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EXIT, ENTRY AND INDUSTRY TURBULENCE IN AUSTRIAN MANUFACTURING, 1981-1994

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EXIT, ENTRY AND INDUSTRY TURBULENCE IN AUSTRIAN MANUFACTURING, 1981-1994

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by

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Abstract

This research explores both industry and temporal aspects of entry, exit and industry turbulence in Austrian manufacturing in the period between 1981 to 1994. It is shown that while the net entry of both firms and establishments is quite stable over time, exit and especially the turnover and volatility of firms is influenced more by temporal effects. A regression analysis into the determinants of industry dynamics associated with entry and exit shows that sunk costs, scale economies and industry growth are primary determinants for different entry and exit regimes across 2-digit sectors. Profitability is found to be significant for dynamics related to exit but not for entry.

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Keywords

Entry, exit, industry turbulence, determinants of entry and exit

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1. Introduction

The modern industrial organisation literature thinks of markets as being dynamic. Entry and exit processes form a central aspect of these dynamics: Entry brings in new firms, with new capital and even new ideas, while exit retires old capital and ideas. This process of economic selection on the firm and plant level fosters industrial efficiency and is subject to incentives and impediments as well as barriers to entry and exit. Most industries are characterised by high levels of turbulence, which arises from entry and exit processes and changes in market shares. Birth rates are quite high even in industries characterised by high barriers to entry (Geroski 1995). Exit rates tend also to be quite high leading to high levels of turbulence and volatility.

The turnover of firms is often linked to entrepreneurship and small business activity assumed to be one of the premier sources of economic progress (Schumpeter 1912). The turnover of firms is seen to promote competition, technological and structural change and hence efficiency. Therefore, the turnover of the population of firms has been under discussion in recent years both in academic research and in policy discussion in most industrial countries. New entrants are often considered to be vehicles for Schumpeterian entrepreneurs to introduce new combinations into economic life.

The purpose of this paper is to explore the empirical regularities of the entry and exit processes and producer turnover in Austrian manufacturing. I investigate whether entry and exit is influenced primarily by industry specific factors such as barriers to entry (minimum efficient scale) and barriers to exit (sunk costs) and by time effects relating to macroeconomic business conditions. The study industry turbulence for Austrian manufacturing is especially interesting as the Austrian manufacturing sector is on hand characterizes by the emergence of small MNE's, by its large share of small and medium size enterprises, but on the other hand the technology structure is low and medium tech and the R&D ratio is low (Tichy 2000). The Austrian Manufacturing sector is populated by firms located in an path-dependent incremental intensive learning regime and an by international comparison low entry and exit dynamics (Hauth 2001). The observation that the dominant strategy in Austrian Manufacturing is one of quality upgrading does not surprise. The strengths of the Austrian Manufacturing sector are in fields which are usually regarded as medium technology and building on a long-maintained knowledge base (Peneder 1999, Tichy 2000).

The next section of the paper provides an overview of the literature and concepts of industrial turbulence. Determinants of entry and exit are discussed, measures of entry, exit and turnover presented. In section three the nature of the data, limitations and interpretations are discussed in some detail, and descriptive statistics provided. Section four presents the empirical evidence regarding industry and time effects and evidence on the process of producer turnover. Section five explores determinants of entry, exit and producer turnover in more detail. Concluding remarks summarise the findings.

2. Industrial dynamics: nature and properties

2.1 The arithmetics of industry dynamics: entry, exit and survival

In the following we consider a simple model of a population of firms in order make clear the working of industry dynamics associated with entry and exit (see also Metcalfe 1998). We assume that the firms which make up the population of the industry differ in their characteristics (costs of production, organisational competencies or innovative competencies). We do not specify the source of those differences, therefore the arguments of the selection process are left unspecified but it is clear that the selection process is governed by the characteristics and the behaviour of the firms making up the population. We look at an industry at two points in time t and $t + 1$, and assume that all exit and entry takes place at the beginning of the entry period.[1] The dynamics in the population of firms in this industry can be described in the way as depicted in table 1.

At time t there are N_t firms in the industry producing an industry output of X_t; at time $t+1$, N_{t+1} firms produce an output of X_{t+1}. Between these two points in time exit and entry takes place, so that $N_{t+1} = N_t + entries - exits$.

Table 1: Industry dynamics: number of firms and output

Time	Number of firms	Output of Industry
T	N_t	X_t
T+1	$N_{t+1} = N_t + entries - exits$	$X_{t+1} = (1 + g)X_t$

The number of firms alone does not tell much about the structure of competition: There could be one large firm and many small ones or a small group of firms, which have all the same size. This consideration indicates that output ratios of the single firms (or groups of firms) are the important variable.

There are three categories of firms in the industry concerning these two points in time: (i) surviving firms, (ii) exiting firms, and (ii) new entrants. As assumed, all exits and entries occur at the beginning of $t+1$. EN_{t+1} denotes the contribution to the output X_{t+1} of entering firms. From this the share of new entrants in $t+1$ can be calculated as $n = EN_{t+1}/X_{t+1}$. In the same way, we can take into account the exits: EX_t denotes the contribution of exiting firm to X_t, and $e = EX_t/X_t$ is the market share of exiting firms in period t. With this definitions a complete overview over the contributions to output and market shares for all three groups of firms is given. Table 2 summarises the development for new firms, exiting firms and surviving firms.

[1] This simplifies the exposition while not harming the dynamics we are interested in.

The growth rate of total output with is given by $X_{t+1} = (1 + g)X_t$. In a similar way the growth rate of the output of the surviving firm can captured as *gs*. Then aggregate output *at t+1* can be written as,

$$1 = ((1-e)(1+gs)/(1+g)) + n.$$

This expression summarises the relation between proportions and growth rates: the growth rate of the surviving firms depends on the rate of exits and entries and the growth rate of aggregate output. The aggregated growth rate of surviving business is not only dependent on the growth rate of the market but also on the relative efficiency of entrants measured by their market share *n*. When entry and exit are measured as numbers of firms as in the this study, the relationship is simpler but there is less informational content in the numbers: $N_{t+1} = N_t + EN_t - EX_t$.

In this "ecological" exposition a genuine economic argument is missing: the selection mechanism is not specified, as well as the behaviour of firms and the structural characteristics of the industry. Competition, the co-ordination on the market, is treated as a black box.

Table 2: Industry dynamics: entry exit and survival

		during t	During t + 1
Entering firms:	Output	-	EN_{t+1}
	Market share	-	$N = EN_{t+1} / X_{t+1}$
Exiting firms:	Output	EX_t	-
	Market Share	$e = EX_t / X_t$	-
Surviving firms:	Output	$X_t - EX_t$	$X_{t+1} - EN_{t+1}$
	Market Share	1-e	1-n

2.2 What determines entry and exit?

Industrial economics does revolve to a large part around the issue of monopoly power. The essence of monopoly power is the ability to set prices above cost. The exercise of market power in turn should attract new firms to enter the market in order to challenge incumbent firms by undercutting prices. Thereby entry should increase competition and facilitate adjustments to changes in demand, technology and factor prices. Entry is a response to perceived profit opportunities. New profit opportunities manifest themselves as a response to a departure from an entry-deterring (long-run) profit level and to expected market expansion. Both high profit opportunities and rapid growth are usually seen to indicate the existence of a industry disequilibrium.

In order to study empirically the behaviour of entry and exit in this section estimable linear equations which account for the determinants of entry and exit. Ignoring time and industry subscripts entry (*EN*) can be expressed as a linear function of deviation of profits from entry deterring (long run) profits:

$$EN = \gamma (\pi - \pi^*). \qquad (1)$$

The long-run entry deterring profits depend on a vector of structural and behavioural entry barriers (**BE**) and the growth rate of demand g^d, accounting for the fact that entry barriers are weakened when there is high growth of the market,

$$\pi^* = \beta_1 \mathbf{BE} - \beta_2 g^d. \qquad (2)$$

Perfect competition or 'perfect contestability' (Baumol et al., 1982) is the common benchmark to evaluate the performance of market. A market is contestable if entry (and subsequent) exit are possible at very low cost (hit and run entry). Barriers to entry do restrict entry and allow incumbents to raise price above the competitive level without attracting entry. Barriers to entry are related to asymmetries between entrants and incumbents in terms of costs leading to high entry costs and/or to high post-entry adjustment costs. These barriers relate to features of the specific production and selling technologies (structural entry barriers) or features of strategic competition (behavioural entry barriers). Economies to scale, product differentiation by incumbents, capital, R&D and advertising intensity as well as long term contracts with important suppliers or buyers are usually seen to reflect barrier to entry. Strategies to raise rivals costs are also barriers to entry (and exit) and can be considered as endogenous sunk costs (e.g. Sutton 1991).

However equation (2) does not reflect the fact that entrants can displace incumbents. The profit variable denotes the perceived opportunities of entrants. As this variable is not observable it is approximated by the average profitability in the industry and the distribution (variance) of profitability among incumbent firms, and a disturbance term:

$$\pi = \alpha_1 \overline{\pi} + \alpha_2 V(\pi) + \varepsilon. \qquad (3)$$

Here, the disturbance term (ε) reflects the perception of profit opportunities by new entrants which deviates from the average profitability and the distribution of profitability in the industry, $V(\pi)$. Those expectations can be erroneous if entrants are overconfident, leading to excess entry. If we combine (1), (2) and (3), entry can be expressed as

$$EN = \gamma \alpha_1 \overline{\pi} + \gamma\alpha_2 V(\pi) + \gamma\beta_2 g^d - \gamma \beta_1 \mathbf{BE} + \gamma\varepsilon. \qquad (4)$$

Equation (4) shows that entry depends positively from the level of profitability within an industry, the variance of profitability and the growth of demand and negatively from entry barriers. This expression accommodates the view that entry is also a process of replacement of relatively inefficient incumbents by more efficient entrants.

While the entry decision is made essentially outside of the market with expectations regarding market growth and potential profits, competition on the market determines the exit decision of incumbent firms: Exit is caused by the ongoing selection process within the industry and reflects the release of productive resources to alternative uses. Persistently low profits may indicate high barriers to exit as firms continue to engage in low-profit activities only when a large part of their investment is sunk.

As entry, exit depends on a number of structural features, which are called barriers to exit (**BX**) and the growth rate of demand (g^d). Moreover it depends on the efficiency of new entrants (the replacement effect). Exit depends negatively on the profitability as the likelihood of exit increases with lower profits, positively on the within distribution of profits (replacement effect) and negatively on the growth of demand and exit barriers. A linear estimable equation for exit is given by:

$$EX = -\theta_1 \overline{\pi} + \theta_2 V(\pi) - \theta_3 g^d - \theta_4 \mathbf{BX} \qquad (5)$$

No error term is included in the exit equation, as exit is an outcome of the market selection process and therefore considered to be an objective phenomenon. However, note that entry driven by wrong expectations is accounted for in the exit equation (5) by the within distribution of profitability $V(\pi)$.The ultimate selection criteria for the individual firm is reached when it's cost is persistently higher than the ruling market price.

Barriers to exit force firms to remain in operation as outside options are unattractive and are generally associated with the presence of sunk costs. If large part of the investment in tangible and intangible assets is sunk firms will be reticent to exit markets as these costs cannot be recovered readily. To qualify for sunk costs the assets under consideration must be committed for a long time and be product- or firm-specific. R&D-expenditures and advertising are usually considered to be sunk costs, as they cannot recovered easily when the firm is terminating production. Investment in machinery is usually more specialised than buildings and therefore more sunk. Caves and Porter (1976) and Eaton and Lipsey (1980) argued that exit barriers could be viewed as entry barriers, as an entrant knowing that a large part of its entry costs will be sunk is less inclined to enter. This creates the idea of symmetry of entry and exit barriers. High capital costs are a barrier to entry and exit only if a large part is sunk. The importance of sunk costs for industry dynamics has been empirically confirmed (e.g. Rosenbaum and Lamort 1992, Kessides 1986) as the thesis of symmetry (Fotopoulos and Spence 1998 provide a recent study and overview).

