The Determinants of and Interaction between Entry and Exit in Taiwan's Manufacturing

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ABSTRACT. Based upon substantial high firm turnover rates, various policy incentives, and developed subcontracting-networks, this paper investigates structure and firm-specific factors that determine the entry and exit rate across industries. The interaction between entry and exit rates of the industry is incorporated in the study, namely the "displacement", "replacement" and "instantaneous causal" effects. The regression results indicate that entry and exit rates are determined by different measures of entry or exit barriers but the effects are not fully symmetric. It is also evident that underlying entry or exit sunk- costs introduced the instantaneous movement of entry and exit rates. In addition, the entry of new plants has a moderate effect to facilitate the displacement or market selection process to displace the inefficient producers but no significant replacement effect is found. The policy implication being that the government support encourages entry it also increases the industry failure rates.

I. Introduction

The dynamics of firm entry and exit are an important issue in industry development. New entrants bring new products and technology into the industry and provide a source of industry expansion and market competition. Alternatively, firm's exiting discontinues old products and inefficient technology and provides opportunities for other firms to potentially enter the market. Hence, firm entry and exit serves industry as a process to reallocate resources away from less productive produces to more efficient users. Empirically, there are numerous studies, which investigate the determinants of industries' entry and exit; see Orr (1974) and the survey done by Siegfried and Evans (1994). A major point concerning firm entry and exit conveyed in the empirical literature is the strong positive correlation between firm entry and exit (Dunne and Roberts, 1991; Geroski, 1991). To account for its impact, there is an increasing amount of empirical research being done exploring the scenarios of different countries. For example, Dunne, Roberts and Samuelson (1988), Austin and Rosenbaum (1991), Audretsch (1995), and Dunne and Roberts (1991), Olley and Pakes (1996), Haltiwanger (1997), Foster, Haltiwanger and Krizan (2001) examined firm turnovers in U.S. manufacturing and many other studies for different countries.[1] Therefore, when characterizing the determinants of industrial entry and exit and examining its effect on the manufacturing sector, it is important to take into account the interdependence between the two processes.

The correlation between firm entry and exit may arise from several sources. First, as was mentioned above, cost differential among firms allows more efficient entrants to displace less efficient incumbents already in the industry (Dunne and Roberts, 1991; Geroski, 1991). Aside from this displacement effect, it is argued that a high industry failure rate provides a vacuum in the market place which encourages new entrants to replace the failing firms (Austin and Rosenbaum, 1991). These displacement and replacement effects result in a symmetrical movement of firms, moving in and out of the industry (Shapiro and Khemani, 1987; Dunne and Roberts, 1991, Geroski, 1991; Siegfried and Evans, 1992).

Entry (exit) barriers, or incentives of the industry, determine the magnitude of the industrial entry (exit) rate. As has been shown in Caves and

Final version accepted on September 22, 2001

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Porter (1976) and Eaton and Lipsey (1980), the durability and specificity of a firm's capital, will lead to some of that capital investment becoming a sunk cost. These sunk costs are barriers to exit as well as barriers to entry. It is possible when exit costs are high, potential entrants may decide not to enter because of the risk of failing following their entry. Therefore, when exit barriers are also entry barriers, industries with fewer exits will also have less entry (Eaton and Lipsey, 1980; Shapiro and Khemani, 1987; Rosenbaum and Lamort, 1992). On the other hand, Hopenhayn (1992) introduced a theoretical model that outlined the role of entry sunk-costs in determining a firm's entry and exit. According to the model, when entry costs are not recoverable, entrants will be deterred. This would result in a lower probability of failure for incumbents and in the way the symmetry between the entry and exit rate is displayed. The effects of entry sunk costs and the interdependence between firm entry and exit has been accounted for in several empirical cases; see Shapiro and Khemani (1987), Dunne and Roberts (1991), Austin and Rosenbaum (1991), and Siegfried and Evans (1992). Though it is difficult to obtain a direct measure of which entry and exit costs are sunk costs to the firm, it can be observed that entry and exit rates may causally related (Rosenbaum and Lamort, 1992), owing to the existence of sunk costs and structure factors.

Conducting firm entry and exit study for one country is constrained by the availability of appropriate firm level micro data. Due to the data constraint, it can be seen that the majority of the empirical works are done for the developed countries and more studies of this type are needed for developing countries. The few exceptions are Jeong and Masson's (1991) study of Korea and Roberts and Tybout's book (1996) for the cases of Chile, Colombia, Morocco and Turkey. Therefore in this paper, a longitudinal panel data set is constructed using the Taiwanese annual Factory Inspection and Operation survey. The benefit from this micro set of data being that, it allows us to measure and investigate the determinants of Taiwan's industrial entry and exit rates. To do so, a regression model that contains simultaneous equations for entry and exit rates is built and estimated. The focus is to determine the sign and magnitude of the effects of different factors based upon the underlying hypothesis of symmetry between entry and exit rates.

II. Taiwan's manufacturing sector

As a small and open developing economy, Taiwan's manufacturing sector is often characterized as sector having fast growth rate with numerous small producers[2] using relatively simple technology. The majority of small producers have a higher turnover rate and a more rapid product adjustment ability than larger firms. The frequent turnover of small enterprises is a major concern for the government in that it causes potential supply fluctuations. Despite high turnover rates, it is generally agreed that the manufacturing sector benefits from the numerous small businesses because of their great flexibility in response to the demand shocks (Lin, 1998; Schive, 1999). This is also considered one of the key factors in continuing growth of the Taiwanese manufacturing sector (Aw, Chen and Roberts, 1997). The contribution and importance of small enterprises to Taiwan's economic growth is supported in Taiwan's industrial growth literature (Schive, 1999).

In order to support the majority of small to medium sized producers, the government has constantly introduced different policy schemes. For example, establishing the state institution for technology research, development and diffusion. Providing tax reductions for production facility investment, tariff exemptions for equipment or material imports; offering tax deductions for worker training schemes, and arranging a satellite production and distribution network in different scales and industries. At least at the early entry stage, these supportive policies result in a relatively easy entry and survival for the small producers within the industry. However, owing to the limitation of micro data, very limited attention has been given to empirically understanding the characteristics of the resulted firm turnovers or its impact on industrial growth or structural change.

