Establishment creation and destruction across business density cycles: US evidence

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Abstract This paper investigates how business establishment entry and exit are affected by cycles in business density. We assess how entry/exit behave when markets over and under shoot a dynamic equilibrium number of businesses and whether these effects differ between manufacturing and service industries. Overall, we find persistent cycles where the actual number of business establishments is typically not equal to the dynamic equilibrium number even though it gravitates towards it. We uncover a systematic pattern which indicates that in disequilibrium entry is dis-equilibrating while closure is equilibrating. For example, the entry rate plays a dis-equilibrating role by accelerating in an overshoot, however as exits accelerate even faster in an overshoot they help move the industry towards an equilibrium. Overall, the results indicate that entrepreneurs and corporations operate with a herd instinct thereby increasing establishments in a cyclical business density over shoot and decreasing them in an under shoot. In terms of economic policy, the results question whether government policy aimed at promoting business creation and expansion ought to have a counter business density cyclical dimension. In other words, should business start-up and growth be promoted more strongly in business density under shoots than over shoots?

JEL Classification L25, L26, L53, D50

Key words Disequilibrium • Business Density • Entry • Exit • Over shooting

INTRODUCTION

The question of whether there are too many or too few businesses is at the very core of most economics and management research. The concept in economics that a sustainable number not only exists but acts as a point of gravity in equilibrium based models on industry dates back to the work of Smith (1776). This view was later formalised by Marshall (1890) to show how markets adjust towards an equilibrium sustainable number of business establishments. Friedman (1953) argued that this adjustment process was sufficiently strong/fast so that one could rely on the efficiency of markets i.e. disequilibrium would be short-lived. By contrast, Austrian economists such as Schumpeter (1939, 1942) argued that the sustainable number of businesses changes so quickly that disequilibrium is more of a permanent than transitory state for markets. Subsequently, developments in game theory and the dynamics of industrial organization have produced a compendium of economic models all with a sustainable number of businesses with varying speeds of equilibrating effects at their core.[1]

At the heart of models in business strategy is the concept of a sustainable number of business establishments denoted by a balance between available profit opportunities and the number of business establishments competing to exploit them (Porter1980). The strategic management literature speculates about how business start-ups and deaths are likely to behave when the actual number of business establishments differs from the sustainable or equilibrium number, particularly in relation to business shakeouts (Burke et al. 2010; Day 1997). Similar logic about dynamic adjustment towards a sustainable density of businesses in a market is also at the core of organizational ecology theory (Geroski 2001).

Remarkably, there has been little empirical analysis documenting how business establishment creation and destruction behaves when business density is manifested in cyclical behaviour with over and under shooting of the actual from the sustainable number of businesses. In this paper we use US industry data to examine business establishment entry and exit in disequilibrium. Our focus on business establishments is driven by both data availability and also with consideration to the core of theory where the concept of market capacity/demand is the central determinant of the sustainability of businesses.[2] Our paper is

[1] For an overview, see Audretsch et al. (2001), Martin (2002), and Tirole (1988).

[2] In essence, the alternative (which is not an option from our dataset) using data on the number of businesses has the weakness that single and multi establishment firms are counted as the same which is highly questionable in an analysis attempting to establish long term equilibrium relationships. By contrast, establishment/plant data (especially having controlled for minimum efficient scale) provides a more reliable measure of business supply

motivated by a desire to provide answers to some fundamental questions arising from theory relating to cyclical dimensions of business density. For example, we do not know if entrants are good judges of market cyclicality and so become more numerous below equilibrium (under shoots) and decline in number in over shoots. Alternatively, we do not know if the opposite occurs where entrants behave with a herd instinct and so exacerbate a cycle by becoming more numerous in an over shoot and less so in an under shoot. Similar vagaries relate to establishment exit. Combined we are still unsure whether entry and exit work in harmony towards the restoration of equilibrium or whether one or other plays the lead equilibrating role.

The paper aims to address this shortcoming by estimating an error correction model to ascertain whether a sustainable/equilibrium number of business establishments existed across industries over a particularly turbulent period (1998-2003) in the USA and if so whether an equilibrating adjustment process is in evidence. Next we test whether periods of over and under shoots have an impact on the behaviour of entry and exit. We make use of a rich panel dataset of American business entry and exit for a wide array of industries between 1998 and 2003. The data relates to establishments and exits by both independent ventures as well as corporations although the former obviously dominate the data set. Therefore, the results pertain to enterprise activity in the broad sense and are not limited to small firms.

