The Success of Entrepreneurial Networks: Evidence from Brazil*

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Abstract

This paper examines the relationship between the network structure among initial employees and the performance of a newly founded firm. We use a large employee-employer linked panel data set from Brazil that allows us to track workers across jobs and establish whether new firm employees have prior joint work experience. We use this information to construct a quantifier for network concentration using the Herfindahl Hirschman Index (HHI), and test the impact of network concentration on new firm performance as measured by survival, employment, and wages. We find that new firms with higher network concentrations, i.e. wherein initial employees have worked together previously, are on average larger, have higher wages and survive longer when controlling for industry fixed effects and employees' human capital, demographic characteristics, formal sector experience, and size of parent firms. This association increases with the initial size of the newly founded firm. However, we find a negative relationship between network concentration and initial firm growth. Finally, we look at how the size of an individual's parent firm affects the success of her new entrepreneurial venture and find that small firm experience correlates with better survival rates, but lower employment and average wages at the new firm.

Keywords: Employee networks; entrepreneurship; firm performance

JEL Classification: L26, L14

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1 Introduction

In recent years, policymakers have placed substantial resources into the promotion of entrepreneurial activity, particularly in small business formation. Entrepreneurial activity can create wealth, employment and innovation, thereby spurring economic growth. It is therefore of great interest to both economists and policymakers to understand what it means for a start-up venture to be successful, and what factors determine this success.

In this paper, we exploit the network structure relating the prior career experiences of employees in a new firm, so as to identify characteristics that predict more successful entrepreneurial ventures. Specifically, we look at how the initial employees in a newly founded firm are linked in terms of previous employment, and how these links are associated with the firm's performance.

This exercise is interesting and relevant for a few reasons. The success of any given venture is determined primarily by three factors: the quality of the proposed undertaking, the competence of its execution, and the external environmental factors that govern market conditions (competition and luck). Our paper will be able to shed some insight into the first two of these three factors. We argue that network structures are associated with factors that reflect the quality of an undertaking, as well as how well it is carried out: both the quality of a venture and its execution are a function of those individuals pursuing it.

Ventures are undertaken both individually and in groups. When individuals come together to engage in entrepreneurial activity, they exchange a variety of information on their compatibility, the availability of opportunities, and the viability of ideas. Different individuals have differential access to information and resources, and it is the confluence of these sets of information that potential entrepreneurs use to approximate their expected returns (Aldrich, 1999; Shane and Shane, 2004). This paper is concerned with understanding the impact of the choices that individuals make on whom to work with initially on the eventual success of that firm.

We outline four primary findings, which revolve around the importance of initial employee networks: using the the Herfindahl Hirschman Index (HHI) to measure network concentration[1], we find a strong link between the HHI and various measures of success. First, we find that survival probabilities increase with network concentration for the average newly founded firm in Brazil. This is to say, new firms wherein the initial employees had worked together previously are more likely to survive. This effect of the HHI on survival is more pronounced for firms that are larger at inception. Second, we look at the relationship between the HHI and the new firm's average earnings and employment levels. These measures are intended to proxy for the firm's

[1] HHI here measures the concentration of parent firms in the new firm, so network concentration is highest when all initial employees come from the same parent firm.

financial success, which we cannot measure directly in our data. We find that firms with higher HHI have both higher average wages and more employees in all periods for which we can track performance (up to six years after entry). Third, when looking at the growth rates of average earnings and employment, we find these measures to be negatively related to the HHI initially, and find no effect after three years. Firms wherein new employees are more closely linked via previous employment (i.e. more concentrated networks) are more likely to survive, are larger, and have higher wages. However, they have lower wage growth between inception and the third year. This relationship between network concentration and growth dissipates between years three and six.

In addition to the HHI, we also measure network concentration using two variables: the share of initial employees *not* linked to any other employee through previous employment, and the share of employees that form the largest network. Regression results suggest our fourth finding: that having new workers who are not related to anyone via previous employment negatively affects the odds of survival in the first two years, but not beyond that. In contrast, having a large proportion of new employees from the same previous network seems to matter more starting in year three, through the sixth year at the least.

The results described above contribute to several literatures. While most of the relevant empirical literature focuses on the impact of networks on entrepreneurial entry (Nanda and Sorensen, 2009; Giannetti and Simonov, 2009), this is one of only a few papers to look at the impact of networks on entrepreneurial outcomes (see also Elfring and Hulsink, 2003; Lerner and Malmendier, 2011). We complement this literature by showing that networks affect not only participation in entrepreneurship, but also the success of new ventures.

This paper also supports the theoretical literature on the effects of networks on outcomes. Drawing mainly on the ideas developed in (Granovetter, 1983), we use the HHI to quantify the strength of ties, and assess their impact on entrepreneurial outcomes. In this seminal piece of work, Granovetter notes that there are three possible types of ties linking individuals: strong, weak and absent. Strong ties link individuals within the same social circle and weak ties connect individuals across social circles. While strong ties motivate individuals to be of assistance and work well together, weak ties provide individuals with access to information and resources beyond those available in their own social circle. This concept is taken to an entrepreneurial setting by Rauch and Watson (2007). They argue that when a potential entrepreneur's default option is to interact with readily available individuals within their social network, those who select into involvement with unrelated individuals are willing to incur a higher search cost. This can be interpreted as a signal of higher venture quality. However, interacting within one's network is not necessarily

a viable default option for everyone. The sheer willingness of an individual's former colleagues to jointly engage in an entrepreneurial venture, signals their trust in his revealed capabilities, as well as their mutual compatibility; an outsider will have far less information about these crucial variables. As such, an outside match can either signal a high venture quality justifying the search cost, or a low quality entrepreneurial venture which cannot garner the support of those with private information.

In light of these theories, one possible interpretation of our empirical findings is the following: the fact that network concentration is positively and significantly correlated with survival suggests that peer assessment of ability and compatibility helps to ensure that a firm will survive through the initial phases. Starting a firm with closely linked individuals reduces many basic uncertainties, thus allowing the firm to get past the most fragile initial stages. However, conditional on surviving, having access to different resource pools and a higher match quality a la Rauch and Watson (2007) could increase the entrepreneurial potential of a firm. This is reflected by the negative and significant relationship between network concentration versus employment and wage growth in the initial periods. This interpretation is consistent with the notion that the strength of ties does matter, but it does so idiosyncratically for different measures of success. In section 4.3 we provide a few other interpretations that are consistent with our results. These interpretations will address three specific alternative channels for our findings. They include selection into different network structures based on underlying qualities, access to financing and the relationship between network structure, and the choice to switch industries.

A secondary finding of this paper relates entrepreneurial success to parent firm size. We find that small firm experience of the founding employees is associated with higher survival likelihoods for the new firm. However, large firm experience is predictive of higher initial employment and average wages, as well as higher employment growth for the first three years. These findings contribute to the literature on the genesis of entrepreneurs (see Gompers, Lerner and Scharfstein, 2005; Hvide, 2005; Lazear, 2004). This literature seeks to understand where entrepreneurs come from and how this affects their performance. Theoretically, it is conceivable that parent-firms of different sizes produce different types of entrepreneurs for several reasons. Small parent firms, with flatter hierarchical structures, may expose their employees to various layers of the firms' organizational structure in addition to honing their specific roles. This varied skill set creates employees that are "jacks of all trades" (as in Lazear, 2004) who may make more successful entrepreneurs. On the other hand, larger firms may have the resources to fund research intensive projects, thus attracting highly educated and innovative individuals (Gompers, Lerner and Scharfstein, 2005).[2]

[2]Hvide (2005) reasons, under the assumption that workers select blindly into employment at large or small firms,

Given that these large parent firms may not have the ability or desire to internalize all the ideas generated by their employees, this could induce workers to leave and become entrepreneurs so as to realize their ideas. These high ability individuals may then prove to be superior entrepreneurs. Our results lend support to both theories. Employees from small parent firms are better able to ensure the survival of their new firms. Presumably, this involves being able to efficiently manage various different components of the organization, which would be a skill small parent firms expose individuals to. However, large parent firms seem to spawn new firms that have an initial size advantage and ultimately outperform other surviving new firms. This result goes hand in hand with the theory proposed by Gompers, Lerner and Scharfstein (2005) that innovative and highly skilled individuals come from large firms which cannot internalize their ideas, or compensate them to appropriately reflect their true marginal productivity, as suggested by Hvide (2005).

