishments are linked to their parent firms in Colombia through firm IDs based on taxpaying unity. In the U.S., the concept of a firm uses a broader notion of common operational control based on the Economic Censuses and the Company Organization Survey. These surveys inquire about company ownership and control based on voting stock as well as having the direction of management and policies. Unfortunately, such information is not available for the Colombian case, so our definitions of firm are not fully comparable. When working at the firm level, we compute firm size by adding up the employment of all establishments belonging to the same firm. For firm age, we follow the procedure used by HJM, whereby a firm is assigned the age of its oldest establishment when we first observe it, and then allowed to age independent of ownership and other organizational changes. We also follow HJM in constructing firm growth, so that firm growth only represents organic growth: we avoid the overstated job creation and destruction figures that could appear at the firm level when acquisitions are counted as job creation by the acquiring firm and job destruction by the selling firm. For this purpose, the growth of any acquired establishment is assigned to the acquiring firm. Our inability to identify parent firms that do not share tax codes with their affiliated establishments may also account for our inability to establish differential patterns of growth between firms and plants.

4.2 Contribution to aggregates in the medium run

We have documented that younger businesses in our sample grow faster than older ones. But also that young businesses are also generally smaller and their high average growth rate hides a fair degree of heterogeneity. Do small size, high exit rates and a relatively small number of very fast growing plants imply that young businesses do little in terms of generating aggregate employment over longer periods of time?[19]

We tackle this question in Table 1 for Colombia and Table 2 for the U.S.. For specific years of our sample (1982, 1985, and so on), these tables decompose aggregate employment in the AMS into the contribution of establishments of different birth cohorts. A cohort is defined by the year reported by the plant as its initial year of operation. Thus, for instance, the 5th row of Table 1 shows that around half of the employment covered by the Survey in 1994 corresponded to workers in plants born before 1970. Since the AMS is a survey of all non-micro manufacturing establishments, aggregate AMS numbers correspond to aggregate manufacturing employment excluding micro establishments and self-employment. We build the analogous figures for the U.S. from the BDS.

We note that monitoring efforts in the Colombian AMS were somewhat weaker before 1993, so that we have less confidence in aggregate figures for that earlier period. We call the attention to these weaker numbers for pre-1993 by using italics in Table 1 for that period.

[19]Notice that our employment-weighted statistics in Figures 2 and 4 do not get at contribution of categories to aggregate employment growth, as weighting is done within age categories.

Table 1: Employment in Colombian Manufacturing Establishments: Cohort analysis

	Cohort: Establishment's initial year of operation										
Year	*before 1970*	*1970 to 1977*	*1978 to 1982*	*1983 to 1987*	*1988 to 1992*	*1993 to 1997*	*1998 to 2002*	*2003 to 2007*	*2008 to 2012*	*Total*	*Pre-1983/ Total*
1982	*341690*	*101672*	*45661*	*0*	*0*	*0*	*0*	*0*	*0*	*489023*	*1.00*
1985	*292866*	*89329*	*50315*	*14261*	*0*	*0*	*0*	*0*	*0*	*446771*	*0.97*
1988	*289361*	*95801*	*56580*	*38605*	*2615*	*0*	*0*	*0*	*0*	*482962*	*0.91*
1991	*285742*	*97333*	*57214*	*44355*	*11828*	*0*	*0*	*0*	*0*	*496472*	*0.89*
1994	342,710	115,044	81,020	73,294	39,095	3,052	0	0	0	654,215	0.82
1997	303,521	99,601	75,635	73,352	50,407	28,130	0	0	0	630,646	0.76
2000	240,128	85,495	61,695	63,024	43,893	32,858	7,574	0	0	534,667	0.72
2003	217,395	82,483	59,881	67,893	51,739	44,255	21,034	1,217	0	545,897	0.66
2006	232,230	89,288	65,035	80,186	58,675	60,158	32,795	6,861	0	625,228	0.62
2009	221,165	81,120	62,723	77,628	60,524	64,807	47,755	31,289	8,745	655,756	0.56
2012	218,391	81,244	62,288	81,441	59,929	70,486	53,834	44,854	22,334	694,801	0.52
2012-1994	-124,319	-33,800	-18,732	8,147	20,834	67,434	53,834	44,854	22,334	40,586	

Source: Own calculation from AMS.