The rest of the paper is structured as follows. In section 1, we provide a review of the literature and develop our model. In section 2 we provide a discussion of the data which relates to the total number of business establishments as well as their birth and death in 290 four-digit industry sectors in the US over the period, first quarter 1998 to first quarter 2003. The analysis is presented in section 3. This takes the following path: an initial estimate of the model for the entire dataset (i.e. across all industries), and then breaking up the dataset and analysis into manufacturing and service industries. Building on these analyses, we then test for the unique impacts of over and under shoots on entry and exit patterns. The paper closes with conclusions.

capacity which would be expected to have some long term equilibrium relationships with measures of market size/capacity.

THEORY AND MODEL SPECIFICATION

Research into the determinants of entry of businesses in an industry has originated with the pioneering work of Mansfield (1962), followed by Orr (1974) and subsequent analysis on these lines by Highfield and Smiley (1987) and Shapiro and Khemani (1987). The prominent feature of this research is that although it establishes long run relationships linking entry of businesses to various incentives and barriers like profitability, industry concentration, minimum efficient scale, and market growth measures, it does not test to see if an equilibrium process exists and if so what it looks like. Researchers particularly in the US have also pointed to the waves that occur in the pattern of entry and exit by industry (Dunne et al. 1988). We extend this line of research by investigating the relationship between the actual and 'equilibrium' level of business establishments in 290 four-digit industry sectors in the US over the period first quarter 1998 to first quarter 2003. We then analyse separately the role of gross entry and exit in achieving equilibrium, concluding with a study of their behaviour in business over and under shoots. The models used are specified as follows:

The sustainable level of business establishments, N^*_{it}, is modelled by the following equation:

$$N^*_{it} = A + \beta X_{it} + \lambda Y_i + \kappa Z_t + \varepsilon_{it} \qquad (1)$$

where N^*_{it} is the equilibrium number of business establishments (plants) in an industry *i* at time *t*, *A* is a constant and X_{it} is a vector of the following explanatory variables which vary by industry *i* as well as time *t*, namely: sectoral GVA, minimum efficient scale, and R & D expenditure. Due to data limitations, the remaining explanatory variables used vary either by industry or by time. Y_i is a vector of variables which vary by industry *i*, namely: small firm share of patents and 2-digit NAICS industry dummies. Z_t is a vector of variables which vary only over time *t* namely: unemployment rate and average income tax rate.

We then test whether an adjustment mechanism appears to be in operation by analysing the impact of the deviation of the actual N_{it} from the sustainable level of business establishments in the previous period, measured by ($N_{it-1} - N^*_{it-1}$), i.e. the lagged error ε_{t-1} from the above regression, on the change in the total number of businesses in the current period.

Accordingly we test,

$$(N_{it} - N_{it-1}) = C + \rho[X_{it} - X_{it-1}] + \upsilon[Z_t - Z_{t-1}] + \alpha\varepsilon_{t-1} + u_{it} \qquad (2)$$

where $[X_{it} - X_{it-1}]$ is the change in:sectoral GVA, minimum efficient scale and R & D expenditure and $[Z_t - Z_{t-1}]$ is the change in: unemployment rate and average income tax rate.

Equation 2 tests whether an adjustment to equilibrium process exists. The coefficient α should be negative and significant in order for an equilibrium process to exist. In other words, the change in the number of businesses should adjust downwards (upwards) if the market is above (below) equilibrium N^*_{it-1} in the previous time period. An insignificant α implies no adjustment process while a positive coefficient would imply an explosive dynamic away from equilibrium. Therefore, both of these latter outcomes present the alternative hypotheses to reject the existence of a dynamic equilibrium number of business establishments.

We then further explore the process by breaking down the net change in the number of business establishments into its two component parts, gross entry and exit. The purpose is to study the impact of the deviation of actual from the sustainable number of business establishments, on gross entry E_{it} and gross exit, F_{it} flows.

Accordingly we model,

$$E_{it} = D + \theta X_{it} + \eta Y_i + \mu Z_t + \gamma \varepsilon_{it-1} + e_{it} \qquad (3)$$

and

$$F_{it} = K + \tau X_{it} + \varphi Y_i + \nu Z_t + \sigma \varepsilon_{it-1} + + \psi_{it} \qquad (4)$$

where E_{it} and F_{it} measure gross entry and gross exit respectively in industry i at time t, and X_{it}, Y_i , and Z_t are the same vectors of variables as in equation 1 and ε_{it-1} as in equation 2. The sign on coefficient γ should be negative and significant if new establishment creation is an equilibrating force. Alternatively, if γ is positive then it implies a herd effect whereby entry accelerates in an over shoot and decelerates in an under shoot. In this case a force towards an adjustment to equilibrium can only exist if σ is positive and of a bigger magnitude (in absolute value) than γ, so that $\gamma - \sigma < 0$ does hold. So estimation of these equations provides another round of tests for the existence of an adjustment process back to equilibrium.