Thus, entry and exit are seen as decisions subject to different inducements, barriers and information sets (new entrants can be supposed to be less informed than incumbents on the competitive nature of the market in question) but linked by the co-ordination of the market conceived as information generating and co-ordinating process (Hayek 1968, Metcalfe 1998).

2.3 Other indicators of industry turbulence

In addition to entry and exit other indicators of industry turbulence are used in this study. Net entry, turnover and volatility capture different aspects of industry dynamics and must be regarded as indicators of their own right (Dunne and Roberts 1991).

Net entry (NE) is the change in the population of firms and is defined as the difference between entry and exit, *NE=EN-EX*. By using (4) and (5) net entry can be written as:

$$NE = (\gamma\, \alpha_1+\theta_1)\ \overline{\pi}\ + (\gamma\alpha_2 -\theta_2)V(\pi) + (\gamma\beta_2+\theta_3)\ g^d - \gamma\, \beta_1\, \mathbf{BE} + \theta_4\, \mathbf{BX} + \gamma\varepsilon. \qquad (6)$$

This expression indicates that the net entry rate is primarily a function of the expansion of the industry and changes in profitability. Net entry can be thought in a first moment as deriving from changes in market size and technological change influencing the efficient scale of operation, reacting to disequilibrium situations due to changes in demand and technology. If barriers to entry are also barriers to exit and their influence is symmetric, then they do not influence the number of firms operating in the industry. The same is true for the within distribution of profits. In the long run the disturbance parameter should become unimportant, as the working of the market mechanism forces overconfident entrants again out of the market via the replacement effect. Replacements do not influence net entry, as the number of firms in the industry remains the same. Net entry (exit) is a measure of the incidence of entry and exit on the number of producers. It does not account for the turnover of producers, as the net entry rate can be constant when no entry or exit takes place or when the number of entrants exactly replaces the number of exits.

The turnover (T) is given by the total activity of entry and exit and accounts for both changes due to disequilibrium situations and replacement effects. The turnover measure is defined as the sum of entry and exit the industry and reflects the dynamics in terms of changes of the identities of producers in the industry. Again by combining (4) and (5) we get:

$$T = (\gamma\, \alpha_1-\theta_1)\ \overline{\pi} + (\gamma\alpha_2 +\theta_2)V(\pi) + (\gamma\beta_2-\theta_3)\ g^d + \gamma\, \beta_1\, \mathbf{BE} + \theta_4\, \mathbf{BX} + \gamma\varepsilon. \qquad (7)$$

As the turnover measure accounts for both the changes in market size and replacement effects they allow to investigate whether barriers to entry are also barriers to exit. When industries differ systematically in their rates of turbulence then then entry and exit should be positively related and barriers to entry work as barriers to exit (Caves and Porter 1976).

The excess turnover, that is the turnover in identities of firms which is not due to changes in the size of the market is a interesting measure in its own right. Volatility (V) measures excess entry and exit is defined as V = T-|NER| and by using (6) and (7) it can be written as

$$V=(\gamma\, \alpha_1-\theta_1)\ \overline{\pi}\ + (\gamma\alpha_2 +\theta_2)V(\pi) + (\gamma\beta_2-\theta_3)\ g^d + \gamma\, \beta_1\, \mathbf{BE} + \theta_4\, \mathbf{BX} + \gamma\varepsilon - |((\gamma\, \alpha_1+\theta_1)\ \overline{\pi} + (\gamma\alpha_2 -\theta_2)V(\pi) + (\gamma\beta_2+\theta_3)\ g^d - \gamma\, \beta_1\, \mathbf{BE} + \theta_4\, \mathbf{BX} + \gamma\varepsilon)|. \qquad (8)$$

Industries with high volatility are those industries where large numbers of new firms displace a large number of old firms without affecting the total number of firms (Geroski 1995). The volatility rate allows to investigate as the turnover rate whether barriers to entry and barriers to exit are symmetric. But by construction this measure indicates what does trigger the replacement of incumbents by new firms.

The very view of industry turbulence holds that entries and exits are contemporaneous processes relating to different decisions interconnected by the market process and subject to underlying business conditions related to novel and innovative ventures over the life cycle of the industry and sunk costs. Audretsch's (1995) metaphor of the 'revolving door' which describes a situation where entry and exit take place in the competitive fringe is related to this view, and emphasises the fact that today's entrants are likely to be tomorrow's exits. Intra-industry dynamics and cross-sectional differences are often related to the nature of the innovation process and learning (Winter 1984) or to sunk costs (Lambson 1991). An entrepreneurial regime is favourable to entrants due to the radical character of innovations, while a routinised regime favours incumbents due to the cumulative nature of the knowledge associated with innovation. The two regimes are related to levels of technology and sunk costs (Lambson and Jensen 1998). A routinised regime should be associated with high sunk costs while a entrepreneurial regime with the unimportance of sunk costs.

3. The data

Industry turbulence is studied at the level of industries (Fachverbände). This classification refers to the code system by institutional aspects of the Austrian Chamber of Commerce (KS - Kammersystematik der Österreichischen Wirtschaftskammer). There is no exact correspondence between KS and ISIC Rev. 2 or NACE but it is approximately comparable to a 2-digit-level SIC and classifies the firms according to activities.

In this study the term firm is used to refer to the legal units. Entry and exit is measured in number of firms. Data from the membership statistics of the Austrian chamber of commerce covering the period between 1981 and 1994 were used for this study. In Austria membership in the Chamber of Commerce is compulsory for every firm. Therefore a new entry is associated with a new membership in the related industry (Fachverband) and each exit with the cancellation of the membership. A membership needs not be associated with actual production activities. The membership is a necessary but not a satisfying condition for actual production. Therefore entries and exits are interpretet as relating to a *potential population* including incumbent firms, newly entering firms and entrepreneurial experimentation at a late stage as well as exiting firms.[2]

[2] As comparison with the Publication "Unternehmensneugründungen in Österreich" shows, the Mitgliederstatistik does cover more than greenfield entry. However the interest of this study is not on greenfield entry but also in diversifying entry and changes in the identity of firms which can traced back to takeovers and mergers.

While the membership statistics of statistic Austria relates to firms the data from industry statistics to active establishments. From the industrial statistics a net entry rate of establishments could be derived. This net entry rate is denoted as NER (IS) and is used to study differences in the determinants of dynamics on the firm and establishment level.

Not all "Fachverbände" were considered in this study, mining activities and industries with a 100% concentration ratio were excludes as were excluded those for which the data was not consistent over time period studied. Table 3 shows the descriptive statistics for gross entry, gross exit and net entry on the establishment level - NER(IS) - by Fachverband. The data show that there is more variation inr absolute entry and exit than for NER(IS) between industries. Most industries - 13 out of 17 - display negative growth patterns in terms of number of enterprises, having more exits than entries and a negative NER(IS). Four industries display a positive growth pattern, while one industry (18 Fabricated Metal products except machinery) is characterised by a divergence between the establishment and firm data: There is a net entry in terms of firms but a net exit in terms of establishment (NER IS) This discrepancy can be traced back to entrepreneurial experimentation. Another explanation would is related to the fact that diversifying entrants are captured more readily in the membership statistics than in the industrial statistics. But this I do consider to be entrepreneurial experimentation. Overall, the sample period is characterised by net exit both in terms of firms and establishments.

Figure 1: Industry turbulence on the firm level in Austrian Manufacturing 1981-1994

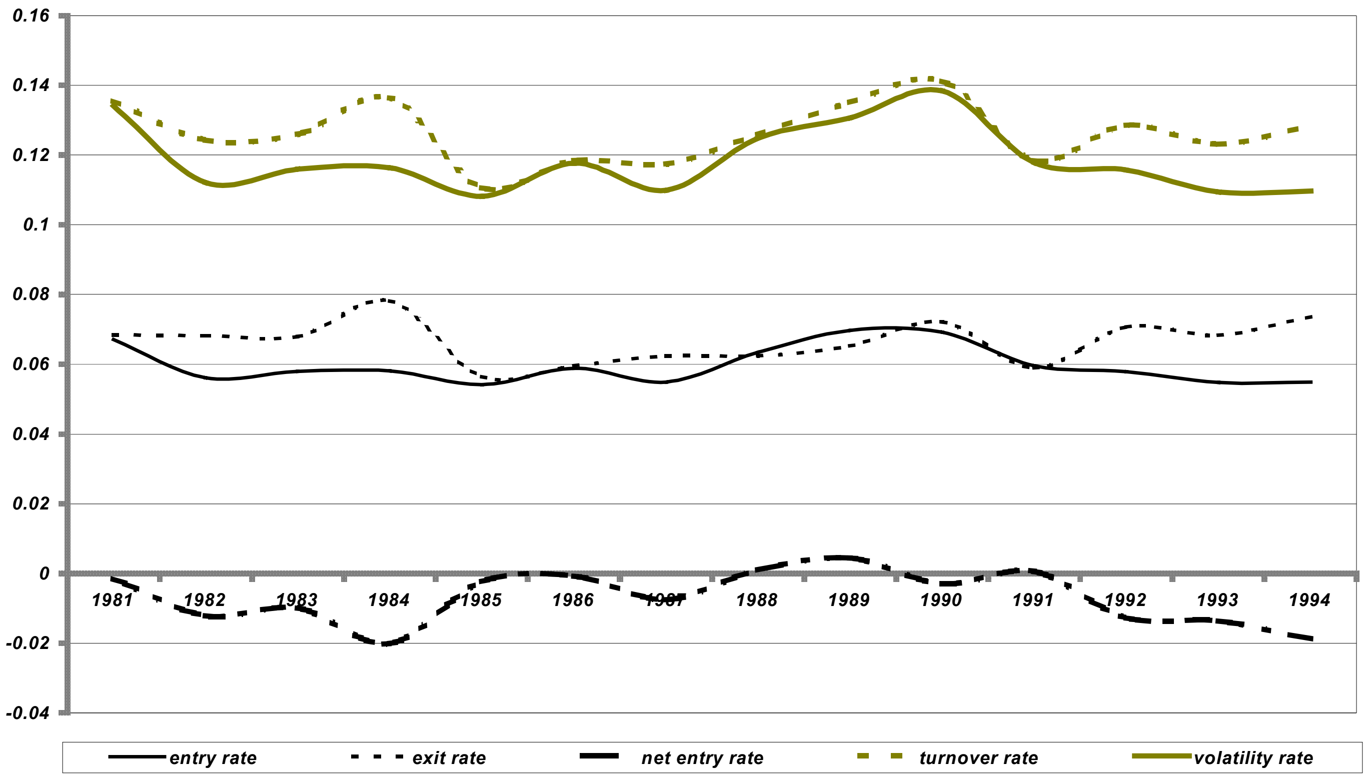

Figure 1 displays the average dynamics for entry, exit, net entry, turbulence and volatility rates. It can be easily seen that the overall number of firms declines. A comparison between the descriptive statistics across Fachverbände and figure 1 shows, that there is more variation between industries than between time periods. In two years 1984-85 and 1980-81 there is positive net entry in terms of establishments. In 1987-88, 1988-89 and 1990-91 there is a positive net entry in terms of firms, reflecting business cycle dynamics.