It is in general the case, for any of the years reported in these tables, that most of the employment is concentrated in plants born before the eighties. For Colombia, less than 5% of employment in any given year is represented by plants born in the previous three years. This large weight of older establishments in total employment reflects the fact that older establishments are on average larger, reinforced by the fact that some plants only outgrow the micro category, and thus enter the survey, a few years after they are born.[20] Startups are similarly unimportant for overall employment (at non-micros) at any point in time in the U.S.

Interestingly, despite young plants representing only a small share of total employment at any point, they contribute the bulk of net employment creation over the 31 year horizon covered by Table 1. Something similar can be stated about the period covered in Table 2 for the U.S. The fraction of jobs represented by the pre-

[20] About a third of all plants that enter the survey are there from birth

Table 2. Cohort Analysis for US Manufacturing Establishment

Total Employment									
Cohort: Establishment's initial year of operation									
Year	before 1980	1980 to 1984	1985 to 1989	1990 to 1994	1995 to 1999	2001 to 2004	2005	Total	Fraction represented by pre-1980 cohort
1990	13,055,792	2,484,685	2,917,997	437,632				18,896,106	0.69
1995	10,957,296	2,186,146	2,532,780	2,213,024	377,085			18,266,331	0.60
2000	9,375,911	1,969,784	2,298,840	1,937,785	2,018,236	430,662		18,031,218	0.52
2005	6,838,438	1,486,619	1,683,964	1,453,381	1,468,927	1,597,354	298,168	14,826,851	0.46
2005-1990	-6,217,354	-998,066	-1,234,033	1,015,749	1,468,927	1,597,354	298,168	-4,069,255	-0.23

Source: Own calculation from BDS.

1980 cohorts, for instance, falls by about 25 percentage points in a fifteen-year span in both countries: from 90% in 1994 to 56% in 2009 in Colombia, and from 69% in 1990 to 46% in 2005 in the U.S. Everything else equal, non-micro manufacturing employment would have collapsed in both countries in the absence of entry.

In fact, a distinguishing feature of U.S. manufacturing is the collapse in manufacturing employment in the post-2000 period (Schott and Pierce, 2016). Over the 1990-2005 period, U.S. manufacturing lost over 4 million jobs. The pre-1985 cohorts lost even more – more than 7 million jobs. This loss of 7 million jobs is accompanied by the exit of about half of the establishments from the pre-1985 cohorts. Interestingly, during this period of massive contraction in aggregate manufacturing employment there was considerable entry of establishments, and the creation of about 3 million jobs by these establishments born after 1985 is more than driven by the post-1990 cohorts, as the 1985-1990 cohort also lost a considerable amount of jobs.

Though aggregate manufacturing employment growth in Colombia over recent decades has not been as critical as in the U.S., it has been slow, and "de-industrialization" is a commonly voiced concern in the country. The contribution of entry is as important as in the U.S. Total employment in the AMS grew by just over 40,000 jobs

between 1994 and 2012. This overall—quite modest—growth hides very diverging patterns by older and younger plants. Total employment by establishments born before 1982 shrank dramatically, by more than 170,000 jobs. Meanwhile, employment by plants born in the more recent years grew, and it did it sufficiently to overcome the contraction of employment at older establishments. The key message is that young establishments, despite being born small and representing a small share of non-micro businesses employment, are the key to employment growth over the medium run.