If the above tests corroborate with the existence of an adjustment process towards an equilibrium number of business establishments then it is valid to ask whether that adjustment process is symmetric i.e. whether the absolute value of γ and σ are identical in both over and under shoots. Therefore we re-estimate equations 3 and 4 by splitting ε_{it-1} into a pure over and under shoot measure.. For an over shoot measure of ε_{it-1} this entails attaching a value of zero wherever ε_{it-1} is negative (i.e. where $N_{it-1\ actual} - N^*_{it-1} < 0$) and vice versa for an under shoot measure.

DATA AND VARIABLES

Dependent variables

Total number of establishments, establishment births, and establishment deaths

The basic unit of analysis in this study is the business establishment. According to Statistics of US Businesses (SUSB) "an establishment is a single physical location at which business is conducted or services or industrial operations are performed"[3].An establishment can then either be an independently owned legal entity in which case it is synonymous with a firm or it could be a branch or a subsidiary of a firm. Given that we have data covering 290 4-digit industries over 5 years (1998-2003), this leads to 1450 establishment-year observations for each of the dependent variable, i.e. total number of establishments, N, new establishment births (gross entry, E) and establishment deaths (gross exit, F).

{Table 1 near here}

Table 1 shows the mean and median values for the total number of establishments, for establishment births and for establishment deaths by industry sectors (based on 2-digit NAICS classification) over the entire sample period (1998-2003).. Observing the mean levels of births and deaths as a percentage of the mean total establishments in each sector, we note that the information sector followed by postal services and transport are the three sectors having the highest birth and death rates. This finding is not surprising given the time period covered, i.e., the technology/dot.com boom and bust era. It is quite expected that internet related businesses (falling under information sector) operating using postal and transport services, should experience a high turnover rate during this period.

An added advantage of using gross measures of entry and exit in our analyses rather than a net entry measure (which treats exits as negative entries) is that it allows us to model the structural determinants of each separately rather than imposing a uniform structure which as Siegfried and Evans (1994) point out may obscure both relationships. Moreover, prior analysis, particularly in the US, has shown that about 61.5% of new small firm entrants exit within the first five years of their life, with more than 90% exiting within ten years (Dunne et al. 1988). This observed pattern, in conjunction with the pattern suggested by Geroski (1995)

[3] See definition at http://www.census.gov/epcd/susb/introusb.htm#definitions

of rather frequent turnover of small businesses in the short term with the total number of businesses remaining more or less stable over time, suggests that a period of five years should be sufficient to observe the error correction process in operation within a particular 4-digit industry in our analyses.

Independent variables

Total US Gross Value Added (GVA) by industry sectors

This variable is used as a measure of the size and buoyancy of market conditions. Much research has analysed the relationship between industry profitability and industry dynamics including the role of entry on profits. Consistent with theory, empirical findings suggest a positive relationship, i.e. increases in market size (GVA by sector) can sustain more business establishments and hence attract new entrants (see for example, Carree and Thurik 1994; Demsetz 1982; and Schmalensee 1981). Accordingly, inclusion of industry GVA accounts for the effect of industry size on the total number of business establishments, as well as on gross entry and exit.

R & D expenditure

A useful indicator of sunk cost barriers to entry is the level of annual research and development (R&D) expenditures made in an industry (Dasgupta and Stiglitz 1980). Prior research has shown that R&D expenditure represents the accumulation of knowledge on the part of the incumbents, and being amenable to sunk cost economies of scale pose a potential barrier to entry for new businesses (Audretsch 2002; Griliches 1984; Orr 1974).

There is however an alternative view put forward by Audretsch (2002) who considers that R&D might actually enable entry of small businesses in industries where small businesses have the innovative advantage and account for the bulk of innovative activity such as R&D and patenting. For the US, these could include among others, electronics/computing equipment manufacturers, electronic components, and engineering and scientific equipment manufacturers. In industries characterised by such a regime, Audretsch suggests that not only will there be greater entry, but also more resistance to exit, as small businesses may continue to operate at suboptimal levels as long as there is a perceived opportunity of making an innovation. Earlier findings e.g. Pakes and Schankerman (1984) support this argument. In order to test these competing hypotheses we account for the relationship between R&D and the total sustainable number of business establishments, N^*_{it}, as well as entry and exit of the same.

Small firm share of patents

In contrast to R&D expenditure, evidence indicates that small businesses play a much more active role with respect to patent activity. A report commissioned by Small Business Administration (SBA), (2003) studied the contribution of small businesses to technical change. Contrary to likely expectations, the study found that small businesses constitute no less than one-third of the most prolific patenting businesses in the US. Small businesses show high levels of patent activity in the areas of biotechnology, pharmaceuticals and medical electronics and equipment. Given that innovation by small businesses could be a countervailing strategy to entry barriers, we *a priori*, expect a positive relationship between this variable and the total number of businesses as well as new entry in the relevant sector.