Muendler et al. (2012) use two distinct definitions to identify employee spinoffs, one of which is based on the number of employees with common work history: a new venture is labeled a spinoff if at least one quarter of initial employees shifted from the same parent firm. These spinoffs are larger at entry and have better survival rates than new firms without parents. However, this definition can only be applied to new firms of 5 or more employees, whereas firms of 2, 3, or 4 initial employees form over 60 percent of new entrants with more than one worker in our data. Furthermore, Muendler et al. (2012) do not distinguish between spinoffs wherein 25, 50, or 100 percent of workers share a common work history. This paper is concerned with identifying the role of employee networks and interaction, and doesn't attempt to pin down the founders and the mode of firm formation. We therefore want to include small firms in our analysis, since arguably the role of joint work experience is most important in these; we also examine the role of increased network concentration on the full range of values and are interested in knowing, for instance, how a firm with half the workforce coming from a common parent differs from a firm whose entire workforce share common work history.

The reader should note that we are careful not to make any causal claims, as such effects are difficult to isolate empirically. We will not be able to observe, and hence discuss, whether it is selection into the networks and firms, or the inherent nature of these institutions and organizations that drive outcomes. This paper provides a documentation of empirical patterns, so as to fertilize the ground for further research on the mechanisms that could lead to these observations, and potential identification strategies.

The rest of the paper is organized as follows. Section 2 describes the data and outlines the estimations strategy we propose. Section 3 describes the informative case studies of survival rates

that larger firms will produce higher quality entrepreneurs, since in these firms wage setting is less fine tuned.

for two- and three-employee firms. Section 4 presents empirical regression results, and discusses possible interpretations and remaining endogeneity concerns. Section 5 concludes.

2 Data and estimation

2.1 Dataset

We employ the Brazilian dataset RAIS (*Relação Anual de Informações Sociais* of the Brazilian labor ministry *MTE*), which is an annual census of salaried employees, required to be filled by all employers.[3] Observations are at the job-year level, and contain unique identifying codes for the firm, the establishment (an establishment is a sub-unit of the firm, such as a plant or office), and the worker. This allows us to track employees as they move from one job to the next, and hence to identify employee networks and how they relate to the performance of new firms.

A job observation in RAIS is identified by the employee ID, the employer's tax ID (CNPJ), and dates of job accession and separation. To avoid double-counting employees at new firms, we keep only one observation for each employer-employee pair, choosing the job with the earliest hiring date. If the employee has two jobs at the firm starting in the same month, we keep the highest paying one. The rules on tax ID assignments make it possible to identify new firms (the first eight digits of the tax ID) and new plants within firms (the last six digits of the tax ID). Our data include 71.1 million employees (with 556.3 million job spells) at 5.52 million plants in 3.75 million firms over the sixteen-year period 1986-2001 in any sector of the economy. We limit our attention to the years 1995-2000 to ensure that firms we label as new have not operated before and to be able to track new firms for at least 1 year.

2.2 Estimation strategy

A firm's success is measured using survival, employment and wages. [4] We seek to understand how the founders' common history (network relationship) affects the performance of a firm. In the RAIS dataset, we are unable to reliably isolate the founding members of a firm, therefore we use a measure of the relationship between all the initial employees. Since most of the new firms in the dataset are relatively small,[5] this measure should pick up to a high degree the relationship

[3] Actual coverage is estimated to be well above 90% of all formally employed individuals.

[4] Unfortunately, RAIS does not contain any data on revenues or profits. Therefore, we use the combination of employment and wages to measure firm performance in terms of revenue.

[5] 91.6% of new firms have 10 or fewer employees while 96.4% of new firms have 20 or fewer employees.

among founders. Even though we will not be able to assign causal attributes of network links amongst founders, we are still able to identify how the patterns linking employees correlates with firm survival. One could make the argument that in small firms, all, or at least a large fraction of employees play a significant role in determining the success of the firm. As such, understanding how they all relate to each other may be just as relevant as looking at the relationship between owner-entrepreneurs. An alternative strategy would be to simply restrict the sample to only very small firms.[6]

To proxy for network concentration, we use the Herfindahl-Hirschman Index (HHI) to measure the degree of clustering within a firm. A higher HHI value is indicative of a higher degree of commonality among initial employees. The index is computed as follows: $\sum_{j=1}^{J} {s_j}^2$, where s_j is the share of initial employees in the new firm from parent-firm j. Naturally, we exclude all one-employee firms from our analysis.

We propose three versions of this index, depending on the treatment of workers who cannot be traced to a previous job. These untracked workers could be employees that are new to the workforce, or individuals who have operated exclusively in the informal sector (estimated at 40% of the Brazilian economy) during the previous years of data.

Suppose a firm has N employees, of whom N_p can be traced to a previous job, and N_u cannot. Further assume that these employees have a total of J parent firms, each represented by N_j employees, so that $N = N_p + N_u = \sum_{j=1}^{J} N_j + N_u$.

Then the first version of the index, HHI_1, counts all employees in the denominator, but assigns zero shares to those that cannot be tracked. The second version is computed using only trackable workers' information (and only for firms with at least 2 such employees), while the third assumes that all workers that cannot be tracked come from different parents:

$$
\begin{aligned}
HHI_1 &= \sum_{j=1}^{J} \left(\frac{N_j}{N}\right)^2 \quad \text{for } N \geq 2 \\
HHI_2 &= \sum_{j=1}^{J} \left(\frac{N_j}{N_p}\right)^2 \quad \text{for } N_p \geq 2 \\
HHI_3 &= \sum_{j=1}^{J} \left(\frac{N_j}{N}\right)^2 + N_u \left(\frac{1}{N}\right)^2 \quad \text{for } N \geq 2
\end{aligned}
$$

[6]One caveat here is that there may just be 1 founder/entrepreneur even in these very small firms. Hence, it is not clear that we will be able to make claims about the relationship amongst founders even in these cases.

Version 2 is the cleanest in terms of assumptions made, but since it requires that we have at least two trackable employees, it reduces the sample size significantly, and not in a random way. Version 3 conforms quite well to the data (as we'll show using 2-and 3-employee firm statistics in the next section) and is our preferred measure of the three.

One drawback of version 3 (as well as version 2) is that the range of values it can take depends heavily on the number of initial employees: in a 2-person firm, HHI_3 has a minimum value of 0.5 when the two employees have no shared experience. However, as the number of employees N gets large, HHI_3 can take on values very close to zero. As such, we create a new rescaled index, HHI_4, to facilitate interpretation of results. In re-scaling this index, regardless of firm size, a value of 0 means there is no joint network experience while a value of 1 means that all employees were previously linked via employment.

HHI_4 is defined as follows: starting from our preferred index measure HHI_3, we subtract the minimum value ($1/N$) it can take for a given number of employees, then rescale the new measure so that the maximum value is again 1. $HHI_4 = \frac{(HHI_3 - 1/N)}{(1-1/N)}$, which simplifies to:

$$HHI_4 = \sum_{j=1}^{J} \frac{N_j(N_j-1)}{N(N-1)} \quad \text{for } N \geq 2$$

Where once again, j indexes parent firms. Note that, since in a group of n individuals there are $n(n-1)/2$ possible pairs, HHI_4 can be interpreted as the share of all pairs of employees that are joined by common work experience. Table 4 shows average values of HHI_3 and HHI_4 for different initial firm sizes. HHI_3 decreases monotonically with the number of initial employees, with the exception of $N > 100$.[7] Comparing HHI_3 and HHI_4, we note that, as intended, HHI_4 is less volatile across initial firm sizes, therefore serving as a better measure for comparisons across initial size categories. In the appendix, we report survival regression results for HHI_1, HHI_2, and HHI_3 as well for completeness.

We regress firm survival on the HHI index and other relevant variables for each cohort from 1995 through 2000, in a linear probability model.

$$y_{it} = \beta_0 + \beta_1 HHI_{i,0} + \beta_2 X_{i,0} + \epsilon_{it} \tag{1}$$

y_{it} is the measure of success of firm i at time t.[8] This can take one of three forms: a survival indicator, performance in terms of employment, and performance in terms of average wages. For

[7] This suggests that as the firm size becomes large enough, we may be capturing some divestitures.

