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Firm Entry and Macroeconomic Dynamics: A State-level Analysis*

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Abstract

Using an annual panel of US states over the period 1982-2014, we estimate the response of macroeconomic variables to a shock to the number of new firms (startups). We find that these shocks have significant effects that persist for many years on real GDP, productivity, and population. This result is consistent with simple models of firm dynamics where a "missing generation" of firms affects productivity persistently.

1 Introduction

Entry of new firms is part of the "churning" process that operates in market economies: new businesses contribute to growth by increasing competition, by innovating, and by capturing market share from some less-productive incumbents.[1] Given the importance of this churning process, the precipitous decline of new business formation since 2006 has attracted attention and concern. The entry rate, defined as the ratio of the number of new firms (startups) to the total number of firms, remained in a fairly narrow range between 9.6% and 11.1% from 1990 through 2007. It then fell to 9.4% in 2008, 8.1% in 2009, and has remained between 7.8% and 8.2% through 2013, according to the Business Dynamic Statistics (BDS) constructed by the Census Bureau.

This decline naturally raises two important questions. First, what are the causes of this decline in entry? Second, what are its consequences? In this paper, we focus on the second question. Our goal is to evaluate the argument that entry acts as a propagation mechanism and leads to a significant persistent decline in GDP and in productivity. The premise of this argument is that entry is a form of investment: entrepreneurs incur significant upfront costs to start up a business, lured by the prospects of future rewards. Hence, the same factors

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[1]A large part of aggregate productivity growth comes from the reallocation of productive inputs toward more productive firms or establishments; see for instance Eric J Bartelsman & Phoebus J Dhrymes (1998).

that affect investment—for example, credit availability, uncertainty, or aggregate demand—naturally affect entry. This effect was particularly strong during the Great Recession.[2] Lower entry reduces the number of firms, and eventually aggregate productivity. Because firm dynamics are slow (in a sense that we discuss below), the effects of reduced entry on output are highly persistent.[3]

We start by briefly reviewing this theoretical argument. We then evaluate it using annual state-level data for the United States. Specifically, we estimate the response of the economy to an increase in the number of startups. We show that output and productivity are persistently affected by an increase in entry: a one-standard deviation shock to the number of startups leads to an increase of real GDP culminating to 1-1.5% and lasting ten years or possibly longer. We discuss some possible interpretations of these findings, and their implications for the aggregate economy.

Finally, we not that there has been much recent work studying the causes and consequences of the decline of entry or more generally business dynamism, which includes Thorsten Drautzburg & Gerald Carlino (2015) and the other papers of this session at the ASSA 2016 conference. In our companion paper, Francois Gourio, Todd Messer & Michael Siemer (2015), we focus on the Great Recession and provide additional empirical evidence using MSA-level data that firm entry propagates the effect of macroeconomic shocks.

2 A propagation mechanism

Why might one expect the effects of an entry shock to be persistent? The answer lies in the firm life cycle. Consider a cohort of firms born at time τ. A fraction of these firms will die before $\tau + 1$. But the firms that do not die will, on average grow. Among the survivors, a fraction again will die before $\tau + 2$; but those that do not die will, on average, grow. Hence, a lower cohort size at time τ lowers the number of age 1 firms at time $\tau + 1$, the number of age 2 firms at time $\tau + 2$, and so on, just like missing births during wartime create a "missing generation" in population demographics. If firms' death rates are large, the effect of a "missing generation" is temporary. But firms tend to grow as they age, conditional on surviving, which makes the missing generation effect more important. As a result, a reasonable calibration implies highly persistent effects. We provide a simple formal model in Gourio, Messer & Siemer (2015).

This persistence argument requires some qualifications. First, as a matter of accounting, the immediate effects of a decline in firm entry cannot be very large, because on average new firms account for only around 2-3% of total employment. Hence, even a large decline in entry has only modest direct effects on total employment and output during economic contractions as defined for instance by the NBER. But the persistence of the effects makes

[2] Other long-term structural factors are also likely at play. While the national entry rate exhibits little trend from 1990 through 2006, there was a pronounced earlier negative trend in the late 1970s and 1980s. Thus, one potential explanation is that the recent decline is the resumption of this earlier trend, which was perhaps temporarily hidden by other factors. The long-run trend may be driven by demographic changes (e.g. Fatih Karahan, Benjamin Pugsley & Ayşegül Şahin (2015)), by sectoral reallocation, or by market concentration. The sudden drop from 2006 to 2009 suggests, however, a significant role for cyclical factors such as those noted above.

