

**Francisco Queiro, Harvard University**  
**Application: NBER Post-Doctoral Fellowship in the areas of Entrepreneurship and Innovation Policy**

Dec 1st, 2014

To the Selection Committee:

Please accept my application for the NBER's Post-Doctoral Fellowship in the areas of Entrepreneurship and Innovation Policy.

I am a PhD student in Business Economics at Harvard and will graduate in May 2015. I am interested in the determinants of productivity, with a focus on the drivers of entrepreneurial performance, innovation and firm growth and the connection between firm dynamics and aggregate productivity.

My job market paper, which I will continue to develop next year, investigates the relationship between managerial education and firm performance and the aggregate implications of differences in managerial education.

Empirical studies of firm dynamics have shown that there is substantial heterogeneity in firm growth and survival within narrowly defined sectors (e.g. Dunne, Roberts, and Samuelson, 1989), but little is known about systematic relationships between these outcomes and firm characteristics other than size and age. Identifying the sources of this heterogeneity will contribute to a better understanding of entrepreneurial performance, of reallocation and selection patterns, and of aggregate productivity growth. It can also have important policy implications for the promotion of entrepreneurship and innovation.

I study one possible source of firm heterogeneity: managerial human capital. The relationship between management and firm performance is an old topic (e.g. Penrose, 1959; Lucas, 1978), but evidence of its importance has only recently started to accumulate (e.g. Bertrand and Schoar (2003), Bloom and Van Reenen, 2007; Gennaioli et al., 2013; Bruhn, Karlan and Schoar, 2013). These studies have mostly focused on small samples of particular sectors or firm sizes over short periods of time, and measured managerial quality through a set of practices or consulting services. My paper complements these studies by using administrative data for the universe of firms in an economy over a 15 year period, and by focusing on a simple attribute of the managers themselves - their educational attainment. This enables me to obtain precise estimates of the relationship between managerial education and firm performance that is representative of the entire distribution of firms and to examine how this relationship varies along key dimensions, such as the firm's lifecycle.

The paper uses data from *Quadros de Pessoal*, a matched employer-employee administrative data set collected by the Ministry of Employment in Portugal covering the universe of firms with at least one employee. The data cover the period from 1995 to 2009 annually, and include six-digit standardized occupational codes for all firm workers, including owners and unpaid family workers, as well as their educational attainment and age. The worker occupational codes include top managerial positions with titles such as "general manager," "operations manager," or "small business manager," and I use these titles to identify a firm's manager(s). On average, firms in the sample have 1.5 managers, out of a total of 13.75 workers. Managers have an average of 8.8 years of schooling, with a standard deviation of 4.34 years of schooling.

I start by using the data to examine the relationship between firm growth and manager education, where firm growth is defined as the yearly growth rate of employment and education as years of completed schooling. I compare firms within cells based on the firm's age, 2-digit sector, headquarter location and year of observation, controlling flexibly for firm size, non-manager education and manager and non-manager age<sup>1</sup>. I find that firm growth increases with manager education, both in expectation<sup>2</sup> and conditional on survival. In expectation, firm growth increases by 0.20 percentage points per year of manager schooling, with a 95 percent confidence interval of (0.16,0.24), while conditional on survival it increases by 0.21 percentage points per year of manager schooling (0.17,0.25). Survival and manager education are, as these results suggest, very weakly related. The results also hold for longer run growth. 10-year growth rates increase by 1.31 percentage points per year of manager schooling in expectation, and 1.40 percentage points conditional on survival. This is at least partly driven by the fact that manager education is a highly persistent firm characteristic, with a 10-year autocorrelation of 0.74. Quantitatively similar results hold when firm growth is measured by sales growth instead of employment growth.

The relationship is increasing at all levels of schooling, and slightly convex. It is stronger at earlier stages of the firm's lifecycle, ranging from 0.42 percentage points for firms up to five years old to 0.07 percentage points for firms beyond age 20. The relationship is also stronger for firms with professional managers, which represent 25 percent of all firm-years in the sample and 40 percent of firm-years with college educated managers. For firms with at least one professional manager, the coefficient on manager education rises to 0.33, while for owner-managed firms it falls to 0.13, both coefficients still highly statistically significant.