[8] Alternatively, we can limit the sample to firms that survived at $t-1$.

the latter two measures, we examine performance both at entry, and up to 6 years later, conditional on survival. Additional controls $X_{i,0}$ include: share of initial employees that can be tracked to a previous job, cohort and sector fixed effects, initial firm size controls, and employee experience and qualifications (average employee age, education level and wage at parent firm).

3 The informal sector and survival case studies

We include a brief analysis of the average survival rates by common history of 2 and 3 person firms started between 1995 and 2000. These entrants make for an interesting case study, since they can have only a handful of possible HHI indices.

Survival of 2-employee firms

Figure 1 shows survival rates for firms with just 2 initial employees using HHI_1. This index takes four possible values, while HHI_2, HHI_3, and HHI_4 can each have two values, as shown in table 1 (however, HHI_2 is undefined whenever fewer than two employees can be tracked to previous employment).

Figure 1 indicates survival by HHI_4. If we use the HHI_1 measure of concentration, survival is very similar across index values 0, 0.25 and 0.5. This suggests that two-man firms wherein one or both employees cannot be tracked behave similarly (in terms of survival) to two-man firms wherein both employees can be tracked, but to different parents. This observation is consistent with the assumption behind versions 3 and 4 of the HHI index: that whenever an employee cannot be tracked to a previous formal sector job, we can reasonably assume they do not have joint work experience with any other employees at the new firm.

Figure 1 also shows that firms with a HHI of 1 display a significantly higher survival rate. This graph confirms that 2-employee firms wherein both employees had common prior work experience are more likely to survive then firms whose two employees were not observed to work together before.

Survival of 3-employee firms

The same qualitative observations hold when we repeat the exercise for firms with 3 initial employees. Table 2 shows index values in the 9 possible scenarios.

The first 4 categories, with HHI_1 values of 0, 0.11, 0.22, and 0.33 have in common the fact that there is no documented shared work history for their founders. These categories of firms

all perform similarly (not shown here) and are less likely to survive than other firms. They are therefore appropriately represented by a single value of HHI_4 (0). The next 2 categories in table 2 are 3-employee firms wherein 2 employees have known common work history. They again perform similarly in terms of survival, and are represented by a unique value of HHI_4 (0.33). Figure 2 shows survival rates for the two types of firms discussed above, as well as firms in which all 3 employees share common work history. The thinner lines indicate the upper and lower bounds of the 95% confidence interval. As long as 5 years after inception, there is no overlap in the 95% confidence intervals of survival for these 3 types of firms: the more initial employees have documented common work experience, the better the odds that the new firm will survive.

Employees for whom we have no job history may be new to the job market, or they may have been exclusively employed at informal firms in the past (since 1986 when our dataset begins). We have no measure of their past work experience, or whether they have established prior working relationships with other untrackable employees in the new firm. However, evidence from 2- and 3-employee firms suggests that untracked workers typically do not share common work experience, or this past informal joint work is not as valuable as common experience in the formal sector.

4 Results

We describe results for different measures of new firm success: first, using survival (section 4.1), and then employment and wages (4.2). Section 4.3 provides a detailed discussion of the various ways to interpret the combined results.

Before we delve into empirical estimates, it is worth discussing two potential confounding elements in the data: divestitures and firm buy-outs.

Some new firms may actually be divestitures from old firms. These divestitures will have several advantages over true new firms, including accumulated capital stock, brand name, established supplier relations, etc. They will also typically have high employee network concentration, so they may be biasing our results upward. Following the approach from Muendler, Rauch and Tocoian (2012), we label a new firm a divestiture if its legal form (*natureza juridica*) is coded as Corporation under private control, Close corporation, or Limited liability company, or if it has unknown legal form, and if it absorbs 70 percent or more of the employees of a plant of an existing firm. Our baseline dataset excludes these divestitures, but results do not change significantly when they are included.

Some new firms may drop out of the sample because they are bought and absorbed into larger corporations - typically an indication of success rather than failure. If we don't account for this

exit mode, we will incorrectly label some well-performing firms as bad performers in terms of survival, which will introduce a downward bias in our estimates. We use the approach from Muendler, Rauch and Tocoian (2012) to identify absorbed firms,[9] and exclude them from our sample in a robustness check. In results not reported here, we find that, as expected, point estimates of the coefficient of interest increase when absorbed firms are excluded, and the difference is often significant.

4.1 Regression results: survival

We run linear probability model regressions for all four versions of the HHI. Our baseline results are computed for HHI_4 and are reported in table 6; the results for HHI_1, HHI_2, and HHI_3 can be found in the appendix. For each version of the HHI, we control for 4-digit sector, cohort, initial size category[10], share of the new firm's employees that can be tracked, share of employees who come from a job in the same sector, mean employee age, share of employees within 5 years of retirement, years of schooling, previous wage, and average parent size category (including a separate category for new firms with no trackable parents).[11]

Common work experience

Table 6 shows that, even controlling for industry fixed effects and employees' human capital, network concentration (as measured by a higher HHI index value) has a positive and significant impact on firm survival. This result holds robustly across all three versions of the HHI index (see the Appendix).

Using the HHI_4 result at $t + 6$, we find that a firm whose workers all have previous common experience ($HHI_4 = 1$) is about 8.8 percent more likely to survive than a firm wherein no two workers can be tracked to the same employer (HHI_4 = 0). This result provides evidence for the hypothesis that individuals who are better acquainted prior to engaging in entrepreneurial activity have a better capacity to judge the potential of a proposed venture and perhaps work better together, thus resulting in a higher likelihood of success. We are, however, not able to parse out whether it is the mechanism described above, or if this is a function of easier access to financing amongst friends, for instance, that drives this result.

Table 8 helps us interpret results further: for the first 2 years, what matters most is that all initial

[9] If 70% or more of a new firm's employees (call this firm A) can be found employed together at a previously existing firm B after the disappearance of firm A, then label the demise of firm A as a likely buy-out.

[10] Categories are: 2 initial employees, 3-4, 5-10, 11-20, 21-50, 51-100, and >100 employees

[11] Although previous wage is included, thus limiting the sample size, some entrants still have unknown parent size, because parent size is measured during the year immediately before the new firm's entry.

employees are linked to at least one other employee in the firm - this ensures some base level of compatibility, the resolution of some of the informational asymmetry with regards partner quality, and also that they are vested in the firm; starting with the 3rd year, the size of the top network is more important. The latter observation speaks to the main hypothesis that the strength of ties matter. Conditional on getting past the most crucial survival hurdle in the early years, having a higher proportion of individuals tightly linked across the group matters more for survival.

Employee human capital

We control for employee human capital by introducing average age, education, and wage at the previous place of employment. To separate the effect of age through experience and proximity to retirement, we also use as a control the share of initial employees who are within 5 years of the nationally-established retirement age. As expected, we find that a higher average level of education among employees improves the survival odds for a new firm. Controlling for previous employment, wage and education, we find that employee age has a negative impact on firm survival. This finding is interesting since intuitively one could hypothesize how this effect could go either way. One thing to note is that previous wage in and of itself captures some of the return to experience. As such, the result essentially says that controlling for previous experience, age negatively impacts firm survival. One explanation is that perhaps younger employees, despite having less experience, are more creative and adapt better to technology. An alternative explanation is that the younger worker is be giving up the certainty of a better defined wage path for a longer period of time than the older worker. As such, choosing to be involved with a new venture which does not offer that certainty could signal the higher quality of that venture. While empirical evidence in the US shows that older individuals are more likely to become entrepreneurs, our results show that conditional on becoming one, younger individuals perform better.[12] The negative correlation between age and firm success, conditional on human capital, may be due to adverse selection of older workers into self-employment. Given an unwanted separation from their previous job, younger workers have better prospects in the labor market , whether this be due to their versatility, adaptability, or willingness to move, whereas older workers may have little choice but to become self-employed. One might suspect the negative relationship may also arise because as older workers approach retirement, they will naturally either sell or close their businesses. To test this possibility, we introduce a control for the share of employees who are within 5 years of retirement, and we find

[12]Previous empirical work has found that, even in the US, the average self-employed individual is older than the average wage-employed individual. This could simply be due to older individuals having better access to financing (including from their personal wealth), so they have an easier time starting a new firm, whereas young would-be entrepreneurs only get financial backing if their idea is exceptionally good.

the opposite: age is still negatively associated with the success of a firm, whereas being close to retirement predicts *better* odds of survival.