On this view, this paper offers a preliminary study to examine the determinants of entry and exit rates and the interaction between the two. The empirical results can help us understand more about the constructive or destructive effects of firm turnover on the manufacturing sector. Furthermore, the study of Taiwan's manufacturing is useful, because it provides a point of comparison between a developing country and the majority of existing empirical studies done on industrialized countries.

This paper is organized as follows: Section III provides a description of the data and the entry and exit rate measurements. Section IV summarizes the industrial entry and exit rates and the simple correlation between them for the Taiwan's manufacturing sector. In Section V different regression equation models are built to test the hypothetical interactions between entry and exit rates. The measures of the variables used in the regression are defined as well. Section VI reports the estimation results, and Section VII concludes the paper.

III. Data, entry and exit measurements

In order to measure firm entry and exit in Taiwanese manufacturing, this paper constructed a panel data set using the annual Factory Inspection and Operation survey of the Taiwanese manufacturing sector. The survey is conducted by the Statistics Department of the Ministry of Economic Affairs (MOEA) in Taiwan. The purpose of the Factory Inspection and Operation survey is to keep track of primary registration data and the operation status of each registered plant.[3] It contains the basic production and operation statistics of all plants that are registered whether they are incorporated or not. Hence, in this paper, each individual plant is defined as one production unit. For a company or firm that owns several plants, each plant is registered separately, treated as an independent observation, and referred to as a plant. The set of data contains the annual data of individual plants from the years 1987 to 1998 (except for the 1991 and 1996 census year) and the annual panels are linked by plants' registration numbers. The ten-year panel data has 780,472 observations that attributed by 162,714 plants in the 20 two-digit level industries, which accounts for 60% to 80% of the total manufacturing establishments.

In the literature, plant entry and exit are defined differently according to the purpose of the analysis or the limitations of the data that is used. In this paper at year t, plants that enter the industry between year t and $t + 1$ are defined as entrants; plants that operate in year t but do not continue to produce in year $t + 1$ are defined as exiting plants; plants that have non zero output in both year t and $t + 1$ are defined as continuing plants or incumbents. According to the above classification, the entry and exit rates for each year are defined as the numbers of entering or exiting plants during year t and $t + 1$ divided by the total number of plants in the industry in year t.

IV. The entry and exit of the manufacturing sector

The entry and exit statistics of the Taiwan's manufacturing sector are reported in Table I. The average entry rate across industry is 13.47% and average exit rate is 12.8%.[4] As a whole, the numbers of new entrants and failures are very similar in many years, which result in very low net entry. Table I also reports the entry and exit rates of three different developing countries (Tybout, 1996). Having the smallest firm size among the four countries and measured within different time periods, the magnitude of average industrial entry and exit rates are similar to the magnitude of other developing countries. Whether the entry of new firms had forced market selection or the high entry rate is just simply due to the high failure rate of existing firms is an issue to be explored in this paper.

The frequent entry of firms into the Taiwanese manufacturing sector may be attributed to the aforementioned government policy and also up-stream and down-stream subcontracting networks. The network allows potential entrants to establish their businesses and to distribute their products easily. It also helps the firms with operation scales smaller than the optimum to survive. Consequently, a majority of small producers, accounting for 96% of the total number of firms in the sector, and a number of large firms have been able to coexist. Owing to relatively easy entry, through changing the mix of their products, many small plants enter an industry whenever market demand expands and switch to other industries whenever market demanded contracts. These small plants usually have lower investments in capitals and use very simple technology without

TABLE I
Entry and exit rates of manufacturing sector

Taiwan			Chile[a]			Colombia[b]			Morocco[c]		
	Entry rate	Exit rate		Entry rate	Exit rate		Entry rate	Exit rate		Entry rate	Exit rate
1987	21.0	16.7	1980	9.5	18.2	1978	10.8	11.6	1984	–	7.1
1988	12.9	11.4	1981	7.1	15.3	1979	12.6	10.5	1985	15.4	6.8
1989	18.5	19.1	1982	7.5	15.5	1980	14.1	12.9	1986	15.4	6.1
1990	11.3	10.7	1983	9.6	15.9	1981	8.7	9.6	1987	12.3	5.2
1992	11.8	11.1	1984	15.0	10.8	1982	12.4	8.3	1988	10.6	4.6
1993	11.4	10.8	1985	6.0	7.1	1983	11.9	–	1989	11.3	–
1994	9.0	9.3				1984	12.2	12.0			
1995	15.3	15.6				1985	14.9	12.6			
1997	9.9	10.5									
Firm size[d]	26.77		40.42			53.9			69.37		

[a] Tybout, James, 1996, 'Chile, 1979–86: Trade Liberalization and Its Aftermath', in Mark Roberts and James Tybout (eds.), *Industrial Evolution in developing Countries*, Oxford University Press.
[b] Mona, Haddad, Jaime de Melo and Berdan Horton, 1996, 'Morocco, 1984–1989: Trade Liberalization, Exports, and Industrial Performance', in Mark Roberts and James Tybout (eds.), *Industrial Evolution in Developing Countries*, Oxford University Press.
[c] Roberts, Mark, 1996, 'Colombia 1977–1985: Producer Turnover, Margins, and Trade Exposure', in Mark Roberts and James Tybout (ed.), *Industrial Evolution in developing Countries*, Oxford University Press.
[d] Firm size is measured as the average employment of firms in the sector.

many R&D activities. Therefore, it is easier for them to reorganize their product mix or product line in response to demand variations. By virtue of the above institutional characteristics, we observe a relatively easy entry and exit within the section.

To examine the basic relationship among entry, exit rate, and the market conditions, Table II reports the simple correlation coefficients between the current and the lagged measure of industrial entry and exit rates as well as average sales and profit growth rates of the sector. The simple correlation coefficient between the current and lagged entry rates (EN_t, EN_{t-1}) is calculated using industrial entry rates from 1988 till 1998. Similar calculations are done for current and lagged exit rates (EX_t, EX_{t-1}), as well as the average sales growth (SGW_t, SGW_{t-1}) and profit growth (PGW_t, PGW_{t-1}) among industries.

