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Mayflies and Long-Distance Runners: The Effects of New Business Formation on Industry Growth

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Abstract

This paper analyzes the effects of new business formation on industry growth. Dynamic panel techniques are used to test two hypotheses. First, does hit-and-run competition secure efficiency in an industry? Second, do innovative start-ups lead to amplified innovations by diminishing the knowledge filter? The results illustrate how new businesses can be viewed as either *mayflies* or *long-distance* runners.

Keywords

Entry and exit, growth, hit-and-run competition, innovation, dynamic panel techniques

JEL classification

L16, M13, O31, O41

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Introduction: New Business Formation and Growth

Does new business formation cause economic growth? Much recent research has been devoted to this question. Parker (2005, 36–37) surveys the recent empirical literature and finds evidence that new business formation is positively linked to growth at three different levels.

- At the level of the *individual* business—smaller and newer businesses tend to have higher growth rates than average.
- At the *industry* level—industries with higher entry rates of small businesses have above-average rates of productivity growth and innovation.
- And finally, there is evidence that new business formation drives *regional* economic growth.

There are two prominent explanations for the positive correlation between new business formation and growth.[1]

One explanation concerns *securing efficiency* by contesting established market positions. In the contestable markets approach, the threat posed by the possibility of new businesses entering the market is taken to be a key determinant of the behavior of existing firms (see Baumol/Panzar/Willig, 1982). Accordingly, barriers to entry and exit play a crucial role. Contestability is a measure of the extent to which a market is open to new entry. At the extreme, a market with no entry or exit barriers is perfectly contestable. The existence of abnormal profit, no matter how small, would trigger new entry in such a market. Assuming that existing businesses wish to deter new entry, the logical conclusion is that they will set prices at such a level that only normal profits are made. They will also produce at lowest possible average cost. In a perfectly contestable market, therefore, we expect firms to be productively efficient. Markets that are highly contestable are likely to be vulnerable to *hit-and-run competition*. Consider a situation where incumbent businesses are pricing at above the entry-limit level. New entry will be profitable as long as there is a time lag between entry and the reaction of the incumbent firms. Having made a profit in the intervening period, the new entrant can then costlessly leave the market as there are no exit barriers. A major exit barrier is sunk costs. Sunk costs will not occur where the firm can sell or in other ways dispose of its capital equipment without cost to itself.

The other explanation for the correlation between new business formation and growth is *amplified innovation*. Theories of endogenous growth in the tradition of Romer (1986) emphasize the influence of research and development on economic growth. Among other activities, private businesses generate new knowledge through research and development. The created knowledge may be exploited by them or by other businesses that compete in the same industry (see Mueller, 2005, 2). One reason for the producer of such knowledge not exploiting it could be that it, as an incumbent firm, does not want to take the risks associated with new products or processes. It might instead focus on exploiting the profit possibilities of its already existing product program (see Geroski, 1995, 431; Audretsch, 1995). Another explanation for the lack of new knowledge exploitation by its producer might be because the necessary reorganization measures can be implemented only with difficulty in established (large) businesses (see Jovanovic, 2001). Entrepreneurial activity, setting up a business, and commercializing unexploited knowledge can be assumed as a mechanism by which knowledge spillovers occur (see Mueller, 2005, 4). Founders of new firms might have worked for incumbent firms or the new venture might be a new branch of a existing firm. Audretsch (1995) points out that many radical innovations have been introduced by new businesses rather than by incumbents. A key assumption (see Acs/Audretsch/Braunerhjelm/Carlsson,

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[1] Fritsch/Mueller (2004, 962–963) actually enumerate four reasons: securing efficiency, acceleration of structural change, amplified innovation, and greater variety of products.

2003) is that new business formation diminishes the *knowledge filter* between the creation and exploitation of knowledge.