Previous earnings are arguably the most direct measure of an employee's human capital. Not surprisingly, average previous wages of initial employees are predictive of better survival odds for the new firm. The effect is highly significant for up to five years after entry. The drop in significance at t+6 is most likely due to the change in cohort composition between column 6 of table 6 and the previous regressions.

We further control for specific human capital by introducing variables that measure the share of employees with formal sector experience ("share trackable") and the share of employees who previously worked in the same sector as the new venture. As expected, both variables are positively correlated with better survival odds.

Transition from informality and new workers

The results indicate that having a higher share of initial employees with no known work history is negatively correlated with firm performance (see coefficients on *share trackable* and *no known parent*). If anything, this coefficient is biased towards positive values by the assumption built into HHI_4 that workers coming in from informality don't share a work history with each other. These individuals could either be new entrants into the labor force or individuals moving from the informal sector into the formal sector. This result is intuitive, indicating that those with little experience in the formal sector who choose to associate with a brand new venture are more likely involved with less successful ones. One explanation is that the prevalence of non-trackable workers signals that the venture is of a low quality and therefore those with experience in the formal sector who are able to evaluate it choose not to join. Alternatively, understanding the formal legal (institutional) framework is vital to any firms' success and those without the experience to do so are more likely to fail.

Size of parent firm

We also find that prior experience at small firms is correlated with a higher chance of survival for a new entrant. This result is consistent with Lazear's (2004) notion that entrepreneurs should be "jacks of all trades". Having experience at a smaller firm more likely exposes employees to the different aspects that underly the mechanics of a firm. This mechanism suggests that a small firm veteran will be a more capable new-firm employee since, aside from being qualified in her own specific tasks, she may have exposure to the logistics involved in running a business. Whether this is a pure treatment effect, meaning only the experience itself distinguishes former small firm vs.

large firm employees, or whether there is selection into small firm employment by workers who either consciously seek to gain small firm experience, or who simply are a better fit for small scale establishments, is beyond the scope of this paper to disentangle.

In table 3 we provide a breakdown of average parent firm sizes in our sample, which consists of new firms of two or more initial employees, started between 1995 and 2000.

Initial firm size

Table 6 includes controls for initial firm size - specifically for the seven bins indicated in table 5. The coefficients, not reported due to space constraints, indicate that larger new firms have significantly and monotonically higher odds of survival. This finding is consistent with common sense expectations that firms which are larger at inception are typically more ambitious ventures, which are better financed. Furthermore, being able to get more individuals immediately on board, either to finance or simply join the venture, is a positive signal for the promise of a firm.

The more interesting question is whether network concentration is correlated with firm survival differentially by starting size. We replace the initial size bins with a continuous measure: the natural logarithm of initial firm size, and add an interaction term between log size and HHI. Results, not reported here, show that the interaction term is positive, in other words network concentration has a stronger positive effect for larger firms.

We also run the specification from table 6, excluding initial size controls, for new firms of different sizes. We plot the relevant coefficient on HHI_4 versus entrant size in figure 3. This shows how larger firms benefit more from strong ties between the founders, up to a point: for firms of over 50 initial employees, network ties matter less. However, in this size category, true entrepreneurial ventures may no longer compose the majority of new firms, as a significant portion of entrants are likely employer-initiated divestitures and spinoffs, which are not the focus of this paper.

4.2 Regression results: firm performance

The results discussed thus far involve survival as the sole measure of success. We now consider other measures of performance, namely employment and wages, in both initial logged values and growth rates. Table 9 reports regression results for firms' performance during their first year, as well as 3 and 6 years later. The two dependent variables intended to capture firm performance are, the natural log of the number of employees and natural log of average wages. Employment and wages are a proxy for entrepreneurial success since job creation is one of the main stated benefits of entrepreneurship, and average wages measure the amount of economic activity the new firm

creates. Running the estimations separately allows us to disaggregated the employment and wage effects.

Table 10 isolates initial levels from subsequent growth: columns 3 through 6 have been replaced with growth in employment and wages, first from t to $t+3$, and then from $t+3$ to $t+6$. To make the comparison more salient, we limit all regressions reported in this table to a common sample of firms: the 1995 entrants that survived through the last year in our sample (2001), and which have at least some employees at the end of years t, $t+3$, and $t+6$.[13] In addition, growth regressions in table 10 (columns 3 through 6) include controls for initial firm size.[14]

Common work experience

Firms with higher network concentration have a higher number of employees (larger firm size) and higher average wages. This relationship is positive and significant in all periods considered: at t (inception), $t+3$ and $t+6$. However, the magnitude of the effect of HHI on both performance measures decreases in time (see table 9). To see this initial and growth effects decomposed, consider table 10: columns 3 and 4 indicate a negative relationship between HHI and firm performance (conditional on survival) in the first 3 years. Columns 5 and 6 suggest that the effect dissipates beyond the 3 year mark.

The magnitude of these effects is economically significant: for instance, table 10 results apply to firms that entered the labor market in 1995 and continued to have employees through 2001. According to columns 1 and 2, new firms with strong employee ties have an immediate advantage in terms of size and wages: holding everything else constant, a new firm A whose employees have all worked together before has 55 percent more employees and 9 percent higher average wages than a new firm B whose employees have no prior joint work experience. In columns 3 and 4, compare firm A above to a firm C of same initial size, same industry and employee characteristics, but no existing employee networks. Firm A will then have 12 percent slower growth in employment, and 3 percent slower growth in average wages during its first 3 years.[15] Firms A and C will have comparable growth in the subsequent 3 years.

[13] Employment and wages in all performance regressions are considered for end-of-year employees only, to avoid double-counting. See Muendler, Rauch and Tocoian (2012) for more details on the way employment spells and earnings are reported in *RAIS*.

[14] We added these to ensure that the effect estimated isn't due merely to compositional effects: for instance, column 1 indicates that more concentrated firms start up larger than new firms with weaker employee networks. But larger firms have lower growth rates. So do more concentrated new firms have lower growth rates, even when compared to other new firms of similar starting size? Column 3 in table 10 suggests that the answer is yes.

[15] We also ran the growth regressions from table 10 without initial size controls, in effect comparing firms A and B mentioned above. These results, unreported in the paper, suggest firm A will grow at a 20 percent slower pace than firm B in terms of employment, and at a 4 percent slower rate in terms of average wages.

Employee human capital

Referring to tables 9 and 10, the impact of education on employment and average wage is mixed. Education has no detectable relationship to initial firm size and enters positively into employment growth in the first three years.[16] While education is positively related to wage levels, it enters negatively in the estimations wherein average wage growth is the measure of success. Conditional on surviving up to three years, education has no impact on the growth rates of both average wage and employment. To summarize, conditional on survival, the impact of education on entrepreneurial success as measured by growth rates in average wage and employment is unclear.

High average human capital of employees, as indicated by previous wages, is positively associated with initial firm size and average wages. This positive relationship persists as we examine performance in terms of employment growth, but is reversed for growth in wages: firms with higher average previous wages experience slower wage growth (although the overall effect is still of higher wages up to 6 years after entry, once we factor in initial levels). One possible explanation is that previous wages proxy not just for the employees' level of human capital, but also for their opportunity cost. Hiring someone away from a well paying job means you have to offer a higher initial wage, at the expense of slower wage growth. Furthermore, it could be that the types of firms that grow larger are ones that are not as intensely dependent on high-skilled labor. To the extent that this isn't controlled for by sector dummies, it could simply be that firms that grow faster are growing on the lower-skill margin and as such, average wage growth captures the composition of skill as it changes over time.

Transition from informality

The results using employment and average wage levels also (as with the survival regressions) suggest that having a higher share of initial employees with no known work history is negatively correlated with firm performance. However, we do not find any significant relationship between traceable work history and, employment and wage growth. Conditional on survival, having no known work history does not seem to impact firm growth.

