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Business Dynamism and Economic Growth: U.S. Regional Evidence

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Business Dynamism and Economic Growth: US Regional Evidence

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Abstract

We document empirical evidence linking regional growth in the United States over the last 25 years with entrepreneurial activity, or 'business dynamism'. The main data source is the Business Dynamics Statistics (BDS) released by the US Census Bureau. We uncover a new stylised fact: across US states, it is not the *level* but rather the *change* in business entry rate that has a significant positive relationship with regional growth. Specifically, those states that have experienced a relatively large decline in the entry rate also have had weaker economic growth. Besides, our research confirms earlier found stylised facts such as the high correlation between entry and exit rates, and the convergence hypothesis which holds across the states. We conduct a number of robustness checks to establish these new and old stylised facts and conditional correlations in the BDS data.

JEL classification: O30, O40, O51.

Key words: Business Dynamism; Entry-Exit Rates; Economic Growth.

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1 Introduction

Recent research has documented a declining trend in business entry and exit rates in the US economy (Decker et al. (2014), Hathaway and Litan (2014)). Similarly, both job creation from startups, and job destruction from business closings have experienced a downward trend (Davis et al. (2007), Davis et al. (2010)). Taken together, these stylized facts are indicative of a decline in 'business dynamism' and entrepreneurial activity. Although understanding the precise sources of these trends and their implications for productivity is an active research area (Haltiwanger (2012)), their relationship with US economic growth has not yet been determined. The purpose of this paper is to fill this gap. The main question that we ask is: how is business dynamism related to long-run US regional growth? We use the term business dynamism as a catch-all for the characteristics of incumbents participating in the market, along with the role of the flows of entry and exit. We consider four dimensions of business dynamism and assess how they are linked with regional growth. These four dimensions are entry, business density per capita, business trend, and business size. The empirical analysis is based on US regional data from 1987 to 2013. The data source is the Business Dynamics Statistics (BDS) released by the US Census Bureau.

Before proceeding further, it is useful to note some aspects of our empirical approach. We follow a cross-sectional approach at the state level in the tradition of cross-country growth regressions (Barro (1991), Mankiw et al. (1992) and many others). One criticism of this earlier literature has been the use of endogenous regressors, which casts doubt on the causal claims about the determinants of economic growth. In this paper we do not make causal claims. Instead, we take advantage of the cross-sectional approach to provide new stylized facts on the links between business dynamism and US regional growth. Our approach is in the spirit of Durlauf (2009) who states (p. 325): "*Cross-country regressions have begun to evolve into a tool for pattern recognition and construction of stylized facts...[they] can eventually play the same constructive role that Kaldor's stylized facts did in the neoclassical literature.*". Our approach is also in the spirit of Geroski (1995) who describes the use of stylised facts as follows (p. 422): "*Stylized facts can be a useful way of organizing one's thinking about* *phenomena of interest, giving a broad direction to theorizing and mapping out an agenda for empirical work.*". In our context, the new stylized facts and conditional correlations based on regression analysis that we report are important for researchers studying business dynamics. The new robust patterns in the BDS data that we uncover can serve to comprehend the underlying structural mechanisms at play in the US economy.

The regional level is a particularly relevant unit of analysis for studying entrepreneurship (Backman and Karlsson (2013)). There is a large body of literature on the ways business dynamics (in particular start-up rates characterizing entrepreneurship) have impact on regional growth and development (in particular regional employment growth). The contributions to this literature are summarised by Acs and Storey (2004), Fritsch (2008), Dejardin and Fritsch (2011), and Fritsch (2011). Other studies that examine the role of entrepreneurship in the US economy at the regional level are Acs and Mueller (2008) and Carree et al. (2015). A key difference between these works and ours is that the former focussed on determining the causal impact of entrepreneurship on regional development. By contrast, our contribution is to provide cross-sectional evidence on the longer term, structural connections between US business dynamics and regional economic growth, so as to provide evidence on some new stylised facts. To obtain this goal, we measure both business dynamism and growth over the same 25-year period of time. This choice also reinforces that our focus is not on causality, but on developing stylized facts and conditional correlations.

Our results indicate that the average entry and exit rates are highly and positively correlated within each US state. This feature of the BDS data is consistent with earlier findings noted in Geroski (1995) and Caves (1998) at the firm level. In the cross-sectional empirical analysis the high positive correlation poses a multicollinearity problem that prevents separating the effects of average entry and exit on regional growth. Since we cannot use both as regressors, we choose to work with the entry rate. There is substantial variation in the entry rates across states, which facilitates our empirical analysis.

One of our main findings is that there is no significant relationship between the rate of business entry and US regional growth. We show this to be a robust feature of the BDS database for alternative measures of business creation (in terms of establishments, firms or new jobs). This result is striking because endogenous growth theories suggest a positive effect of business creation on growth (Aghion and Howitt (1992)).[1] The lack of robust evidence on this relationship, therefore, poses a challenge to theoretical models that deliver a strong and positive connection between the business entry rate and growth.

However, we clearly observe that US states that have experienced a sharper decline of entry rates over time have decreased their average rate of economic growth. Thus, taken together, the evidence suggests that although the *level* of the entry rate is not significantly linked with regional growth, its *change* is.

The rest of the paper is organized in four sections. Section 2 describes our data and methods, the empirical framework, and some descriptive statistics. Section 3 reports and discusses the results of the cross-sectional baseline regression estimation. Section 4 presents a variety of alternative specifications that have been tested to demonstrate that our headline results are robust features of the BDS data. Finally, section 5 concludes.

2 Data and methods

We use regional data from the US economy on business dynamics and economic growth. The sample period runs from 1987 to 2013 (27 annual observations) for each of the 50 states and the District of Columbia (D.C.). The first and last periods are dictated by data availability. The Bureau of Economic Analysis (BEA) compiles state-level annual data for real Gross Domestic Product (GDP) per capita which is available from 1987 onwards.[2] Each observation is defined by state s and year t. Let $y_t(s)$ denote the real GDP per capita of the US state s in year t. The source for entry and exit data is the Business Dynamics Statistics (BDS) from the US Census Bureau, with annual data covering the 50 states and D.C.[3] The last available observation is year 2013. We directly retrieve the following time series from the BDS: the total number of establishments, $N_t(s)$, establishment entry, $N_t^E(s)$, and establishment exit, $N_t^X(s)$. An establishment is defined in the BDS as 'a single physical location where business

[1] Particularly, innovation-based growth theories (Romer (1990), Aghion and Howitt (1992)) imply that the long-run rate of growth should be positively related to the level of business entry.

[2] Source: https://www.bea.gov/regional/.