The goal of this paper is not to introduce further potential links between new business formation and growth but, instead, to use dynamic panel techniques to test the two hypotheses of secured efficiency by hit-and-run competition and amplified innovation as new business formation diminishes the knowledge filter. Dynamic panel techniques have been used fruitfully in empirical research on the determinants of economic growth (for an overview, see Kappler, 2004). These techniques take the time-series properties of the following data into account.

Data

The analysis is carried out at the industry level. The information on the number of establishments and startups in an industry is generated from the German Social Insurance Statistics.[2] The data are comprised of the yearly number of existing and new establishments in West Germany for 44 private industries (manufacturing, construction, and services) from 1984 to 2001. The data cover only establishments with at least one employee other than the founder; startups of establishments that remained very small (i.e., without any employees) are not included. For each cohort it is possible to track the new establishments over time. To test the two hypotheses of secured efficiency by hit-and-run competition and amplified innovation as new business formation diminishes the knowledge filter, a short-run start-up rate and a long-run start-up rate are defined as follows. The short-run start-up rate is the number of new establishments surviving for only one year per 1,000 establishments, which is used as a proxy for hit-and-run competition. The long-run start-up rate is the number of new establishments surviving for at least five years per 1,000 establishments. Assuming that long-lived startups are innovative or at least high-quality, the long-run start-up rate can be used as a proxy for the diminished knowledge filter by new firm formation. The industry gross domestic product, in prices of 1991, is from the Federal Statistical Office.

[2] See Fritsch/Brixy (2004) for a description of this data source.

As new establishments must be tracked for at least five years to calculate the long-run start-up rate, the final panel data set covers 44 private industries over the time period 1984–1996. Descriptive statistics for the variables in use are set out in the Appendix.

The time series data is partially nonstationary, which must be taken into account in econometric estimation. To test the nonstationarity of the variables, panel unit root tests are carried out by the method proposed by Im/Pesaran/Shin (2002). Table 1 shows the results of the tests.

Table 1: Panel unit root test

variable	**test statistic**	***p* value**
gross domestic product (log)	2.04	0.98
Δ gross domestic product (log)	–8.07	0.00
number of establishments (log)	5.10	1.00
Δ number of establishments (log)	–7.81	0.00
long-run start-up rate	–4.10	0.00
short-run start-up rate	–8.15	0.00

Number of cross-sections = 44. Number of time periods = 13. Individual effects (all variables) and time trends (gross domestic product (log) and number of establishments (log)). Null hypothesis: unit root (individual unit root process). Lagged differences are included according to the modified Schwarz-criterion.

The results are clear cut: the gross domestic product (log) and number of establishments (log) variables are integrated of order one, whereas the short-run start-up rate and long-run start-up rate variables are stationary.

Estimation Method

Determining the order of integration for the variables is important for setting up the cointegration analysis. If there is a linear combination of two or more nonstationary series that is stationary, the nonstationary time series are said to be cointegrated. This stationary combination can be interpreted as a long-run equilibrium. Only the nonstationary series enter the cointegration relationship. All stationary series enter as exogenous variables in the estimation of the corresponding (short-run) error correction model.

The results of the unit root tests support a long-run relation between the industry gross domestic product (log) and the number of establishments in the industry (log). The long-run relationship represents the underlying production condition in the industry:

$$gross\ domestic\ product\ (\log)_{it} = \alpha_i + \beta \cdot number\ of\ etablishments\ (\log)_{it} + \varepsilon_{it}\,. \qquad (1)$$

In Equation (1), the industry-specific intercept α_i stands for the gross domestic product (log) of a representative firm in the industry under inspection. The slope coefficient β is assumed to be 1 for all industries. It can be interpreted as an elasticity: if the number of representative establishments in the industry grows by 1%, the industry gross domestic product also increases by 1%. ε_{it} represents an error term.