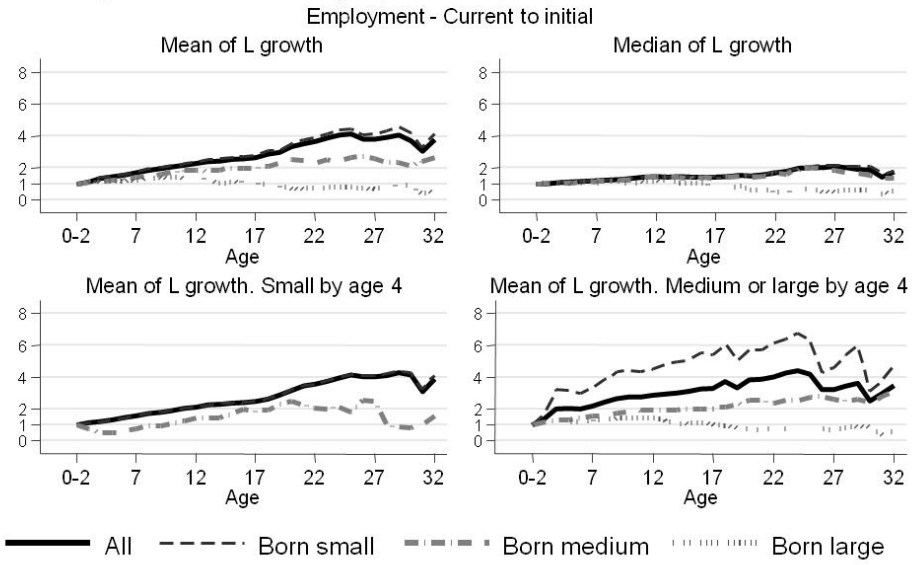
4.3 Age vs. size

Is age simply proxying for size in our above findings? Figures 3 and 4 indicate that the answer is no. Figure 3 shows that the finding that net growth for continuers declines with age is robust to holding size constant, so that the cross-age patterns emphasized in the past sections are not simply reflecting cross-size patterns. In fact, once we control for establishment age, net growth rates are higher for medium and large establishments than for small establishments. This finding, documented by HJM for the U.S., is confirmed in our Colombian data. Arkolakis et al (2018) show that the finding that growth decreases with age holding size constant may emerge in the context of a model with firm heterogeneity and selection, in the presence of learning about demand.

Overall, age is a more important determinant of a continuer's growth than size is and, controlling for age, large establishments grow faster than small ones. The latter statement, however, does not mean that small establishments are in general laggards. Average small startups do grow at a very healthy pace, as illustrated in

Figures 3 and 4. For a longer-run perspective, consider the lines of Figure 6 that show employment relative to birth level for plants born in different size categories. The dashed line corresponds to establishments born small, the dashed-dotted line to those born medium, and the dotted line to large-at-birth ones. On average, establishments born small grow more rapidly than those born medium or large, and those born large grow less rapidly than those in the other two categories, and they also exhibit greater heterogeneity, implying a much larger 90th-50th range than that observed for plants born larger. An implication is substantial long run convergence in size across plants born into different size categories.

Figure 6: Plant employment by age and initial size.



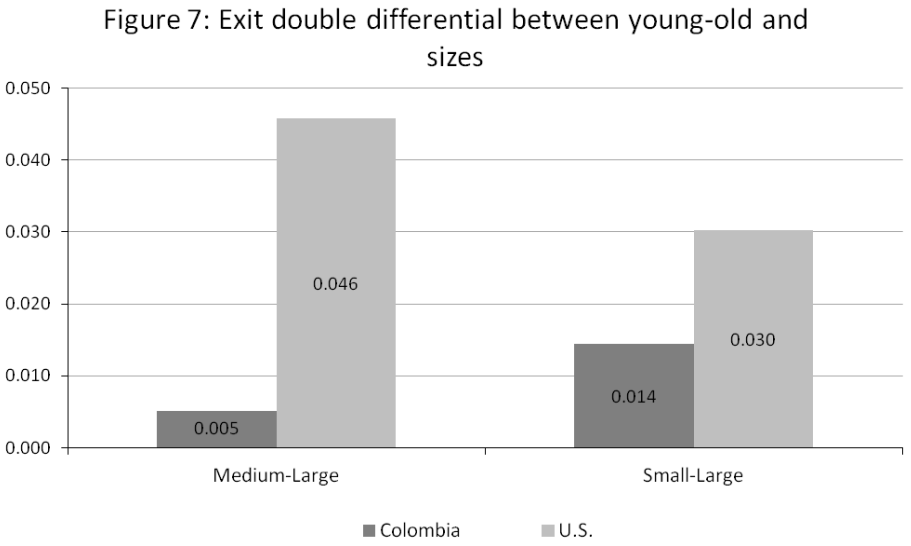
Source: Own calculation from AMS. Current to initial employment calculated as the ratio between employment at a given age and employment at birth. Lines depicts average of plants current to initial employment by size at birth. Sizes categories: Small: L<50; Medium: 50≤L<250; Large: L≥250.