Table 2 reports the results of the correlation analysis between the different indicators of industry turbulence. As entry and exit are said to reflect an important aspect in the reallocation of productive resources from less profitable uses to more profitable activities the relationship between entries and exits is fundamental. Two different kinds of replacement effects can be differentiated: inter-industry and intra-industry replacement (Cable and Schwalbach 1991). If there inter-industry replacement is dominant (i.e. firms flow from industries with low profitability to industries with high profit opportunities) then the correlation between entry and exit should be negative. The sign will be positive if intra-industry replacement is the predominant form of replacement. Table 2 shows that the correlation between entry and exit rates is significant and positive: intra-industry replacement dominates inter-industry replacement. The other correlation coefficients show also the expected directions: net entry rates are positively correlated with entry (ER) and negatively correlated with exit (XR). There are differences between the two net entry rates (NER, NER(IS)) but the correlation between them is high and significant.

Table 3: Descriptive statistics: for entry, exit and net entry (IS) by Fachverband, 1981-1994

		Mean	Std. Dev.	Min	Max
Overall	EN	26.24603	25.80039	0	99
	EX	29.19444	25.52145	0	94
	NER(IS)	-0.0150544	0.0421651	-0.1666667	0.1851852
3	EN	29.35714	9.810568	14	46
	EX	33	7.35893	23	48
	NER(IS)	-0.014678	0.019197	-0.0667939	0.002331
4	EN	4.357143	2.239751	1	9
	EX	4.714286	2.614415	0	8
	NER(IS)	-0.0058737	0.0372669	-0.1	0.0526316
5	EN	58.85714	5.260259	47	67
	EX	67.71429	10.61515	50	85
	NER(IS)	-0.0078231	0.0224696	-0.0613893	0.0243112
6	EN	3.5	1.870829	0	6
	EX	5.142857	3.460928	2	14
	NER(IS)	-0.0338622	0.027872	-0.0789474	0
7	EN	11.07143	2.758603	8	16
	EX	12.21429	2.8603	8	19
	NER(IS)	-0.0117779	0.0277265	-0.0522388	0.0338983
10	EN	36.28571	10.68017	19	58
	EX	43.71429	8.57033	27	56
	NER(IS)	-0.0144936	0.0178179	-0.0413793	0.0163551
11	EN	35.35714	12.79187	17	72
	EX	41.14286	9.542271	28	64
	NER(IS)	-0.0140003	0.0171779	-0.057041	0.0084459
12	EN	1	1.1094	0	3
	EX	2	1.414214	0	5
	NER(IS)	-0.051057	0.0961762	-0.1666667	0.1578947
13	EN	5.214286	2.577374	0	9
	EX	10.21429	3.400873	3	16
	NER(IS)	-0.0510201	0.0366117	-0.1090909	0
14	EN	6.928571	4.25105	1	18
	EX	7.571429	2.208873	4	11
	NER(IS)	-0.012535	0.0293048	-0.0625	0.0416667
15	EN	6.857143	2.107026	3	11
	EX	6.142857	4.32981	2	19
	NER(IS)	-0.0102163	0.0472313	-0.075	0.1
16	EN	83	10.17539	61	99
	EX	66.71429	8.137554	58	83
	NER(IS)	0.0120357	0.0193167	-0.0116279	0.0529248
17	EN	19.78571	5.161672	12	31
	EX	18.42857	6.009151	10	30
	NER(IS)	0.0048301	0.0263224	-0.0416667	0.0427807
18	EN	78.92857	8.361673	63	97
	EX	78.28571	9.075992	61	94
	NER(IS)	-0.003151	0.0160761	-0.0316265	0.0239163
19	EN	37.07143	9.840765	25	60
	EX	36.64286	6.307592	29	48
	NER(IS)	0.0088068	0.0281025	-0.0368664	0.076087
20	EN	24.21429	7.836586	10	35
	EX	40.57143	11.74547	25	62
	NER(IS)	-0.0315526	0.0124139	-0.0487805	-0.0023529
21	EN	29.35714	9.270359	14	41
	EX	50.71429	12.95215	28	78
	NER(IS)	-0.0428874	0.0282273	-0.0870968	0.009434

Table 4: Contemporaneous correlation between industry turbulence indicators, 1981-1990

	Entry	Exit	Entry rate	Exit rate	Net entry rate	Turnover rate	Volatility rate	Net entry rate (IS)
Entry	1.0000							
Exit	0.8942*	1.0000						
Entry rate	0.2119*	0.0274	1.0000					
Exit rate	-0.1511*	-0.0338	0.3868*	1.0000				
Net entry rate	0.3197*	0.0498	0.4826*	-0.6105*	1.0000			
Turnover rate	0.0201	-0.0066	0.8040*	0.8594*	-0.1261*	1.0000		
Volatility rate	0.2019*	0.1335*	0.8795*	0.6076*	0.1671*	0.8796*	1.0000	
Net entry rate (IS)	0.2871*	0.1557*	0.3789*	-0.2043*	0.5099*	0.0784	0.3242*	1.0000

Note: asterix denotes significant at the 10% level

4. Sectoral and temporal patterns of industrial turbulence in Austrian Manufacturing

In this section the extent of influence industry effects and time effects on industry turbulence is studied. Industry effects refer to sectoral differences related to technology, unbalanced growth processes due to changes in preferences and to differences in barriers to entry and exit. Time effects account for yearly differences of the indicators of industry turbulence and refer to symmetric temporal shocks of a macroeconomic or regulatory nature. These sources of variation are systematic in the sense that they are controlled for by industry-fixed and time-fixed variables. We focus on the existence, or otherwise, of temporal and sectoral variations. The observation that variables like capital intensity, advertising intensity, R&D intensity – along with structural measures like concentration and performance measures – differ widely across sectors is at the very origin of industrial economics as a discipline. Therefore, it should present no surprise that the phenomena of entry and exit should exhibit significant inter-industry variability. Which leads the hypothesis that fixed industry effects should be more important than time effects in explaining entry and exit records. In order to examine the relative importance of across-industry and within-industry effects of the turnover of firms we use variance decomposition. The total sample variation across firms is for each of the 8 variable is given by

$$\sigma^2 = \frac{1}{NT}\sum_{i=1}^{N}\sum_{j=1}^{T}(x_{i,t} - \bar{x})$$

where $x_{i,t}$ represents one of the eight industry turbulence measures, N is the number of industries (Fachverbände), T is the number of time periods and $\bar{x} = (\sum\sum x_{i,t}) / NT$ the overall mean. The total sample variation can be decomposed into the sum of within- and between-industry variation:

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}\sigma_i^2 + \bar{\sigma}_i^{\,2}$$

where

$$\sigma_i^2 = \frac{1}{T}\sum_{i=1}^{T}(x_{i,t} - \bar{x}_i)^2,$$

$$\bar{\sigma}_i^2 = \frac{1}{N}\sum_{i=1}^{N}(\bar{x}_i - \bar{x})^2 \text{ , and}$$

$$\bar{x}_i = \frac{1}{T}\sum_{i=1}^{T}x_{i,t} \text{ .}$$

σ_i^2 is the average of the within variances over all industries and the second term is the variance across industries in industry values of the variable. The same decomposition scheme was also used for within- and between-time variation. The results of the variance decomposition are reported in table 5. Column 6 reports (in terms of per cent) the ratio of the between-industry variation to total variation and column 7 the ratio of between-time variation and total variation.

In the case of variable measured as rates, the net entry rate has the highest proportion of between-industry variation followed by the net entry (IS), entry, exit, turnover and volatility rates. Absolute entry and exit count data display significant industry size effect and much more in their variation is explained by between-industry effects, this shows that industry size is an important determinant of entry and exit. As regards fixed time effects, the ranking for rates is the net entry rate (IS) followed by turnover, volatility, exit, entry and net entry rate.

I employ also three year moving averages in order to reduce the influence of one-shot outliers. Not surprisingly, the results favour much more industry specific factors. For indicators expressed as rates the proportion of variation explained by fixed between-industry effects almost doubled, while the influence of time-specific effects remained approximately the same. Their influence was reduced for exit rates, entry rates and net entry rates.

Table 5: Entry and exit into Austrian manufacturing 1981-1994: variance decomposition for industry specific effects and time specific effects

	Overall Mean	Total sample variation	Between-industry variation	Between-time Variation	Variation explained by fixed industry effects	Variation explained by fixed time effects	Unsystematic variation	
Entry	27.7143	663.1621	614.4166	7.2510	92.65%	1.09%	41.4945	6.26%
Exit	30.8781	635.8633	585.2982	7.5993	92.05%	1.20%	42.9658	6.76%
Entry rate	0.0591	0.0007	0.0001	0.0001	19.62%	8.27%	0.0005	72.10%
Exit rate	0.0709	0.0010	0.0001	0.0001	14.97%	9.66%	0.0007	75.37%
Net entry rate	-0.0114	0.0010	0.0003	0.0001	34.46%	5.21%	0.0006	60.34%
Turnover rate	0.1299	0.0024	0.0002	0.0003	10.16%	10.63%	0.0019	79.21%
Volatility rate	0.1044	0.0021	0.0002	0.0002	8.47%	9.79%	0.0017	81.74%
Net entry rate (IS)	-0.0164	0.0015	0.0004	0.0002	23.32%	11.80%	0.0010	64.88%
			3-periods moving average					
Entry	27.9245	726.9757	700.3612	3.8321	96.34%	0.53%	22.7824	3.13%
Exit	30.7797	674.5508	651.4674	3.3172	96.58%	0.49%	19.7662	2.93%
Entry rate	0.0586	0.0003	0.0002	0.0000	53.77%	7.95%	0.0001	38.28%
Exit rate	0.0700	0.0003	0.0001	0.0000	46.65%	6.93%	0.0001	46.42%
Net entry rate	-0.0114	0.0006	0.0004	0.0000	66.21%	4.02%	0.0002	29.77%
Turnover rate	0.1287	0.0006	0.0002	0.0001	35.45%	10.54%	0.0003	54.01%
Volatility rate	0.1033	0.0006	0.0002	0.0000	37.61%	8.69%	0.0003	53.69%
Net entry rate (IS)	-0.0163	0.0007	0.0004	0.0001	51.74%	15.04%	0.0002	33.22%

An explicit account for the statistical significance of industry and time effects is required to determine whether or not industry-fixed and time-fixed effects are significant sources of variations. Multiplying column 4 of table 5 by 208/16 yields the relevant F-test for between time variation for each turbulence measure and multiplying column 5 of table 5 by 208/13 the F-test for between-time variations. Both tests relate to two-way fixed effects ANOVA procedures. Table 6 presents the results of the analysis of variance for yearly values and 3-years moving averages. The results suggest that industry effects are significant for all the measures of industry turbulence in statistical terms. Column 2 shows the F-value for industry fixed effects. The hypothesis that all industries have the same mean is rejected for all indicators comfortably with $p<0.01$ except for the turnover rate ($p<0.10$) and the volatility rate ($p<0.20$). When three years moving averages are considered the hypothesis of that all industries have the same mean can be rejected comfortably with $p<0.0001$, suggesting that adjustment mechanisms associated with entry and exit do not work instantaneously.