As is indicated in Table II, the simple correlation coefficient of the instantaneous entry and exit rates is 0.5182. This suggests that the two rates have a strong positive correlation and is also consistent with the findings of the literature (Dunne, Roberts and Samuelson, 1988). Both the current and lagged sales growth rates are not significantly correlated with the entry rates. However both current and lagged market sales and lagged market profit growth rates are negatively correlated with the exit rates. This suggests firm's exit rates are more closely related to market conditions than entry rates. Among others, the correlation coefficients between current entry (exit) and lagged entry (exit) are significant. These indicate that there may be some market demand conditions which encourage industry entry (exit) and are having a persistent effect on it.

V. Regression model and variables

In order to examine the determinants of firm entry and exit rates, and to incorporate the interdependence of the two rates, four different structures of entry and exit equations are built and three hypotheses of the interactions between entry and exit rates are tested. The first hypothesis assumes that the industrial entry and exit rates are correlated but determined independently by entry and exit incentives or barriers respectively. Based upon this assumption the regression equations are defined as follows:

TABLE II
The simple correlation coefficients of entry and exit rates

	EN_t	EX_t	EN_{t-1}	EX_{t-1}	SGW_t	PGW_t	SGW_{t-1}	PGW_{t-1}
EN_t	1.0000*	0.5182*	0.1543*	0.1118	0.1347	0.1296	–0.0153	–0.1329
EX_t	0.5182*	1.0000*	0.0491	0.1919*	–0.1416*	0.1067	–0.1855*	–0.1787*
EN_{t-1}	0.1543*	0.0491	1.0000*	0.5185*	–0.0075	0.0513	0.1148	0.1369
EX_{t-1}	0.1118	0.1919*	0.5185*	1.0000*	–0.2111*	0.0023	–0.1340	0.1085
SGW_t	0.1347	–0.1416*	–0.0075	–0.2111*	1.0000*	0.1894*	–0.0189	0.2442*
PGW_t	0.1296	0.1067	0.0513	0.0023	0.1894*	1.0000*	–0.2758*	–0.1903*
SGW_{t-1}	–0.0153	–0.1855*	0.1148	–0.1340	–0.0189	–0.2758*	1.0000*	0.1982*
PGW_{t-1}	–0.1329	–0.1787*	0.1369	0.1085	0.2442*	–0.1903*	0.1982*	1.0000*

* Indicates the correlation coefficient is significantly different from zero at 5% significance level.

Model I:

$$EN_{it} = a_1 + b_1X_{it} + \varepsilon_{it} \quad (1)$$

$$EX_{it} = a_2 + b_2X_{it} + \mu_{it} \quad (2)$$

Where EN_{it} and EX_{it} are the entry and exit rates for the ith industry in year t; X_{it} is a vector of industry specific factors or market conditions that affect the entry and exit rates. ε_{it} and μ_{it} are error terms, which are independently and identically distributed (iid). However, it is likely that even firm entry and exit is independently decided, both rates are affected by some common unobservable market factors and are negatively correlated. That is, favorable market conditions may increase entry and also prevent plants from failing at the same time. Therefore, the error terms in the two regressions are not independent and the two equations should be estimated by the seemingly unrelated regression (SUR) estimation method. The OLS and SUR estimate results are reported in the first column in Table IV.

The second hypothesis assumes that the interdependence between entry and exit is resulted from the displacement effect of firm entry and the replacement effect of firm exits (Sleuwaegen and Dehandschutter, 1991). Based upon the way in which the entry and exit rates are constructed, the lagged entry rate is included in the exit equation to test the whether the previous entry could cause currently inefficient producers to exit the market. The lagged exit rate is included in the entry equation to test whether the previous exit creates a vacuum and thus market space to attract new entries. Furthermore, previous entry and exit rates are included to control for the persistent effect of market demand, which indicates the effects of above or below average entry or exits form the previous period on current entry or exits. Hence, Equations (1) and (2) become as follows:

Model II:

$$EN_{it} = a_3 + b_3X_{it} + c_3EN_{i,t-1} + d_3EX_{i,t-1} + \varepsilon_{it} \quad (3)$$

$$EX_{it} = a_4 + b_4X_{it} + c_4EN_{i,t-1} + d_4EX_{i,t-1} + \mu_{it} \quad (4)$$

Since the lagged entry and exit rates are predetermined, Equations (3) and (4) are firstly considered as independent and are estimated by OLS. Then, to take into account the instantaneous effect of the two error terms, the model is measured by the SUR method as well.

Finally, following Rosenbaum and Lamort (1992), if exit sunk costs are entry barriers, or some entry costs are sunk costs to firms, then the current entry and exit rate will be causally related. Under this third hypothesis, the current entry or exit rate should be included in the exit or entry equation and the two equations are simultaneously determined (Austin and Rosenbaum, 1991). The resulting regression equation should be written as the following:

Model III:

$$EN_{it} = a_5 + b_5X_{it} + c_5EN_{it} + d_5EN_{i,t-1} + e_5EX_{i,t-1} + \varepsilon_{it} \quad (5)$$

$$EX_{it} = a_6 + b_6X_{it} + c_6EN_{it} + d_6EN_{i,t-1} + e_6EX_{i,t-1} + \mu_{it} \quad (6)$$

Since EN_{it} and EX_{it} are endogenous variables in the system, Equations (5) and (6) are estimated simultaneously. Given that εs and μs are independent, these two equations should be estimated by the two stage least square (2SLS) estimation method. If consider the instantaneous effect between the two error terms (εs and μs), then the model should be measured by the three stage lease square (3SLS) estimation method.

Finally, the model III are estimated by the limited-information maximum likelihood (LIML) and the full-information maximum likelihood (FIML) to cross check the efficiency of the least square estimates, the estimates are reported as model IV. Finally, due to the panel character of the data, the estimation of entry and exit equations may subject to heteroskedasticity problems because the variance of both rates are correlated with their level (Hause and Du Rietz, 1984; Dunne and Roberts, 1991). Therefore, the regression equations in each model include the dummies variables for industry and time effect to account for the fixed effects and the time effects.