Size of parent firm

As we examine initial performance and new firm growth, we find that small firm experience is no longer an advantage, in contrast with results from the survival analysis. Medium and large

[16]Note that the regressions control for previous wage as well. Therefore, the interpretation of the education coefficient speaks to the effect of education to the extent that it does not manifest in previous wage.

firm experience is predictive of higher initial employment and average wages, as well as higher employment growth for the first three years (see table 10). There is no significant correlation between parent size and wage growth or employment growth beyond the first three years, but early differences persist through the entrants' first six years, conditional on survival, as columns 5 and 6 in table 9 show.

4.3 Interpreting the results

Our main results are that network concentration is positively correlated with new firm survival, initial firm size and initial average wage levels. However, network concentration is negatively correlated with new firm growth between inception and the third year, both in terms of employment and average wage. This relationship goes to zero between years three and six. Below we provide four possible mechanisms that would generate these results. Distinguishing between these mechanisms is beyond the scope of this paper, but we hope to provide the reader with some food for thought.

Networks affect entrepreneurial outcomes

Strong network ties are indicative of better information on partner compatibility. Individuals who are well acquainted are also more motivated to ensure their joint survival. Therefore, new firms displaying stronger network links amongst employees are more likely to survive, especially through the initial phases where compatibility and determination to pull through matter most. Moreover, a closer relationship amongst new firm employees may lead to higher initial investments resulting in higher initial wages and a larger initial firm size. This is consistent with HHI being positively related to new firm survival, initial firm size, and initial average wage.

Conditional on survival, access to different (and complementary) information sets and skill backgrounds makes for more entrepreneurial firms that display higher growth in employment and earnings. This is reflected in the negative relationship between HHI and growth rates in the first 3 periods.

Financing

When starting a firm with individuals that are well acquainted, the initial level of trust may be higher. Therefore individuals may be more willing to pool resources to be better financed. Alternatively, individuals who are well acquainted may be willing to provide joint collateral, and the shared liability may make banks more willing to finance ventures involving such individuals.

These better financed new firms may start larger with higher initial wages and may be more likely to survive, especially given that access to capital is one of the biggest barriers faced by new firms.

However, conditional on survival, once a venture displays good prospects, individuals who are involved may themselves be willing to put in more of their personal/ family wealth. Furthermore, banks may also be more willing to lend once some information on venture quality is revealed. As such, these firms may display higher growth with time. Individuals who are weakly linked may be more likely to have experiences consistent with this explanation. The coefficients on the HHI could conceivably be a reflection of this differential access to financing which passes through network concentration.

To investigate the impact of this channel, we run a separate estimation for industries with low needs for external financing, using the share of external financing measured by Rajan and Zingales (1996). We find that the impact of network concentration on survival is *not* weaker for these industries - the coefficients are comparable or even higher (although not significantly so) at t+1 through t+4. At t+5 and t+6, coefficients are imprecisely estimated due to the low number of observations.[17] These results suggest that increased access to credit is not a significant channel through which network concentration relates to firm survival.

Selection into entrepreneurial networks

Individuals of different types may select into network types differentially. For example, less risk averse individuals (say younger people) may be more likely to work with people they are less acquainted with in exchange for a higher payoff upon success. This characteristics may also reflect the choice to engage in riskier ventures that are more likely to fail. Conditional on initial survival, these firms could be the ones to experience higher growth. This story would also result in the relationships we find between HHI and our various measures of success.

Selection by entrepreneur type need not be dictated by risk tolerance alone. Work style preferences and life goals may vary as well, and may account for selection not just into different types of networks, but also into different types of (previous) employment: perhaps there exist two large classes of entrepreneurs: on one hand, there are small scale entrepreneurs who start a firm because they value their independence, not because they aim to create a multi-billion dollar company. They are likely to partner up with close friends, and have most likely been employed at other small firms before. They keep their new business afloat even if performance is less than stellar, so their firms

[17] We tried a similar estimation for industries with *high* external finance needs, but the number of observations is too small to obtain predictive power.

will have higher survival rates, even as they create less employment. On the other hand, we have ambitious entrepreneurs, with prior work experience at higher-performing larger firms. They start on a bigger scale, have more aggressive growth plans for their company, and need to take more risks to achieve higher growth, therefore face higher failure rates.

Choice to stay in or leave an industry

Firms that display higher network concentration may be ones that remain in the same industry as the entering employees (hence the larger starting size and initial wage since industry specific productivity is more transparent). Individuals who jointly choose to move into being involved with a start-up may be more likely to do so within the same industry. Therefore, employees have industry specific skills and knowledge gathered from their previous place of employment and as such are more likely to survive. Firms that display low network concentration may reflect the founders' / employees' choice to switch into a different industry. This shift may reduce the odds of survival due to their lack of familiarity with the internal workings of the new industry. Conditional on surviving these firms with "industry switchers" catch up and do as well or better (steeper learning curve, leading to initial growth). This is another possible explanation for our results.

This section shows that there are multiple interpretations for the results found in this paper. While we do not causally identify any single mechanism that leads to entrepreneurial success, this exercise still documents a striking relationship between network concentration and new firm success. We also show how sensitive results are to the definition of entrepreneurial success and the timeline over which our hypotheses are evaluated. Our results combined with these various interpretations gives the reader some direction in thinking through what successful entrepreneurship means.

Unobserved heterogeneity and selection bias

This paper does not seek to make any causal claims. Firstly, we have yet to address the fact that there is heterogeneity in the number of previously conjoined workers in new firms. Unobserved heterogeneity can come from any factor that correlates with the the type of network links we observe, but that doesn't actually pass through the network. For example, firms with higher human capital could have higher social capital and this may result in over-emphasizing the impact of strong links. Secondly, the process by which the future entrepreneur selects which (if any) employees to hire away from the parent firm introduces selection bias: even if worker quality in the parent firm varies randomly, an entrepreneur that happens to have higher quality coworkers will enlist more of them than his unlucky counterpart, so what we observe as a higher preponderance

of cluster networks in well-performing start-ups may in fact be due to the higher quality of workers. We do control for worker skill as much as possible (education, age, formal sector experience, former wage), but there are always residual unobserved characteristics, so the risk remains that we are over-estimating the impact of strong links (cluster networks) on firm performance. Thirdly, it is possible that the very quality of one's peers induces them into jointly forming a new firm.

5 Conclusion

This paper provides some strong empirical evidence for multiple phenomena in entrepreneurship. Our main result is that the strength of ties does matter for entrepreneurial success. Specifically, firms whose employees have previous joint work experience tend to survive longer, are bigger at inception, and have higher initial average wages. Conversely, joint previous work experience is *negatively* associated with new firm *growth* up to three years after entry, and uncorrelated with growth thereafter. However, this latter effect is of smaller magnitude, so that the initial performance differentials persist, and firms with higher initial network concentrations have more employees and higher wages up to six years after entry - the maximum length of time we can track them. We also find that new firms wherein the initial employees were previously employed at smaller firms are more likely to survive than new firms whose employees have larger firm experience instead. Despite this, employees from larger parent firms are positively associated with success as defined by a new firm's initial size, wage and employment growth rates.

As incidental findings, we observe that firm success is positively correlated with mean employee education and negatively correlated with mean employee age. Our final observation is that new firms that have a larger proportion of "untracked" employees, i.e. employees newly entering the labor force or transitioning in from the informal sector, are less likely to succeed.

The literature on entrepreneurial networks is a fairly thin one, and this paper provides at least a sliver of insight into the types of links that contribute to entrepreneurial success. While we use the most basic of measures to estimate network ties, we are able to point to startling and significant trends that have yet to be addressed in the empirical literature. In pointing to these trends, this paper guides readers to thinking more carefully about what being a successful entrepreneur means, how this can be measured, and what characteristics lead to successful outcomes.

From a policy perspective, thinking about these issues should provide some insight into why individuals start new firms, whom they choose as business partners, and which ventures we should encourage when trying to promote truly entrepreneurial activity.