Table 6: Analysis of variance of industry turbulence measures by years and sectors

	Industry fixed effects F(17,221)	p-value	time fixed effects F(13,221)	p-value	Tukey F-Test	p-value
Entry	192.49	0.0000**	2.80	0.0011**	17.24	0.0000**
Exit	177.09	0.0000**	2.83	0.0009**	19.30	0.0000**
Entry rate	3.54	0.0000**	1.84	0.0396*	0.70	0.4018
Exit rate	2.58	0.0011**	2.05	0.0184*	37.04	0.0000**
Net entry rate	7.42	0.0000**	1.38	0.1707	0.06	0.8119
Turnover rate	1.67	0.0551+	2.15	0.0130*	14.13	0.0002**
Volatility rate	1.35	0.1716	1.92	0.0299*	1.99	0.1589
Net entry rate (IS)	4.67	0.0000**	2.91	0.0007**	6.73	0.0101*
			3-periods moving averages			
Entry	368.90	0.0000**	2.69	0.0023**	16.52	0.0001**
Exit	395.50	0.0000**	2.69	0.0023**	14.80	0.0002**
Entry rate	15.45	0.0000**	3.32	0.0004**	0.51	0.4718
Exit rate	11.05	0.0000**	2.39	0.0088**	22.90	0.0000**
Net entry rate	24.47	0.0000**	2.16	0.0185*	1.55	0. 2135
Turnover rate	7.22	0.0000**	3.12	0.0007**	0.05	0. 8199
Volatility rate	7.71	0.0000**	2.59	0.0045**	9.15	0.0028**
Net entry rate (IS)	17.13	0.0000**	7.24	0.0000**	6.75	0. 0101*

Note: + denotes significant at the 10%, * significant at 5% and ** significant at 1 % level

The results for time-fixed effects are even more mixed. Column four presents the F-values for time fixed effects. For all measures the hypothesis of uniform means across the time dimension must be rejected at the 10 per cent significance level except for the net entry rate based on firm data when yearly data are considered. This is especially puzzling as time-effects are found to be significant for the net entry rate (IS). This may be related to a different speed of exit of firms and establishments. With three year moving averages all measures display statistically significant time effects. The difference between yearly measures and moving averages is most likely related to the averaging out of asymmetric effects and unsystematic outliners. The implication of this findings is that industry turbulence is primarily determined by sectoral differences, but that time influences have also a role in determining the fate of turbulence measures, especially for the volatility and the turnover rate.

Simple interaction effects cannot be captured in this set-up of variance analysis, as the data are non-experimental, which implies that the “experiment” cannot be replicated and there is only one observation per cell (sector and year). Possible interaction effects are residual variation. In order to study interaction effects with ANOVA methods in more detail experimental data with more than one observation per cell would be necessary and no direct account for interaction effects can be given. In the case of no replications the assumption of no interaction is called additivity. Tuckey’s test for non-additivity is relevant in this context, as it allows to detect whether or not the additivity assumption is sensible or not (see appendix for the statistics of the Tuckey test). A rejection of the additivity assumption implies that there are multiplicative interaction effects. The results of Tuckey’s test are reported in columns 6 and 7 of table 6. As regards measures of turbulence expressed as rates only for the turnover rate and the exit rate the assumption of additivity had to be rejected. For the net entry rate (IS) additivity is rejected at the 10 per cent level for both yearly measures and three year moving averages. This findings suggest that there are some interactions between year and time effects especially for the net entry rate (IS) and exit rate.

The interpretation of the result of the two-way analysis of variance is that industries differ significantly in the ease of entry and exit. This finding is consistent with the view that differences across industries are related to technology, industry specific demand factors, and sunk costs. However, it has been also shown that the industry turbulence measures are influenced in an significant by time effects. This findings suggest that net entry, entry and exit rates are quite stable over time but that the turnover and volatility are influenced much more by time effects deriving from business cycle dynamics and perhaps regulatory reforms. In order to examine this question in more detail simple correlation of the industry turbulence measures between time periods is used. Table 7 reports the pairwise correlation for each of the 5 3-year-time periods (note that for the both the time periods 1990-1992 and 1992-1994 the year 1992 was used). The closer the time periods under consideration the higher is the correlation. The overall highest correlation is exhibited by the net entry rates. This result is in sharp contrast to the results obtained by Dunne and Roberts (1991) for U.S. manufacturing, who find that the volatility rate is stable over time but not the net entry rate. This different finding may be related to the different sample periods under consideration or resulting from imbalances within industries and be associated with fact that most of the industries under consideration here are characterised by declining employment. As Ghemawat and Nalebuff (1990) have shown the dynamics of decline are not the same as the dynamics of expansion. In table 8 the correlations between two adjoining time periods spanning seven years are presented. The entry rate and both net entry measures are significant, suggesting that industry dynamics related to entry and net entry are quite stable over time, while those related to the exit, turnover and volatility rate are less stable over time.

The overall conclusion to be drawn from this evidence is that inter-industry differences in industry turbulence related to net entry and entry are quite persistent. Regarding the previous discussion on entry barriers and exit barriers and the different measures of industry turbulence, this leads to suspect that the features of industrial competition which are captured by entry and net entry processes are quite stable over time. Changes in entry and net entry regimes are therefore expected to be long run phenomena and quite likely associated with radical breaks in the environment such as radical changes in technology, regulation and demand (related to structural change) while exit, volatility and the turnover are much more influenced by overall business conditions.

Table 7: Correlations between industry turbulence measures between time periods – 3 year periods

	1981-83 and 1984-86	1981-83 and 1987-89	1981-83 and 1990-92	1981-83 and 1992-94	1984-86 and 1987-89	1984-86 and 1990-92	1984-86 and 1992-94	1987-89 and 1990-92	1987-89 and 1992-94	1990-92 and 1992-94
Entry rate	0.5492*	0.4919*	0.4098	0.1526	0.6967*	0.6040*	0.4760*	0.5825*	0.4511*	0.366
Exit rate	0.4086	0.4411*	0.5513*	0.0181	0.2015	0.4309*	0.0109	0.5154*	0.7095*	0.5623*
Net entry rate	0.8104*	0.5469*	0.6611*	0.3688	0.5172*	0.6112*	0.3739	0.6305*	0.7712*	0.6720*
Turnover rate	0.1677	0.263	0.1733	-0.162	0.5167*	0.4491*	0.1763	0.3872	0.5952*	0.4014
Volatility rate	0.1598	0.2275	0.3169	-0.1482	0.6768*	0.4513*	0.0188	0.4322*	0.1932	0.2837
Net entry rate (IS)	0.1266	0.3892	0.4176*	0.3553	0.6062*	0.4822*	0.3588	0.8399*	0.7445*	0.8686*

Note: asterix denotes significant at the 10% level

Table 8: Correlations of industry turbulence measures between time-periods – 7 year periods

	1981-87 and 1988-4
Entry rate	0.5153*
Exit rate	0.2480
Net entry rate	0.5372*
Turnover rate	0.1493
Volatility rate	0.1865
Net entry rate (IS)	0.6310*

Note: asterix denotes significant at the 10% level

These findings support the reading that exit and entry are associated in an asymmetric way by overall and specific demand conditions, leading to higher exit and lower entry during downturns and to higher entry and lower exit during upswings. This reading is suggested primarily by the behaviour of turnover and volatility rates. The divergence in behaviour between NER and NER(IS) related to the fact that the net entry of establishments reacts much more to temporal influences than the net entry of firms is striking and warrants an explanation. Regulatory changes should not influence the two net entry measures as long as firms do not decide to set up another legal entity which is not associated with an establishment. The correlation between the two net entry measures is stronger than the correlation between the entry and the exit rate and suggests that other reasons may be of relevance. Three potential sources for this divergence can be identified. First, the difference may be related to the temporal dimension exit: a final exit of firms does not need to coincide with the closure of a the associated establishment. Second, the firm population needs not be related in a strong way to the population of establishments, as large enterprises usually consist of more than one establishment and are most likely a collection of a variety of legal entities (firms). And thirdly and perhaps most important, the very nature of entrepreneurial experimentation needs not to be associated with the set up of an establishment if related to an unsuccessful venture.

5 Regression Analysis

In this section the determinants of entry and exit are studied explicitly. The regression equations follow equations (4), (5), (6), (7) and (8), the set up is uniform for each industry turbulence variable (*DEPVAR*):

DEPVAR = f(PCMGR, PCMGR(t-1), MARKETGR, MARKETGR1, MESM, CAPINT, COMP, ADVINT, SUBOPT, time dummies *or* macroeconomic variables*)*

The growth rate of price cost margins (PCMGR) is used to proxy the changes of average profitability in the industry. The price cost margin is defined as annual value added from industrial activity minus expenditures for wages and salaries over turnover. The growth rate of profitability was used in order to make this indicator comparable across the industries, as price cost margins do not adequately reflect the level profitability, capital, R&D and advertising expenditures are not accounted for. The interpretation does therefore not relate to an absolute level of profitability but to short term changes in profitability conditions.[3]

In order to account for industry growth two measures are used. I use the growth rate in terms of deflated industry turnover (INDGR) and the growth rate in terms of employment (EMPLGR). Details on the construction of the industry specific deflator are available in the appendix. Both indicators are used as the account for different aspects of industry growth and can therefore be used to account for the stability of the estimates. I do not use both indicators in the same regression as they both relate to industry growth. As PCMGR industry growth is thought to have an positive effect on entry and a negative on exit.

The centrality of expectations to both entry and exit processes suggests that entry and exit are likely to respond with some delay or anticipation to changes in profitability and market growth, so both PCMGR and the market growth measure are taken lagged and with zero lags into the equations to be estimated. Unfortunately no proper measure of the within distribution of profitability is available, therefore no adequate measure for $V(\pi)$ used in equations (4) – (8) can be included in the regression analysis. However, a variable expressing intertemporal changes in profitability over time could be constructed. V(PCMGR) measures the volatility of PCMGR and is defined as the standard deviation of PCMGR over four years (t-3 to t). This measure is likely to capture aspects of the overall business climate as temporal changes in profitability dominate the within dimension. Therefore, this measure is most likely associated with the formulation of

[3] The evidence suggests that the impact of entry on average profit margins is extremeley modest (Geroski 1991, 1995), and it is more likely that entry reacts to profitability than the other way around. The price cost margins do vary much more between industries than within industries and seem to be persistent. Therefore Geroski (1991) suggests 15 – 20 years to be the minimum appropriate time scale to track activities of entrants and look for effects on margins.

expectations by entrepreneurs and managers and should measure aspects of uncertainty. An aspect which is relevant for processes of replacement.

Table 9: Descriptive statistics of independent variables

Variable		Mean	St.Dev	Min	Max
		Industry level indicators			
PCMGR	overall	0.0786629	0.9892576	-50.174816	110.77631
	between		0.1334685	-0.0153719	0.4328622
	within		0.980711	-50.490186	110.46094
V(PCMGR)	overall	0.3110623	0.8369561	0.010414	6.388344
	between		0.5163013	0.0369264	2.151455
	within		0.6695223	-1.626065	4.547952
INDGR	overall	0.0616891	0.125369	-0.2241288	0.422174
	between		0.0506475	-0.0521967	0.1276706
	within		0.115295	-0.2187446	0.4275581
EMPLGR	overall	-0.0202757	0.0456367	-0.2179756	0.1372973
	between		0.0200489	-0.0679028	-0.0000248
	within		0.0412649	-0.2011729	0.1202728
MESM	overall	-3.72989	1.119943	-5.256164	-1.567661
	between		1.134825	-5.176031	-1.78965
	within		.1925747	-4.218394	-3.052201
CAPINT	overall	0.0312771	0.0259164	0.0065883	0.1246988
	between		0.0245819	0.007605	0.0823564
	within		0.0100267	0.0012508	0.0736195
COMP	overall	0.3493759	0.0799788	0.1308807	0.569705
	between		0.0791728	0.1929348	0.5170107
	within		0.021728	0.2751396	0.4221587
ADVINT		0.0076417	0.0017859	0.0037358	0.0105036
SUBOPT	overall	50.034745	20.565301	10.689059	120.4022
	between		20.46256	20.082908	90.664552
	within		0.9215225	10.806057	70.772394
		Macroeconomic indicators			
RGDPGR		0.0220106	0.0134524	-0.0009981	0.0455394
UNEMP		5.107143	1.068257	2.05	6.08
DUNEMP		0.1006067	0.1456995	-0.0566038	0.48
COCGR		0.0047143	0.0169193	-0.028	0.028

The second set of variables has strong across sector variation and is thought to represent impediments to entry and exit (see Table 9 for the summary statistics).