Enormous heterogeneity hides behind these patterns of very dynamic growth by small startups. The upper right panel of Figure 6 shows the median of the

distribution of growth by size at birth. Median life cycle growth is much flatter than the mean of the same distribution, for all categories of size at birth. Most of the differences between the life cycle patterns of plants born small compared to those born larger come from plants that were born small but transited rapidly into the medium and large size classes (bottom panels). However, only 8% of establishments born small make this transition. Moreover, 35% of them exit the market by age four. Again, a sign of the weak presence of high-growth entrepreneurship.

On the other hand, selection at young plants is much more related to size in the U.S. compared to Colombia. Larger plants are less likely to exit in both countries compared to smaller and medium sized plants but the interaction of size and age related selection is much more pronounced in the U.S. Figure 7 depicts the difference in the young-old differential in exit rates between medium and large plants (this is a double difference) and small vs. large plants. For medium-large, this double differential is almost 5 percentage points in the U.S.,. but about zero in Colombia. The small-large differential is also larger in the U.S: 3 percent vs. 1.4 percent. Since size is a crude proxy for productivity, the closer size-exit relationship in the US, and its relationship to age, is a signal of more intensive selection of young less productive plants in the U.S. relative to Colombia. Less selection of young-small plants in Colombia suggests a higher probability that low productivity plants stay in business for a long time, a sign of sclerosis that we see reinforced in the size distribution of plants (see section 4.5). We do note an anomaly in the pattern of double-differenced exit rates highlighted above: the small-medium double difference is not larger for the US, given the very high exit rate for just-born plants in medium compared to small

plants in the U.S.



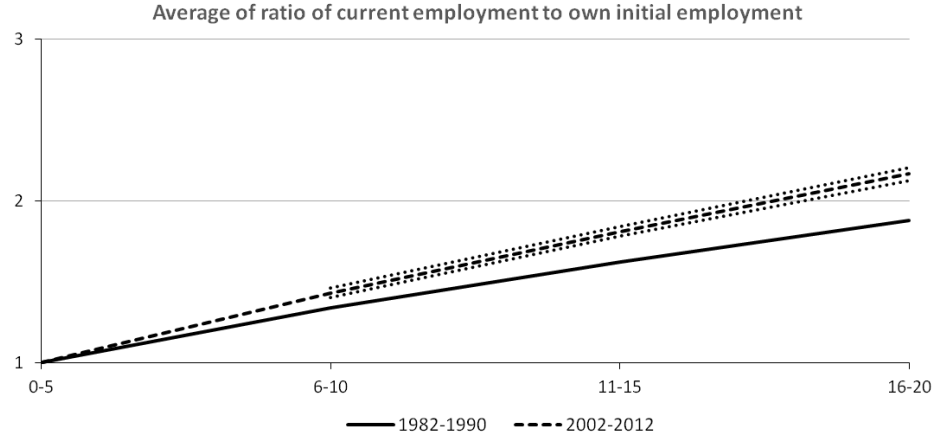
Source: AMS for Colombia and BDS for U.S. Authors' construction. Bars represent the double difference in exit rate between firms in the age categories "0 to 4" and "15+" and two given sizes, from Figure 4.

4.4 Evolution over time

There is some sensitivity of patterns of growth over the life cycle to the periods considered. Figure 8 shows that life cycle employment growth for plants in the AMS has been faster in the 2000s compared to the 1980s (the doted lines surrounding the dashed one correspond to the confidence interval for the difference in growth between the 1980s and the 2000s).[21] Though of course many changes occur in twenty years, the 1990s are an outstanding transition period characterized by large-scale structural

[21] Figure 8 is obtained by running a regression of life cycle growth for a plant against dummies for age intervals, alone and interacted with a post-2000s dummies. The 1990s transition period is excluded.

