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Micro-Dynamics of Industrial Competition: Evidence from Korean Manufacturing Plants

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Micro-Dynamics of Industrial Competition: Evidence from Korean Manufacturing Plants

December 2000

Sung Wook Joh *

Korea Development Institute

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Foreword

Since the 1997 economic crisis, firms have failed, and workers have lost their jobs. Because some surviving firms still have high debts and chronic losses, many of these firms are expected to fail as well. People have argued that corporate restructuring improves efficiency as weak, failing firms exit. However, we have observed that policy makers are still trying to save failing firms by giving them more money. So the question arises, should we try to save these failing firms? Or, should we let them to fail?

Sung Wook Joh of the Korea Development Institute (KDI) provides an insightful article that addresses this issue. By documenting why firm entries and exits occur and whether it improves efficiency, Joh implies that government policies supporting failing firms to maintain jobs cause inefficiency.

Through empirical analysis of Korean manufacturing census data, Joh examines how macro-, industry- and plant-level factors affect plant entries and exits. In addition, the study also shows continual replacement of inefficient producers by efficient producers. Joh also documents that the performance of entrants and dying plants was lower than that of continuing plants. Moreover, the performance of surviving entrants has improved while that of dying plants has deteriorated over time. Such observation provides an important implication. Because entrants use resources released from closing plants and their performance improves over time, turnovers will improve efficient resource allocation.

I believe that this work will benefit scholars and policymakers interested in the corporate restructuring and efficiency improvement of the Korean economy.

Jin-Soon Lee

President

Korea Development Institute

Abstract

This article examines the dynamic industrial competitive process in Korea through an analysis of determinants and consequences of industry turnovers. Entering firms include both entirely new producers (births) and producers that have moved in from another industry (switch-ins). Likewise, exiting producers include both producers that close their businesses (deaths) and producers that move into another industry (switch-outs). Using data of 690,000 establishments from 580 industries between 1990 and 1998, this paper shows that the turnover rate in Korea is one of the highest among countries.

Statistical analysis shows that a large part of turnover variance is related to industry specific factors. At the same time, the analysis shows that macro-effects (GNP growth and inflation) industry characteristics (industry growth rate, capital requirement, market concentration, etc.) and producer specific factors (efficiency) affect industry turnover rates and performance at the plant level differently. The study also shows continual replacement of inefficient producers by efficient producers.

In addition, the study also finds that the performance of entrants and dying plants was lower than that of continuing plants. Moreover, birth plants show better performance than dying plants. The paper also shows that the performance of surviving entrants has improved while that of dying plants has deteriorated over time. Such observation provides an important implication. Because entrants use resources released from closing plants and their performance improves over time, turnovers will improve efficient resource allocation.

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Summary

While many have argued for efficiency improvement through entry and exit as well as restructuring, policy makers in many countries do not seem to be convinced. Korea is not an exception, even after it experienced the economic crisis. One major reason is the lack of empirical evidence (using the Korean data) that shows industrial entry and exit actually improves efficiency. In order to prove our point, we first need to understand the patterns and properties of dynamic industrial competitive process and why entry and exit occur. Then, we need to document the empirical evidence showing that such a process is likely to increase efficiency.

Using the survey data of 694,286 establishments from 580 industries in Korea during 1990-1998, this study finds that the Korean manufacturing sector shows higher entry and exit rates compared to other countries. New plant births accounted for an average of 14.4 percent of the total number of plants each year. During the same period, 17.7 percent of all plants died. When including plants that change their primary business, the total entry and exit rates exceed 24.6 percent and 32.4 percent, respectively. Cross-industry variation is also large. For example, more than 90 percent of the total number of plants in the tobacco industry are continuing plants. In contrast, less than 30 percent of plants in the office and calculating industry are continuing plants.

In addition to the cross-country and cross-sectional variation, this study shows that industry turnover depends on the size of plants. Smaller plants experience more births and deaths than large plants. Turnover occurs more often in the smallest plants, accounting for more than 60 percent of total plants, while turnover occurs in only 40 percent of the largest group.

After reviewing previous literature that explains why entry and exit occur, we

examine three multi-level factors that affect industry turnover: macro-economic factors, industrial characteristics and producer-specific factors. For industry characteristics, we examine industry growth rate, average capital requirement as a proxy for the sunk cost, market concentration using the Herfindahl index, and R&D intensity. Controlling for the unobserved industry specific factors and time fixed effects, the empirical analysis yields the following results on industry turnover determinants.

First, macro-economic conditions such as booms and recessions affect turnover rates. GNP growth rates and inflation rates are positively related to births. The 1997 economic crisis lowered entry rates while it increased exit rates. Second, industry characteristics explain industry turnover rates as well. Industries with high demand growth facilitate industry turnovers. In these industries, both entry and exit rates are higher. In contrast, capital requirement seems to play a role of entry and exit deterrence. Both entry and exit rates decrease when the industry's mean value of assets increases. Similarly, market concentration is negatively correlated with switching plants. Third, inefficient producers are replaced by efficient producers. The study finds continual replacement of one group of producers by another group. A rise in dying plants in the previous year increases births in the current year. At the same time, more births are followed by more deaths in the subsequent year.

Lastly, the study also examines the performance differences of entry and exit. It shows that entering plants' performance is initially lower. But the outputs and value-added of surviving entrants have rapidly increased over time. In contrast, the performance of dying plants has been lower than the continuing plants even before their death.