Minimum efficient scale

Most of the industrial organization literature suggests that in general, economies of scale pose a significant entry barrier for new business establishments (Highfield and Smiley 1987; Orr 1974; Shapiro and Khemani 1987). As we noted above, previous analyses suggest that in some industries, innovative activities of small businesses constitute a significant counter strategy for entry or more significantly, survival barriers (Audretsch 1989, 2002). Hence, controlling for the level of innovative activity of small businesses (as measured by the small firm share of patents variable above), we would expect an inverse relationship between the minimum efficient scale requirement in an industry and the total number of business establishments in that industry. A similar negative relationship would be expected to hold between entry and exits, assuming that there is symmetry in factors that constitute barriers to entry and exit (Eaton and Lipsey 1980; Shapiro and Khemani 1987).

Income tax rate

Income tax can have countervailing effects on new business establishment entry and exit. As a component of the cost of labor one would expect a negative relationship with the number of business establishments. However, a recent trajectory of research has argued that it could also have a positive effect. Birley and Westhead (1994), Blau (1987), Parker (1996), Robson and Wren (1999), and Scheutz (2000) suggest that the income tax rate is a significant incentive (mainly as a tax avoidance mechanism), in influencing self-employment and new small business start-up. Robson and Wren (1999), in particular find average tax rates to have a significant evasion incentive for small business owners. Accordingly, we include the average annual income tax rate on personal income as an explanatory variable in our analyses.

Unemployment rate

Prior evidence including studies by Parker (1996), Reynolds (1994), Schuetze (2000), and Storey (1991), provide empirical support for unemployment having a positive (push) effect on entry or new business creation. We further test this relationship by including the annual unemployment rate for the US.

Industry dummies

In order to account for other industry-specific factors (for example, the stage of the life cycle of an industry), we include industry dummies in all regressions excluding agriculture which is therefore the reference industry.

Please note that the explanation of how each variable is measured and its data source is given in the Appendix.

ECONOMETRIC ANALYSES AND RESULTS

We conduct regression analyses on the pooled cross-section and time series data using OLS estimator with robust errors clustered at the 4-digit NAICS level. This procedure assumes the observations (no. of establishments in an NAICS-years) to be independent across NAICS, but does not assume different observations for the same NAICS to be independent across the sample years.

{Table 2 near here}

Table 2 and Figure 1 show the results of estimating the equilibrium number of firms in a particular industry and a particular year, N^*_{it}, as in Equation 1. Figure 1 illustrates that the model employed fits the data reasonably well, thus supporting further analysis. In terms of the individual explanatory variables, Table 4 shows that for both the entire sample and for service industries the level of industry GVA and the level of innovative activity of small businesses (measured by the small firm share of patents), have a positive relationship with the total number of business establishments in the industry. We also find a negative relationship of minimum efficient scale (MES) and R&D expenditure with the total level of business establishments which is also consistent with *a priori* expectations. We interpret the negative effect of unemployment as a business cycle effect. The negative relationship of average income tax rate with total number of business establishments though appears to represent a tax distortion effect increasing the costs of running a business. The estimation of N^*_{it} for manufacturing industries yields similar results except that GVA becomes insignificant (possibly due to business cycle effects being captured by an increase in the coefficient value on the unemployment variable[4]) while R&D as expected becomes significant.

Table 3 presents the estimation of Equation 2 i.e. the short run relationship between the change in the number of business establishments and the first difference of the variables used in equation 1 along with an error correction term (i.e. lagged residuals from equation 1 denoted by ε_{t-1}). This tests the existence of an equilibrating error correction mechanism in the number of sustainable business establishments in an industry. We find support for this view with the coefficient on the lagged error term ε_{t-1} (which measures $N_{it-1\ actual} - N^*_{it-1}$) becoming negative and significant for all industries as well as for manufacturing industries. However it is not significant for service industries. Nevertheless in the next stages of the analyses when we disaggregate both net entry (into gross entry and exit) and the error correction term (into overshoots and undershoots) a statistically significant equilibrating process is revealed for service industries. That said, the overall findings must be viewed as more conclusive for manufacturing than service industries.

{Table 3 near here}

We then estimate Equations 3 and 4 in order to examine how an equilibrium adjustment process operates in terms of gross entry and exit. We start with the estimation of entry (Equation 3), shown in Table 4, for all industries as well as for manufacturing and service industries. In each case we find a significant but positive coefficient on the lagged error term which suggests that entry operates as a dis-equilibrating force in disequilibrium. We explore this further by unpacking the error term into both undershoots (that is those values of the

[4] Another explanation could be that because manufacturing establishments have longer gestation periods, they may be less responsive to yearly changes in GVA.

lagged error term where $N_{it-1\ actual} - N^*_{it-1} < 0$) and overshoots (i.e. values of the lagged error term where $N_{it-1\ actual} - N^*_{it-1} > 0$). We then use these two variables to re-estimate equation 3.. This analysis reveals that the dis-equilibrating force from entry occurs in both undershoots and overshoots. In undershoots entry rate plays a dis-equilibrating role by slowing down when the actual number of establishments is below the equilibrium level i.e. a positive coefficient on a negative value variable (as $N_{it-1\ actual} - N^*_{it-1} < 0$). Similarly, in an overshoot entry is dis-equilibrating as its rate is positively related to the extent to which the actual number of establishments is above the equilibrium level i.e. a positive coefficient on a positive value variable ($N_{it-1\ actual} - N^*_{it-1} > 0$).