Figure 8: Employment over the life cycle of manufacturing plants
Colombia: 1980s vs. 2000s



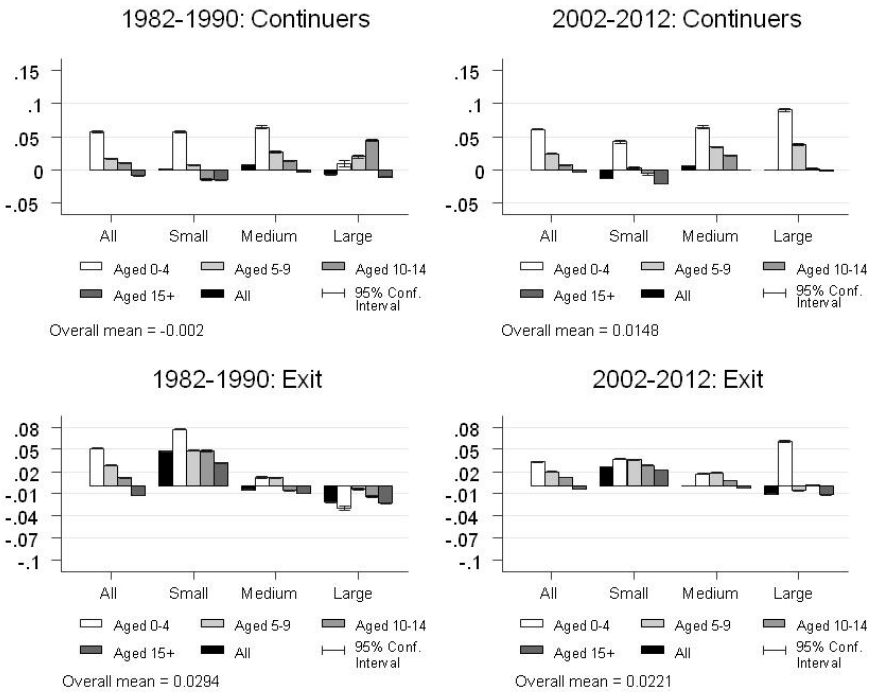
Confidence interval for the differences between 2002-2012 and 1982-1990 in dotted lines. Own calculation from AMS.

reforms. Figure 8 thus points in the direction, suggested by Hiseh and Klenow (2014) that better market institutions provide stimulus for high business growth.

Figure 9 further explores changes over time in growth patters by depicting annual growth for continuers and job destruction from exit for the two sub-periods. The higher life-cycle growth post 2000 in Figure 8 is reflected mainly in higher average annual continuer growth rates, which go from -0.2% in the 1980s to 1.5% in the 2000s, on a weighted basis. Up-or-out dynamics (i.e. both higher growth and higher exit for young relative to old establishments) are observed in both periods for all categories of size, except for large businesses. In this category, up-or-out dynamics are present, and indeed very marked, in the 2000s but not in the 1980s. These set of patterns are consistent with more high growth- high risk entrepreneurship in the 2000s than the 1980s.

Figure 9: Employment growth for continuers and exit rate
by age and size, 1980s vs. 2000s

Employment-weighted -- Deviated from mean



Upper panel: employment-weighted average of $2(L_{it}-L_{it-1})/(L_{it}+L_{it-1})$. Lower panel: employment-weighted average of exit rates. All bars are deviated from overall mean. CI calculated in a linear regression environment. Size categories: Small: L<50; Medium: 50≤L<250; Large: L≥250. Own calculations from the AMS.

4.5 Size-age distribution

Before closing, we zoom-out to go from these patterns of individual growth for non-micro plants to the overall size-age distribution that they end up determining. Table 3 presents the size-age distribution of plants in Colombia and the U.S. Since the Colombian Manufacturing Survey does not cover micro-establishments, whose high weight in both the population of establishments and employment in Latin American relative to developed countries is well known and therefore crucial for our understanding of the size-age distribution (e.g. Pagés, ed, 2010; Eslava, 2018), we complement the information in the AMS with data on micro-establishments from the establishments module of the 2005 Colombian Census.

According to the 2005 Colombian Census, 87% of establishments are micro-establishments and 32% of employment is employed in microestablishments.[22] We use these numbers to impute a share of establishments and employment represented by age-size categories for small, medium and large establishments. We impose that the relative weight of small vs. large or small vs. medium firms is as in the AMS and the absolute weights for these categories add to 13% of establishments and 68% of employment. We do not have information on the age distribution of the population of establishments below 10 employees, thus the empty cells in Table 4 for Colombia. All of the numbers for the U.S. are from the Business Dynamics Statistics.