[3] Source: http://www.census.gov/ces/dataproducts/bds/data.html

is conducted or where services or industrial operations are performed', and the total number of establishments is counted by the existence of some employment on March 12th of each year. Establishment entry (exit) is defined as the number of births (deaths) within the last 12 months. We have chosen to look at establishment-level data because in the BDS a firm with establishments in multiple states is counted multiple times, once in each state, irrespective of the portion of the firm residing in that state.

The BDS normalizes the ratio of entry and exit rates by the average of the current and previous observations (the Davis-Haltiwanger-Schuh (DHS) denominator).[4] Hence, the business entry rate of state s in year t is (in percentage terms)

$$B\_Entry_t(s) = 100\left(N_t^E(s)/(0.5(N_t(s) + N_{t-1}(s)))\right),$$

whereas the corresponding exit rate is

$$B\_Exit_t(s) = 100\left(N_t^X(s)/(0.5(N_t(s) + N_{t-1}(s)))\right).$$

2.1 Empirical framework

Our main objective is to examine how business dynamism is related to US regional economic growth. We adopt a cross-sectional regression approach that is widely used in the empirical analysis of economic growth. The dependent variable is the average state-level growth rate of real GDP per-capita, $g_y(s)$. There is a methodological discontinuity of the time series in 1997, when data change from SIC (1987-1997) industry definitions to NAICS (1997-2013) industry definitions. We construct $g_y(s)$ as a weighted average of the compound annualized growth rates for the 1987-1997 and 1997-2013 sub-periods, where the weights are the number

[4]Following Haltiwanger et al. (2011), the DHS denominator is the average of employment for the current and previous period in order to prevent a bias to the relationship between net growth and size due to transitory shocks.

of observations in each period relative to the sample size.[5] This is given as

$$g_y(s) = \left(\frac{10}{26}\right) g_{y,SIC}(s) + \left(\frac{16}{26}\right) g_{y,NAICS}(s),$$

where $g_{y,SIC}(s) = \left(\frac{y_{1997}(s)}{y_{1987}(s)}\right)^{1/10} - 1$ and $g_{y,NAICS}(s) = \left(\frac{y_{2013}(s)}{y_{1997}(s)}\right)^{1/16} - 1$.

One immediate constraint for the empirical analysis is that we have 51 observations (average growth rates) corresponding to 51 US regions. Since our estimation will involve at least 6 independent variables, the ratio between the number of observations to the number of independent variables can become low (say, below a 'rule-of-thumb' value of 10). This can adversely affect inference. Recognizing this constraint, we proceed by splitting the full sample in 3 subsample periods (1987-1995, 1996-2004 and 2005-2013), and construct averages of the desired variables for each of these subperiods. This step increases the number of observations by 3, to 153. We use this expanded number of observations in all our estimation exercises, and as a check also report the results based on the full sample period averages (51 observations). We will use standard errors that are clustered by state.

Let us introduce the variables to be included in the cross-sectional regression, separated between the dependent variable and the set of independent variables (regressors).

Dependent variable:

Economic growth is the dependent variable measured as the compound annual rate of growth of state-level real GDP per capita:

$$g_y(s, t_0) = \left(\frac{y_{t_0+T}(s)}{y_{t_0}(s)}\right)^{1/T} - 1$$

for the 3 subsamples specified by $t_0 = 1987$, 1996, and 2005 and $T = 8$ accumulated years in each subsample.

Independent variables:

[5]The NAICS-based statistics of GDP by state are consistent with US GDP while the SIC-based statistics of GDP by state are consistent with US gross domestic income. With the comprehensive revision of June 2014, the NAICS-based statistics of GDP by state incorporated significant improvements to more accurately portray the state economies. Two such improvements were recognizing research and development expenditures as capital and the capitalization of entertainment, literary, and other artistic originals. These improvements have not been incorporated in the SIC-based statistics, which may bring aggregation problems to construct a single time series.

The average establishment annual state-level entry rate is

$$B\_Entry(s, t_0) = \frac{1}{T+1} \sum_{t=t_0}^{t_0+T} B\_Entry_t(s).$$

for the 3 subsamples specified by $t_0 = 1987$, 1996, and 2005 and $T = 8$ accumulated years in each subsample. Likewise, the average establishment annual state-level exit rate is:

$$B\_Exit(s, t_0) = \frac{1}{T+1} \sum_{t=t_0}^{t_0+T} B\_Exit_t(s).$$

for the 3 subsamples and accumulated years specified above.

Business density is computed as the average stock of state-level establishments per 1,000 people

$$B\_Density(s, t_0) = \frac{1}{T+1} \sum_{t=t_0}^{t_0+T} \frac{N_t(s)}{P_t(s)/1,000},$$

for the 3 subsamples and the accumulated years specified above.

We measure business trend as the average annual change in the rate of state-level establishment entry

$$B\_Trend(s, t_0) = \frac{1}{T+1} \sum_{t=t_0}^{t_0+T} \left(B\_Entry_t(s) - B\_Entry_{t-1}(s)\right),$$

which misses the initial year and the 3 subsamples are specified by $t_0 = 1988$, 1996, and 2005, with accumulated years $T = 7$ for $t_0 = 1988$, and $T = 8$ for the other two subsamples $t_0 = 1996$ and 2005.

$B\_Small(s, t_0)$ is the fraction of state-level small businesses (defined as establishments with less than 20 employees) relative to all private establishments.[6] Since data availability does not cover the whole sample period, $B\_Small(s, t_0)$ is obtained with the observations in the median year of the sample period that begins in t_0 (i.e., in 1992, 2000 and 2008).

The state-level natural logarithm of per-capita real GDP in the first observation of the sample, is denoted as $\log y_{t_0}(s)$, for the 3 subsamples specified by $t_0 = 1987$, 1996, and

[6]The BDS includes establishments without any employee in the total number of establishments and we have added them to compute the small-sized shares $B\_Small(s, t_0)$.

2005. Finally, the rate of population growth is the compound annual rate of growth of total state-level population:

$$g_P(s, t_0) = \left(\frac{P_{t_0+T}(s)}{P_{t_0}(s)}\right)^{1/T} - 1,$$

again for $t_0 = 1987$, 1996, and 2005 and $T = 8$ accumulated years.

2.2 Descriptive statistics

The descriptive statistics are based on the full sample annualized averages for each state. Figure 1 plots the annual time series of real GDP per capita (both in levels and per-cent growth rates), the per-cent rates of establishment entry and exit, and the per-cent rates of job creation and destruction associated to openings and closings, respectively.

[Figure 1 about here.]