As indicator of relative economies of scale the indicator MESM is used. This compound variable is defined as the logarithm of minimum efficient plant size (MES) over total employment in the industry. Minimum efficient plant size was calculated in a way similar to that suggested by Pashighian (1969) in terms of employment as a weighted average measure of the form:

$$MES = \sum (A_i / n_i)(A_i / A)$$

where A_i is total employment in the i-th size class, n_i the number of firms in the size i-th size class and A total industry employment. This indicator is of course not perfect. It does not measure absolute economies of scale but economies of scale in relation to market size (expressed in terms of employment) yet minimum efficient scale does only then indicate high entry barriers when the MES is high in comparison to the total market. In order to account for the fact that small firms need not to compete with large firms a second indicator was used. SUBOPT is calculated as MES over average establishment size (employment over number of establishments). This indicator measures the heterogeneity within an industry, as a large number of firms operating below MES must not indicate that these firms operate at an inefficient scale, it may reflect the fact that large and small firms do not compete with each other (Audretsch, Prince and Thurik, 1998). These two measures capture different underlying tendencies: MESM measures the extend of economies of scale and SUBOPT capture the aspect of competition relating to size heterogeneity. If SUBOPT displays a positive (negative) coefficient in a entry (exit) regression, this reflects different patterns of specialisation between large and small firms. If the coefficient for SUBOPT is negative (positive) in an entry (exit) regression this reflects large firms driving small firms out of the market.

Capital intensity (CAPINT) was proxied as the ratio of fuel and energy expenditures over sales. This variable can represent capital intensity because energy expenditure is related to mechanisation. Capital intensity is expected to be a barrier to entry as it reflects high capital requirements and to be a barrier to exit. As this capital proxy captures machinery but not buildings, and machinery is usually thought to be more specific this indicator is thought to reflect sunk costs.

But physical capital alone does not represent non-recoverable sunk costs upon exit. Non-capital costs such as the opportunity cost of entrepreneurship and the sunk cost of acquired competence, product-specific know-how and a skilled workforce constitute important part of sunk costs. In order to account for intangible sunk costs the complexity of operations and/or the degree of vertical integration (COMP) calculated as value added over gross production value is used (see also Pennings and Sleuwagen 2000). This indicator accounts for the complexity of the production process. Higher complexity of the production process is associated with higher vertical integration and to reflect the fact predicted by transaction cost theory (Williamson xxx) and the theory of property rights (Hart and Moore) that in this case it is not efficient to contract out up- or downstream production. However, if COMP displays a strong within downward tendency then the expected negative sign is likely reflect primarily barriers to entry as the declining vertical integration of incumbent firms offers new opportunities for entrants (spin-offs) taking up the outsourced activities. As Table 3 reports the between variation is considerably larger than the within variation. Furthermore, there is no evidence for large outsourcing of activities by looking at COMP: In the sample period the (not weighted) average value of change in complexity is 0.0007, suggesting that the degree of vertical integration remained almost the same. Therefore COMP is expected to reflect primarily sunk cost aspects and to have a negative effect on both entry and exit. As COMP is expected to be symmetric, the influence on net entry rates should be insignificant and significantly negative for turbulence and volatility.

Advertising intensity (ADVINT) measured as expenditures for advertising and related activities over sales. The advertising intensity is derived from the Input-Output statistics (see appendix).Advertising should to capture sunk costs, as advertising expenditures are not at all recoupable upon exit. High advertising intensity should hinder exit and prevent small scale entry.

The primary interest of this study is related to industry specific determinants of entry and exit, therefore the macroeconomic variables are used primarily to test the stability of the estimates. As macroeconomic variables thought to capture influences of the overall business climate are used: the real growth rate of the gross domestic product (RGDPGR), the unemployment rate (UNEMP), the change in the unemployment rate (DUNEMP) and the growth rate of the wholesale price index for investment goods reflecting the cost of capital (COCGR). As the influence of the business cycle is primarily reflected by the PCMGR and MARKETGR (EMPLGR) variables I do not expect RGDPGR and UNEMP to be an important influence on entry. Entrepreneurs into the manufacturing should not be carried away by overall business conditions. DUENMP should capture the effect of setting up firms by previously released workforce. If this is an important source of new firm entry DUNEMP should have a positive sign in the entry equation. The cost of new machinery is expected to be deterrent to entry, reflecting the fact that higher capital requirements depress entry and act by increasing the exit rate, as higher capital cost should reduce the likelihood to continue risky ventures. As the primary goal of the regression analysis is to uncover industry specific determinants I use also time dummies to capture changes in business climate and regulatory changes. The use of the macroeconomic variables is to test whether the results for the industry specific variables are robust.

Table 10: Industry turbulence in Austrian Manufacturing 1982-1994: sales as industry growth indicator

	(1-1) ER	(1-2) XR	(1-3) NER	(1-4) TR	(1-5) VR	(1-6) NER (IS)	(2-1) ER	(2-2) XR	(2-3) NER	(2-4) TR	(2-5) VR	(2-6) NER (IS)	(3-1) ER	(3-2) XR	(3-3) NER	(3-4) TR	(3-5) VR	(3-6) NER (IS)	(4-1) ER	(4-2) XR	(4-3) NER	(4-4) TR	(4-5) VR	(4-6) NER (IS)
PCMGR	0.000	-0.005	0.004	-0.005	-0.004	0.001	0.000	-0.005	0.004	-0.005	-0.005	0.001	0.001	-0.005	0.005	-0.003	-0.002	0.003	0.001	-0.005	0.005	-0.004	-0.003	0.003
	(0.11)	(1.96)**	(1.88)*	(1.08)	(1.16)	(0.26)	(0.01)	(2.10)**	(1.88)*	(1.24)	(1.31)	(0.27)	(0.61)	(1.97)**	(2.51)**	(0.74)	(0.53)	(1.12)	(0.53)	(2.05)**	(2.45)**	(0.87)	(0.65)	(1.14)
PCMGR(t-1)	0.001	-0.005	0.004	-0.004	-0.001	0.001	0.001	-0.005	0.004	-0.004	-0.001	0.001	0.002	-0.007	0.006	-0.005	-0.001	0.002	0.002	-0.007	0.006	-0.005	-0.002	0.003
	(0.56)	(2.03)**	(2.04)**	(0.87)	(0.27)	(0.30)	(0.58)	(2.00)**	(2.00)**	(0.85)	(0.18)	(0.32)	(0.63)	(2.61)***	(2.98)***	(1.11)	(0.34)	(0.84)	(0.64)	(2.85)***	(3.21)***	(1.25)	(0.38)	(1.05)
INDGR	0.047	-0.025	0.071	0.022	0.069	0.087	0.049	-0.008	0.058	0.042	0.086	0.080												
	(2.27)**	(1.09)	(3.84)***	(0.57)	(1.82)*	(3.00)***	(2.68)***	(0.36)	(3.18)***	(1.19)	(2.50)**	(2.98)***												
INDGR(t-1)	-0.006	-0.032	0.025	-0.038	-0.011	0.019	-0.012	-0.056	0.042	-0.068	-0.041	0.031												
	(0.29)	(1.40)	(1.32)	(0.96)	(0.29)	(0.65)	(0.66)	(2.77)***	(2.45)**	(2.00)**	(1.21)	(1.21)												
EMPLGR													0.080	0.062	0.001	0.142	0.184	0.166	0.069	0.053	0.002	0.122	0.162	0.155
													(1.22)	(0.79)	(0.01)	(1.10)	(1.46)	(1.62)	(1.10)	(0.70)	(0.03)	(0.98)	(1.34)	(1.62)
EMPLGR(t-1)													0.044	-0.171	0.213	-0.126	-0.031	0.182	0.044	-0.190	0.228	-0.147	-0.054	0.208
													(0.67)	(2.16)**	(3.27)***	(0.98)	(0.25)	(1.83)*	(0.78)	(2.80)***	(4.35)***	(1.30)	(0.49)	(2.54)**
MESM	-0.002	0.008	-0.009	0.006	-0.004	-0.009	-0.001	0.008	-0.009	0.006	-0.004	-0.009	-0.002	0.008	-0.009	0.006	-0.004	-0.009	-0.002	0.008	-0.009	0.007	-0.004	-0.009
	(0.60)	(2.44)**	(3.50)***	(1.20)	(0.73)	(2.14)**	(0.57)	(2.51)**	(3.50)***	(1.24)	(0.73)	(2.15)**	(0.64)	(2.43)**	(3.67)***	(1.17)	(0.79)	(2.34)**	(0.58)	(2.47)**	(3.70)***	(1.21)	(0.74)	(2.38)**
CAPINT	-0.022	-0.238	0.200	-0.261	-0.111	0.039	-0.031	-0.242	0.196	-0.273	-0.120	0.042	-0.014	-0.248	0.218	-0.262	-0.097	0.055	-0.024	-0.253	0.215	-0.277	-0.110	0.056
	(0.32)	(3.55)***	(2.65)***	(2.27)**	(1.07)	(0.37)	(0.44)	(3.55)***	(2.50)**	(2.40)**	(1.18)	(0.40)	(0.18)	(3.49)***	(2.37)**	(2.16)**	(0.80)	(0.52)	(0.30)	(3.52)***	(2.35)**	(2.25)**	(0.89)	(0.54)
COMP	-0.074	-0.072	-0.013	-0.146	-0.127	0.008	-0.073	-0.071	-0.013	-0.143	-0.124	0.008	-0.076	-0.072	-0.014	-0.148	-0.130	0.004	-0.074	-0.070	-0.014	-0.143	-0.125	0.005
	(2.50)**	(1.73)*	(0.50)	(2.21)**	(2.13)**	(0.20)	(2.45)**	(1.69)*	(0.47)	(2.15)**	(2.04)**	(0.20)	(2.49)**	(1.79)*	(0.57)	(2.24)**	(2.13)**	(0.11)	(2.43)**	(1.75)*	(0.57)	(2.19)**	(2.07)**	(0.12)
ADVINT	-2.917	0.930	-4.102	-1.987	-2.929	-3.230	-2.918	0.893	-4.073	-2.025	-2.988	-3.240	-3.050	0.996	-4.295	-2.054	-3.261	-3.534	-3.007	1.016	-4.279	-1.991	-3.207	-3.516
	(3.30)***	(0.90)	(4.72)***	(1.12)	(1.78)*	(2.15)**	(3.34)***	(0.88)	(4.63)***	(1.17)	(1.87)*	(2.13)**	(3.49)***	(1.01)	(5.16)***	(1.20)	(2.13)**	(2.49)**	(3.44)***	(1.02)	(5.14)***	(1.16)	(2.08)**	(2.48)**
SUBOPT	0.003	-0.002	0.004	0.001	0.003	0.005	0.003	-0.002	0.004	0.001	0.003	0.005	0.003	-0.002	0.005	0.001	0.003	0.005	0.003	-0.002	0.005	0.001	0.003	0.005
	(2.63)***	(1.75)*	(6.60)***	(0.52)	(1.61)	(3.42)***	(2.65)***	(1.76)*	(6.72)***	(0.51)	(1.62)	(3.52)***	(2.71)***	(1.84)*	(6.60)***	(0.44)	(1.73)*	(3.26)***	(2.68)***	(1.84)*	(6.53)***	(0.43)	(1.72)*	(3.28)***
Time dummies not reported																								
RGDPGR							0.312	0.151	0.148	0.463	0.270	0.174							0.338	0.053	0.286	0.390	0.276	0.200
							(2.43)**	(0.93)	(1.08)	(1.80)*	(1.00)	(0.85)							(2.40)**	(0.32)	(2.92)***	(1.33)	(0.89)	(1.25)
RGDPGR(t-1)							-0.114	0.009	-0.149	-0.105	-0.209	-0.369							-0.211	0.099	-0.345	-0.112	-0.265	-0.519
							(0.94)	(0.06)	(1.13)	(0.43)	(0.82)	(1.89)*							(1.51)	(0.60)	(3.36)***	(0.39)	(0.87)	(3.07)***
M_ARBLOS_O							0.003	-0.003	0.007	-0.000	0.004	-0.002							0.002	-0.003	0.006	-0.001	0.003	-0.003
							(1.39)	(1.24)	(2.81)***	(0.09)	(1.01)	(0.66)							(0.92)	(0.88)	(3.05)***	(0.10)	(0.54)	(0.88)
DUNEMP							-0.006	-0.039	0.030	-0.045	-0.010	0.022							-0.018	-0.028	0.005	-0.045	-0.022	0.012
							(0.47)	(2.16)**	(1.85)*	(1.68)*	(0.35)	(1.00)							(1.09)	(1.32)	(0.35)	(1.31)	(0.64)	(0.55)
COC_GR							0.059	0.352	-0.272	0.411	0.356	-0.523							0.094	0.279	-0.162	0.373	0.387	-0.440
							(0.61)	(2.76)***	(2.40)**	(2.12)**	(1.74)*	(3.38)***							(0.84)	(1.98)**	(2.21)**	(1.54)	(1.52)	(3.67)***
Constant	0.083	0.117	-0.026	0.200	0.137	-0.050	0.065	0.155	-0.084	0.221	0.118	-0.047	0.088	0.117	-0.022	0.204	0.144	-0.035	0.077	0.146	-0.063	0.223	0.133	-0.026
	(5.45)***	(5.66)***	(1.53)	(6.19)***	(4.61)***	(2.13)**	(3.22)***	(5.73)***	(3.60)***	(5.29)***	(2.92)***	(1.36)	(5.09)***	(5.38)***	(1.37)	(5.74)***	(4.20)***	(1.40)	(3.55)***	(5.18)***	(3.08)***	(4.85)***	(2.93)***	(0.80)
Observations	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221	221
Number of groups	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
r2	0.22	0.31	0.36	0.23	0.18	0.32	0.19	0.26	0.33	0.19	0.14	0.28	0.21	0.32	0.36	0.24	0.18	0.33	0.18	0.28	0.34	0.18	0.12	0.31
LR	90.52	137.30	51.94	140.35	141.54	124.65	96.27	151.38	151.96	151.96	154.82	135.79	97.69	132.43	49.75	136.78	137.86	126.36	97.69	157.13	55.88	157.92	161.13	133.95
	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**
LM	184.78	248.67	164.92	229.40	226.96	135.55	175.79	174.26	138.91	183.02	198.26	115.18	209.06	253.34	166.34	241.11	248.39	135.06	186.28	188.51	143.45	188.87	192.45	117.47
	[0.00]**	[0.00]**	[0.04]*	[0.00]**	[0.00]**	[0.49]	[0.01]*	[0.01]*	[0.41]	[0.00]**	[0.00]**	[0.90]	[0.00]**	[0.00]**	[0.04]	[0.00]**	[0.00]**	[0.51]	[0.00]**	[0.00]**	[0.31]	[0.00]**		[0.87]