{Table 4 and 5 near here}

Table 5 shows the results for exit Equation (4). In all models it is apparent that exit acts as an equilibrating force. The sign on the lagged error term is positive and so too are the signs on both the overshoot and undershoot variables. So in an overshoot exit accelerates while it slows down in an undershoot. In terms of the error correction process for each of the entire sample, the manufacturing and the services, it is important to note that the coefficient on the lagged error correction term although positive is higher for the exit regressions compared to the entry regressions so that the equilibrium condition $\gamma - \sigma < 0$ holds. Taken together, the magnitude of the coefficients on the lagged error correction term for entry and exit regressions indicate that in disequilibrium exit is both the only and the effective equilibrating force. The equivalent results also hold for the coefficients on the over and undershoot lagged error variables i.e. the absolute value of the coefficients in the exit models in Table 5 are greater than the equivalent coefficients in the entry models in Table 4. So, for example, in an overshoot the exit rate accelerates enough to overpower the fact that the entry rates actually inflate in an overshoot. Put differently, the throughput in the ‘entry to exit revolving door’ alongside the closure of establishments of incumbents increases sufficiently in overshoots to drive the total number of establishments back towards equilibrium.

CONCLUSION AND DISCUSSION

The concept of the existence of an equilibrium or sustainable number of business establishments has been at the core of economic theory since Adam Smith wrote the Wealth of Nations in 1776. Yet at an empirical level we know very little about how business establishment creation and exit behave in over and under shoots above and below equilibrium and how they contribute (if at all) to an equilibrating adjustment process. Using industry data for the USA we find that in disequilibrium entry plays a dis-equilibrating role by appearing to mirror current business density levels. In other words, entry rates increase when the actual number of establishments is above the equilibrium number (an overshoot) and slow down when it is below the equilibrium number (undershoot). Exit plays an equilibrating role by accelerating in an overshoot and slowing down in an undershoot. Exit's equilibrating effects are sufficiently strong to overpower entry's dis-equilibrating effects in order to bring about a net equilibrating force in the economy. This pattern is in contrast to the theoretical depiction of the equilibrium process outlined in orthodox economic theory and textbooks where both entry and exit are assumed to play equilibrating roles in disequilibrium. At this point it is worth noting that the results discussed depend on the correct modelling of the sustainable level of firms. However as we show in Table 2 and Figure 1, the model employed fits the data reasonably well, thus lending support to our analyses. Future research covering other country settings, cross country settings and other time periods can verify these results.

The results have some policy implications. In terms of economic policy, the identification of periods when business density over and under shoot sustainable levels raises issues about whether government policy aimed at promoting new business start-up ought to adjust to take account of business density cycles. In other words, should business start-up and expansion be promoted more strongly in business density undershoots than overshoots? For avoidance of misinterpretation it is important to stress here that business density overshoots and undershoots do not necessarily correspond with economic booms and slumps. For example, a business density overshoot (undershoot) may easily occur in an economic downturn (upswing) when low (high) industry GVA levels diminish (boost) the number of sustainable business establishments that any industry can sustain. Moreover, the evidence we find here is consistent with a pattern where entrepreneurs and enterprising corporations adopt a herd instinct gauging market opportunities by the current level of business creation activity – thereby aggravating the extent of overshoots and undershoots. They seem to learn the hard way as the tendency for actual number of business establishments to approach the equilibrium or sustainable number of business establishments is brought about by presumably more economically costly exit.

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Table 1 Summary statistics for all dependent variables by industry sectors