The most outstanding feature of the size distribution is the extreme concentration of resources in smaller establishments, especially micro ones, in Colombia. While the

[22]These weights are similar across Latin America. Eslava (2018), for instance, reports that, according to household surveys, 36% of salaried manufacturing employment in Latin America concentrates in firms of 1-9 employees.

Table 3: Establishments and employment represented by different size as % of age categories (2005)

Colombia (AMS and contribution of micro from 2005 Census)

		Age categories					
		0 to 4	**5 to 10**	**11 to 15**	**16+**	**Total**	**Total level****
	Panel A: Establishments						
	Micro (1≤L<10)*	?	?	?	?	87%	41,065
Size (L)	**Small (10≤L<50)**	0.4%	1.0%	1.2%	4.8%	8%	3,519
	Medium (50 ≤ L<250)	0.1%	0.4%	0.5%	3.3%	4%	1,997
	Large (250 ≤ L)	0.0%	0.1%	0.1%	0.9%	1%	511
	Total (in non micro)	4.2%	11.0%	14.0%	70.8%	100%	47,092
	Panel B: Employment						
	Micro (1≤L<10)*	?	?	?	?	32%	273,759
Size (L)	**Small (10 ≤ L<50)**	0.5%	1.2%	1.6%	6.4%	10%	84,848
	Medium (50 ≤ L<250)	0.6%	2.1%	2.5%	19.3%	25%	211,727
	Large (250 ≤ L)	0.3%	1.3%	2.8%	29.6%	34%	293,911
	Total (in non micro)	2.0%	7.0%	10.0%	81.0%	100%	864,245

USA (Business Dynamics Statistics)

		Age categories					
		0 to 4	**5 to 10**	**11 to 15**	**16+**	**Total**	**Total level**
	Panel A: Establishments						
	Micro (1≤L<10)	18.0%	11.3%	6.2%	14.3%	50%	162,886
Size (L)	**Small (10 ≤ L<50)**	5.8%	6.3%	4.3%	16.3%	33%	106,783
	Medium (50 ≤ L<250)	1.6%	2.0%	1.4%	9.0%	14%	45,952
	Large (250 ≤ L)	0.2%	0.3%	0.3%	2.5%	3%	10,937
	Total (in non-micro)	15.2%	17.2%	12.1%	55.5%	100%	
	Total	25.6%	19.9%	12.3%	42.2%	100%	326,558
	Panel B: Employment						
	Micro (1≤L<10)	1.5%	1.0%	0.5%	1.3%	4%	657,894
Size (L)	**Small (10 ≤ L<50)**	3.1%	2.9%	2.0%	8.2%	16%	2,443,164
	Medium (50 ≤ L<250)	4.0%	4.5%	3.2%	21.6%	33%	5,021,219
	Large (250 ≤ L)	2.4%	3.9%	4.0%	35.8%	46%	6,919,183
	Total (in non-micro)	9.9%	11.8%	9.7%	68.6%	100%	
	Total	11.0%	12.3%	9.8%	66.9%	100%	15,041,460

* The total weight of micro establishments for Colombian manufacturing is obtained from the 2005 Colombian Census. There is no information on the age distribution of micro establishments

** For Colombia, the figures for total number of establishments and total employment are directly taken from the Manufacturing Survey for non-micro establishments. We use the fact that the total for non-micro corresponds to 13% of establishments and 68% of employment to calculate the number of micro-establishments and their employment.

U.S. has 4% of employment in the micro and small establishments, the figure in Colombia is eight times as large: 32%. While micro establishments are also much more prevalent in Colombia than in the U.S. in terms of the distribution of numbers of plants (87% rather than 50%), the difference is not as marked as it is in terms of employment. This implies a larger average size of micro-establishments in Colombia than in the U.S.

In terms of the cross size-age distribution (which we can characterize only for non-micro plants), there is also a greater prevalence for small businesses among the categories of older plants in Colombia. Conditional on being small (size between 10-50), 64% of employment in Colombia is more than 16+ while the analogous fraction is only 50% in the U.S. In both countries, the size and age distribution of establishments are clearly tied to each other: small establishments are more likely young than larger ones.