[3] This mechanism has been analyzed by Erzo GJ Luttmer (2012), Gian Luca Clementi & Berardino Palazzo (forthcoming) and Michael Siemer (2014) among others.

this a plausible mechanism for fluctuations at a lower frequency, such as the slow recovery following the Great Recession or other financial crises.

Second, the argument implicitly takes as fixed several margins of adjustment. First, incumbents may benefit from lower entry. Second, the composition of entrants may change due to time-varying selection, so that the average productivity of entrants increases as the number of entrants goes down. Third, potential entrants might simply delay entry. To quantify the importance of these offsetting effects, we now turn to the data.

3 Measuring the effects of firm entry shocks

We estimate the effects of entry on output and other macroeconomic outcomes in an annual panel of US states over the period $1982-2014$.[4] We follow Òscar Jordà (2005) and estimate local projections, which can be readily used to construct impulse responses. For each lead $k = 1, 2, ..., 12$ (in years), we estimate by least squares

$$y_{i,t+k} = \alpha_i^k + \delta_t^k + \gamma_k s_{i,t} + x'_{i,t}\beta^k + \varepsilon_{i,t}^k, \tag{1}$$

where $y_{i,t+k}$ is an outcome variable, α_i^k is a state fixed effect, δ_t^k is a time fixed effect, $s_{i,t}$ is the log change in the number of startups in state i between $t-1$ and t, and $x_{i,t}$ a vector of controls (which always includes $y_{i,t}, y_{i,t-1}$ and $y_{i,t-2}$). Our baseline set of controls includes the t, $t-1$, and $t-2$ values of the logs of state's population, real GDP, house price index, and labor force participation rate. The impulse response at horizon k is γ_k.

Figures 1 present the response of the number of age 1 firms, the number of age 4 firms, the number of exiting firms, and the total number of firms, together with a 90% confidence band.[5] By definition, the impulse response depicts the response to a 1 percent increase in the number of startups, holding the controls fixed.[6] The panel (a) shows that a shock leads to a persistent increase in the number of firms age 1 before entry returns to normal. Panel (b) shows that the number of firms age 4 initially declines a bit, suggesting that some incumbents are displaced by the new entrants, but later rises, by about 0.6%, when the new entrants age. This panel demonstrates that the age dynamics on which the propagation mechanism is predicated are present in the data. That is, an increase in the number of young firms leads, with a delay, to an increase in the number of "middle-aged" firms (and, later, to an increase in the number of "old" firms). Hence, the additional entrants do not disappear after a few years as might be expected if either the "selection" or "delay" story holds. Moreover, a shock to entry increases slightly the number of exiting firms, figure 1 panel (c). The panel (d) finally shows that the overall number of firms rises for several years by about 0.1% following an entry shock. Hence, the increase in entry is not offset by a simultaneous, equal increase in exit of incumbents.