The explanatory variables used in the regression model are summarized in Table III, the definitions of the variables are mainly follow the studies of Shapiro and Khemani (1987) and Rosenbaum and Lamort (1992). The chosen variables can be divided into two groups. The first group is the structure factors of industry that include the market demand conditions and the industry characteristics. The former is characterized by lagged industry sales growth rate (LSGW) and lagged profit growth rates (LPGW)[5] (Orr, 1974; Duetsch, 1984; Acs and Audretsch, 1989; Shapiro and Khemani 1987; Chappell, Kimenyi and Mayer, 1992; Rosenbaum and Lamort, 1992; Rosenbaum, 1993). The history of market sales growth and profit growth are market incentives for entry and disincentive for exit and are expected

TABLE III
Industry characteristics

Abbreviation	Variable descriptions	Means	Standard deviation
LSGW	Lagged industry sales growth rate	0.071	0.099
LPGW	Lagged industry profit growth rate[a]	0.002	0.039
SSR	Proportion of small-sized plants[b]	0.873	0.058
SCR	Proportion of subcontracting plants[c]	0.044	0.042
KL	The real capital[d] labor ratio of industry	1,104.37	643.93
MK	Capital requirement per dollar sale of the MES plant[e]	135,393.3	24,415.7
KS	Real capital used per dollar sale	1.5778	0.9754
MESAD	The value added of the MES plant[f]	198,544.5	268,925
MESR	The ratio of average employment of the MES plant to the industry employment[g]	0.00354	0.00364
CDR	The cost disadvantage ratio[h]	0.678	0.168
WG	The growth rate of average wage expenses[i]	0.084	0.063

[a] The profit of each plant is defined as value-added minus its wage expenditure. The industry profit is the average profit of the plants within the industry.
[b] SSR is defined as the proportion of plants within the industry that has less then 50 workers.
[c] SCR is calculated as the proportion of subcontracting plants within the industry. The subcontracting plant is defined as having 75% of its total revenue comes from subcontracting.
[d] The capital is measured as the value of the real capital used at the end of the year.
[e] The variable associated with the MES size plant is defined as the average of that variable over the largest firms whose accumulated employment accounts for 50% of the total employment of the industry. Therefore, the variable MK is the real capital per dollar sales of the industry multiplied by MESAD.
[f] MESAD is the average value added of the largest plants whose accumulated employment accounts for 50% of the total employment of the industry.
[g] This ratio equals to the number of workers of the MES plant divided by the total employment of the industry.
[h] The Cost Disadvantage Ratio is the ratio of average value-added per worker in the group of small plants to that for the remaining plants. The large-sized plant group includes plants whose accumulative employment accounts for 50% of the industry employment. The group of small-sized plants consists of the remaining plants.
[i] The growth rate of wage is annual growth of average wage expenses of the industry.

to have a positive effect on entry and a negative effect on exit rates. As discussed before, the proportion of small to medium sized plants (SSR) and the proportion of subcontracting plants[6] (SCR) in the industry are important proxies for Taiwan's industry structure since it describe the probability of fringe producer's survival. When an industry is having a lot of small producers it indicates the industry is less concentrated and is easier for potential entrants to enter (Rosenbaum and Lamort, 1992), so as the industry has a high proportion of subcontracting plants. These two variables are used to proxy the industry characteristics and are expected to have positive effects on industry entry and exits.

The second group of the explanatory variable is entry barriers or the exit barriers, which include the absolute cost barriers and scale economies as introduced in Orr (1974). Three variables are used to proxy the absolute cost barriers. The first variable is capital labor ratio (KL), which measures the intensity of capital utilization of the industry and is expected to have negative effect on plant entry and exits (Acs and Audretsch, 1989; Dunne and Roberts, 1991; Chappell, Kimenyi and Mayer, 1992). The second variable is the capital requirement for operating a minimum efficient scale plant (MK), which is defined as the capital sales ratio multiplied by the average sales of the minimum efficient scale plant (MacDonald, 1986; Shapiro and Khemani, 1987; Rosenbaum and Lamort, 1992). The remaining variable is the capital to sales ratio (KS) that measures the capital used per dollar sales of the industry (Rosenbaum and Lamort, 1992). These two variables are expected to have negative effects on both entry and exit rates.

Two other variables are used to proxy the effect of scale economies. The first one is the average value-added of minimum efficient scale plants (MESAD), which is defined as the average value added of the plants whose accumulated works accounts for 50% of industrial employment (Shapiro and Khemani, 1987; Chappell, Kimenyi and Mayer, 1992). The other variable is the scale disadvantage ratio (MESR) as used in Shapiro and Khemani (1987) and Rosenbaum and Lamort (1992), which is defined as the MES plants' average employment as the percentage of industry employment. The effect of scale economies on entry and exit rates as a barrier to entry is less conclusive in the literature (Siegfried and Evans, 1994). Since the majority of Taiwan's entrants are fringe producers, the higher economies of scale may indicate that there exists a range of umbrella pricing by the larger dominant firms, which can provide a basis for small fringe producers to compete and survive in the industry (Chappell. Kimenyi and Mayer, 1992). Therefore the scale economies may have positive effect on potential entry that concentrated among small-sized plants and the prior expectation signs for the effects are undetermined.

Finally, to capture the disadvantage of small size operation, we use the Cost Disadvantage Ratio (CDR) as introduced by Caves et al. (1976), also in Shapiro and Khemani (1987), Rosenbaum and Lamort, (1992). Since the labor cost is one of the important comparative advantages of Taiwan's manufacturing, therefore the average wage growth rate (WG) is included to measure the labor cost effects on entry and exit rates. The regression also tried to include the concentration ratio, the R&D intensity, and the number of the plants in the industry in the estimation but they never obtain significant estimates and are excluded.

To characterize the structural heterogeneity among industries, table III also gives the mean and standard deviation of each independent variable. According to the size of the standard deviation, it suggests that there is substantial variation across industries. These variables are used as proxy of entry and exit barriers or incentives for different industries and are expected to play a role in determining the entry and exit rates of each industry.