Notes: Panel-corrected z-statistics in parentheses, LR is the likelihood ratio test statistic for groupwise heteroskedasticity, and LM the likelihood multiplier test statistic for contemporaneous correlation.
* significant at 10%; ** significant at 5%; *** significant at 1%

The estimation method used is OLS with panel corrected standard errors. This method was suggested by Beck and Katz (1995) to be appropriate in the case of time-series cross-section data with small time dimension (see Appendix for details) as OLS standard errors are over confident and the often utilised feasible GLS-method (often called Kmenta or Parks model) is only consistent with large T and requires the time dimension to be larger than the number of groups (see Beck and Katz 1995, Greene 1993, Kmenta 1997).

The use of an fixed effect estimator would allow to account for the omission of relevant variables in a pooled research design, when the effects of the omitted variables can be assumed to be constant over time (e.g. Greene 1993, Geroski 1991, Dunne and Roberts 1991). I performed the usual F-test for the introduction of industry-dummies. The test results favoured their introduction. However, their introduction seriously affected the significance of the estimated coefficients of almost all variables than dummies. This problem is related to the fact that some of the independent variables do not vary much by time and due to the fact that profitability and industry growth are measures as growth rates. Most of the behaviour of dependent and independent variables used in this study is explained by industry effects. By taking off these effects and removing most of the between-variation the within transformation leaves the remaining variables with variation that does not account for much. This has been recorded for a number of studies of entry and exit and is due to the fact that entry barriers and exit barriers are quite time invariant (Geroski 1995). In light of this explanation and the purpose of this study to shed light on industry-specific effects determinants I did not use the fixed effect estimator and the risk that the estimated might be biased is acknowledged.

Table 10 presents the results of the economic estimation. Columns 1-1 to 1-6 display the estimation results where INDGR is used as industry growth indicator and time dummies are used, 2-1 to 2-6 displays the result for macroeconomic variables instead of time dummies. 3-1 to 3-6 presents the regression results where EMPLGR is used as indicator of industry growth and time dummies. Columns 3-1 to 3-6 presents the results with macroeconomic indicators instead of time dummies. Row two indicates the dependent variables while column one indicates the explanatory variables. The estimations were made in the presence of moderate multicollinearity. The highest condition indices (Belsley, Welch and Kuh. 1980) were 19.34 for estimation set 1, 19.36, 19.30 and 19.32 for estimation sets 2, 3 and 4, all well below the suggested cut-off level indicating severe multicollinearity.

I tested for the appropriateness of using Panel-corrected standard errors (PCSE) by testing for heteroscedasticity, groupwise heteroscedasticity and contemporaneous correlation. Even if it is unlikely that errors from pooled cross-sectional time-series data will satisfy the Gauss-Markov assumptions of sphericality. The OLS standard errors will be wrong if the residuals show groupwise heteroscedasticity, are contemporaneously correlated and/or serially correlated.

The appropriate tests suggested that the data are heteroscedastic, groupwise heteroscedastic and contemporaneously correlated, suggesting that the use of PCSE is not only suggested but also warranted. First, in order to test for groupwise heteroscedasticicity, a likelihood ratio (LR) test has been employed. This LR test statistic is defined as,

$$LR = n \ln s^2 - \sum_g n_g \ln s_g^2 ,$$

where s^2 is the estimated of the pooled residual variance and s_i^2 is the estimated groupwise unit-specific residual variance and *g* is the number of groups. The *LR* statistic is asymptotically distributed as chi-squared with (*i-1*) degrees of freedom (Greene 1993: 395-6).

Second, in order to test for cross-sectional correlation, the following Breusch-Pagan Lagrange multiplier test utilised in order to test for cross-sectional independence. The test statistic is computed as

$$LM = T / 2 \sum_i \sum_{j<i} r_{ij}^2$$

where r_{ij}^2 is the squared *ij*th residual correlation coefficient. This test statistic is asymptotically distributed as chi-squared with (*i(i-1)/2*) degrees of freedom (Greene 1993, 454-5). The results of these tests (reported in tables 10 and 11) show that groupwise heteroscedasticity is always an issue while contemporaneous correlation is less problematic for the net entry rates than for the other industry turbulence measures. The critical values are given for the LR test (groupwise heteroskedasticity) by $\chi^2(16)$ and for the LM test as $\chi^2(136)$. I looked also into the issue of autocorrelation, an appropriate Durbin-Watson test statistic (Bhargava et al, 1983) revealed that for the entry rate and the net entry rate autocorrelation could be problematic (DW ~1.67 for the entry rate and a DW of ~1.64 for NER). However, experiments with lagged dependent variables and Prais-Winsten regression did not modify the results in a way that warranted their application. Therefore I do report OLS coefficients with panel-corrected standard errors.

5.1 Regression results

The results show that increasing profitability does reduce the exit rate. Consequently it increases the net entry rate of firms in a positive way, as entry seems not to be influenced by the average growth rate in profitability. A higher average profitability is associated with a relaxation of the selection pressure and exit is reduced. For the turbulence rate also a joint test of significance for PCMGR and PCMGR1 does not lead to an rejection of the hypothesis that the (joint) coefficient of growth of profitability is zero. Interestingly PCMGR has no influence on the net entry of establishments. In terms of economic importance profitability growth is important for exit: A change of one standard deviations would reduce (increase) exit in the average industry by 3.68 firms (from an average of approximately 33 exits p.a.).

The growth rate of the market measured as growth of turnover (INDGR) and growth of employment (EMPLGR) is significant and positive for the entry rate, negative but not significant for exit rate – however is a test on hypothesis that both INDGR indicators in 1-2 are 0 rejected at the 95 % significance level with a chi-squared test with 2 degrees of freedom, suggesting that industry growth reduces exit. A fact which is born out by the facts when EMPLGR is considered, EMPLGR (t-1) is significant for exit. Industry growth does reduce the pressure to exit and is hence positively associated with NER and NER(IS) in both the sets of equations. For TR and VR the joint hypothesis of a positive influence is not generally significant. The turbulence rate seems not to be influenced in a significant way by industry growth, as there the lagged value of the growth rate influences TR negatively: the joint hypothesis if both industry growth measures are different from zero is never significant. In regard to VR INDGR has a significant positive influence, the negative coefficient of the lagged measure is less important. The economic importance of the industry growth indicator is of approximately the same magnitude as profitability growth and is of central importance to the net entry process. A change in one standard deviation for NER(IS) in INDGR would lead to an increase (reduction) of NER (IS) by 3.4 establishments for the average industry characterised by an average of -7.6 net entries in terms of establishments per annum – the effect is of comparable magnitude for NER.

The effect of scale economies (MESM) is as expected: higher scale economies reduce entry (but is not at all significant) and increases exit. Both net entry rates are negatively influenced by higher scale economies. From an economic perspective, here the within standard deviation is the relevant standard deviation, as it reflects better than the overall standard deviation the possible magnitudes of change in (realised) scale economies. A change of one within standard deviation leads to a reduction (increase) of 0.8 establishments for NER(IS), and to an increase (reduction) of exits of 0.7 firms.

CAPINT seems to be primarily a barrier to exit, showing the sunk cost property of the installed machinery base. I do not find evidence for a symmetric relationship. CAPINT is not significant for the entry rate. The influence on the turnover rate is negative and significant. Interestingly, CAPINT does influence NER in a significant way but NER(IS) is independent of influences of CAPINT: There is a higher net entry of firms associated with higher capital intensity but no net entry of establishments. As COMP is also an indicator of sunk costs it is interesting to compare its influence on NER and NER(IS): It is insignificant, as COMP is significant for both the entry and the exit equation, this shows that COMP is symmetric. The reduction of both entry and exit implies that net measures are not influenced by the complexity of operations. COMP does influence in an significant way both the turbulence rate and the volatility rate. In terms of economic significance the impact of both COMP and CAPINT is comparable in magnitude to MESM.

ADVINT a barrier to entry but displays no symmetry as its coefficient is positive albeit not significant for exit. Hence, it is also significantly for NER and also for NER(IS). The interpretation of this result is that the sunk cost nature of advertising reduces the entry of new firms and establishments while not hindering exit. No within standard deviation is available therefore I investigated the economic importance of advertising by comparing a change in the magnitude of one overall standard deviation for ADVINT, MESM, CAPINT and COMP. Even if the coefficient is large, in terms of economic significance advertising is likely to be less important, its impact being of magnitude 2 or 3 lower than the impact of the other structural indicators.