5 Conclusions

This paper characterizes Colombian manufacturing (non-micro) establishments over their life cycle, as compared to the U.S. On average, younger businesses outperform older businesses on a number of dimensions, even after controlling for size differences. These differences are marked by greater heterogeneity among the young, with high average startup growth driven by superstars. Moreover, despite the relatively modest contribution of the young to overall employment at any given point in time, it is the youngest cohorts of plants that explain the bulk of employment growth over

the medium term. Overall employment by establishments from pre-1980 cohorts collapsed over our period of study.

That there is very dynamic growth among some young establishments has been previously documented using data for the US (HJM). Interestingly, young establishments and firms in Colombia exhibit similar patterns to those in the U.S. with a few notable differences. First, among non-micro establishments the upper tail of high growth establishments is less dynamic in Colombia than the U.S. and exhibits less distance with respect to laggard establishments, which despite their poor performance are more likely to survive to old ages than similarly slow growers in the U.S. As a result of the less marked up-or-out dynamics in Colombia, especially in terms of growth at the upper end of the distribution, the size-age distribution displays a larger concentration on old-small establishments and average employment growth over a plant's life cycle is slower in Colombia. This is complemented by a much greater concentration of establishments and employment in the segment of micro-establishments, perhaps the most salient differential characteristic of Colombian manufacturing vs. the U.S.' This set of findings suggests that less dynamic high-growth entrepreneurship is a likely a source of the development differentials between Colombia and the U.S.

6 References

Aghion, Philippe and Peter Howitt. 2006. "Appropriate Growth Policy: A Unifying Framework" Journal of European Economic Association, April-May 2006 4(2–3):269–

314.

Arkolakis, C. 2016. "A Unified Theory of Firm Selection and Growth," The Quarterly Journal of Economics, Oxford University Press, vol. 131(1), pages 89-155.

Arkolakis,C., Theodore Papageorgiou and Olga Timoshenko. 2018. "Firm Learning and Growth," Review of Economic Dynamics, Elsevier for the Society for Economic Dynamics, vol. 27, pages 146-168, January.

Autor, D., David Dorn, Lawrence F. Katz, Christina Patterson, John Van Reenen. 2017. "The Fall of the Labor Share and the Rise of Superstar Firms," NBER Working Paper No. 23396.

Ayyagari, Meghana; Asli Demirguc-Kunt, and Vojislav Maksimovic, 2014, "Who creates jobs in developing countries?," Small Business Economics 43, 75-99.

Baldwin, John and Garnet Picot. 1995. "Employment Generation by Small Producers in the Canadian Manufacturing Sector?," Small Business Economics 7, 317-331.

Banerjee, Abhijit V., and Esther Duflo. 2005. "Growth Theory through the Lens of Development Economics." In Handbook of Economic Growth, edited by Philippe Aghion and Steven Durlauf, 473–52. Amsterdam: Elsevier Science.

Barnes, Matthew and Jonathan Haskel. 2002. "Job Creation, Job Destruction and the Contribution of Small Businesses: Evidence for UK Manufacturing," Working Papers 461, Queen Mary University of London, School of Economics and Finance.

Bartelsman, Eric, John Haltiwanger and Stefano Scarpetta. 2013. "Cross Country Differences in Productivity: The Role of Allocative Efficiency," American Economic Review, 103(1): 305–334.

Birch, D. L., 1981, 'Who Creates Jobs?', Public Interest 65,3–14.

Broersma, Lourens and Pieter Gautier. 1997. "Job Creation and Job Destruction by Small Firms: An Empirical Investigation of the Dutch Manufacturing Sector," Small Business Economics 9, 211-224.

Caballero, Ricardo J. and Mohamad L. Hammour. 1994. The Cleansing Effect of Recessions. The American Economic Review 84, no. 5: 1350-68.

Davis, Steven J., John Haltiwanger and Scott Schuh, 1996, Job Creation and Destruction, MIT Press.

Decker, Ryan A. & Haltiwanger, John & Jarmin, Ron S. & Miranda, Javier, 2016. "Where has all the skewness gone? The decline in high-growth (young) firms in the U.S," European Economic Review, Elsevier, vol. 86(C), pages 4-23.

Drozd, Lukasz A. and Jaromir B. Nosal. 2012. "Understanding International Prices: Customers as Capital." American Economic Review, 102(1), 364-95.