The existence of a long-run relation between the industry gross domestic product (log) and the number of establishments in the industry (log) is consistent with the findings of Agarwal (1998), who presents strong empirical evidence on the product lifecycle of an industry. Agarwal (1998) shows the evolution of industries through regularities in the time paths of key industry variables, in particular the number of firms and the price and quantity of a product. Her study summarizes the time trends of the industry variables by regressing the key industry variables on product market age. The number of firms and the sum of the logarithms of product price and quantity follow very similar time patterns so that a long-run relation between these variables can be assumed. Consequently, the presented long-run relation between the industry gross domestic product (log) and the number of establishments in the industry (log) can be interpreted from an evolutionary point of view as the product lifecycle of the respective industry.

The stationary variables now enter the short-run error correction model:

$$\begin{aligned} &\Delta gross\ domestic\ product\ (\log)_{it} = +\beta_1 \cdot \Delta number\ of\ establishments\ (\log)_{it} \\ &+\beta_2 \cdot short\text{-}run\ start\text{-}up\ rate_{it} + \beta_3 \cdot innovative\ start\text{-}up\ rate_{it} + \beta_4 \cdot error\ correction\ term_{it} + \upsilon_{it} \end{aligned}\,. \qquad (2)$$

According to the hypotheses of secured efficiency by hit-and-run competition and amplified innovation as new business formation diminishes the knowledge filter, on average, positive slope coefficients β_2 and β_3 are expected. As the influence of the short-run start-up rate and the long-run start-up rate may vary at different stages of the industry lifecycle, the slope coefficients are allowed to be different depending on the stage of the industry lifecycle. Following Gort/Klepper (1982), the 44 industries studied in this paper are classified into five lifecycle stages during the observation period 1984–1996. Stage I begins with the commercial introduction of new products and ends with a sharp increase in the rate of entry of new competitors. Stage II is the period of sharp increase in the number of producers. Stage III is the period in which the number of entrants is roughly balanced by the number of exiting firms. Stage IV is the period of negative net entry. Stage V is a second period of approximately zero net entry. Industries were classified by visual inspection of the plotted series: there were 0 in Stage I, 23 in Stage II, 8 in Stage III, 11 in Stage IV, and 2 in Stage V. In Equation (2), β_4 has to be negative and represents the average of the industry-specific speed of adjustment to equilibrium. υ_{it} represents an error term.

Results and Policy Conclusions

Table 2 shows the results of the long-run and short-run error correction models. Because there might be a certain degree of multicollinearity between the short-run start-up rate and long-run start-up rate variables, the error correction model was carried out in different specifications, including both variables or including only one of the two variables.

Before interpreting the results, the estimated long-run relationship needs to be tested for cointegration. Cointegration analysis is carried out using tests proposed by Pedroni (1995, 1997, 1999). Pedroni (1995, 1997) first proposed tests for the null hypothesis of no cointegration in heterogeneous panels for bivariate equations and then extended them for multiple regressors (see Pedroni, 1999). Table 3 shows the results of the seven test statistics Pedroni proposes.

Table 2: Results

variable	coefficient	**t statistic**
long-run model (dependent variable: gross domestic product (log)) with industry-specific intercepts		
number of establishments (log)	0.9291	6.13
short-run Model I (dependent variable: Δ gross domestic product (log))		
Δ number of establishments (log)	0.6285***	4.73
long-run start-up rate	0.0002***	2.79
long -run start-up rate * Stage III	–0.0002**	–2.10
long -run start-up rate * Stage IV	–0.00003	–0.14
long -run start-up rate * Stage V	0.0001	0.39
error correction term	–0.2181***	–8.05
short-run Model II (dependent variable: Δ gross domestic product (log))		
Δ number of establishments (log)	0.7526***	5.79
short-run start-up rate	0.0002	1.30
short-run start-up rate * Stage III	–0.0009*	1.88
short-run start-up rate * Stage IV	0.0002	0.41
long -run start-up rate * Stage V	0.0013	1.27
error correction term	–0.2204***	–8.11
short-run Model III (dependent variable: Δ gross domestic product (log))		
Δ number of establishments (log)	0.6064***	4.49
long-run start-up rate	0.0006***	3.36
long -run start-up rate * Stage III	–0.0003	–0.87
long -run start-up rate * Stage IV	0.0001	0.29
long -run start-up rate * Stage V	–0.0007	–1.17
short-run start-up rate	–0.0007**	–2.15
short-run start-up rate * Stage III	–0.0004	–0.41
short-run start-up rate * Stage IV	–0.0005	–0.39
long -run start-up rate * Stage V	0.0028	1.52
error correction term	–0.2177***	–8.06