We normalize the series of real GDP per capita at 100 in year 1987 for all the states and D.C. There is significant dispersion in the US regional economic performance over the last 26 years. US economic growth is not synchronized across its states except for the 2008-09 economic recession and the bands of variability of the annual rates of growth are wide (see the top right-hand side cell of Figure 1). The US state with the fastest growth in the whole period is North Dakota, which multiplies by a factor of 2.5 its real GDP per capita from 1987 to 2013, while Alaska, with negative growth, reduces its real GDP per capita in 2013 to 87.6% of its 1987 level. In aggregated US data, the real GDP per capita (in chained 2009 dollars) has risen from $33,920 in 1987 to $49,066 in 2013. It implies a 49% higher value, which corresponds to a compound rate of growth of 1.54% per year (Illinois being the *representative* median state).

Table 1 provides cross-sectional regional data for the full sample, displayed in alphabetical order across the 50 states and the District of Columbia. Hence, Table 1 shows the compound annual average rates of US regional economic growth, $g_y(s)$, and the variables that describe business dynamism over the period 1987-2013.

[Table 1 about here.]

The fastest annual growth has been observed in North Dakota (3.74%), Oregon (3.01%), South Dakota (2.86%), Iowa (2.34%) and Nebraska (2.19%). Thus, high average growth is concentrated on the Mid-West region and 3 of the top-5 states are aligned to the 100^o meridian on Earth. Such geographical coincidence is likely due to the bulk of investment plans on oil and gas drills undergone in the last decade.[7] On the bottom of the growth standings, we have found a much more geographically disperse set with Alaska (-0.30%), Nevada (0.29%), Hawaii (0.67%), Florida (0.77%) and Michigan (0.83%), all of them with annualized rates of growth below the 1% threshold.

There are also significant differences across states regarding business entry rates. For the full sample period (1987-2013), we have calculated the state-level average annual values of the dependent and independent variables by setting $t_0 = 1987$ and $T = 26$. Following alphabetical order, Table 1 reports the values (and the state-level ranking in parentheses) of the average economic growth and the variables that measure the regional business dynamism. As Table 1 displays, the states with the highest average annual rates are Nevada (16.3%), Utah (14.7%) and Florida (14.6%), where sectoral activities are oriented to services. Meanwhile, the lowest entry rates are found in industrial states such as Iowa (9.6%), Pennsylvania (9.8%) and Ohio (9.9%). The ranking on average exit rates is quite similar to the respective entry rates. The correlation between these two columns of Table 1 is 0.96. The high correlation between entry and exit is consistent with the findings in Geroski (1995) and Caves (1998) at the firm-level.

Figure 1 displays three states with unrealistically high numbers in 1990 for establishment entry rates (between 23% and 29%) and in 1989 for establishment exit rates (between 21% and 26%). These states are Alaska, Oregon and Washington which have been grouped as the dummy variable 'NW' to take this statistical error into account in the regression analysis below.

As for the dimension of business density collected in Table 1, the maximum stock of establishments per 1,000 people are found in D.C. (31.3), Wyoming (31.1) and Vermont

[7]Both the discoveries of shale gas reserves and the successful use of horizontal drilling and hydraulic fracturing brought the energy boom in the region from 2006 through 2013.

(30.8), whereas the values of low business density are observed in poorer states such as Mississippi (18.7), Arizona (19.4) and Kentucky (19.6).

Meanwhile, both the entry and exit rates show a downward trend as markedly spotted in Figure 1. The decline in business creation and entrepreneurial activity have characterized aggregate firm and labor dynamics in the US over the last decades (Haltiwanger et al (2011), Pugsley et al. (2015)). Is the business detrending also empirically observed at US regional level? Table 1 shows in the B_Trend column the estimated slope coefficients in the linear time trend of the establishment entry rates during the period 1987-2013. All the states have a negative entry rate trend, with the exception of North Dakota that has a zero slope, essentially flat. The states that have suffered the largest decline in entry rates are New Hampshire, Washington, and Alaska, with estimated slopes around -0.25. The interpretation of this result is that entry rates in these states decreased at a pace of 0.25% per year over the 1987-2013 period. When business creation and destruction is measured in terms of jobs (bottom graphs of Figure 1), the downwards time trend is also observed across the US states.

Figure 2 displays the pairwise data of state-level annual rates of growth in the three subsamples, $g_y(s, t_0)$ with $t_0 = 1987$, 1996 and 2005, and the six independent variables discussed above, from the three expanded subsample periods. There is also a linear fit that shows the slope of the univariate relationship. The visual analysis of Figure 2 indicates several signs of the relationships.

[Figure 2 about here.]

Entry rates, $B\_Entry(s, t_0)$, and economic growth, $g_y(s, t_0)$, are slightly positively related (linear correlation at 0.21). The cases of New Mexico and Idaho are the two states with the highest contribution for this link. The density of establishments per capita, $B\_Density(s, t_0)$, is also slightly positively correlated to regional growth (0.17) in the scattered points displayed in Figure 2. The business trend, $B\_Trend(s, t_0)$, measured as the average annual change in entry rates, has a positive correlation with regional growth (0.48). Hence, the states with smaller decline in entry rates over time usually come out with higher rates of growth. The state-level prevalence of small businesses, $B\_Small(s, t_0)$, provides a significant one-to-one relationship with regional growth (their linear fit in Figure 2 brings a correlation of 0.3). The convergence effect shows up clearly in Figure 2, with a strong inverse relation between the log of the initial real income per capita, $\log y_{t_0}(s)$, and the economic growth that came over the next 8 years (correlation is -0.48). Finally, the average rates of growth of population, $g_P(s, t_0)$, do not seem to be connected to US regional growth as indicated by the flat line displayed in Figure 2 and their very low coefficient of correlation (0.02).

Checking for collinearity:

Before proceeding to regression analysis, we formally check for the presence of multicollinearity among all the independent variables.

As suggested in Neter et al. (2004), we calculate the Variance Inflation Factors (VIFs) and use a cut-off of 10 as a threshold indicating the presence of multicollinearity. We find that collinearity is not high, except for the case of the average rates of establishment entry and exit. The pairs of average entry and exit rates across states are remarkably aligned along a linear fit. The VIF results are consistent with the correlation patterns reported in Table 2 and recommend against the introduction of both variables in regression analysis.

[Table 2 about here.]

Subsequently, the average exit rate has been dropped from the list of regressors.[8]

2.3 Baseline specification

The baseline cross-sectional linear regression for US regional growth is

$$\begin{aligned} g_y(s, t_0) \quad = \quad & \phi_0 + \phi_1 B\_Entry(s, t_0) + \phi_2 B\_Density(s, t_0) + \phi_3 B\_Trend(s, t_0) \\ & + \phi_4 B\_Small(s, t_0) + \phi_5 g_P(s, t_0) + \beta \log y_{t_0}(s) \\ & + Dum(s)\gamma' + u(s, t_0) \end{aligned} \tag{1}$$

[8] The Variance Inflation Factors and the figure showing the relation between entry and exit, are available on request from the authors.

where $s = 1, ..., 51$, is index for the US states (including also D.C.), $t_0 = 1987, 1996, 2005$ denotes the starting period of each of the three subsamples, ϕ_0 is a constant, and $u(s, t_0)$ is the error term.