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6 Figures

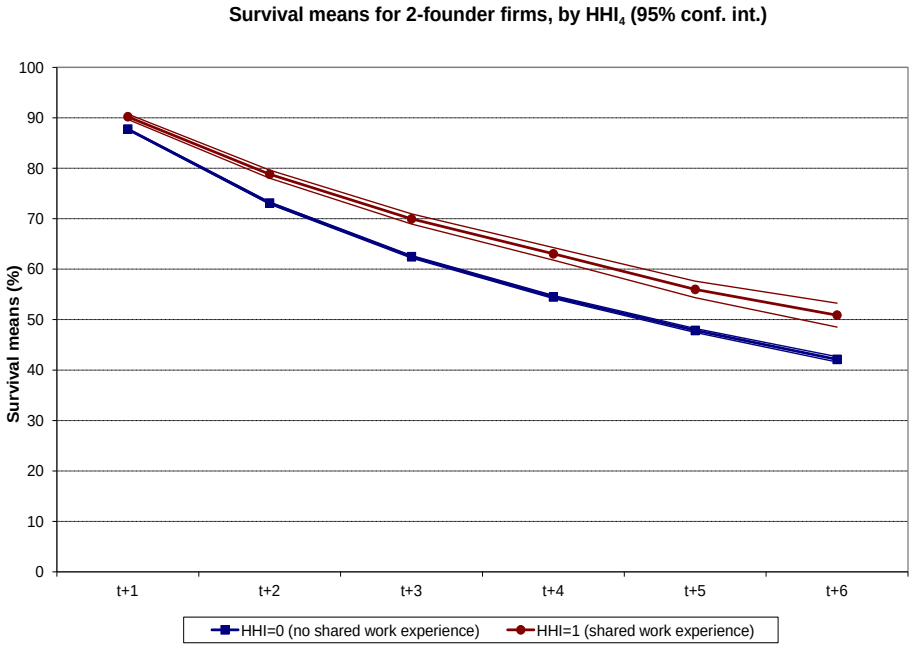

Figure 1: Average survival rates for 2-employee firms, by HHI_4

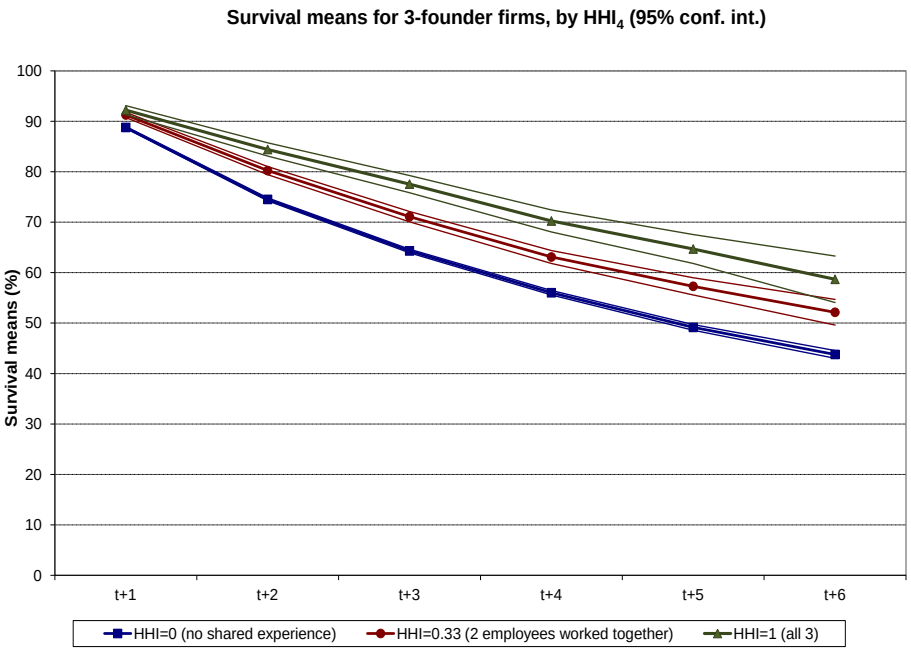

Figure 2: Average survival rates for 3-employee firms, by HHI_4

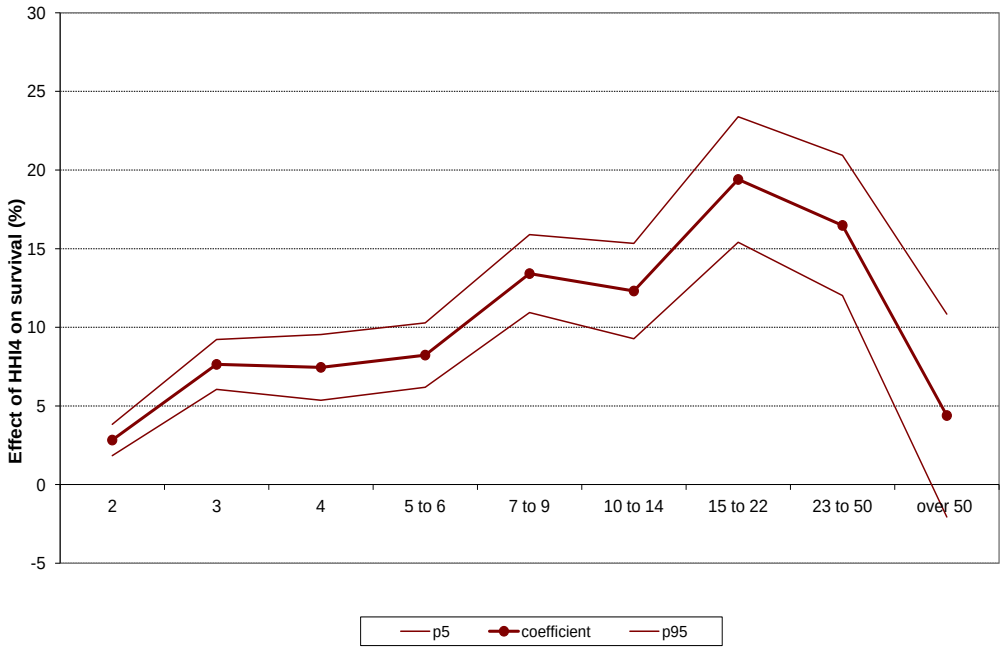

Figure 3: Survival impact of HHI_4 at t+3, by initial firm size

7 Tables

Table 1: HHI values in 2-employee firms

HHI_1	HHI_2	HHI_3	HHI_4	
0	.	0.5	0	No worker can be tracked
0.25	.	0.5	0	One can be tracked
0.5	0.5	0.5	0	Both tracked, but to different parents
1	1	1	1	Both tracked to same parent

Table 2: HHI values in 3-employee firms

HHI_1	HHI_2	HHI_3	HHI_4	
0	.	0.33	0	No worker can be tracked
0.11	.	0.33	0	One can be tracked
0.22	0.5	0.33	0	Two can be tracked, to different parents
0.33	0.33	0.33	0	All three can be tracked, all to different parents
0.44	1	0.56	0.33	Two can be tracked, to the same parent
0.56	0.56	0.56	0.33	All three can be tracked, 2 to the same parent
1	1	1	1	All three can be tracked tracked, all to same parent

Table 3: Average parent size breakdown

Unknown parent size	14.3%
Small parents (less than 10)	14.7%
Medium parents (10 to 100)	37.1%
Large parents (100 to 1,000)	26.5%
Very large parents (1,001+)	7.4%

Table 4: HHI_3 and HHI_4, by initial number of employees

			HHI_3		HHI_4	
Initial size	N	Percent of total	mean	sd	mean	sd
2	227,563	32.9%	0.527	0.113	0.054	0.226
3	121,557	17.6%	0.374	0.126	0.061	0.189
4	76,332	11.0%	0.301	0.136	0.067	0.182
5	52,088	7.5%	0.256	0.138	0.070	0.172
6	36,806	5.3%	0.226	0.140	0.071	0.167
7	27,226	3.9%	0.207	0.142	0.075	0.166
8	20,962	3.0%	0.190	0.139	0.074	0.159
9	16,631	2.4%	0.175	0.138	0.072	0.156
10	13,508	2.0%	0.168	0.143	0.075	0.159
11	10,868	1.6%	0.159	0.143	0.075	0.158
12	8,879	1.3%	0.151	0.138	0.074	0.151
13	7,518	1.1%	0.151	0.150	0.080	0.162
14	6,459	0.9%	0.149	0.154	0.084	0.166
15	5,528	0.8%	0.143	0.151	0.082	0.162
Subtotal	631,925	91.4%	0.365	0.188	0.063	0.196
Total	691,098	100.0%	0.345	0.197	0.066	0.194