	All establishments (E)		Births		Deaths	
Industry Code	**Mean**	**Median**	**Mean**	**% of (E)**	**Mean**	**% of (E)**
11(agriculture)	2784	1308	368	13.21	394	14.15
21 (mining)	4377	5104	449	10.25	479	10.94
22 (utilities)	5515	4908	505	9.15	381	6.9
23 (construction)	42670	35367	5817	13.63	5418	12.69
31 (manufacturing, food, textiles and leather)	2424	1674	253	10.43	294	12.12
32 (manufacturing, wood, plastics and other non-metallic products)	4997	2247	312	6.24	405	8.1
33 (manufacturing, metallic products)	4050	1954	279	6.88	345	8.51
42 (wholesale)	22696	15744	2046	9.01	2333	10.27
44 (retail)	48238	37081	4586	9.5	4555	9.44
45 (retail)	23085	21995	2478	10.73	2511	10.87
48 (transport)	6201	1473	889	14.33	867	13.98
49 (postal)	5905	6179	967	16.37	708	11.98
51 (information)	12993	9545	2258	17.37	1933	14.87
52 (finance & insurance)	39293	29643	5250	13.36	4414	11.23
53 (real estate, rental & leasing)	33357	20580	4313	12.92	3651	10.94
54 (professional, scientific, & technical services)	69146	70562	9599	13.88	8272	11.96
55 (management of companies and enterprises)	44875	45417	5573	12.41	5195	11.57
56 (administrative, waste management & remediation services)	27347	22263	3913	14.3	3848	14.07
61 (educational services)	8724	5757	1035	11.86	785	8.99
62 (health care & social assistance)	34349	15905	3246	9.45	2685	7.81
71 (arts, entertainment, & recreation)	9445	3548	1207	12.77	1071	11.33
72 (accommodation & food services)	69582	44033	8614	12.37	7976	11.46
81 (other services)	51297	29342	4495	8.76	4290	8.36

Table 2 Modelling equilibrium level of firms (N*)

Table 2 reports the results of modelling the sustainable level of business establishments, $N^*_{it.}$ as in Equation (1). Dependent variable $N_{it,}$ is the number of business establishments in an industry *i* at time *t*.

	ALL		MANUFACTURING		SERVICES	
Explanatory Variables[a]	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**
Log (real sectoral gross value added)	0.361	3.95***	0.134	0.91	0.481	4.08***
Min. efficient scale	-0.002	-3.92***	-0.002	-3.92***	-0.003	-2.47**
R&D expenditure	$-1.56*10^{-7}$	-1.10	$-6.52*10^{-7}$	-2.94***	$-1.10*10^{-7}$	-0.46
Small firm share of patents	0.059	2.44**	0.067	2.98***	0.145	2.33**
Personal income tax rate	-0.043	-4.49***	-0.065	-3.46***	-0.038	-2.94***
Unemployment rate	-0.060	-4.27***	-0.123	-5.16***	-0.044	-2.21**
Constant	3.965	3.99***	7.919	5.26***	4.498	3.90***
Industry fixed effects†	Yes		Yes		Yes	
R-squared	0.591		0.214		0.511	
No. of observations	1450		430		870	

† Classification of industries is the same as in Table 1, with agriculture used as the reference industry. *, ** and *** denote significance at 10%, 5% and 1% level respectively. [a] All variables are defined in the Appendix.

Figure 1 Modelling equilibrium level of firms (N*)

Figure 1 plots the predicted equilibrium number of firms in a particular industry and a particular year (N^*_{it}, as predicted by model described by Equation (1) against the actual number of firms in a particular industry (N_{it}). Both variables are expressed in logarithmic terms.