Vector $Dum(s)$ contains two dummy variables. First, it is well-known that in state-level analysis D.C. is an outlier in that it is more like a city than a state. So we introduce a DC dummy. Second, the NW dummy controls for the possible effects from the noted statistical errors in years 1989-1990 in Alaska, Oregon, and Washington.

3 Results

Table 3 presents the estimation results for baseline specification (1) by the Ordinary Least Squares (OLS) method with clustered standard errors. Since we have multiple observations per region we cluster the variance-covariance matrix at the state level to reduce the downward bias in standard errors following the procedure described in Cameron and Miller (2015).[9]

[Table 3 about here.]

The overall fit of the model to the data is good and reflected by the high adjusted-R^2 coefficient of 0.63. The average rate of business entry, $B\_Entry(s, t_0)$, does not have a statistically significant relationship with US regional growth. The point estimate is positive, $\phi_1 = 0.024$, with a p-value of 0.77. This is one of our key findings. The US states with higher average annual entry rates do not show any statistically significant connection with the US states with higher economic growth, once such relation has been controlled for other factors of business dynamism, convergence and population growth.

The estimated coefficient on the number of establishments per capita, $B\_Density(s, t_0)$, is positive ($\phi_2 = 0.079$) and just statistically significant (p-value = 0.02). Innovation-based growth theories (for example, Romer (1990), Aghion and Howitt (1992)), imply that ϕ_1 and ϕ_2 should be both positive, consistent with the notion that the higher the number of productive businesses, the higher the economic growth. We only find supporting evidence

[9]See Cameron and Miller (2015) pages 8-9. A Matlab code is available upon request.

for this positive relationship for the number of establishments per capita and not for the rates of establishment entry.

The trend associated with the establishment entry rates, $B\_Trend(s, t_0)$, has a positive and statistically significant relationship with regional income growth ($\phi_3 = 3.34$, with a p-value of 0.000). In words, US states experiencing a sharper decline in business trend experienced slower growth, hence a positive sign of the estimated coefficient. Therefore, the decline in entrepreneurial activity has been associated with decreased regional economic growth. In quantitative terms, the interpretation of the estimated coefficient says that an average decrease of 10 basis points in the annual entry rate corresponds to a decline in the annual rate of growth of 33 basis points.

Regarding business size, we find that having a high share of small versus large establishments is positively associated with growth. The estimated coefficient of $B\_Small(s, t_0)$ is positive ($\phi_4 = 2.78$) but not statistically significant (p-value $= 0.42$). The result thus suggests that having large establishments may have some advantages for growth, possibly due to scale-effects, and the prevalence of small establishments does not conclusively harm or benefit regional growth.

In summary, two of the four dimensions of business dynamics that we examined turn out to be strongly linked with US regional growth. The annual entry rates and the share of small businesses do not have any significant relationship with state-level growth.

The baseline estimation controls for economic convergence and population growth, as two traditional factors for explaining US regional growth. As reported in Table 3, population growth has a positive influence to economic growth ($\phi_5 = 0.064$), but the relationship is not statistically significant (p-value 0.634). Thus, the internal mobility of labor across the US states, reflected in the state-population growth, does not appear to have a strong link with economic growth. The positive sign may be due to reverse causality: the states with high growth will offer better job opportunities and will receive net domestic immigrants from other states. As one opposing effect, a high rate of population growth ought to have a direct negative impact on per capita growth. These two opposing effects seem to cancel each other in our estimation as the coefficient is not statistically different from zero.

As for the convergence hypothesis, we do find strong evidence that supports β-convergence across the US states because the sign of the estimated coefficient of the log of the initial per capita income in (1) is negative ($\beta = -3.12$) and it is statistically significant (p-value 0.000). According to this result, one state with a per-capita real income 10% below the US level in some initial year has grown 0.31% more annually over the next 8-year period. The gap between poor and rich states has shrunk over 1987 to 2013 (*ceteris paribus*). The convergence can explain the reduction in labor mobility as the benefits of inter-state migration might now be lower than in the past, as argued in Molloy et al. (2011).

Finally, both dummy variables are statistically significant and positive. The NW dummy picks up the effect of the error of registering the entry rates of Alaska, Oregon and Washington in 1990 (overestimated by around 10% as the spikes displayed in Figure 1). The DC dummy is positive and statistically significant with a p-value 0.00. This result suggests that the special characteristics of D.C. are positively associated with its economic growth over the last decades.[10]

4 Robustness

We conduct a number of relevant robustness checks. We briefly describe each of them in separate subsections.

i. Firm-Level Data:

As we have discussed above, our choice of establishment-level data is due to the BDS setup that counts multi-state firms as their own firm in each state. Each firm may have one establishment (a single–unit establishment) or many establishments (a multi–unit firm). The BDS compiles firm-level data based on the aggregation of establishments with the same ownership. Therefore, the creation or destruction of establishments of existing firms has no effect on the accounting of firm-level data.

Despite all these caveats, and considering that the business dynamism literature (for

[10] In fact, D.C. shows a good performance on entrepreneurial activity because its business density is high (ranked 1/51), and its detrending of the entry rate is very mild (ranked 3/51). However, D.C.'s economic growth has been close to US average (ranked 22/51).

example, Decker et al. (2014)) has looked at both establishment-level and firm-level data, it is of interest to investigate how the choice of establishment versus firm matters for the results. We, therefore, reconstruct the four dimensions of business dynamism using firm-level data. Table 4 presents the estimation results of the OLS regression based on firm-level business activity.[11]

[Table 4 about here.]

One of our key findings from the baseline case—that the link between business entry rates and regional economic growth is statistically insignificant—also holds for the firm-level entry rates. The sign of the relationship, however, is negative. Thus, both establishment- and firm-level data speak with one voice regarding the statistical importance of the relationship between the entry rate and regional economic growth. All the other baseline results are robust to using firm-level data with one exception. The coefficients on the dummy variables are not statistically significant when we use the BDS firm-level data.

ii. Great Moderation (1987-2004):[12]

Using only two of the three subsamples, 1987-1995 and 1996-2004, for a total of 102 observations that belong to the Great Moderation period (1987-2004), we re-estimate the baseline specification (1). Table 5 presents the results.

[Table 5 about here.]

Relative to the baseline results in Table 3, the four independent variables providing indicators of business dynamism are statistically significant. However, the sign of the relationship for the entry rate and business size are both negative. It means that US states with lower entry rates and large-sized businesses tend to report higher growth during the Great Moderation.

The β-convergence is not found as strong for the Great Moderation period as it is in the baseline specification, but it is still connecting low-income regions with faster economic

[11] The cross-sectional correlation between average firm entry and exit rates in the BDS is 0.90.