VI. Estimation results

The regression results of model I through model IV are reported in Table IV. The Breusch-Pagan (1980) Lagrange Multiplier statistic is used to test the null hypothesis of the error terms of the entry and exit equations are not instantaneously correlated. According to the LM-statistics, the null hypothesis is rejected in all four models at the 1% significance level. Hence the seemingly unrelated regression (SUR) estimates, the three stage least square (3SLS) estimates and the full-information maximum likelihood (FIML) estimation are

TABLE IV
The entry and exit regressions results

Dependents / Independents	Model I				Model II			
	OLS		SUR		OLS		SUR	
	EN	EX	EN	EX	EN	EX	EN	EX
LPGW		−0.026***		−0.020**		−0.120*		−0.012
		(−2.787)		(−2.498)		(1.899)		(−1.431)
LSGW	−0.036		0.009		−0.038		0.011	
	(−0.919)		(0.265)		(−0.872)		(0.31)	
SSR	0.258***	0.244***	0.265***	0.244***	0.264***	0.302***	0.279***	0.309***
	(4.065)	(5.284)	(4.167)	(5.278)	(3.56)	(5.664)	(3.755)	(5.81)
SCR	0.216	0.323**	0.220	0.327**	0.283	0.367**	0.298	0.380***
	(1.195)	(2.447)	(1.212)	(2.468)	(1.415)	(2.546)	(1.484)	(2.639)
KL	−6.838***	−1.842	−7.143***	−1.873	−6.389***	−3.733	−6.767***	−3.930**
	(−3.416)	(−1.269)	(−3.560)	(−1.290)	(−2.776)	(−2.255)	(−2.935)	(−2.380)
MK	0.321***	−0.203***	0.321***	−0.199***	0.315*	0.005	0.303*	0.020
	(3.12)	(−2.687)	(3.104)	(−2.637)	(1.92)	(0.040)	(1.838)	(0.171)
KS	−0.009	−0.009*	−0.006	−0.009*	−0.009	−0.009**	−0.009	−0.001**
	(−1.482)	(−1.881)	(−1.456)	(−1.918)	(−1.424)	(−2.095)	(−1.403)	(−2.157)
MESAD	−0.025***	0.021***	−0.025***	0.020***	−0.026*	−0.003	−0.026*	−0.005
	(−2.984)	(3.351)	(−2.990)	(3.284)	(−1.838)	(−0.316)	(−1.83)	(−0.469)
MESR	0.012*	−0.006	0.011*	−0.005	0.018**	−0.001	0.018**	−0.001
	(1.931)	(−1.24)	(1.893)	(−1.136)	(2.376)	(−0.27)	(2.282)	(−0.180)
CDR	−0.037	−0.031	−0.044	−0.032	−0.065	−0.065	−0.073	−0.068
	(−0.633)	(−0.727)	(−0.745)	(−0.760)	(−1.032)	(−1.446)	(−1.141)	(−1.496)
WG	−0.162**	−0.107*	−0.187**	−0.106*	−0.133	−0.167**	−0.161*	−0.169**
	(−2.068)	(−1.945)	(−2.397)	(−1.913)	(−1.373)	(−2.493)	(−1.669)	(−2.505)
EN_{t-1}					0.117	0.111*	0.128	0.118*
					(1.332)	(1.750)	(1.452)	(1.867)
EX_{t-1}					0.083	0.078	0.073	0.067
					(0.72)	(0.936)	(0.631)	(0.800)
EN								
EX								
F value	39.637***	64.684***			29.188***	52.091***		
R	0.8580	0.9088	0.8736		0.8409	0.9055	0.8672	
λ_{LM}	82.14				88.16			
D-W	2.195[a]	1.952	2.209[a]	1.929	2.072[a]	1.914	2.055[a]	1.872
N	180	180	180	180	160	160	160	160
Cross model correlation	0.484				0.551			

Note:

1. All regressions include 19 dummy variables for 20 two-digit level industries and 7 or 8 dummy variables for 8 or 9 time periods, but the coefficients of these dummy variables are only reported in the Appendix Table A-1 for OLS estimates of modelI and 3SLS estimates for model III.
2. Numbers in parentheses are *t*-statistics.
3. * indicates the coefficients are significant at 10% significance level, ** represents coefficients are significant at 5% significance level; *** represents coefficients are significant at 1% significance level.

TABLE IV *(Continued)*

Dependents / Independents	Model III				Model IV			
	OLS		SUR		OLS		SUR	
	EN	EX	EN	EX	EN	EX	EN	EX
LPGW		−0.010 (−0.564)		−0.011 (−1.025)		−0.012 (−1.313)		−0.007 (−0.297)
LSGW	0.0414 (0.791)		0.0924 (0.022)		0. 009 (0.236)		0. 015 (0.343)	
SSR	0.154** (1.949)	0. 046 (0.242)	0.134* (1.736)	0.135 (1.054)	0.103 (1.405)	0.217*** (4.259)	−0.015 (−0.101)	−0.059 (−0.233)
SCR	0.017 (0.085)	0. 174 (0.827)	0.013 (0.066)	0.039 (0.209)	0.070 (0.394)	0.298** (2.359)	−0.072 (−0.308)	0.003 (0.011)
KL	−5.369** (−2.660)	−4.538 (−0.766)	−5.023** (−2.504)	−4.417 (−0.578)	−3.557* (−1.720)	−4.288 (−0.892)	−2.856 (−1.143)	−4.889 (−0.785)
MK	0.443*** (3.915)	−0.395** (−2.031)	0.442*** (3.901)	−0.569*** (−3.923)	0.266* (1.898)	−0.048 (−0.463)	0.259** (2.026)	−0.366 (−1.209)
KS	−0.002 (−0.030)	−0.049 (−0.057)	0.008 (0.011)	0.007 (0.978)	−0.003 (−0.525)	−0.006 (−1.498)	0.059 (0.087)	1.002 (0.189)
MESAD	−0.038*** (−3.790)	0.024*** (2.871)	−0.038*** (−3.754)	0.027*** (3.353)	−0.023* (−1.929)	−0.003 (−0.277)	−0.019* (−1.688)	0.028 (1.075)
MESR	0.009 (1.568)	−0.004 (−0.734)	0.009 (1.603)	−0.003 (−0.473)	0.017** (2.625)	−0.002 (−0.510)	0.018** (3.030)	−0.024 (1.414)
CDR	−0.120* (−1.770)	−0.039 (−0.743)	−0.117* (−1.735)	−0.048 (−0.924)	−0.075 (−1.391)	−0.064 (−1.625)	−0.007 (−0.121)	0.025 (0.280)
WG	−0.094 (−1.122)	0. 041 (0.319)	−0.082 (−1.022)	0.189** (1.984)	−0.040 (−0.466)	−0.123** (−2.067)	−0.006 (−0.058)	0.045 (0.260)
EN_{t-1}		0.059 (0.864)		0.134*** (3.285)	0.072 (0.960)	0.097* (1.763)	0.008 (0.097)	0.038 (0.280)
EX_{t-1}	0.007 (0.071)		0.067 (1.174)		0.083 (0.849)	0.064 (0.877)	0.029 (0.320)	−0.070 (−0.442)
EN		0. 806 (1.169)		1.560*** (3.546)		0.350*** (3.874)		1.400 (1.505)
EX	0.962** (2.127)		1.001** (2.226)		0.732*** (4.268)		0.921* (1.977)	
F value	41.350***	40.490***			39.620***	67.718***		
R	0.871	0.869	0.9264		0.882	0.928		
λ_{LM}	149.11				101.61			
D-W	2.124[a]	1.804	2.005	1.882	2.014	1.976	2.024	2.244[a]
N	179	179	179	179	160	160	160	160
Cross model correlation	−0.832							