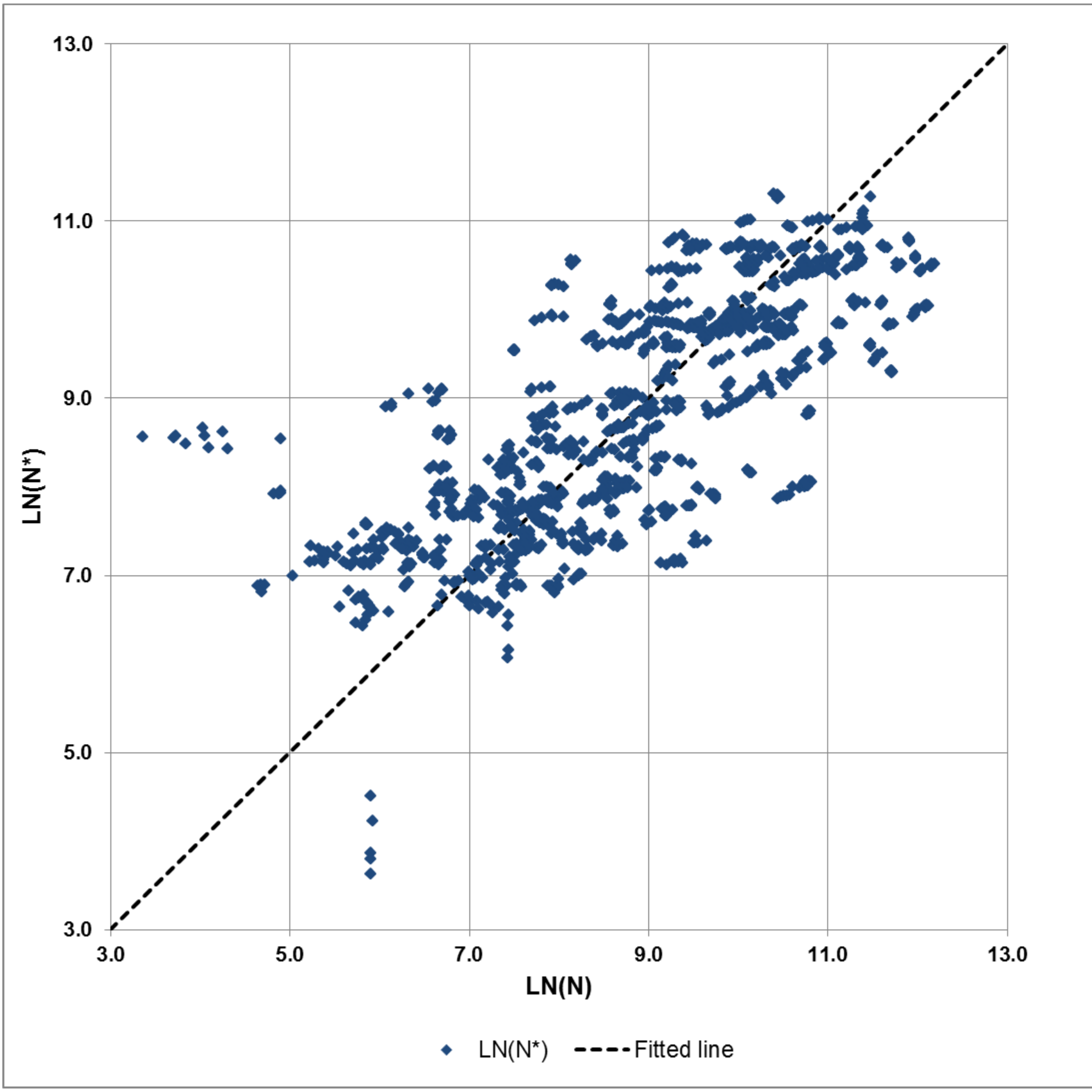

Table 3 Error correction model

Table 3 reports the results of testing the existence of an adjustment to equilibrium process as in Equation (2). The dependent variable is the change in the total number of businesses in the current period $(N_{it} - N_{it\text{-}1})$.

	All Industries		Manufacturing		Services	
Explanatory Variables[a]	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**
Δ (Log real sectoral gross value added)	0.096	1.31	0.091	1.67*	-0.035	-0.14
Δ Min. efficient scale	0.000	-1.14	0.000	-1.49	0.000	-0.58
Δ Income tax rate	-0.023	-3.47***	-0.061	-4.33***	-0.002	-0.24
Δ Unemployment rate	-0.029	-2.70***	-0.100	-4.91***	0.006	0.39
lagged residuals	-0.009	-2.04**	-0.007	-1.77*	-0.009	-1.44
Constant	0.005	1.59	-0.008	-2.07**	0.014	1.57
R-squared	0.027		0.144		0.022	
No. of observations	1157		344		693	

*, ** and *** denote significance at 10%, 5% and 1% level respectively. [a] All variables are defined in the Appendix.

Table 4 Regression results for gross entry (E) including adjustment for disequilibrium

Table 4 reports the results of modelling gross entry E_{it} as in Equation (3).

	All industries		**All industries (with overshoots and undershoots)**		**Manufacturing**		**Manufacturing (with overshoots and undershoots)**		**Services**		**Services (with overshoots and undershoots)**	
Explanatory Variables[a]	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**
Log (real sectoral gross value added)	0.375	14.25***	0.375	14.34***	0.062	1.30	0.068	1.49	0.539	15.51***	0.541	15.76***
Min. efficient scale	-0.002	-12.55***	-0.002	-12.16***	-0.001	-5.09***	-0.001	-5.20***	-0.004	-24.59***	-0.004	-23.66***
R&D expenditure	0.000	1.52	0.000	1.52	0.000	0.32	0.000	0.40	0.000	1.50	0.000	1.48
Small firm share of patents	0.058	9.58***	0.058	9.50***	0.064	10.14***	0.065	9.53***	0.181	7.08***	0.176	6.74***
Income tax rate	-0.136	-2.87***	-0.136	-2.87***	0.135	2.01**	0.132	1.94*	-0.298	-4.44***	-0.298	-4.43***
Unemployment rate	-0.240	-4.03***	-0.240	-4.02***	0.074	0.94	0.072	0.90	-0.449	-5.19***	-0.449	-5.18***
Lagged residuals	0.959	47.50***			0.943	23.83***			0.941	37.44***		
Overshoot			0.949	23.30***			1.081	16.79***			0.898	19.11***
Undershoot			0.968	24.86***			0.785	11.13***			0.976	21.13***
Constant	3.894	3.94***	3.900	3.95***	1.957	1.28	1.801	1.18	7.261	5.23***	7.247	5.20***
Industry fixed effects†	Yes		Yes		Yes		Yes		Yes		Yes	
R-squared	0.952		0.952		0.877		0.884		0.938		0.938	
No. of observations	1160		1160		344		344		696		696	

† Classification of industries is the same as in Table 1, with agriculture used as the reference industry. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

[a] All variables are defined in the Appendix.