Stage III, Stage IV, and Stage V are dummies with value of 1 if the industry is classified in the respective stage of the lifecycle.
***: statistically significant at the 1 percent level. **: statistically significant at the 5 percent level. *: statistically significant at the 10 percent level.

Table 3: Cointegration test for the long-run model

statistic	test statistic	**p value**
panel ν -stat	2.89	0.99
panel ρ -stat	–0.60	0.27
panel PP-stat	–1.81	0.04
panel ADF-stat	–3.32	0.00
group ρ -stat	2.53	0.99
group PP-stat	–0.11	0.45
group ADF-stat	–2.29	0.01

Number of cross-sections = 44. Number of time periods = 13.
All reported values are distributed N(0,1) under null of unit root or no cointegration.

The cointegration tests result in a somewhat conflicting pattern. For panels with a limited number of observations, the ADF-based statistics are most suitable and indicate the existence of cointegration.

The slope coefficient in the long-run equation is, as expected, significantly positive and close to 1. The coefficient of the error correction term is significantly negative in all short-run models, which signals a stable long-run equilibrium.

The results confirm the hypothesis of a diminished knowledge filter by long-run start-ups. The slope coefficient for the long-run start-up rate is significantly positive. However, no differences for the different stages of the industry lifecycle can be found except in short-run Model I. The slope coefficients for the different stages of the industry lifecycle are calculated as the sum of the overall slope coefficient for the start-up rate and the stage-specific slope coefficient. Only coefficients significantly different from zero are taken into account. Following this procedure, the influence of the long-run start-up rate for Stage III in short-run Model I is close to zero. According to Gort/Klepper (1982), during Stage III, technology matures and the most dramatic product improvements are realized, after which the rate of important innovations declines. Consequently, innovative entries play a subordinated role during Stage III.

On the other hand, the hypothesis of hit-and-run competition has not been confirmed by empirical evidence. The slope coefficient for the short-run start-up rate is either not significantly different from zero or significantly negative. Potential competition already disciplines incumbent firms. Incumbents cannot exploit consumers by reducing output, raising prices, and earning supernormal profits in a market without barriers to entry and exit. Consequently, short-run startups, having misinterpreted their market opportunities, are nothing but *mayflies*.

However, as long-run start-ups have a significantly positive impact on industry growth, growth policy should be concerned with the number of these high-quality firms, which could be called *long-distance runners*. Storey (2003) identifies examples of such a growth policy, including actions as diverse as facilitating access to loan finance and equity capital for high-quality startups, reducing administrative burdens for startups, building up science parks, and entrepreneurial education.