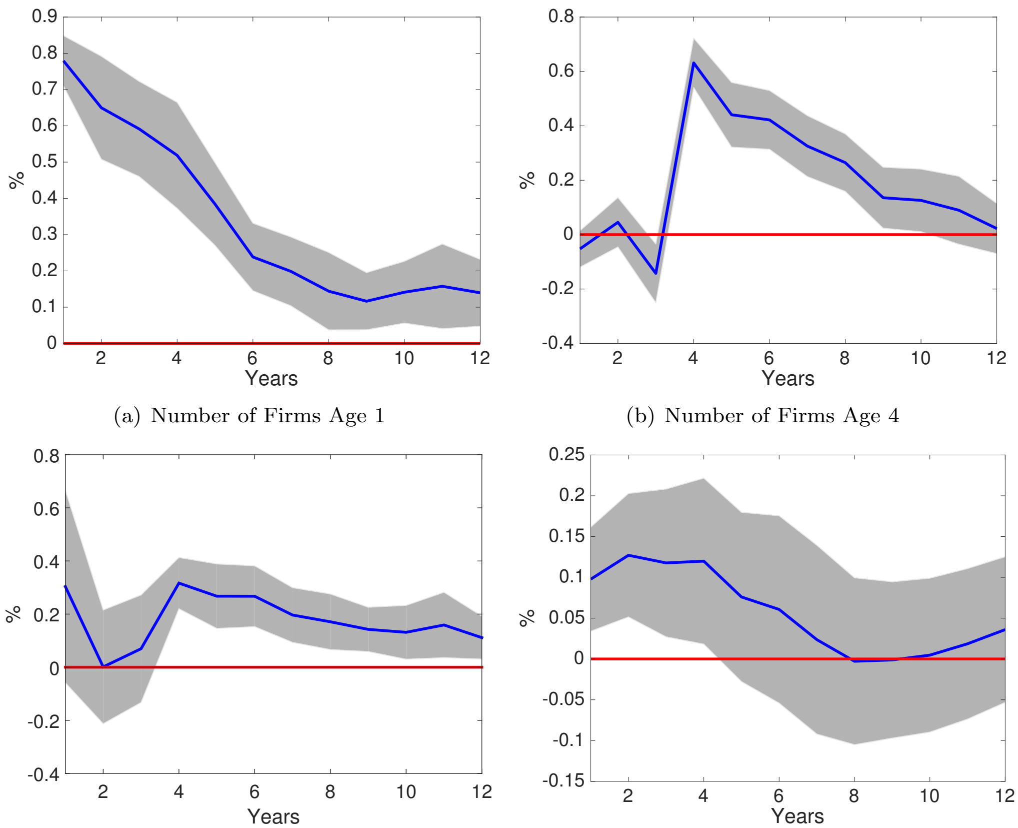
Figure 2 depicts the response of real GDP, a proxy for total factor productivity (TFP), employment, population and the house price index (HPI). Our proxy for TFP is the ratio

[4] Our panel is constructed by merging entry data from the Census (BDS) with measures of economic activity from the BEA and the BLS, house prices from FHA, and population from the Census Bureau.

[5] The standard errors are obtained by SURE and clustered by year.

[6] Note that the standard deviation of the change in the log number of startups is around 8%, and around 5.5% once the controls are included.

Figure 1: Impulse response to a shock to entry



(a) Number of Firms Age 1 (b) Number of Firms Age 4

(c) Number of Exiting Firms (d) Total Number of Firms

Notes: This figure reports the impulse response functions for the number of firms age 1, Age 4, the number exiting firms, and the total number of firms. The impulse response functions are computed using local projection methods. For each lead $k = 1, 2, ..., 12$ (in years), we estimate by least squares

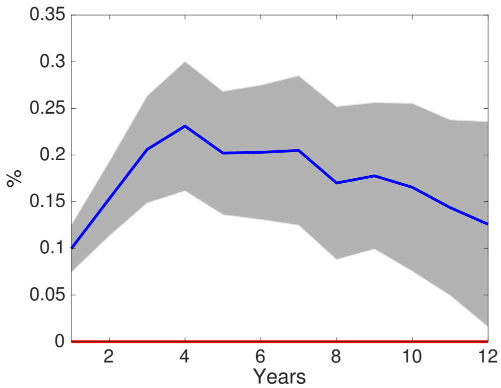
$$y_{i,t+k} = \alpha_i^k + \delta_t^k + \gamma_k s_{i,t} + x'_{i,t}\beta^k + \varepsilon_{i,t}^k, \tag{2}$$

where $y_{i,t+k}$ is an outcome variable, α_i^k is a state fixed effect, δ_t^k is a time fixed effect, $s_{i,t}$ is the log change in the number of startups in state i between $t-1$ and t, and $x_{i,t}$ a vector of controls (which always includes $y_{i,t}, y_{i,t-1}$ and $y_{i,t-2}$).

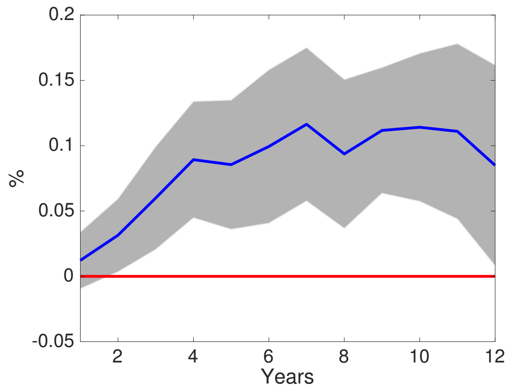
of real GDP to nonfarm employment to the power 2/3. The left panel shows that real GDP rises by about 0.1% on impact and 0.2% after three years, and the effects are persistent, with zero being outside the 90% confidence band even twelve years later. The initial hump-shape might be due either to young firms' growth dynamics or more simply to the persistence of the entry shock. The increase in real GDP is sustained over time, and lasts longer than the entry increase, suggesting that the persistence mechanism has some bite. The magnitude is economically important - a one standard deviation shock to the number of startups leads to an increase of GDP around 1.2%.