Ericson, Richard, and Ariel Pakes. 1995. "Markov-Perfect Industry Dynamics: A Framework for Empirical Work." Review of Economic Studies, 62(1): 53–82.

Eslava, Marcela and Xavier Freixas. 2018. Public Development Banks and Credit Market Imperfections. SSRN Working Paper 3251933.

Eslava Marcela. 2018. The anatomy of productivity in Latin America. in "Institutions for Productivity: Improving the Business Environment." CAF.

Fariñas, J. C., & Moreno, L. 2000. Firms' growth, size and age: A nonparametric approach. Review of Industrial organization, 17(3), 249-265.

Foster, Lucia, John Haltiwanger, and C. J. Krizan. 2006. "Market Selection, Reallocation and Restructuring in the U.S. Retail Trade Sector in the 1990s." Review

of Economics and Statistics 88, no. 4:748–58.

Foster & John Haltiwanger & Chad Syverson, 2016. "The Slow Growth of New Plants: Learning about Demand?," Economica, London School of Economics and Political Science, vol. 83(329), pages 91-129, January.

Haltiwanger, John. 2015. "Job Creation, Job Destruction, and Productivity Growth: The Role of Young Businesses," Annual Reviews, 7:341–58.

Haltiwanger, John, Ron Jarmin, and Javier Miranda. 2013. "Who Creates Jobs? Small vs. Large vs. Young." Review of Economics and Statistics, 95(2), 347-361.

Hopenhayn, Hugo 1992. "Entry, exit, and firm dynamics in long run equilibrium", in Econometrica, Vol. 60, No. 5, pp. 1127–1150.

Hopenhayn, Hugo and Richard Rogerson. 1993. "Job turnover and policy evaluation: A general equilibrium analysis", in Journal of Political Economy, Vol. 101, No. 5, pp. 915–938.

Hsieh, Chang-Tai and Peter Klenow. 2009. "Misallocation and Manufacturing TFP in China and India," Quarterly Journal of Economics. 124 (4): 1403–48.

Hsieh, Chang-Tai and Peter Klenow, 2014.. "The Life Cycle of Plants in India and Mexico," Quarterly Journal of Economics, 129(3): 1035-1084.

Hurst, Erik and Benjamin Pugsley, 2012. "What Do Small Businesses Do?", Brookings Papers on Economic Activity. vol. 43(2 (Fall)), pages 73-142.

Jovanovic, B. 1982. "Selection and the evolution of industry", in Econometrica, Vol. 50, No. 3, pp. 649–670.

Klapper, Leora and Christine Richmond, 2011. "Patterns of business creation, survival and growth: Evidence from Africa," Labour Economics, Elsevier, vol. 18(S1),

pages 32-44.

Levy, Santiago. 2018. Under-rewarded efforts: the elusive quest for prosperity in Mexico. InterAmerican Development Bank

Levy.Mondragon, C., X. Peña and D. Wills, 2010. Labor Market Rigidities and Informality in Colombia. Economía.

Mortensen, Dale T., and Christopher A. Pissarides. 1994. Job Creation and Job Destruction and the Theory of Unemployment. Review of Economic Studies LXI, no. 3:397-415.

Neumark, David, Brandon Wall, and Junfu Zhang, 2011, "Do Small Businesses Create More Jobs? New Evidence for the United States from the National Establishment Time Series", Review of Economics and Statistics, 93, 16-29.

OECD. 2017. Business Dynamics and Productivity. OECD Publishing, Paris.

Pagés, Carmen (ed). 2010. The age of Productivity. Inter American Development Bank, Washington.

Pierce, Justin, and Peter Schott. 2016. The Surprisingly Swift Decline of U.S. Manufacturing Employment. American Economic Review 106(7):1632-62.

Restuccia, Diego and Richard Rogerson. 2008. "Policy Distortions and Aggregate Productivity with Heterogeneous Plants," Review of Economic Dynamics, 11(October): 707-720.

Schoar, Antoinette, 2010, "The Divide between Subsistence and Transformational Entrepreneurship," Innovation Policy and the Economy, 10(1), pp. 57-81.

Syverson, Chad, 2011. "What Determines Productivity?" Journal of Economic Literature.

Yasuda, Takehico. 2005 "Firm Growth, Size, Age and Behavior in Japanese Manufacturing," Small Business Economics 24, 1-15.