[12] The Great Moderation period refers to the low volatility in output and inflation observed in the US economy.

growth. By contrast, the rate of population growth gains statistical significance when restricting the analysis to the Great Moderation. Our interpretation is that inter-state mobility was more closely connected to the prospects of better job opportunities during the years of stable economic growth.

iii. Job Creation & Job Destruction Data:

We consider an alternative definition of business dynamism using the rate of job creation (entry) and the rate of job destruction (exit)

$$Job\_Entry_t(s) = 100 \left(Job_t^E(s)/(DHS_t(s)) \right),$$

where $Job_t^E(s)$ is the count of jobs created by the establishment births of the state s during the year t, and $DHS_t(s)$ is the Davis-Haltiwanger-Schuh denominator, which is the average of employment over the current and previous year, $DHS_t(s) = 0.5\,(E_t(s) + E_{t-1}(s))$.

The average annual job creation rate (entry) is then calculated as follows

$$Job\_Entry(s, t_0) = \frac{1}{T+1} \sum_{t=t_0}^{t_0+T} Job\_Entry_t(s).$$

Similarly, for the state-level annual job destruction rate and the average annual job destruction rate (exit), we have

$$Job\_Exit_t(s) = 100 \left(Job_t^X(s)/(DHS_t(s)) \right),$$

$$Job\_Exit(s, t_0) = \frac{1}{T+1} \sum_{t=t_0}^{t_0+T} Job\_Exit_t(s),$$

where $Job\_Exit_t(s)$ is the count of jobs destroyed due to the establishment deaths of the state s during the year t.

For the business trend effect in terms of jobs, we have

$$Job\_Trend(s, t_0) = \frac{1}{T+1} \sum_{t=t_0}^{t_0+T} \left(Job\_Entry_t(s) - Job\_Entry_{t-1}(s) \right).$$

In addition, $B\_Small(s, t_0)$ is still the ratio between the number of jobs in establishments with less than 20 employees and the total number of jobs in the median year of the sample period that begins in t_0. Finally, the average business density is not measured in this specification because the numerator would be identical to the job entry rate (i.e., number of jobs created at establishment births).

[Table 6 about here.]

Table 6 shows the estimation results. In the comparison with the baseline regression, we observe that the job entry rate has a positive but statistically insignificant link with US regional growth, which confirms the relation found with establishment-level data. The results also provide robustness of the business trend effect when measured in terms of the average change of job creation rates. The estimated size effect changes from negative to positive, though it comes out with no statistical significance. The β-convergence is as strong as it is in the baseline specification, whereas population growth has no link whatsoever to regional economic growth.

iv. Entry rates relative to population:

The entry rate measure that we have used is relative to existing businesses. Audretsch and Fritsch (1994) label this as the 'ecological approach'. However, it is also possible to scale the entry rate on the size of the state-level population (the 'labour market' approach). This distinction may have an influence on empirical results (Garofoli (1994)). To investigate this point, we calculate entry rates relative to population levels as

$$B\_Entry\_P_t(s) = 100 \left(N_t^E(s)/(P_t(s)) \right)$$

and its average annual value is computed as

$$B\_Entry\_P(s,t_0) = \frac{1}{T+1} \sum_{t=t_0}^{t_0+T} B\_Entry\_P_t(s).$$

Table 7 shows the results.

[Table 7 about here.]

The findings for business dynamism and traditional variables are similar to those in the baseline case. Only the two dummy variables become statistically significant.

v. Full Sample Averages:

Finally, we consider the full sample averages, giving us only 51 observations for the whole period 1987-2013. Table 8 shows the results.

[Table 8 about here.]

The statistical significance of the business dynamics variables is similar to the baseline case in Table 3 but the signs on the entry rate and small business size are negative. The independent variables that show a clear statistical relation to economic growth are the business density, the business trend and the convergence effect, which supports the findings of the baseline 153-observation estimation.

5 Conclusions

How is business dynamism linked with US regional growth? We have conducted a cross-sectional analysis using empirical measures of business dynamism based on BDS data and long-run regional economic growth from 1987 to 2013 to answer this question. The average annual rates of growth of real GDP per capita over this period range between 3.74% (North Dakota) and -0.30% (Alaska), with the median value at 1.47% (Illinois). We have also found significant differences in state-level annual rates of business entry, both across time and states. The highest average entry rates are found in Nevada (16.3% per year) and Florida (14.6% per year) and the lowest average entry rates are observed in Iowa, Pennsylvania and Ohio (below 10% per year in all three cases). Despite these differences, we find that there is a high correlation, 0.91, between average annual entry and exit rates across US states over the full sample and over three 8-year subsample periods.

We combine four elements that describe entrepreneurial activity to characterize business dynamism, and also include traditional factors such as population growth and initial per capita income in a linear model of US regional growth. The estimation results show no significant relationship between the *level* of the average annual business entry rate and average regional economic growth. Nevertheless, the downward time trend observed for these entry rates over time (their *change*) is strongly linked with regional growth. In particular, states with a milder decline in the business entry rates, observed from 1987 to 2013, tend to have greater economic growth (for example, North Dakota or Wyoming).

Regarding other characteristics of entrepreneurship, we report that business density (measured in per capita terms) has a positive and statistically significant link with US regional growth. Furthermore, a higher prevalence of small-size business units and regional economic growth have a negative and statistically significant relationship during the Great Moderation period (1987-2004). When we also include the post-Great Recession period in the estimation sample there is no statistically significant relationship.

Labour mobility across the states is an important and well-known feature of the US labour market. Molloy et al. (2011) report a secular decline in inter-state migration over the last decades, but they still find greater internal mobility in the US than in the Euro Area.[13] Since fertility rates are quite similar across the US states, one way to capture this internal mobility is via state-level population growth. We find that although population growth has a positive relationship with regional growth, the effect is statistically significant only during the Great Moderation period.

We also find strong evidence for β-convergence *a la* Barro and Sala-i-Martin (1992) across the US, whereby states with low initial per capita income have tended to grow faster and converge towards the level of per capita income of richer states.

We conducted a variety of robustness tests. Our headline result of a significant positive relationship between the change in business entry rate and US regional growth remains a robust feature of the BDS data in all cases.

Finally, although our research does not allow to make causal interpretations regarding the impact of business dynamics on economic growth, our results do suggest that it is business dynamics in terms of the *change* in business entry rates (rather than levels) that is

[13] Kaplan and Schulfhofer-Wohl (2012) claim that the observed decline is basically due to a methodological change in the statistical procedure used to obtain the data.

significantly related to economic growth. This, in turn, suggests that future research should focus more on structural developments of entry rates over time rather than on the level of entry rates, in order to better understand structural mechanisms at play in the US economy.