One interesting question is whether these results are mostly driven by typical firms or by "superstars". Previous research has shown that the vast majority of firms never grow much, and that this is often a deliberate choice (e.g. Hurst and Pugsley, 2011). Preliminary results from quantile regressions show that the relationship is indeed stronger at the top quintile of the distribution, suggesting that manager education may be an important constraint for the small fraction of firms that do strive to grow. I plan to explore this further.

To get a sense of the magnitude of these results, I next turn to the relationship between manager education and initial firm size. Comparing firms at entry within 2-digit sector, headquarter location, and year of observation cells, I find that firms are 2.6 percent larger per year of manager schooling. I then combine the coefficients from the firm growth and initial size regressions to construct expected relative employment histories, conditional on survival, for managers with different levels of education. I use age-specific growth coefficients to capture the stronger relationship in the early stages of the lifecycle. As an example, a firm with a university-educated manager (17 years of schooling) starts out about 40% larger than a firm with a primary-school-educated manager (4 years of schooling). By age 12, the average firm age in the sample, a firm with a university-educated manager is over twice as large. And by age 40 it is nearly four times larger.

---

<sup>1</sup> The results also hold using only within-firm variation in manager and non-manager education

<sup>2</sup> Where a growth rate of -1 is assigned to firms that exit

The final section of this project, which I am planning for the coming year, will focus on interpreting these results in light of standard models of firm dynamics and using calibrations to investigate the aggregate implications of differences in managerial education.

In standard models of firm dynamics with heterogeneous firms (e.g. Jovanovic, 1982; Hopenhayn, 1992; Melitz, 2003), firm size reflects productivity differences and firm growth reflects productivity growth. At each moment in time, each firm grows to the point where decreasing returns to scale or downward sloping demand curves equalize marginal products across all firms. In these models, firm size and growth are better measures of a firm's true productivity level and growth than measures like labor productivity or revenue-based TFP. For example, Hsieh and Klenow (2014) use a closed economy version of Melitz (2003) to infer that average lifecycle productivity growth in manufacturing plants is higher in the U.S. than in Mexico or India, even though revenue-based TFP growth is similar in the three countries. Their result is driven by the fact that average lifecycle employment growth is higher in the U.S..

If the relationship between managerial education and firm growth is given a causal interpretation, then in light of these models this relationship should be interpreted as the effect of managerial education on firm productivity growth. And in addition to this within-firm effect, managerial education can also drive aggregate productivity through selection, allowing more productive firms to expand and forcing the least productive ones to exit. I plan to do a calibration exercise similar to that implemented by Hsieh and Klenow (2014) to quantify these effects and investigate the extent to which differences in managerial education can explain differences in aggregate productivity.

In addition to my job market paper, I plan to continue working on a project on the history of knowledge production leading up to the Industrial Revolution. For this project, I constructed a new database of over ten million books published in Europe from 1450 to 1800. The database consists of individual book records from over 72,000 library catalogs around the world, including most major national libraries. The data show that in Protestant countries there was a striking increase in book production after the introduction of Protestantism, while in Catholic countries book production remained low throughout the period. The same pattern holds when comparing Protestant and Catholic territories within Germany after the Peace of Westphalia in 1648.

The relationship between Protestantism and literacy has been attributed to the emphasis on personal bible reading (e.g. Becker and Woessmann, 2009), but this hypothesis is not supported by the data. Except for a brief spike around the publication of Luther's 95 Theses in 1517, there were no differences in religious book production across Protestant and Catholic territories. The differences were instead spread over a variety of other fields: literature, history, philosophy, science, technology, medicine, law and social sciences. These findings suggest Protestantism significantly increased the production of knowledge. In ongoing work I am collecting biographical data on inventors to examine the city-level relationship between book production and innovation in the Industrial Revolution.

I believe my research would greatly benefit from the opportunity to learn from the community of entrepreneurship and innovation policy scholars at the NBER, to which I hope to contribute as well. I look forward to hearing from you.