SUBOPT is positive for the entry rate equation and negative for the exit rate regression and significant and associated with a net entry of firms and positively associated with NER (IS) and NER. This result does suggest that different patterns of specialisation between small and large firms exist, giving credibility to the strategic niche hypothesis which states that small firms and large firms do not compete with each other and that small firms operate in a segment of product markets which are relatively protected against competitive actions of larger firms. However, this interpretation is only suggestive, a more detailed study would be necessary to substantiate this claim. In each case, industries characterised by small firms (high presence of "suboptimal" firms) have higher entry, lower exit, and a higher net entry rate in terms of both firms and establishments.

The main idea behind their introduction in this research design was to isolate macroeconomic influences, therefore the coefficients should not be overvalued. While RGDP and RGDP(t+1) are significant for ER, TR and NER(IS) their joint influence is no case significant, as in these cases the coefficient of RGDP is positive and the lagged one negative. This suggests that better business conditions lead to entry first but that the high entry rate then depress entry. For establishment a recession push story seems to be possible as the coefficient for RGDP(t+1) is negative and significant. The evidence on the unemployment indicators is mixed. An increase in the unemployment rate leads to a higher NER as less firms exit. However there is no significant effect for NER(IS). Higher DUNEMP reduces the exit rate of (at least in the equation set 2). This pattern is highly interesting and warrants a study of the underlying employment dynamics in its own right. In each case there is no significant positive effect of a change in unemployment in regard to entry, thereby the hypothesis that newly laid off worker put up new businesses is not born out by the facts in Austrian Manufacturing. The cost of capital (COCGR) increases exit reduces net entry for both firms and establishments, indicating that the cost of capital is relevant variable regulating net entry via the exit channel. The economic importance of the macroeconomic factors is quite large – the least important being RGDPGR – showing the influence of business cycles on entry and exit dynamics.

As expected the regressions capture the definitions of ER, XR, NER, VR and TR provided in section two, indicating that the specification is sound. Table C.1 presents the r-squared and the adjusted r-squared from OLS regressions utilising only time dummies and industry fixed effects. This comparison shows that the regression analysis in table 10 does not fall into a dummy variable trap and that the indicators used do reflect important aspects of the differences between industries. Table C.2 in the appendix displays regression results where for the growth rate indicators only lagged or not lagged variables are used. The results confirm the intuition that entry and exit are subject to inducement mechanisms which are medium not short-term. Overall, the results are quite robust to the introduction of macroeconomic variables instead of time dummies and to the choice of industry growth variable. Another test into the sensitivity of the results is the introduction of V(PCMGR) into the picture. Table 14 reports the regression results. V(PCMGR) is significant for all indicators except NER(IS), suggesting that changes in profitability do influence the population of firms but not the population of establishments. Interestingly V(PCMGR) is significant and positive for entry, changing the sign of the profitability growth indicators, the lagged sales indicator and the CAPINT (however all of these indicators were and are highly insignificant). A higher volatility in profitability does increase exit. The combined effect causes an increase of net entry with a higher volatility of profitability and causes that the insignificant COMP changes sign. V(PCMGR) is significant for both the turbulence rate and the volatility rate also in these instances causing the change of sign in insignificant coefficients. In regard to NER(IS) the significance changes from the lagged value of employment growth to the contemporaneous one. Why this happens is not easily determined, however both EMPLGR indicators were important (z-statistic >> 1) already before.

The results indicate that the time dimension of entry and exit has a quite long memory. Abrupt changes lead to changes in the identities of firms but not in an increase in number of establishments. Overall the differences between the results in table 11 and 12 are not overwhelming. The changes in signs occurred with insignificant coefficients. All significant and important variables kept their sign and magnitude, indicating that the results are quite robust.

Table 11: Industry turbulence in Austrian Manufacturing 1984 -1994

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	ER	XR	NER	TR	VR	NER (IS)	ER	XR	NER	TR	VR	NER (IS)
PCMGR	-0.001	-0.009	0.005	-0.010	-0.008	0.001	-0.000	-0.008	0.006	-0.006	-0.008	0.003
	(0.49)	(3.51)***	(2.12)**	(2.44)**	(2.15)**	(0.43)	(0.02)	(3.50)***	(2.79)***	(1.38)	(1.93)*	(1.05)
PCMGR(t-1)	-0.002	-0.008	0.003	-0.010	-0.006	0.000	-0.002	-0.009	0.004	-0.006	-0.011	0.001
	(0.70)	(3.63)***	(1.30)	(2.55)**	(1.61)	(0.08)	(0.71)	(4.05)***	(2.12)**	(1.63)	(2.71)***	(0.39)
V(PCMGR)	0.008	0.006	0.006	0.015	0.011	-0.001	0.009	0.006	0.008	0.012	0.015	0.001
	(2.55)**	(2.24)**	(2.13)**	(2.84)***	(2.21)**	(0.31)	(3.03)***	(2.03)**	(2.82)***	(2.40)**	(2.97)***	(0.22)
INDGR	0.046	-0.034	0.080	0.012	0.060	0.068						
	(2.01)**	-0.021	0.029	(0.29)	0.015	0.042						
INDGR(t-1)	0.006	(1.50)	(4.18)***	-0.015	(1.43)	(2.34)**						
	(0.25)	(0.86)	(1.43)	(0.35)	(0.34)	(1.43)						
EMPLGR							0.111	0.056	0.048	0.231	0.167	0.189
							(1.54)	(0.61)	(0.69)	(1.66)*	(1.13)	(2.03)**
EMPLGR(t-1)							0.054	-0.166	0.230	-0.039	-0.112	0.137
							(0.74)	(1.80)*	(3.21)***	(0.28)	(0.76)	(1.48)
MESM	-0.003	0.007	-0.009	0.004	-0.006	-0.012	-0.003	0.007	-0.010	-0.007	0.003	-0.012
	(0.99)	(1.77)*	(3.31)***	(0.61)	(1.08)	(3.62)***	(1.03)	(1.74)*	(3.41)***	(1.16)	(0.56)	(3.50)***
CAPINT	0.040	-0.157	0.175	-0.117	0.000	0.122	0.048	-0.174	0.200	0.015	-0.126	0.134
	(0.60)	(2.48)**	(2.07)**	(1.22)	(0.00)	(1.49)	(0.63)	(2.34)**	(1.84)*	(0.15)	(1.25)	(1.54)
COMP	-0.065	-0.077	0.013	-0.142	-0.128	-0.012	-0.064	-0.080	0.017	-0.128	-0.144	-0.010
	(2.09)**	(1.84)*	(0.41)	(2.15)**	(2.01)**	(0.28)	(2.03)**	(1.98)**	(0.57)	(1.98)**	(2.21)**	(0.25)
ADVINT	-3.082	0.951	-4.070	-2.131	-3.387	-4.625	-3.211	0.966	-4.208	-3.762	-2.245	-4.855
	(3.47)***	(0.78)	(4.47)***	(1.08)	(2.04)**	(4.72)***	(3.69)***	(0.82)	(4.50)***	(2.46)**	(1.20)	(5.37)***
SUBOPT	0.003	-0.001	0.004	0.001	0.003	0.005	0.003	-0.002	0.004	0.004	0.001	0.005
	(2.54)**	(1.33)	(5.75)***	(0.69)	(1.64)	(4.51)***	(2.50)**	(1.34)	(5.30)***	(1.72)*	(0.61)	(4.21)***
Constant	0.071	0.130	-0.059	0.200	0.126	-0.076	0.076	0.130	-0.054	0.135	0.206	-0.064
	(4.02)***	(5.57)***	(3.08)***	(5.49)***	(3.67)***	(2.98)***	(3.96)***	(5.43)***	(2.89)***	(3.56)***	(5.27)***	(2.47)**
Observations	187	187	187	187	187	187	187	187	187	187	187	187
Number of industy	17	17	17	17	17	17	17	17	17	17	17	17
r2	0.29	0.35	0.41	0.29	0.24	0.41	0.29	0.36	0.40	0.25	0.31	0.41
LR	80.48	116.71	48.39	120.07	120.07	78.15	74.92	115.23	50.88	116.31	109.19	78.72
	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**	[0.00]**
LM	181.78	251.69	158.03	211.93	197.38	141.12	198.27	250.58	165.60	213.74	218.32	147.77
	[0.00]**	[0.00]**	[0.09]	[0.00]**	[0.00]**	[0.36]	[0.00]**	[0.00]**	[0.04]	[0.00]**	[0.00]**	[0.23]

Notes: Panel-corrected z-statistics in parentheses, LR is the likelihood ratio test statistic for groupwise heteroskedasticity, LM the likelihood multiplier test statistic for contemporaneous correlation.
 * significant at 10%; ** significant at 5%; *** significant at 1%

6. Concluding remarks

This paper studied the dynamics of entry and exit over time in Austrian manufacturing industries. The findings of variance decomposition and regression analysis revealed that there is quite some volatility in the entry and exit process over time most likely reflecting business cycle activity and unbalanced structural change. The results confirm that industry growth and profitability drive changes in the population of industrial firms. In this context emerged that that within changes in profitability are more important to exit than to entry. This is related to the fact that entry depends on expected profitability which may not be associated with the actual dynamics of profits of incumbents. On the other hand the influence on exit is well captured as exit is the result of selection processes within the industry: Low industry profits push less efficient firms out of the market.

The importance of sunk costs for industry dynamics were confirmed. Not only for tangible but also for intangible sunk costs. While physical capital works primarily as barrier to exit, advertising is a barrier to entry as it captures primarily product differentiation efforts. Complexity of operations which captures the sunk cost aspect of knowledge and organisational capital is symmetric, both a barrier to entry and a barrier to exit. Interestingly only complexity of operation is symmetric, all other industry-specific indicators are asymmetric.

Highly interesting in this respect are the differences between NER and NER (IS). Profitability indicators are generally not relevant in inducing net changes in the number of establishments while it is significant for changes in the number of firms. This result is likely not to be related to the entry side but related to the exit side making up NER(IS), reflecting entrepreneurial experimentation and the reorganisation of firms. The influences in regard to structural variables are of approximately the same magnitude, with the exception of capital intensity (however this difference is reduced once the V(PCMGR) is introduced into the regression), suggesting that while the dynamics of firms and establishments are different, they are influenced by the same set of determinants with the exception of profitability and capital intensity. The very source of this results must remain subject to speculation as no interference into the determinants of entry and exit on the establishment level can be made.

Further research should investigate in more detail the macroeconomic determinants of industry turbulence and the extend of symmetry and asymmetry of barriers to entry and barriers to exit.

[to be continued]

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Appendix A:

A.1 Industry-specific output-deflators

As the Austrian statistical office does not provide data on real production values or specific output-deflators, the index of physical production and nominal production values were used to calculate the desired industry-specific deflators. The current value of production for the quantity produced in 1995 for each year was calculated by multiplying the nominal production with the index of production (100=1995). Then industry-specific output-deflators are obtained by dividing the current value of the quantity produced in 1995 by the nominal production value in 1995.

A.2 Construction of advertising proxies

Austrian industrial statistics do not provide any information about advertising expenditures. Therefore data from the input-output tables for 1983 and 1990 (Güterkonten: Verwendung for 935 Dienstleistungen des Werbe-, Messewesens, etc.) was used to construct a proxy for advertising intensity. As this data is not available for the classification of the Austrian Chamber of Commerce, the data was aggregated to the 2-digit level according table A-1. The expenditures for advertising were divided by nominal sales in 1983 and 1990 and the average was used as advertising intensity proxy in the regressions.