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Figure 1: Regional US annual data for the 50 states and the District of Columbia, 1987-2013

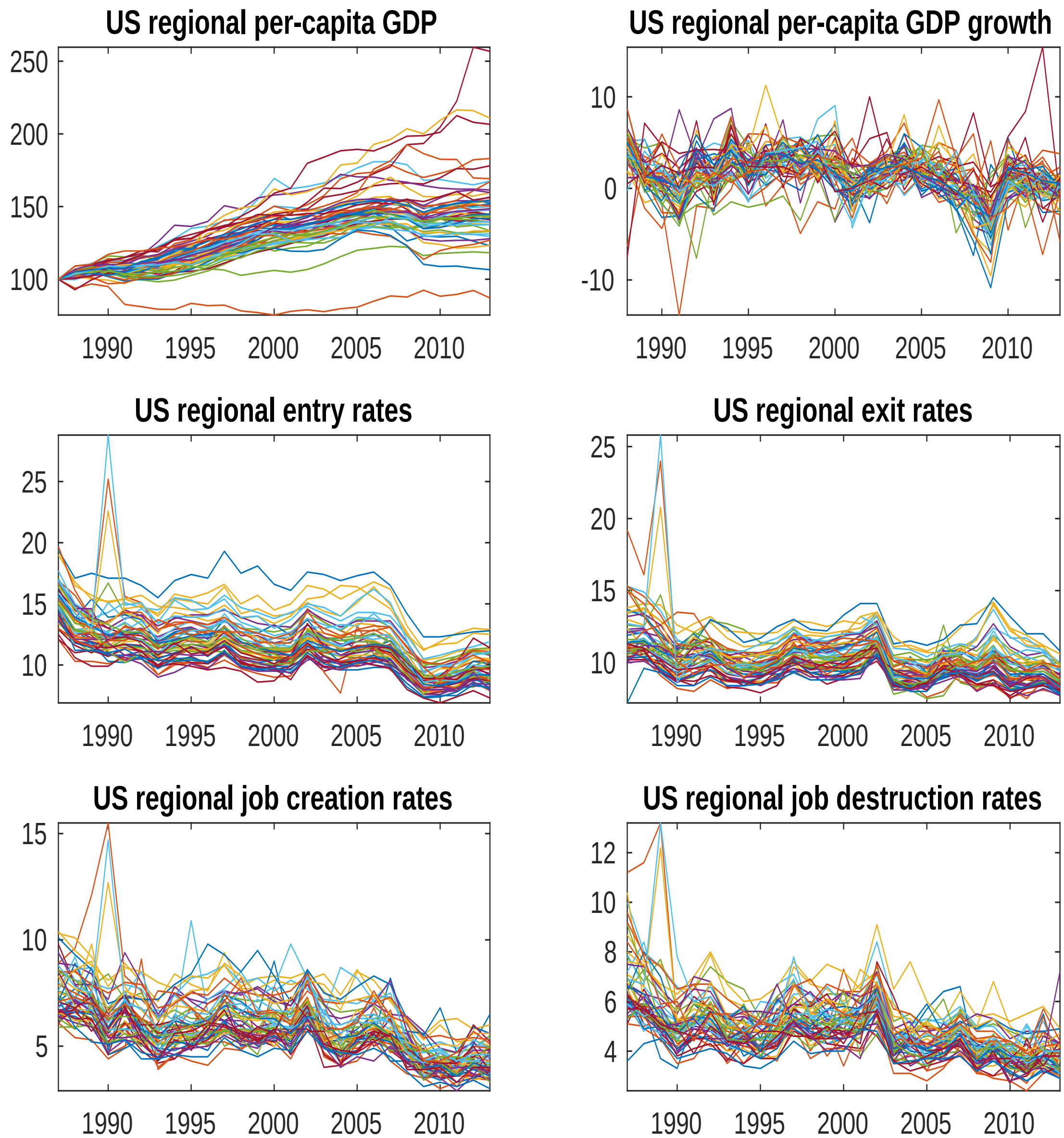
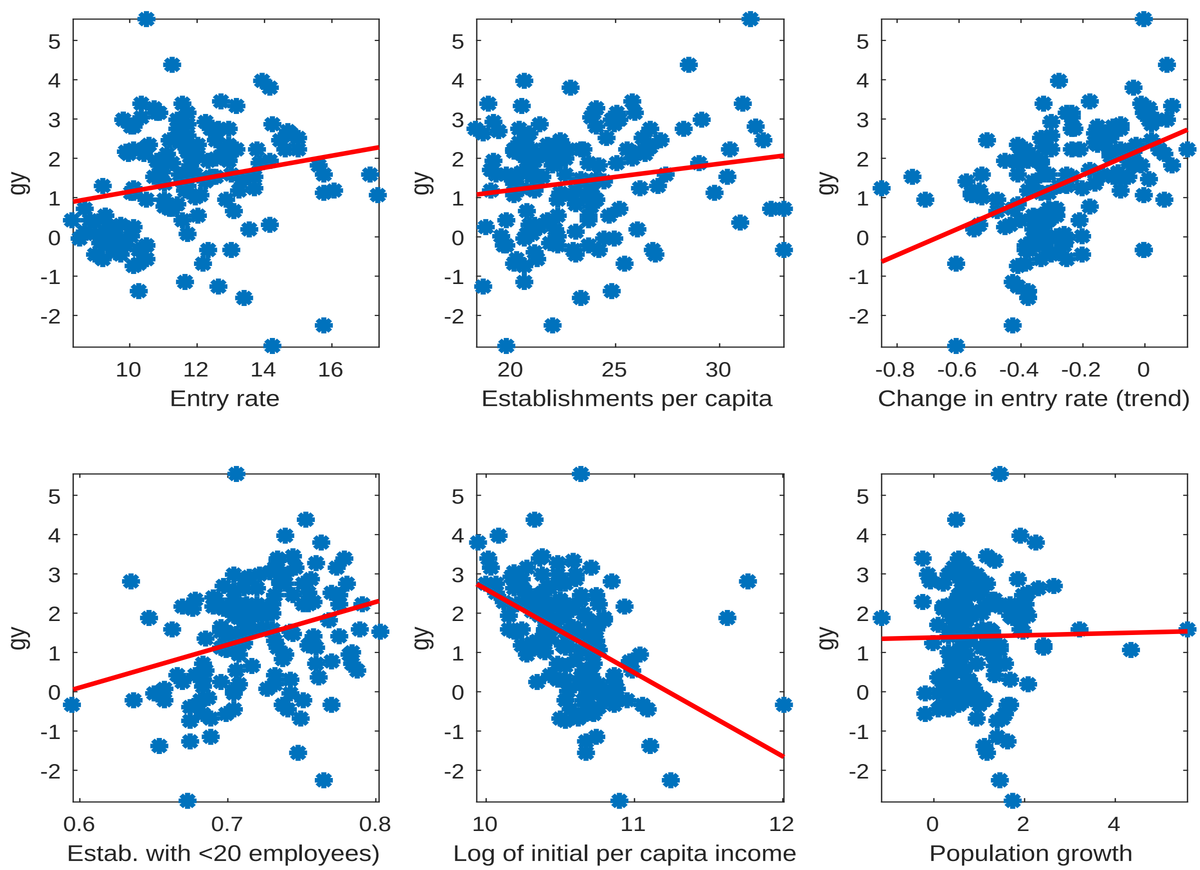


Figure 2: Variables in the empirical specifications: cross-sectional averages for the 50 states and the District of Columbia, 1987-2013



Note: gy = growth rate of output. Each figure shows the relation with regional annual economic growth (averaged over 1987-2013).