The panel (b) shows that our proxy for total factor productivity also responds significantly and persistently, as suggested by simple models of firm dynamics. The increase in the proxy for TFP occurs as the increase in output is accompanied by only a minor increase in employment, see panel (c). Panel (d) depicts the effect on population (16-64 years

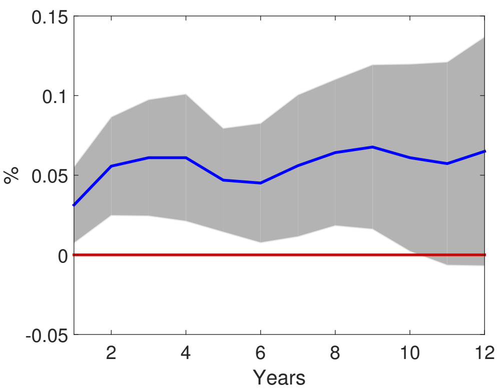
Figure 2: Impulse response to a shock to entry cont.



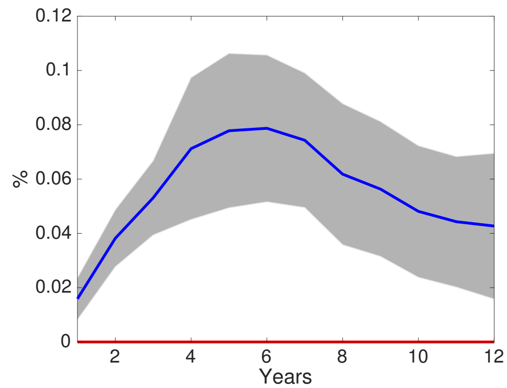
(a) Real GDP



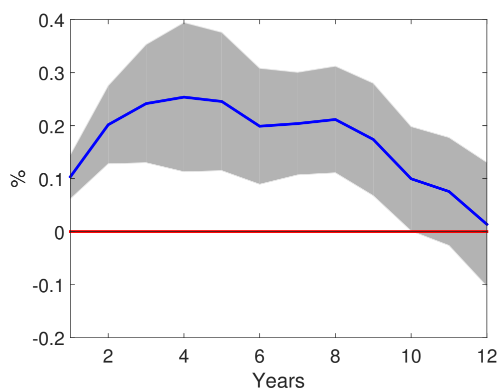
(b) TFP Proxy



(c) Employment



(d) Population



(e) House Price Index

Notes: This figure reports the impulse response functions for real GDP, a proxy for TFP, non-farm employment, population and the house price index. The impulse response functions are computed using local projection methods. For each lead $k = 1, 2, ..., 12$ (in years), we estimate by least squares

$$y_{i,t+k} = \alpha_i^k + \delta_t^k + \gamma_k s_{i,t} + x'_{i,t}\beta^k + \varepsilon_{i,t}^k, \tag{3}$$

where $y_{i,t+k}$ is an outcome variable, α_i^k is a state fixed effect, δ_t^k is a time fixed effect, $s_{i,t}$ is the log change in the number of startups in state i between $t-1$ and t, and $x_{i,t}$ a vector of controls (which always includes $y_{i,t}, y_{i,t-1}$ and $y_{i,t-2}$).

old), which is also significant and long-lasting, but is smaller, around 0.02% growing to 0.08%, so that GDP per capita rises following the entry shock. The increase in population likely reflects higher economic activity in the state attracting population from other states.[7] The state's labor market hence tightens in response to the entry shock, which leads to the population inflows, bringing the employment-population ratio (not shown) back to normal.

As shown in panel (e), house prices increase significantly with the entry shock, as would be expected given the increase in income and population, while the employment rate increases.

Table 1 presents the estimated γ_k for $k = 4$—that is, the effect after four years—for different outcome variables, together with several robustness exercises. The first column is our baseline estimate. We next consider a sample that excludes the Great Recession (column 2; 1982-2006) and one that includes the pre-1982 period (column 3; 1977-2014). The results are fairly similar to our baseline. Column 4 shows the results when the only controls are the lagged dependent variable $y_{i,t}, y_{i,t-1}$ and $y_{i,t-2}$. The effects appear larger, which likely reflects that entry is now proxying for economic conditions more broadly. In unreported results, we find a smaller but still significant effect when we weight states by population.