Table A-1: Avertising intensity

KS			Own BS-68 to KS	VALUE
3	Stein- und Keramische Industrie	Stone and ceramic industry	47x	0.0079973
4	Glasindustrie	Glass and glass product manufacturing	48x	0.0064537
5	Chemische Industrie	Chemical industries	44x, 45x	0.0103636
6	Papiererzeugende Industrie	Manufacture of pulp and paper	411	0.0063408
7	Papierverarbeitende Industrie	Paper processing industry	412, 413, 415	0.0037358
10	Holzverarbeitende Industrie	Furniture and fixtures	38x	0.009807
11	Nahrungs- und Genußmittelindustrie	Food and tobacco industry	31x+32x	0.0105036
12	Ledererzeugende Industrie	Leather producing industry	36	0.0084291
13	Lederverarbeitende Industrie	Leather processing industry	35+36	0.0070322
14	Giessereiindustrie	(mills – except steel mills)	513	0.0070603
15	NE-Metallindustrie	(basic metal products – except mills)	512, 515	0.0061198
16	Maschinen- und Stahlbauindustrie	Machinery and appliances, except electrical	54x, 55x, 59x	0.0065649
17	Fahrzeugindustrie	Transportation Equipment Manufacturing	58x	0.0075512
18	Eisen- und Metallwarenindustrie	Fabricated metal products except machinery	52x, 53x	0.0098328
19	Elektroindustrie	Electrical Equipment, Appliance, and Component Manufacturing	56x, 57x,	0.0063189
20	Textilindustrie	Manufacture of textiles except clothes	33x	0.0092626
21	Bekleidungsindustrie	Manufacture of clothes	34x	0.0065345

Table A-3: Descriptive statistics of dependent variables

Variable		Mean	St.Dev	Min	Max
er_wk	Overall	0.0590779	0.0270502	0	0.2142857
	Between		0.012326	0.0440896	0.0928382
	Within		0.0242511	0.003646	0.2228431
xr_wk	Overall	0.0709011	0.031454	0	0.2857143
	Between		0.012516	0.0580354	0.1000925
	Within		0.0290051	-0.0291914	0.2565229
ner_wk	Overall	-0.0114263	0.0317409	-0.1363636	0.0634921
	Between		0.0191652	-0.049572	0.015917
	Within		0.0256968	-0.1147406	0.0836003
tr_wk	Overall	0.129979	0.0487781	0	0.5
	Between		0.0159903	0.1095188	0.1741686
	Within		0.0462346	-0.020634	0.479366
vr_wk	Overall	0.1044484	0.046074	0	0.4285714
	Between		0.0137915	0.0881791	0.1358688
	Within		0.04408	0.008011	0.4384722
ner	Overall	-0.0164268	0.0389108	-0.1666667	0.1578947
	Between		0.0193282	-0.051057	0.0120357
	Within		0.034073	-0.1320365	0.1925249

Table A-4: Correlation matrix of independent variables

	PCMGR	PCMGR(t-1)	V(PCMGR)	INDGR	INDGR(t-1)	MESM	CAPINT	COMP	ADVINT	SUBOPT	RGDPGR	m_bip_~1	UNEMP	DUNEMP	COCGR
PCMGR	1.0000														
PCMGR(t-1)	-0.3118	1.0000													
V(PCMGR)	0.1640	0.3245	1.0000												
INDGR	0.0988	-0.0810	-0.0817	1.0000											
INDGR(t-1)	-0.0572	0.0978	-0.0738	0.3099	1.0000										
MESM	0.0631	0.0908	0.3042	0.0303	0.0174	1.0000									
CAPINT	0.0153	-0.0099	0.0597	0.0676	0.0476	0.3187	1.0000								
COMP	-0.0417	-0.0846	-0.3566	0.0446	0.0399	-0.2435	0.0347	1.0000							
ADVINT	-0.0163	-0.0154	-0.1405	-0.0383	-0.0375	-0.3622	-0.0801	-0.0635	1.0000						
SUBOPT	0.0350	0.0489	0.0359	0.1956	0.1920	0.1890	0.0354	0.1387	0.1764	1.0000					
RGDPGR	0.0078	-0.1318	-0.1290	0.3125	0.2549	0.0094	-0.1192	0.0106	-0.0000	0.0039	1.0000				
RGDPGR(t-1)	0.0435	0.0089	-0.1042	0.1150	0.3183	0.0016	-0.1294	0.0124	0.0000	-0.0194	0.3811	1.0000			
UNEMP	-0.0300	0.0041	0.0511	-0.1545	-0.2012	0.0242	-0.1905	0.0482	-0.0000	-0.0837	0.2565	0.1979	1.0000		
DUNEMP	-0.0313	0.0107	0.0326	-0.2340	0.0214	-0.0179	0.1918	-0.0481	-0.0000	0.0366	-0.3405	-0.3973	-0.6101	1.0000	
COC_GR	0.0557	-0.0571	0.0497	0.1571	0.2307	-0.0190	0.1570	-0.0704	-0.0000	0.0319	-0.0782	0.0224	-0.6636	0.5039	1.0000

Appendix B:

B.1 The Tuckey test for additivity

For the one-way ANOVA and the two-way ANOVA the reader is referred to any intermediate statistics book. As the Tuckey test for non-additivity is usually not presented in these books, its statistics are presented here. This follows Krause and Metzler, 1988: 290.

Tuckey's test for additivity tests whether the assumption of additivity holds. The hypothesis of addivity reads as follows:

H_0 *(additivity)*: $(\alpha\beta)_{ij} = x_{i,j} + \mu_{i.} + \mu_{j.} + \mu = 0$ for all $i=1,...,I$ *and* $j=1,...,J$

Non-additivity imply that multiplicative interaction effects are present. The test statistic is calculated as follows:

$$T = \frac{\frac{SSN}{SSE - SSN}}{(n-1)(m-1)-1}$$, where $$SSN = \frac{[\sum_i \sum_j x_{ij}(\bar{x}_i - \bar{x})(\bar{x}_j - \bar{x})]^2}{\sum_i (\bar{x}_i - \bar{x})^2 \sum_j (\bar{x}_j - \bar{x})^2}$$ and SSE is the sum of squares of the error. The values of this test statistic are F-distributed with df1=1 and df2= (I-1)(J-1)-1). H_0 is rejected if $T > F(1-\alpha, df1, df2)$ holds, where α denotes a given significance level. The rejection indicates that that a experiment with more than one observation per cell would be necessary to examine interaction effects.

B2. Panel Corrected Standard errors

For time-series coss-sectional (TSCS) models with contemporaneously correlated and groupwise heteroskedastic errors, $\mathbf{\Omega}$ the variance-covariance matrix is a *NTxNT* block diagonal matrix with an *NxN* matrix of contemporaneous covariances Σ. As the OLS estimates are consistent, OLS residuals can be used to estimate Σ. Let e_{it} be the OLS residual for unit i at time *t*, then an element of Σ is estimated by

$$\hat{\mathbf{\Sigma}}_{ij} = \sum_{t=1}^{T} \frac{e_{it} e_{jt}}{T}.$$

The estimate of Σ is given by $\hat{\mathbf{\Sigma}} = (\mathbf{E'E})/T$, and the estimate of the variance-covariance matrix $\mathbf{\Omega}$ by $\hat{\mathbf{\Omega}} = \hat{\mathbf{\Sigma}} \otimes \mathbf{I}_T$. Panel corrected standard errors – a variant of Whites standard errors (but note the difference!) – are calculated by taking the square root of the diagonal elements of

$$(\mathbf{X'X})^{-1}\mathbf{X'}(\hat{\mathbf{\Sigma}} \otimes \mathbf{I}_T)\mathbf{X}(\mathbf{X'X})^{-1}.$$

Appendix C: Additional Regressions

Table C-1: R^2's for industry turbulence measures with industry and time dummies only

		(1)	(2)	(3)	(4)	(5)	(6)
		ER	XR	NER	TR	VR	NER (IS)
Industry dummies only	r2	0.20	0.15	0.34	0.10	0.08	0.23
	adjusted r2	0.14	0.09	0.30	0.04	0.02	0.18
Time dummies only	R2	0.08	0.10	0.05	0.11	0.10	0.12
	Adjusted r2	0.03	0.04	0.00	0.05	0.5	0.07
Time and industry dummies	R2	0.28	0.25	0.40	0.21	0.18	0.35
	Adjusted r2	0.18	0.14	0.31	0.10	0.07	0.26

Table C-1: Industry turbulence in Austrian Manufacturing 1981-1994, Regression with only lagged or not lagged regressors

	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
	ER	XR	NER	TR	VR	NER (IS)	ER	XR	ner_wk	TR	VR	NER (IS)
PCMGR	-0.000	-0.003	0.002	-0.004	-0.004	0.000						
	(0.16)	(1.23)	(0.96)	(0.89)	(1.24)	(0.06)						
PCMGR(t-1)							0.001	-0.003	0.002	-0.002	-0.000	-0.000
							(0.33)	(1.22)	(1.09)	(0.58)	(0.08)	(0.12)
INDGR	0.038	-0.024	0.062	0.014	0.064	0.088						
	(1.95)*	(1.12)	(3.18)***	(0.40)	(1.96)**	(3.44)***						
INDGR(t-1)							0.006	-0.036	0.042	-0.030	0.009	0.041
							(0.30)	(1.67)*	(1.95)*	(0.85)	(0.24)	(1.41)
MESM	-0.001	0.006	-0.007	0.005	-0.004	-0.008	-0.002	0.008	-0.009	0.006	-0.004	-0.009
	(0.55)	(1.87)*	(2.68)***	(0.96)	(0.93)	(1.98)**	(0.62)	(2.33)**	(3.30)***	(1.11)	(0.80)	(2.23)**
CAPINT	-0.006	-0.129	0.112	-0.135	-0.066	-0.002	-0.009	-0.242	0.218	-0.252	-0.089	0.064
	(0.08)	(1.40)	(1.27)	(0.97)	(0.64)	(0.02)	(0.10)	(3.32)***	(2.16)**	(2.04)**	(0.71)	(0.57)
COMP	-0.066	-0.072	-0.003	-0.138	-0.114	0.024	-0.074	-0.068	-0.016	-0.142	-0.124	0.007
	(2.22)**	(1.77)*	(0.09)	(2.16)**	(1.94)*	(0.58)	(2.53)**	(1.58)	(0.60)	(2.11)**	(2.04)**	(0.21)
ADVINT	-3.076	0.741	-4.036	-2.335	-3.214	-3.124	-3.069	1.058	-4.372	-2.011	-3.105	-3.517
	(3.58)***	(0.76)	(5.06)***	(1.38)	(2.08)**	(2.26)**	(3.38)***	(0.99)	(4.79)***	(1.12)	(1.85)*	(2.34)**
SUBOPT	0.003	-0.002	0.005	0.001	0.003	0.005	0.003	-0.002	0.005	0.001	0.003	0.005
	(3.03)***	(2.49)**	(8.00)***	(0.49)	(1.90)*	(3.74)***	(3.16)***	(2.09)**	(7.20)***	(0.58)	(1.99)**	(3.81)***
Time dummies not reported												
Constant	0.092	0.132	-0.034	0.224	0.142	-0.042	0.098	0.146	-0.038	0.244	0.167	-0.063
	(6.59)***	(6.19)***	(2.04)**	(7.09)***	(4.97)***	(1.82)*	(6.63)***	(7.04)***	(2.42)**	(7.54)***	(5.50)***	(2.79)***
Observations	238	238	238	238	238	238	221	221	221	221	221	221
Number of industy	17	17	17	17	17	17	17	17	17	17	17	17
r2	0.21	0.24	0.29	0.20	0.18	0.32	0.19	0.28	0.29	0.22	0.16	0.27

Notes: Panel-corrected z-statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%