TABLE 1: Regional US data on growth and business dynamism, 1987-2013

State(s)	g_y	*B_Entry*	*B_Exit*	*B_Density*	*B_Trend*	*B_Small*
Alabama	1.38(31)	11.28(29)	10.03(27)	19.7(47)*	-0.21(45)	.691(45)
Alaska	-0.30(51)*	13.25(8)	11.50(8)	23.4(23)	-0.27(51)*	.770(5)
Arizona	1.25(38)	14.34(4)**	11.87(3)**	19.4(50)*	-0.20(42)	.697(41)
Akansas	1.68(14)	11.55(22)	10.17(22)	20.8(37)	-0.18(37)	.725(21)
California	1.33(34)	13.02(10)	11.52(7)	20.8(38)	-0.15(26)	.734(18)
Colorado	1.56(20)	13.93(5)**	11.67(4)**	26.5(7)	-0.16(29)	.744(13)
Connecticut	1.31(36)	10.21(45)	9.66(36)	23.9(18)	-0.16(31)	.735(17)
Delaware	0.90(46)	12.30(14)	10.20(21)	24.9(12)	-0.20(44)	.704(34)
D.C.	1.50(22)	10.51(42)	9.41(41)	31.3(1)**	-0.07(3)**	.634(51)*
Florida	0.77(48)*	14.59(3)**	12.37(2)**	23.5(22)	-0.14(19)	.751(11)
Georgia	0.92(45)	13.18(9)	11.10(9)	21.1(35)	-0.16(28)	.696(42)
Hawaii	0.67(49)*	10.59(39)	9.39(42)	22.4(27)	-0.17(34)	.708(30)
Idaho	1.95(7)	13.53(7)	11.02(11)	24.4(15)	-0.12(12)	.755(9)
Illinois	1.47(25)	10.86(33)	9.71(34)	21.7(31)	-0.10(9)	.715(24)
Indiana	1.58(19)	10.43(43)	9.28(45)	21.2(33)	-0.16(30)	.678(48)*
Iowa	2.34(4)**	9.61(51)*	8.79(50)*	24.7(13)	-0.10(8)	.704(35)
Kansas	1.43(28)	10.74(36)	9.79(33)	24.5(14)	-0.14(20)	.708(31)
Kentucky	1.50(23)	10.82(34)	9.59(38)	19.6(49)*	-0.18(36)	.685(47)*
Louisiana	1.22(40)	10.76(35)	9.90(32)	20.2(45)	-0.13(14)	.696(43)
Maine	1.04(44)	11.40(28)	10.00(28)	25.8(10)	-0.20(43)	.769(6)
Maryland	1.37(32)	11.61(20)	10.04(26)	21.2(34)	-0.18(35)	.711(28)
Massachusetts	1.68(13)	10.51(41)	9.61(37)	23.6(21)	-0.13(13)	.732(19)
Michigan	0.83(47)*	10.54(40)	9.67(35)	20.3(43)	-0.15(24)	.713(26)
Minnesota	1.63(17)	11.02(31)	9.36(43)	24.1(16)	-0.13(17)	.722(23)
Mississippi	1.44(26)	11.13(30)	10.14(23)	18.7(51)*	-0.17(33)	.701(38)
Missouri	1.09(42)	11.44(27)	10.23(20)	23.0(24)	-0.13(16)	.707(33)
Montana	1.50(24)	12.38(13)	10.54(16)	30.1(4)**	-0.11(11)	.792(1)
Nebraska	2.19(5)**	10.18(46)	8.96(48)*	26.1(9)	-0.10(7)	.725(20)
Nevada	0.29(50)*	16.27(1)**	12.39(1)**	20.3(44)	-0.18(38)	.699(39)
New Hampshire	1.60(18)	11.52(24)	10.24(19)	26.3(8)	-0.25(49)*	.736(16)
New Jersey	1.11(41)	11.52(23)	10.54(15)	23.8(19)	-0.11(10)	.769(7)
New Mexico	1.89(8)	12.25(15)	10.79(13)	20.5(41)	-0.21(46)	.712(27)
New York	1.43(27)	11.59(21)	10.59(14)	22.9(26)	-0.06(2)**	.776(3)
North Carolina	1.23(39)	11.86(19)	9.94(31)	21.8(30)	-0.14(21)	.704(36)
North Dakota	3.74(1)**	10.27(44)	8.98(47)*	29.1(5)**	0.00(1)**	.738(15)
Ohio	1.42(29)	9.85(49)*	9.10(46)	20.9(36)	-0.15(25)	.676(49)*
Oklahoma	1.66(16)	11.48(26)	10.35(18)	21.9(28)	-0.14(22)	.724(22)
Oregon	3.01(2)**	12.92(11)	10.99(12)	25.4(11)	-0.23(48)*	.744(14)
Pennsylvania	1.51(21)	9.84(50)*	8.85(49)*	21.4(32)	-0.13(15)	.703(37)
Rhode Island	1.40(30)	10.72(37)	9.99(29)	24.1(17)	-0.15(23)	.760(8)
South Carolina	1.05(43)	11.91(18)	10.13(24)	20.8(39)	-0.19(40)	.699(40)
South Dakota	2.86(3)**	11.01(32)	9.42(40)	28.1(6)	-0.10(6)	.752(10)
Tennessee	1.35(33)	11.51(25)	10.08(25)	20.3(42)	-0.19(39)	.669(50)*
Texas	1.85(10)	12.75(12)	11.03(10)	20.0(46)	-0.13(18)	.690(46)
Utah	1.76(11)	14.66(2)**	11.61(6)	20.6(40)	-0.08(4)**	.715(25)
Vermont	1.86(9)	10.60(38)	9.47(39)	30.8(3)**	-0.22(47)*	.779(2)

Notes: Continued on next page. ** denotes Top-5 states, * denotes Bottom-5 states. State-level ranks are in parentheses.