4. λ_{LM} is the Lagrange multiplier statistics.
5. "a" represents that the *D-W* statistics are greater than the correspondent critical bounds and cannot reject the autocorrelation hypothesis.
6. *N* reports the number of observations in the regression.

adopted to obtain the efficient estimates, respectively.

1. *The replacement effect and displacement effect between entry and exit rates*

As a reference point, the OLS or SUR estimates of the first model provide a basic idea of the effects of the determinants on entry and exit rates independently. Then the remaining regressions are used to examine the interaction between the entry and exit rates. According to model II, it is revealed in both OLS and SUR estimates that the previous entry has a moderate positive effect on current exit rates (it is significant only at the 10% significance level) and the previous exits rate has no effect on both entry and exits rates. That means, after control for the persistent effect of market demand on plant entry and exits, new entrants tent to increase the degree of competition of the market in the following year and may displace the less efficient plants. However, the current entry is not affect by the previous exit, which is an indication of no replacement effects exist. It is also worth noting that the positive correlation between the two equations indicates that there may be a mis-specification in the regressions. In addition to the correlation between the two random terms, there may exist some underlying relationship between the two equations, which lead us to the estimation of the III and the IV model.

The remaining two models are used to examine our third hypothesis that some of the entry barriers actually are sunk costs to firm which are unobserved and they may cause entry and exit rates has a causal relationship and the two equations are simultaneously determined. Since lagged entry (exit) rate is never significant in any entry (exit) regressions, Model III is estimated with or without the two variables. It turns out that without including the two variables is a better estimation result. The fourth model is defined as model III plus the lagged entry or exit rate in the entry or exit equation, but estimated using maximum likelihood method in order to obtain more efficient estimates. However, the estimates obtained from the limited-information maximum likelihood (LIML) method cannot pass the independence test of the two error terms. Hence taking into account the correlation of the two error terms, one should use the full-information maximum likelihood (FIML) method to estimate model IV. However, according to the FIML in Table IV the exit equation in the FIML method is not performed well, therefore, the 3SLS estimates of the third model excluded the lagged entry and exit rates are the results discussed.

According to model III, the significant current entry effect in the exit equation and the less significant (at 5% significance level) current exit effect in the entry equation indicate that current entry and exit are simultaneously determined by some unobserved sunk costs and the two effects are symmetry. At the same time the significant positive coefficient of the lagged entry rate in exit regression indicates a displacement effect and the insignificant coefficient of the lagged exit rate in entry equation reveals there is no replacement effect.

2. *The determinants of entry and exit rates*

According to basic results in model I, the lagged sales growth rate and lagged profit growth rate are used to proxy the market demand effect on entry and exit rates respectively.[7] They are as expected to have positive effect on entry and negative effect on exit rates when two equations are estimated independently. However, when two equations are estimated simultaneously they turn to be insignificant. It is worth noting that, plant entry is more affected by the "market size" and the plant survival is more sensitive to the "profitability" of the market in Taiwan's manufacturing. Besides the market growth, other two structure factors are the proportion of small-sized plant (SSR) and the subcontracting plants (SCR). Both variables have positive effect on entry and exit rates in both model I and III, it indicates that when the industry have more small-sized plant or has more subcontracting plants it would attract more entry because it is easier for potential entrant to enter and survive with sub-optimal scale. But according to results in model III, only the effect of SSR on plant entry is significant. Under the same token, when the industry has a lot more small-sized plant and contracting producers, it is likely that these plants are having higher probability to fail, but these effects are only significant in exit regression in model I but not in model III. That means, when the displacement and sunk-cost effects are considered all the significance of industry structure effects are reduced. The result implies that the industry structure characteristics and the underlying unobserved entry or exit sunk-costs are highly related.

The following three variables are used to proxy the absolute cost barriers of the industry. According to estimates obtained in model I, capital labor ratio has significant negative effect on plant entry but has no significant effect on plant exit, which is also obtained in the 3SLS estimation results. The capital requirement for operating MES plant (MK) has a positive effect on plant entry and negative effect on plant exit and both are significant in the first and the third model. The result indicates that a bigger optimal operation scale will encourage plant entry and prevent plant from failing. These two results indicate that while a more capital-intensive production can indeed discourage plant entry and exits, but under the subcontracting system, to star a business with an optimal operation scale or to continuous to operate with an optimal scale is less crucial for Taiwanese manufacturing producers. The capital to sales ratio performed less well in both models. It has insignificant negative effect on entry and moderate significant positive effect on exit in the first model, but both turn into positive and insignificant in both equations in the third model. It is hard to make any assertion from the estimates. In sum, in the entry equation, only capital intensity has a negative coefficient. The positive effect of MK in the entry regression implies that when the MES plant in the industry is big, it actually provides a basis for fringe entrants to compete in the market with a sub-optimal scale. Therefore the variable MESR that measures the effect of scale economies also has positive effect on industrial entry rates in both models though the effect is insignificant. Therefore we can conclude that only the real capital intensity as proxies for entry barriers has the symmetric effects on industrial entry and exit rates.

The two variables that represent the scale economies of the industry are having opposite effects on entry and exits rates. When the value-added per worker is higher in the industry, it will deter entry and induce more failures. The result may indicate that when the efficiency of the operation is measured by the value-added per worker, it can deter the less efficient small entrants, however it does not ease the degree of competition in the high value-added industry and neither can it prevent plants from failing. In addition, the variable MESR measures the scales economies as the ratio of average employment of MES plants to the industry employment. The positive coefficient in the entry equation reveals the fact that when the efficient scale of the industry is big it will attract more entry and deter plant exit. It is because the variable basically indicates the efficient size of production in the industry, therefore when the dominant plant is bigger it may provide room for small entrants to compete on the fringe and results in positive effect on industrial entry. On the other hand, a higher MESR means the MES plant accounts for a bigger share of the industry employment, therefore the incumbents are less likely to exit and it is a barrier to exits.