Table 5: HHI_3 and HHI_4, by bins of initial number of employees

			HHI_3		HHI_4	
Initial size bins	N	percent of total	mean	sd	mean	sd
2	227,563	32.9%	0.527	0.113	0.054	0.226
3-4	197,889	28.6%	0.345	0.135	0.063	0.186
5-10	167,221	24.2%	0.218	0.143	0.072	0.166
11-20	57,699	8.3%	0.146	0.148	0.079	0.159
21-50	29,201	4.2%	0.120	0.156	0.088	0.162
51-100	7,357	1.1%	0.115	0.168	0.101	0.170
101+	4,168	0.6%	0.147	0.222	0.142	0.223
Total	691,098	100.0%	0.345	0.197	0.066	0.194

Table 6: Survival regressions for HHI_4

Survival at:	t+1	t+2	t+3	t+4	t+5	t+6
	(1)	(2)	(3)	(4)	(5)	(6)
HHI4	1.76	4.84	6.47	6.80	5.98	7.41
	(.20)***	(.31)***	(.40)***	(.50)***	(.68)***	(1.05)***
Share trackable	1.17	1.85	2.28	2.52	3.11	3.04
	(.20)***	(.31)***	(.40)***	(.49)***	(.66)***	(.97)***
Share from same sector	2.24	4.31	4.87	5.43	6.42	5.56
	(.13)***	(.20)***	(.26)***	(.31)***	(.42)***	(.60)***
Mean employee age	-.07	-.07	-.07	-.09	-.07	-.11
	(.008)***	(.01)***	(.02)***	(.02)***	(.03)***	(.04)***
Share close to retirement	2.00	2.24	3.43	3.55	.16	4.94
	(.77)***	(1.14)**	(1.43)**	(1.77)**	(2.34)	(3.49)
Mean years of schooling	.32	.31	.26	.19	.12	.16
	(.02)***	(.03)***	(.03)***	(.04)***	(.05)**	(.07)**
Mean previous wage	.06	.13	.17	.18	.14	.08
	(.01)***	(.02)***	(.02)***	(.03)***	(.04)***	(.05)
Unknown parent size	-1.61	-2.23	-2.13	-2.16	-3.24	-3.63
	(.28)***	(.44)***	(.59)***	(.78)***	(1.21)***	(1.94)*
Medium parents (10 to 100)	-.23	-.17	-.28	-.27	-.37	-.94
	(.12)*	(.19)	(.25)	(.31)	(.43)	(.63)
Large parents (100 to 1,000)	-1.41	-1.95	-2.14	-1.92	-1.89	-2.77
	(.14)***	(.21)***	(.27)***	(.34)***	(.46)***	(.67)***
Very large parents (1,001+)	-1.59	-1.97	-2.09	-1.63	-1.58	-2.58
	(.19)***	(.28)***	(.35)***	(.43)***	(.58)***	(.86)***
Initial size categories	Yes	Yes	Yes	Yes	Yes	Yes
Cohorts	Yes	Yes	Yes	Yes	Yes	Yes
Sectors	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	556,707	447,820	343,444	245,502	139,709	64,591
R^2	.02	.03	.04	.05	.07	.08

Notes: Dependent variable is the survival indicator multiplied by 100. Robust standard errors are shown in parentheses. Significance indicated is at 10%(*), 5%(**), and 1%(***).

Table 7: Survival regressions for HHI_4, hazard rate (conditional on survival the year before)

Incremental survival at:	t+1	t+2	t+3	t+4	t+5	t+6
	(1)	(2)	(3)	(4)	(5)	(6)
HHI4	1.76	3.65	3.14	2.04	1.81	4.07
	(.20)***	(.27)***	(.31)***	(.39)***	(.52)***	(.79)***
Share trackable	1.17	1.06	.83	.87	.03	1.06
	(.20)***	(.28)***	(.33)**	(.41)**	(.57)	(.88)
Share from same sector	2.24	2.69	1.43	1.72	1.47	.47
	(.13)***	(.18)***	(.21)***	(.25)***	(.33)***	(.51)
Mean employee age	-.07	-.03	-.01	-.06	-.001	-.06
	(.008)***	(.01)**	(.01)	(.02)***	(.02)	(.03)*
Share close to retirement	2.00	.28	.38	1.54	-2.82	-1.56
	(.77)***	(1.00)	(1.14)	(1.38)	(1.84)	(3.08)
Mean years of schooling	.32	.07	.04	.02	-.0000925	.05
	(.02)***	(.02)***	(.03)	(.03)	(.04)	(.07)
Mean previous wage	.06	.09	.07	.07	.01	-.03
	(.01)***	(.02)***	(.02)***	(.02)***	(.03)	(.05)
Unknown parent size	-1.61	-.97	-.18	-.63	-1.66	-4.25
	(.28)***	(.40)**	(.50)	(.68)	(1.09)	(1.93)**
Medium parents (10 to 100)	-.23	-.11	-.27	.22	-.35	-.43
	(.12)*	(.17)	(.21)	(.26)	(.36)	(.55)
Large parents (100 to 1,000)	-1.41	-1.07	-.91	-.36	-.58	-1.11
	(.14)***	(.19)***	(.23)***	(.28)	(.38)	(.59)*
Very large parents (1,001+)	-1.59	-.91	-.87	-.24	-1.28	-.92
	(.19)***	(.25)***	(.29)***	(.35)	(.48)***	(.75)
Initial size categories	Yes	Yes	Yes	Yes	Yes	Yes
Cohorts	Yes	Yes	Yes	Yes	Yes	Yes
Sectors	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	556,707	404,115	265,097	164,884	82,606	33,897
R^2	.02	.02	.02	.02	.02	.03

Notes: Dependent variable is the survival indicator multiplied by 100. Robust standard errors are shown in parentheses. Significance indicated is at 10%(*), 5%(**), and 1%(***).

Table 8: Survival regressions for HHI_4, hazard rate, alternate measures of concentration

Incremental survival at:	t+1	t+2	t+3	t+4	t+5	t+6
	(1)	(2)	(3)	(4)	(5)	(6)
Share unconnected workers	-2.93	-3.25	-.44	-.11	-.06	1.44
	(.40)***	(.54)***	(.65)	(.81)	(1.09)	(1.65)
Share of top network	-.80	.94	4.34	3.15	3.64	7.48
	(.59)	(.80)	(.97)***	(1.21)***	(1.62)**	(2.48)***
Share trackable	3.61	3.75	.82	.68	-.39	-.63
	(.43)***	(.59)***	(.70)	(.88)	(1.18)	(1.79)
Share from same sector	2.03	2.47	1.24	1.58	1.24	.34
	(.13)***	(.18)***	(.21)***	(.26)***	(.34)***	(.52)
Mean employee age	-.07	-.03	-.01	-.06	-.003	-.06
	(.008)***	(.01)***	(.01)	(.02)***	(.02)	(.03)*
Share close to retirement	1.93	.23	.31	1.50	-2.96	-1.55
	(.77)**	(1.00)	(1.14)	(1.38)	(1.84)	(3.07)
Mean years of schooling	.32	.07	.04	.02	-.001	.04
	(.02)***	(.02)***	(.03)	(.03)	(.04)	(.07)
Mean previous wage	.06	.09	.07	.07	.01	-.03
	(.01)***	(.02)***	(.02)***	(.02)***	(.03)	(.05)
Unknown parent size	-1.66	-1.03	-.25	-.68	-1.76	-4.28
	(.28)***	(.40)***	(.50)	(.68)	(1.09)	(1.93)**
Medium parents (10 to 100)	-.17	-.05	-.23	.25	-.29	-.42
	(.12)	(.17)	(.21)	(.26)	(.36)	(.55)
Large parents (100 to 1,000)	-1.33	-.99	-.83	-.31	-.50	-1.07
	(.14)***	(.19)***	(.23)***	(.28)	(.38)	(.59)*
Very large parents (1,001+)	-1.60	-.94	-.92	-.29	-1.38	-1.01
	(.19)***	(.25)***	(.29)***	(.35)	(.48)***	(.75)
Initial size categories	Yes	Yes	Yes	Yes	Yes	Yes
Cohorts	Yes	Yes	Yes	Yes	Yes	Yes
Sectors	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	556,707	404,115	265,097	164,884	82,606	33,897
R^2	.02	.02	.02	.02	.02	.03

Notes: Dependent variable is the survival indicator multiplied by 100. Robust standard errors are shown in parentheses. Significance indicated is at 10%(*), 5%(**), and 1%(***).