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Appendix

Descriptive statistics

industry	real gross domestic product (in billions)		number of establishments (in thousands)		long-run start-up rate (per 1,000 establishments)		short-run start-up rate (per 1,000 establishments)	
	mean	std. dev.	mean	std. dev.	mean	std. dev.	mean	std. dev.
Chemicals	68.34	5.65	2.65	0.04	32.24	4.39	10.94	2.40
Mineral oil processing	39.52	7.04	0.12	0.00	26.03	15.23	7.92	7.35
Plastics	22.23	3.29	5.49	0.26	40.54	5.89	14.25	2.70
Rubber	8.20	0.41	0.82	0.01	30.25	6.47	8.72	3.13
Stone and clay	19.49	1.51	9.58	0.36	24.00	1.76	7.19	0.92
Ceramics	2.74	0.35	0.94	0.02	40.80	9.34	16.60	5.36
Glass	6.01	0.62	0.88	0.04	30.00	6.51	13.14	4.28
Iron and steel	14.97	0.89	0.18	0.01	34.05	15.96	9.19	8.30
Nonferrous metals	6.52	1.25	0.26	0.02	48.51	12.90	16.90	7.46
Foundries	7.59	0.85	0.91	0.02	26.61	7.36	8.83	2.32
Steel processing	20.87	2.38	20.08	0.36	34.38	2.63	11.32	1.11
Steel and light metal construction	14.17	1.63	5.84	0.78	51.92	5.21	25.00	2.18
Machinery, gears, drive units other machine parts	85.92	7.03	12.26	0.78	42.09	4.73	11.42	1.13
Office machinery and computers	10.93	2.86	1.16	0.12	59.67	11.22	21.58	3.57
Motor vehicles	85.15	8.41	31.04	0.78	36.02	4.29	10.25	0.94
Shipbuilding	2.37	0.25	0.41	0.02	38.52	13.63	16.54	6.69
Aerospace	6.23	1.24	0.16	0.03	59.40	17.71	19.92	11.53
Electronics	88.81	9.61	14.14	1.16	47.66	5.42	14.60	1.29
Fine mechanics, watches, and gauges	14.70	1.25	10.74	0.99	49.27	4.99	7.89	1.35
Iron and metal goods	26.96	2.74	7.44	0.24	36.33	2.81	12.01	1.39
Jewelry, musical instruments, and toys	4.90	0.33	3.50	0.12	36.20	7.30	14.21	3.21
Wood (excluding furniture)	3.63	0.54	3.24	0.20	17.21	2.89	7.18	1.92
Furniture	20.13	1.08	33.62	0.29	32.15	2.32	11.21	1.38
Paper making	6.43	0.47	0.17	0.01	31.61	11.21	14.08	12.97
Paper processing and board	9.11	1.15	1.98	0.02	30.05	5.02	10.59	2.82
Printing	17.61	1.15	11.48	0.55	38.41	4.42	12.61	1.68
Textiles	13.04	1.93	3.47	0.31	24.79	4.49	12.56	1.68
Leather	3.32	0.52	4.24	0.27	28.67	3.20	14.64	2.55
Apparel	9.44	1.05	7.11	1.16	27.45	3.24	23.34	2.29
Food	44.95	1.67	44.00	4.97	19.53	1.18	6.16	0.58
Beverages	14.12	0.79	2.36	0.18	13.75	2.79	5.73	1.85
Construction	77.88	3.03	63.27	5.19	40.08	3.50	29.11	5.66
Installation	53.38	3.65	81.98	2.43	34.23	2.90	10.31	1.19
Wholesale trade	112.81	12.33	109.91	4.68	44.38	2.98	22.50	1.50
Resale trade	101.56	14.63	218.46	8.59	44.44	2.80	22.65	2.12
Traffic and freight	6.05	0.59	2.65	0.22	42.92	7.45	16.25	3.20
Postal services	59.37	11.11	59.03	5.13	50.06	2.69	28.69	2.09
Banking and credit	95.63	13.05	17.05	0.42	23.48	2.76	11.15	1.71
Insurance	29.98	5.90	17.68	2.47	57.50	10.95	31.23	7.38
Real estate and housing	180.14	20.55	33.74	5.37	56.61	3.18	36.47	4.52
Hotels, restaurants, etc.	30.97	2.12	110.49	7.25	52.64	3.15	49.43	3.95
Science, publishing, etc.	43.34	4.47	29.24	3.68	61.06	4.82	39.26	6.60
Healthcare	59.72	11.91	107.50	11.23	53.30	4.78	7.12	0.79
Other private services	307.33	81.89	197.48	22.62	52.15	2.48	20.84	1.20

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