Finally, the cost factors that determine the industry entry and exits are cost disadvantage ratio (CDR) and the growth of wage expenses (WG). The former is defined as the ratio of the value-added per worker of the small- sized plants to that of large size plants. When the ratio is higher or close to one, the cost difference between the small and big firms are less and will attract more entry and result in more exits. However, according to the estimates in model III, CDR has a significant negative effect in the entry equation and has an insignificant negative sign in the exit equation. In this case, we can consider that the homogeneous cost among the plants may be an indication of the degree of competition is high, given the fact that 94% of the plants in the industry are small-to-medium sized plants. Therefore, when CDR is higher or close to 1, which may actually indicate that competition in the industry is more severe and entrants are less likely to survive hence the potential entrants are deterred.

Finally, according to estimates in model III, the growth of average wage expenses (WG) has a significant positive coefficient on exit equation. The result is consistent with the prior assertion that the labor cost is an important factor of market competition, when wage expenses growth rate is high, it will deter entry and induce plant failure. The coefficients of industry dummies and time dummies for model I and model III are reported in the appendix Table A-1. The inclusion of these dummy variables is necessary because based on the panel properties of the data, the explanatory power of the model are reduced significantly and the models are subject to heteroskedasticity problem without including the industry fixed effects and the time effects.

VII. Conclusion

According to the estimation result reported above, a significant structure effect is obtained without incorporating the interaction between entry and exit rates. However, by taking into account for the significant displacement and instantaneous interaction between the entry and exit rates the structure effects reduced substantially. It doesn't mean the structure effects has no importance, but the structure effects are indeed highly correlated with the contemporary plant entry and exit and facilitated the symmetry between the two rates. On top of that, in general, the entry and exit rates are affected by various measures of entry or exit barriers. In particular, when the production is more capital-intensive the entry is deterred and the incumbents are less likely to exit. It indicates that the capital investment required for the existing technology of the industry is an important determinant of plant entry and exit. Whereas given the structure of Taiwan's manufacturing sector, the efficient scale of operation in the industry is not a crucial factor in deterring plant entry or exiting the industry. Hence, these two capital variables do not play the conventional roles as they are in the literature. It can be concluded from this study that the distinct characteristics of the Taiwan's manufacturing result in estimates that deviate from the conventional results obtained in the literature. To the extent that the scale economies are having different effects on entry and exit rates with the ones suggested in the literature.

Furthermore, though the determinants are not fully symmetry in entry and exit rates as found in other studies, the high correlation between the two rates can still attribute to the underlying unobserved sunk costs as well as the industry structure factors, namely the size distribution and the importance of subcontracting network. Besides, the existing policy incentives to support the new entrants and their ex post survival may also reduce the importance or the effects of the structural factors or entry and exit barriers as well as the incentives provided by the previous exits.

If we look back further to the infrastructure of the Taiwanese manufacturing sector, it can be conveyed that market entry incentives introduced by the government trying to help small firm survival may have induced too many new firms' entries that otherwise may not have happened. As a result, despite the fact that the efficient scale of the industry is bigger, fringe producers are supported to compete in the market with a suboptimal operation scale. As a result, we observe moderate selection effect of the entry given the fact that these supported entrants are not necessarily more efficient then the incumbents. The implication is that the policy aimed to help the survival of the entrants might actually induce too many inefficient entrants and result in high failure rates among these small size firms later on. Maybe the entrants can survive and grow after their entry or they will just stay small and compete on the margin? How do these entrants affect the market structure? Whether the selection process has forced the inefficient incumbents to exit and reallocated the resource from less efficient producers to more efficient ones? These are the further issues to be examined in order to answer the above questions. They are beyond the scope of this paper. Furthermore, if the entry and exit decisions can be investigated at the firm level, we could have a clearer picture about the entry and exit differences among industries, which is a worthwhile direction for future studies.

Acknowledgements

The author is grateful to two anonymous referees for their comments.

The National Science Council in Taiwan funded the study under the project No. 87-2415-h155-002.

Appendix

TABLE A-1
The entry and exit regressions results

Model I — OLS								
Dependent var. / Independent var.	EN	EX	Dependent var. / Independent var.	EN	EX	Dependent var. / Independent var.	EN	EX
LPGW		–0.026***	*IND11*	–0.004	–0.105***	*IND28*	0.072***	–0.028**
		(–2.787)		(0.102)	(–5.429)		(2.665)	(–2.224)
LSGW	–0.036		*IND13*	0.059**	0.015	*IND29*	0.055**	–0.041***
	(–0.919)			(2.020)	(1.140)		(2.053)	(–3.222)
SSR	0.258***	0.244***	*IND14*	0.097***	0.056***	*IND31*	0.133***	–0.034***
	(4.065)	(5.284)		(3.715)	(4.604)		(4.381)	(–2.402)
SCR	0.216	0.323**	*IND15*	–0.068	0.047*	*IND32*	0.065**	–0.039***
	(1.195)	(2.447)		(–1.352)	(1.943)		(2.280)	(–2.901)
KL	–6.838***	–1.842	*IND16*	–0.068***	–0.038***	*IND33*	0.035	–0.066***
	(–3.416)	(–1.269)		(–2.916)	(–3.393)		(1.069)	(–2.785)
MK	0.321***	–0.203***	*IND17*	–0.000	0.004	*YEAR87*	0.190***	0.117***
	(3.12)	(–2.687)		(–0.006)	(0.423)		(4.644)	(5.195)
KS	–0.009	–0.009*	*IND18*	–0.004	–0.025*	*YEAR88*	0.082*	0.055***
	(–1.482)	(–1.881)		(–1.450)	(–1.940)		(2.577)	(3.131)
MESAD	–0.025***	0.021***	*IND19*	–0.016	–0.038***	*YEAR89*	0.138***	0.118***
	(–2.984)	(3.351)		(–0.610)	(–3.098)		(4.618)	(7.356)
MESR	0.012*	–0.006	*IND21*	–0.132	–0.019	*YEAR90*	0.202***	0.159***
	(1.931)	(–1.24)		(–1.391)	(–0.411)		(5.608)	(8.300)
CDR	–0.037	–0.031	*IND22*	–0.035	–0.078***	*YEAR92*	0.067**	0.037***
	(–0.633)	(–0.727)		(–1.299)	(–6.128)		(2.491)	(2.611)
WG	–0.162**	–0.107*	*IND24*	–0.040	–0.004	*YEAR93*	0.051**	0.018
	(–2.068)	(–1.945)		(–1.421)	(–0.311)		(2.371)	(1.578)
			IND25	0.025	–0.030***	*YEAR94*	0.032	0.007
				(1.019)	(–2.582)		(1.378)	(0.634)
			IND26	–0.032	–0.059***	*YEAR95*	0.077***	0.057***
				(–1.131)	(–4.463)		(3.399)	(5.095)
			IND27	0.058*	–0.047***			
				(1.744)	(–2.986)			