Table 9: Performance at entry and conditional on survival, for HHI_4

	t		t+3		t+6	
	ln(empl)	ln(ave wage)	ln(empl)	ln(ave wage)	ln(empl)	ln(ave wage)
	(1)	(2)	(3)	(4)	(5)	(6)
HHI4	.49	.07	.29	.04	.20	-.003
	(.006)***	(.003)***	(.01)***	(.005)***	(.03)***	(.01)
Share trackable	-.42	.33	-.13	.29	-.13	.26
	(.005)***	(.003)***	(.01)***	(.005)***	(.03)***	(.01)***
Share from same sector	.25	.07	.22	.05	.19	.05
	(.004)***	(.002)***	(.007)***	(.003)***	(.02)***	(.008)***
Mean employee age	.003	.007	.0003	.002	.0004	.0004
	(.0002)***	(.0001)***	(.0004)	(.0002)***	(.001)	(.0005)
Share close to retirement	-.32	-.12	-.41	-.02	-.34	.09
	(.02)***	(.01)***	(.04)***	(.02)	(.10)***	(.05)*
Mean years of schooling	-.005	.02	.008	.02	.01	.01
	(.0005)***	(.0003)***	(.0009)***	(.0005)***	(.003)***	(.001)***
Mean previous wage	.007	.04	.02	.04	.02	.03
	(.0003)***	(.0005)***	(.0008)***	(.0008)***	(.002)***	(.002)***
Unknown parent size	-.19	.02	-.11	.01	-.03	-.08
	(.004)***	(.004)***	(.01)***	(.007)	(.06)	(.03)***
Medium parents (10 to 100)	.50	.07	.47	.07	.42	.06
	(.003)***	(.002)***	(.006)***	(.003)***	(.02)***	(.008)***
Large parents (100 to 1,000)	.64	.08	.61	.08	.59	.07
	(.003)***	(.002)***	(.007)***	(.003)***	(.02)***	(.009)***
Very large parents (1,001+)	.14	.02	.20	.03	.24	.04
	(.005)***	(.003)***	(.01)***	(.005)***	(.03)***	(.01)***
Cohorts	Yes	Yes	Yes	Yes	Yes	Yes
Sectors	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	551,674	551,674	213,071	213,071	29,565	29,565
R^2	.18	.28	.15	.25	.17	.25

Notes: Robust standard errors are shown in parentheses. Significance indicated is at 10%(*), 5%(**), and 1%(***). Number of employees and average wages reported are for workers employed on December 31st of each year. Columns 1 and 2 include all firms born between 1995 and 2000, but since some no longer have employees by the end of their first year, the number of observations is lower than in t+5 survival regressions (for example column 1 of table 7). Columns 3 and 4 include firms born in 1995 through 1998, and which have survived through their third year. Columns 5 and 6 include firms born in 1995, and which have survived through 2001.

Table 10: Performance at entry and growth conditional on survival, for HHI_4, controlling for initial size

	performance at entry		growth from t to t+3		growth from t+3 to t+6	
	ln(empl)	ln(ave wage)	ln(empl)	ln(ave wage)	ln(empl)	ln(ave wage)
	(1)	(2)	(3)	(4)	(5)	(6)
HHI4	.39	.04	-.14	-.03	.03	.001
	(.03)***	(.02)***	(.02)***	(.01)**	(.02)	(.01)
Share trackable	-.45	.35	.15	-.07	.02	-.05
	(.02)***	(.02)***	(.03)***	(.01)***	(.02)	(.01)***
Share from same sector	.22	.06	.02	-.006	-.005	.007
	(.01)***	(.009)***	(.01)	(.007)	(.01)	(.007)
Mean employee age	.005	.006	-.002	-.005	-.003	-.001
	(.001)***	(.0006)***	(.001)*	(.0005)***	(.0009)***	(.0004)**
Share close to retirement	-.46	-.17	-.02	.17	.02	.07
	(.08)***	(.06)***	(.08)	(.05)***	(.07)	(.04)*
Mean years of schooling	-.001	.02	.009	-.007	.002	.0003
	(.002)	(.001)***	(.002)***	(.001)***	(.002)	(.0009)
Mean previous wage	.01	.05	.01	-.007	.002	-.004
	(.002)***	(.003)***	(.002)***	(.0009)***	(.002)	(.0007)***
Unknown parent size	-.16	-.05	.09	.003	.04	-.04
	(.04)***	(.03)	(.05)*	(.03)	(.05)	(.02)
Medium parents (10 to 100)	.53	.08	.08	.002	-.02	-.0009
	(.01)***	(.009)***	(.01)***	(.008)	(.01)	(.007)
Large parents (100 to 1,000)	.72	.10	.11	-.002	.01	-.001
	(.01)***	(.01)***	(.02)***	(.009)	(.01)	(.008)
Very large parents (1,001+)	.24	.07	.09	-.007	-.01	-.01
	(.02)***	(.01)***	(.02)***	(.01)	(.02)	(.01)
Initial size categories			Yes	Yes	Yes	Yes
Cohorts	Yes	Yes	Yes	Yes	Yes	Yes
Sectors	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	27115	27115	27115	27115	27115	27115
R^2	.22	.33	.12	.04	.05	.03

Notes: Robust standard errors are shown in parentheses. Significance indicated is at 10%(*), 5%(**), and 1%(***). Number of employees and average wages reported are for workers employed on December 31st of each year. Only firms with end-of-year employees at t, t+3, and t+6 are included. If we don't control for initial size in the growth regressions (columns 3-6), results don't change substantively.

A Appendix

Table 11 summarizes the results from 36 survival regressions, showing just the coefficients on the relevant network concentration variable.

First, we compare the three indices with each other (since HHI_4, our baseline measure, is just a rescaling of HHI_3). Note that the coefficients on the HHI_1 and HHI_3 indeces are remarkably similar, given the different definitions. The impact of "share trackable" (not reported here) does change in the direction we expect, since HHI_1 unfairly gives zero share to employees who are new to the formal labor market.

Comparing the coefficients on HHI_4 in the baseline regressions (tables 6 and 7) with the coefficients on HHI_3 reported in table 11, we observe that the coefficients on the HHI variable are smaller in the former; this is natural, since HHI_4 takes on a wider range of values for small firms (0 to 1, instead of 1/N to 1 for HHI_3), and small firms form the majority of new entrants. Other coefficients (not reported here) are largely unchanged.

Table 11: Summary of survival regressions for HHI_1, HHI_2, and HHI_3

Survival at:	t+1	t+2	t+3	t+4	t+5	t+6
HHI1	1.92 (.28)***	6.16 (.43)***	8.86 (.57)***	9.27 (.72)***	8.83 (.97)***	10.40 (1.51)***
HHI2	2.46 (.23)***	6.30 (.37)***	8.70 (.48)***	9.08 (.61)***	9.12 (.83)***	11.02 (1.28)***
HHI3	2.43 (.28)***	6.88 (.44)***	9.77 (.57)***	10.35 (.72)***	10.05 (.98)***	12.16 (1.54)***
Incremental survival at:	t+1	t+2	t+3	t+4	t+5	t+6
HHI1	1.92 (.28)***	4.77 (.37)***	4.59 (.44)***	2.73 (.55)***	3.14 (.74)***	5.98 (1.15)***
HHI2	2.46 (.23)***	4.36 (.32)***	4.24 (.37)***	2.72 (.47)***	3.34 (.64)***	5.20 (.98)***
HHI3	2.43 (.28)***	5.03 (.37)***	4.93 (.44)***	3.09 (.55)***	3.31 (.75)***	6.30 (1.17)***

Notes: Dependent variable is the survival indicator multiplied by 100. Robust standard errors are shown in parentheses. Significance indicated is at 1%(*), 0.1%(**), and 0.01%(***). Regressions include all variables indicated in table 6, coefficients are omitted for brevity.