ECONOMIES BEFORE SCALE:
I.T. INVESTMENT AND PERFORMANCE IN YOUNG FIRMS

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Young firms are important yet curious entities. They drive not only a significant portion of U.S. employment and output growth (Haltiwanger et al. 2016, 2013) but also innovation (Hansen 1992). And they have become economically more important in recent years, comprising a larger percentage of the U.S. manufacturing economy. Yet they are patently different from their older rivals. The latter tend to emerge from the crucible of competition, expansion, and recombination with superior productivity, greater long-term survival, and robust ongoing contributions to innovation and economic prosperity (e.g., Garcia-Macia, Hsieh, and Klenow 2015). Young firms may be more likely to die (Decker et al. 2014); yet the most successful firms in the U.S. economy today are relatively young – and becoming more youthful over time.

One explanation for this trend is that, as technology cycles shorten, the “gales of creative destruction” (Schumpeter 1934, 1942) are becoming more intense. Younger, more nimble firms may be more able to leverage cutting-edge technologies to gain advantages vis-a-vis large incumbents (e.g., Arrow 1974, Hannan and Freeman 1984, Tushman and Anderson 1986,

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1 Disclaimer: This research was conducted while the authors were Special Sworn Status researchers at the U.S. Census Bureau Research Data Centers in Atlanta and Boston. Any opinions and conclusions expressed herein are those of the authors and do not necessarily represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed.

2 Based on authors’ calculations using the Longitudinal Business Database (LBD), the average age of establishments in the manufacturing sector became younger in recent years due to a shift in the population’s overall age composition. Pending disclosure review. Also consistent with and consistent with a recent report from the Executive office of the President (2014) stating that the rate of growth of entrepreneurship in manufacturing is at its fastest pace in over two decades. (https://www.whitehouse.gov/sites/default/files/docs/manufacturing_and_innovation_report.pdf)

Anecdotal evidence suggests that new ventures are in fact taking advantage of recent IT innovations such as Cloud Computing, the Internet of Things, and “Big Data” to scale rapidly in ways that may be transformative for the economy as a whole (e.g., Machi 2010, Manyika et al. 2011).

Empirically testing this intuition, however, poses a significant data challenge. It requires recent and representative data following new ventures from birth (or soon after), including details of their IT investments in early years, and tracking their growth and performance over a significant span of time. A lack of such data has restricted our understanding to the activities in large – often public – incumbent firms. Prior work has flagged this limitation (Dedrick et al. 2003) and recent contributions (Tambe and Hitt 2012) have improved matters by collecting data with a larger proportion of small and medium-sized firms. However, an essential swath of the firm age and size distribution remains missing from our conceptualization of how diverse organizations take advantage of new technologies. The impact of recent advances in IT – in particular, vast advances in the speed, scalability, and modularity of IT and IT services – remains poorly understood (Bryne and Corrado 2016). Finally, prior work does not account for the essential distinction between size and age. While young firms are often small, the difference between size and age is critical for understanding economic dynamics – particularly employment growth (Haltiwanger et al. 2013).

This paper leverages heretofore untapped administrative data to provide evidence about emerging uses of information technology – in particular, the rise of purchased IT services such as Cloud Computing – and explores the implications for firms at different stages of their lifecycles. This advance relies on a large panel of U.S. Census Bureau micro data that provides detailed breakdowns of IT investment for the entire size and age distribution in U.S. manufacturing. To
delve into the mechanisms at work, we further link this highly representative data set to other Census surveys offering insights into variation in firm and product characteristics indicative of “entrepreneurial quality” (Guzman and Stern 2015) and potential to grow.

Using a variety of approaches to measuring firm performance, we find positive correlations between performance and three distinct subcategories of IT investment: traditional IT capital stock (computers and data processing equipment), expensed hardware and software, and purchased IT services (including Cloud Computing, among other outsourced IT services). Despite concerns about slowing IT productivity in the wake of the internet boom of the 1990s (Stiroh 2008), we find no evidence of slowing IT productivity, across all sizes and ages of firms. We take advantage of the fact that our sample spans the Great Recession (2008-2009) to explore how exogenous shocks to demand and access to capital may affect our findings, however our main results are robust to omitting these years from our sample.

Disentangling this average productivity effect for young (5 or fewer years old) versus older firms, we find that young ventures enjoy equivalent or even higher IT productivity than older establishments. Given the fact that most young firms are also small, this appears contrary to prior findings that IT productivity tends to be lower and slower to develop in smaller firms (e.g., Tambe and Hitt 2012). However, the pattern begins to make sense when we delve into different margins of IT investment, finding that the effect is driven primarily by more recent expenditure on purchased IT. Consistent with anecdotal evidence regarding sharp recent declines in the costs of purchased IT services and the importance of shifting from a fixed to a variable cost structure, we find that younger firms are able to use IT such as Cloud Computing to achieve production economies without first becoming large – i.e., gaining economies before gaining
scale. This effect increases as the technology – particularly the supply of Cloud services – takes off in the later years of our sample.4

Moreover, we see a dynamic interaction, whereby lagged purchased IT (4 years or more) boosts the productivity of accumulated IT capital stock in later years. This is consistent with learning models of IT capabilities (Attewell 1992) and makes sense of how and why investment shifts over the plant lifecycle.5 It also is consistent with anecdotes such as the dramatic shift from outsourced IT to own IT capital by the successful startup DropBox. Long-term productivity gains, in fact, only show up for traditional IT capital over the timeframe we observe.

Startups, contrary to common intuition, are also able to take advantage of traditional IT capital stock. However, this appears to be a high-risk, high reward proposition for this population. When we look at other measures of performance such as survival and growth, we find that such investments increase startups’ risk of exit, but also are better engines of long-term productivity growth than outsourced IT.

This finding has potentially important implications for economic dynamism and growth in U.S. manufacturing. Unsurprisingly, our findings are stronger in subsamples that exclude young firms that might be less growth-oriented or that might be engaged in more “artisanal” production. Finally, preliminary work using techniques to address the endogeneity of IT adoption (e.g., Blundell and Bond 2000 and Levinsohn and Petrin 2003) suggest that the relationships in our data may be interpreted as causal.

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4 Nominal expenditures at Amazon (AWS), Microsoft (Azure), Goole and Apple increased 27 percent per year between the first quarter of 2003 and the third quarter of 2015 (Bryne and Corrado 2016).
5 Young firms devote a higher share of expenditure to purchased IT services (particularly in later years) compared to older firms, which spend proportionally more on hardware and software (authors’ calculations, pending disclosure ).
An important implication of these findings is that the incidence of certain types of IT productivity in the economy may be shifting from where they had been concentrated in the past to younger, more dynamic firms. This makes it ever more important to collect data on younger and smaller establishments in order to understand the ongoing relationship between economic growth and technological change. This study speaks directly to a public-policy debate on the decline of new ventures and suggests a potential technology solution for improving the competitiveness of startups. These and other findings in the paper (e.g., concerning complementary management practices) are also vital to managers grappling with strategic technology investment decisions in the digital age.
REFERENCES