Table 1 – continued from previous page

State(s)	g_y	B_Entry	B_Exit	$B\_Density$	B_Trend	B_Small
Virginia	1.33(35)	11.93(17)	9.96(30)	21.8(29)	-0.17(32)	.692(44)
Washington	1.28(37)	13.67(6)	11.63(5)**	23.7(20)	-0.26(50)*	.745(12)
West Virginia	1.69(12)	10.01(47)*	9.34(44)	19.7(48)*	-0.19(41)	.710(29)
Wisconsin	1.66(15)	10.00(48)*	8.73(51)*	23.0(25)	-0.15(27)	.707(32)
Wyoming	2.06(6)	12.11(16)	10.51(17)	31.1(2)**	-0.08(5)**	.776(4)

Notes: ** denotes Top-5 states, * denotes Bottom-5 states. State-level ranks are shown in parentheses.

TABLE 2: Cross correlations for business dynamism-related regressors

(3-subsample average values, 153 observations)

	$B\_Entry(s,t_0)$	$B\_Exit(s,t_0)$	$B\_Density(s,t_0)$	$B\_Trend(s,t_0)$	$B\_Small(s,t_0)$
$B\_Entry(s,t_0)$	1	0.91	-0.14	-0.03	0.39
$B\_Exit(s,t_0)$		1	-0.16	-0.05	0.39
$B\_Density(s,t_0)$			1	0.12	0.36
$B\_Trend(s,t_0)$				1	-0.02
$B\_Small(s,t_0)$					1

TABLE 3: Baseline specification: BDS establishment-level data

$g_y(s,t_0)$ is the dependent variable

	Estimate	Clustered standard error	t-stat	p-value
Constant	30.90	3.556	8.691	<0.00001
$B\_Entry(s,t_0)$	0.024	0.082	0.293	0.7699
$B\_Density(s,t_0)$	0.079	0.033	2.412	0.0171
$B\_Trend(s,t_0)$	3.345	0.304	10.993	<0.00001
$B\_Small(s,t_0)$	2.784	3.456	0.805	0.4221
$\log y_{t_0}(s)$	-3.116	0.308	-10.133	<0.00001
$g_P(s,t_0)$	0.064	0.135	0.476	0.6348
NW dummy	0.678	0.247	2.748	0.0067
DC dummy	3.328	0.813	4.086	0.00007
		$R^2 = 0.631$	N=153	

TABLE 4: Robustness I. BDS firm-level data.

	$g_y(s,t_0)$ is the dependent variable			
	Estimate	Clustered standard error	t-stat	p-value
Constant	24.37	5.531	4.407	0.00002
$B\_Entry(s,t_0)$	-0.141	0.097	-1.462	0.1458
$B\_Density(s,t_0)$	0.105	0.031	3.410	0.00083
$B\_Trend(s,t_0)$	2.615	0.367	7.120	$<$0.00001
$B\_Small(s,t_0)$	-7.431	4.877	-1.524	0.196
$\log y_{t_0}(s)$	-1.632	0.371	-4.399	0.00002
$g_P(s,t_0)$	0.160	0.162	0.988	0.3247
NW dummy	0.367	0.489	0.749	0.4550
DC dummy	0.257	0.748	0.343	0.7321
		$R^2 = 0.629$	N=153	

TABLE 5: Robustness II. Great Moderation (1987-2004).

	$g_y(s,t_0)$ is the dependent variable			
	Estimate	Clustered standard error	t-stat	p-value
Constant	28.84	4.912	5.871	$<$0.00001
$B\_Entry(s,t_0)$	-0.167	0.078	-2.126	0.0359
$B\_Density(s,t_0)$	0.129	0.027	4.753	$<$ 0.00001
$B\_Trend(s,t_0)$	1.685	0.259	6.504	$<$ 0.00001
$B\_Small(s,t_0)$	-7.314	2.475	-2.955	0.0039
$\log y_{t_0}(s)$	-2.131	0.367	-5.808	$<$ 0.00001
$g_P(s,t_0)$	0.254	0.132	1.923	0.0573
NW dummy	0.513	0.384	1.336	0.1845
DC dummy	1.518	0.424	3.577	0.0005
		$R^2 = 0.519$	N=102	

TABLE 6: Robustness III. BDS job creation & destruction data.

$g_y(s,t_0)$ is the dependent variable				
	Estimate	Clustered standard error	t-stat	p-value
Constant	26.62	4.884	5.451	< 0.00001
$Job\_Entry(s,t_0)$	0.099	0.129	0.760	0.4484
$Job\_Trend(s,t_0)$	4.277	1.154	3.707	0.0003
$Job\_Small(s,t_0)$	2.731	4.320	0.632	0.5283
$\log y_{t_0}(s)$	-2.439	0.408	-5.978	< 0.00001
$g_P(s,t_0)$	-0.018	0.147	-0.124	0.9015
NW dummy	0.313	0.252	1.241	0.2165
DC dummy	2.281	0.676	3.373	0.0009
		$R^2 = 0.468$		N=153

TABLE 7: Robustness IV. Entry rate relative to population

$g_y(s,t_0)$ is the dependent variable				
	Estimate	Clustered standard error	t-stat	p-value
Constant	31.31	3.871	8.088	<0.00001
$B\_Entry(s,t_0)$	0.436	0.346	1.260	0.2096
$B\_Density(s,t_0)$	0.065	0.036	1.789	0.0756
$B\_Trend(s,t_0)$	3.391	0.313	10.852	< 0.00001
$B\_Small(s,t_0)$	-1.636	3.020	-0.542	0.5886
$\log y_{t_0}(s)$	-2.891	0.308	-9.360	<0.00001
$g_P(s,t_0)$	-0.069	0.140	-0.495	0.6213
NW dummy	0.848	0.231	3.667	0.0003
DC dummy	1.533	0.633	2.423	0.0166
		$R^2 = 0.597$		N=153

TABLE 8: Robustness V. Full sample, 1987-2013

$g_y(s,t_0)$ is the dependent variable				
	Estimate	Standard error	t-stat	p-value
Constant	21.33	2.481	7.978	< 0.00001
$B\_Entry(s,t_0)$	-0.128	0.107	-1.194	0.2380
$B\_Density(s,t_0)$	0.089	0.028	3.182	0.0025
$B\_Trend(s,t_0)$	5.519	1.344	4.108	0.0001
$B\_Small(s,t_0)$	-4.208	2.988	-1.408	0.1652
$\log y_{t_0}(s)$	-1.610	0.229	-7.034	< 0.00001
$g_P(s,t_0)$	0.126	0.202	0.627	0.5335
NW dummy	1.053	0.314	3.354	0.0015
DC dummy	0.497	0.569	0.873	0.3868
	$R^2 = 0.763$		N=51	