Table 1: Effect of a shock to entry four years later

	(1)	(2)	(3)	(4)	(5)
GDP	.23	.21	.16	.3	.12
	(4.78)	(3.92)	(2.56)	(6.34)	(3.52)
TFP proxy	.09	.09	.05	.21	.06
	(3.12)	(3.31)	(1.74)	(5.04)	(2.45)
Population	.07	.07	.06	.11	-
	(3.77)	(3.26)	(2.52)	(4.6)	-
Employment	.06	.07	.04	.09	.01
	(2.4)	(2.4)	(1.46)	(3.86)	(.68)
Total Number of Firms	.2	.18	.17	.28	.09
	(3.61)	(3.52)	(3.35)	(3.93)	(2.34)
Number of Firms Age 1	.52	.44	.4	.67	.31
	(5.33)	(4.52)	(3.29)	(6.23)	(4.6)
Number of Exiting Firms	.33	.31	.19	.51	.23
	(4.77)	(4.43)	(1.71)	(3.42)	(5.28)
House Price Index	.25	.22	.21	.28	.09
	(2.74)	(2.07)	(2.44)	(2.82)	(1.1)

Notes: Estimates of γ_4 for different outcome variables and different specifications: column (1) is baseline, (2) sample without the Great Recession, (3) including pre-1982 data, (4) only lagged dependent variable as a control, and (5) includes future population growth as a control. Standard errors are two-way clustered.

Of course, one key question is how to interpret shocks to firm entry. They could reflect changes in the cost of creating a firm, such as credit availability for young firms, or changes in government policies such as regulation or taxes. They could also reflect changes in outside opportunities for entrepreneurs, or the effect of current and anticipated economic activity, which are more likely to create endogeneity issues. In particular, one might think that the

[7] We found that the population of neighboring states actually increases with the shock, while the non-neighboring states declines, suggesting that the shock may be regional in nature.

impulse responses reflect reverse causality: potential entrepreneurs anticipate population and economic growth in the state and decide to start more businesses to serve this incoming demand. In this case, the patterns depicted in the figures would be an artefact of forward-looking behavior. Column 5 of Table 1 quantifies this story by adding as a control future population (4 years ahead). The estimated effects are significantly weaker, by about 50%, but remain statistically significant at conventional levels.

This last specification (5) may amount to "overcontrolling:"we would expect that fundamental shocks to entry affect future population, so controlling for future population will reduce the magnitudes even if there is no reverse causation from expected growth to entry. Hence, these results are arguably a lower bound on the effects of entry.

One other potential worry is that we use the log change in the number of startups as our measure of the shock. We verified that alternative measures give similar results. For instance, using the change in the entry rate as a shock, or the residual of the entry rate on lagged entry rates and various controls yields similar results.

One can also test directly the "selection" story by calculating the impulse response to a change in the average size of startups (rather than a change in the number of startups). This requires the average size at birth to be a good measure of firm quality. In unreported results, we found no significant effects of average size of startups on macroeconomic outcomes.

Finally, one can use these state-level estimates to quantify the aggregate effects of the recent decline in business formation. The decline of the number of startups observed during the Great Recession is about 25%. Our estimated effect on real GDP per capita of a 1% shock is around 0.1% upon impact (this is the more appropriate variable for an aggregate analysis since population is likely exogenous to firm entry at the national level). Hence, the decline of entry leads mechanically to a 2.5% decline in GDP per capita. Since GDP per capita is currently about 10% below its pre-recession trend, this suggests that lower firm entry may account for a nontrivial share of this decline. Obviously, these estimates need to be used with caution given the significant standard errors, the imperfect identification of the entry shock, and the complexity of mapping state-level results to the national level.

4 Conclusion

Our empirical results show that at the state level, shocks to firm entry have persistent effects on macroeconomic variables including GDP, productivity, and population. At the very least, entry rates reveal information about future conditions in a state—even when a variety of controls are included. Further work is needed to understand better what shocks to entry represent. But our results are consistent with the argument that lower entry leads to persistent effects on economic activity because of a "missing generation" of firms.

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