Table 5 Regression results for gross exit (F) including adjustment for disequilibrium

Table 5 reports the results of modelling gross exits, F_{it} as in Equation (4).

	All industries		**All industries (with overshoots and undershoots)**		**Manufacturing**		**Manufacturing (with overshoots and undershoots)**		**Services**		**Services (with overshoots and undershoots)**	
Explanatory	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**	**Coeff**	**t-stat**

Variables[a]												
Log (real sectoral gross value added)	0.363	17.01***	0.363	17.09***	0.025	0.90	0.029	1.06	0.538	18.17***	0.541	18.34***
Min. efficient scale	-0.002	-15.56***	-0.002	-15.62***	-0.001	-14.03***	-0.001	-14.08***	-0.004	-21.66***	-0.004	-25.01***
R&D expenditure	0.000	0.36	0.000	0.36	0.000	0.22	0.000	0.28	0.000	-0.18	0.000	-0.19
Small firm share of patents	0.054	16.05***	0.054	15.78***	0.065	16.71***	0.066	19.51***	0.130	6.77***	0.125	6.34***
Income tax rate	-0.302	-6.26***	-0.302	-6.24***	-0.385	-6.42***	-0.387	-6.43***	-0.274	-3.80***	-0.275	-3.78***
Unemployment rate	-0.416	-7.00***	-0.416	-6.99***	-0.557	-6.98***	-0.559	-6.99***	-0.384	-4.44***	-0.384	-4.42***
Lagged residuals	0.988	44.38***			1.006	44.32***			0.960	31.55***		
Overshoot			0.972	28.47***			1.083	29.35***			0.918	21.03***
Undershoot			1.001	21.99***			0.917	25.91***			0.994	17.10***
Constant	7.254	6.97***	7.263	7.00***	12.816	10.47***	12.729	10.23***	6.738	4.28***	6.724	4.23***
Industry fixed effects†	Yes		Yes		Yes		Yes		Yes		Yes	
R-squared	0.969		0.969		0.959		0.961		0.957		0.958	
No. of observations	1160		1160		344		344		696		696	

† Classification of industries is the same as in Table 1, with agriculture used as the reference industry. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

[a] All variables are defined in the Appendix.

APPENDIX: DESCRIPTION OF VARIABLES AND DATA SOURCES

Establishments (N), establishment births (E), and establishment deaths (F)

According to Statistics of US Businesses (SUSB) "an establishment is a single physical location at which business is conducted or services or industrial operations are performed". These range in size from 1-4 employees to 500+ employees, and are classified according to the 4-digit NAICS classification system. Data on these have been obtained from the website of US Small Business Administration (SBA) Office of Advocacy. We use the log of N, E and F for all analyses.

Value added to total US GVA by industry sectors

Gross value added (GVA) is equal to an industry's annual gross output minus its intermediate input. This data is obtained from Bureau of Economic Analysis (BEA). With the exception of retail and wholesale industry which is aggregated at the two digit NAICS level, value added for other industries is available at the three digit industry level. We convert the nominal GVA to real values using the GDP deflator for the year 2000 as the base and use its log form in the analysis.

R & D expenditure

Research and Development (R&D) expenditure is calculated as a percentage of total industry sales based on the 3-digit NAICS classification for each year of the analysis. This data is also obtained from the Bureau of Economic Analysis (BEA).

Small firm share of patents

The Small Business Administration (2003, Table 6, p. 17) reports the small firm share of patenting technology by technology areas which are broadly aligned with the NAICS/SIC industry classification. We use the data from this table to create a variable capturing the percentage share of patenting by small businesses in different industries.

Minimum efficient scale

We measure the minimum efficient scale requirement in each of the four-digit industries, as the average size (in terms of employees) of the largest plants accounting for 50% of the industry employment.

Income tax rate

This is the average annual income tax rate on personal income. Data on this variable has been obtained from the tax statistics site of the US Internal Revenue Service website.

Unemployment rate

This is the annual unemployment rate for the US. Data on this variable has been obtained from the Bureau of Labor Statistics, U.S. Department of Labor.

Lagged Residuals

These are the lagged residuals ε_{it-1} from the regression of N*. These capture the deviation of actual from sustainable level of business establishments in the previous period.

Overshoots and Undershoots

An over shoot indicator of ε_{it-1} is created by placing a value of zero (where the value of ε_{it-1} is negative), and vice versa for an under shoot measure.