Note: The base industry is industry 39 and the base year is year 1997.

TABLE A-1 *(Continued)*

	Model III							
	OLS							
Dependent var. / Independent var.	EN	EX	Dependent var. / Independent var.	EN	EX	Dependent var. / Independent var.	EN	EX
LPGW		−0.011 (−1.025)	*IND11*	−0.004 (0.103)	−0.087** (−2.225)	*IND28*	0.054* (1.807)	−0.026 (−0.084)
LSGW	0.0924 (0.022)		*IND13*	−0.006 (−1.205)	−0.064** (−2.271)	*IND29*	0.049 (1.628)	−0.027 (−0.909)
SSR	0.134* (1.736)	0.135 (1.054)	*IND14*	0.044 (1.407)	0.004 (0.109)	*IND31*	0.119*** (3.224)	−0.080** (−2.092)
SCR	0.013 (0.066)	0.039 (0.209)	*IND15*	−0.065 (−1.177)	0.011 (0.190)	*IND32*	0.023 (0.728)	−0.097*** (−3.094)
KL	−5.023** (−2.504)	−4.417 (−0.578)	*IND16*	−0.054** (−2.038)	0.006 (0.204)	*IND33*	0.027 (0.803)	−0.039 (−1.630)
MK	0.442*** (3.901)	−0.569*** (−3.923)	*IND17*	−0.012 (−0.500)	0.007 (0.301)	*YEAR88*	−0.024 (−0.616)	−0.011 (−0.977)
KS	0.008 (0.011)	0.007 (0.978)	*IND18*	−0.043 (−1.425)	−0.045 (−1.577)	*YEAR89*	−0.013 (−0.297)	0.062*** (4.944)
MESAD	−0.038*** (−3.754)	0.027*** (3.353)	*IND19*	0.003 (0.087)	−0.036 (−1.235)	*YEAR90*	0.092** (2.179)	0.082*** (7.574)
MESR	0.009 (1.603)	−0.003 (−0.473)	*IND21*	−0.132 (−1.391)	0.103 (1.083)	*YEAR92*	0.036 (0.755)	−0.006 (−0.543)
CDR	−0.117* (−1.735)	−0.048 (−0.924)	*IND22*	−0.047 (−0.467)	−0.060** (−2.352)	*YEAR93*	0.041 (−1.213)	−0.024*** (−2.561)
WG	−0.082 (−1.022)	0.189** (1.984)	*IND24*	−0.052 (−1.693)	−0.028 (−0.945)	*YEAR94*	−0.055 (−1.538)	−0.036*** (−3.918)
EN_{t-1}		0.134*** (3.285)	*IND25*	0.001 (0.048)	−0.043 (−1.651)	*YEAR95*	0.018 (0.434)	0.023 (2.073)
EX_{t-1}	0.067 (1.174)		*IND26*	−0.018 (−0.604)	−0.075*** (−2.580)			
EN		1.560*** (3.546)	*IND27*	−0.072** (2.145)	−0.042 (−1.307)			
EX	1.001** (2.226)							

Note: Taking into account the lagged entry and exit rates, the regressions are estimated using only observations from years 1988 to 1997 therefore the 3SLS only includes 7 year-dummies and the base year is 1997.

Notes

1 Similar studies were done for British manufacturing by Geroski (1991), for Canadian manufacturing by Shapiro and Khemani, (1987), for Belgian manufacturing by Van Herck (1984), Sleuwaegen and Dehandschutter (1991), for Norwegian industries by Morch Von der Fehr (1991) and for Dutch manufacturing by Kleijweg and Lever (1996), for export entry and exit decision of German firm (Bernard and Wagner, 1998), for Chili and Colombia industries by Liu (1993) Liu and Tybout (1996), for Israel industries by Griliches and Regev (1995).

2 According to the formal definition of the Ministry of Economic Affairs (MOEA), any manufacturing establishment that has real capital value in use under 40 million New Taiwan dollars or the size of employment is less than 100 is defined as a medium to small size business. Under this classification, 96% of the manufacturing firms can be classified as small to medium size firms.

3 For instance, whether the plant is operating, or producing less for one year, temporarily shut down, or permanently closed.

4 Since 1991 and 1996 are census years, the annual survey is not performed in both years. Hence, the number of entering plants in 1990 (1995) is calculated as the number of entrants between year 1990 (1995) and 1992(1997) divided by 2. Analogous to the number of entries, the number of exiting plants in the year 1990 (1995) is measured as the number of failing plants during 1990 (1995) and 1992 (1997) divided by 2. The average entry and exit rates reported here are the 9-year average rates reported in Table I.

5 The current sales and profit level, the current sales and profit growth rate, are all used in the regression to proxy the market demand conditions. But it turns out that the lagged sales and profit growth rates are the appropriate variables to proxy the market demand effects on the entry and exit rates.

6 The subcontracting plant is defined as having 75% or more of its revenue coming from subcontracting or OEM for other plants.

7 Several combinations of the estimation are tried for the market demand variables, for example using the current sales or profit growth rate instead of the lagged growth rate, using lagged sales or lagged profit growth rate in both equations. It turns out that using lagged sales growth rate in the entry equation and using the lagged profit growth rate in the exit equation gives the most sensible results.

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