Using a panel of plant level data while controlling for industry characteristics and industry and time fixed effects, this study examines the performance differences of plants depending on their entry and exit status. When performance is measured through total output and labor productivity, the analysis shows that performance increases in

the order of dying plants, entering plants, switching plants and continuing plants. The study finds that the performance of entrants and dying plants is lower than that of continuing plants. Moreover, the performance of entrants is higher than that of deaths, with other conditions being equal. Also, the performance of plants increases with the age of plants, suggesting the role of economies of scale or learning effects

Combined with the earlier observation that more births are followed by more deaths, it can be argued that today's inefficient entrants become tomorrow's deaths. At the same time, efficient producers (new births) replace inefficient ones (deaths) given the prevailing market conditions. Because entrants use resources released from inefficient closing plants and their performance improves over time, turnovers will improve efficient resource allocation.

Such observations provide an important implication for the Korean economy because the results are based on the plant level information of the Korean manufacturing sector. Industry turnovers through entry and exit are an important process of increasing and maintaining the economy's efficiency. Therefore, we can also argue that the restructuring process will eventually increase the efficiency of resource allocation. Moreover, the lower performance level of the death plants suggests that rescuing them would reduce efficiency of the economy.

1. Introduction

As numerous Korean firms have failed since the 1997 economic crisis, many people have lost their jobs. For example, when the country's second largest conglomerate, Daewoo, collapsed in August of 1999, its subsidiaries and sub-contractors also went out of business. As a result, many workers have lost their jobs. Firms still rely on high debt leverage while experiencing losses¹, and thus more failures are expected to occur during the process of corporate restructuring. Because of the loss of jobs and concern for economic contraction, the government and policy makers seem to try to save those distressed firms through injecting more capital. So the question arises, should we try to save these failing firms? Or, should we let them to fail?

Other countries' experiences show that government policies supporting failing firms to maintain jobs have been grossly inefficient (e.g., Little, Mazumdar & Page, 1987; Pursell, 1990). In general, some producers die while others are born. Failing firms are less efficient than other firms. As weak firms fail, new stronger firms will replace them. Resources are released and shifted from the dying factories and firms to entering producers. Entering firms will employ people who lost jobs. Such 'creative destruction' process is argued to increase efficiency of resource allocation, and therefore, the industry entry and exit process is an important factor for an economy to maintain and improve its efficiency.

While many have argued for efficiency improvement through entry and exit as well as restructuring, many policy makers do not seem to be convinced. One major reason is the lack of empirical evidence (using Korean data) that shows industrial entry and exit actually improves efficiency. In order to prove our point, we first need to understand the pattern of dynamic industrial competitive process and why entry and

¹ It is reported that more than 40 percent of publicly traded firms have shown losses after paying

exit occur. Then, we have to document the empirical evidence that such a process is likely to increase efficiency.

Using data of 694,286 establishments from 580 industries in the Korean manufacturing sector during 1990-1998, this study examines the determinants of plant entries and exits and their performance differences. Compared with other countries, the Korean manufacturing sector shows higher entry and exit rates. New plant births accounted for an average of 14.4 percent of the total number of plants each year. During the same period, 17.7 percent of all plants died. When including plants that change their primary business, the total entry and exit rates exceed 24.6 percent and 32.4 percent, respectively.

This study examines three multi-level factors that affect industry turnovers: macro-economic factors, industrial characteristics and producer specific factors. First, macro-economic conditions such as booms and recessions affect the turnover rates. GNP growth rates and inflation rates are positively related to the birth rates. Thus, the 1997 economic crisis lowered entry rates while it increased exit rates. Second, industry characteristics explain industry turnover rates as well. Industries with high demand growth facilitate industry turnovers. In these industries, both entry and exit rates are higher. In contrast, capital requirement seems to play a role of entry and exit deterrence. Both entry and exit rates decrease when the industry's mean value of assets increases. Similarly, market concentration is negatively correlated with switching plants. Third, inefficient producers are replaced by efficient producers. The study finds continual replacement of one group of producers by another group. A rise in dying plants in the previous year increases births in the current year. At the same time, more births are followed by more deaths in the subsequent year.

The study also finds that the performance of entrants and dying plants is lower than that of continuing plants. Moreover, birth plants show better performance than

interest. (Korea economic daily: 2000.4.)

that of dying plants. It also shows that the performance of surviving entrants has improved over time. Combined with the observation that more births are followed by more deaths, it can be argued that today's inefficient entrants become tomorrow's deaths. Given the prevailing market conditions, efficient producers (new births) replace inefficient ones (deaths).

Taken together, such observations provide an important implication. Because entrants use resources released from closing plants and their performance improves over time, turnovers will improve efficient resource allocation.

This paper is organized as follows. In section 2, using the experiences of other countries, I review previous empirical literature that explains three aspects of industrial competition; why entry and exit occurs; what are properties of entry and exit; what consequences they have. Then, the Korean data and methodology are discussed in sections 3. Entering firms include both entirely new producers (births) and producers that have moved in from another industry (switch-ins). Likewise, exiting producers include both producers that close business (deaths) and producers that move into another industry (switch-outs). In section 4, I examine the patterns and properties of entry and exit process. I conduct a more extensive statistical analysis of the data in section 5. Section 6 concludes.

2. Literature Review

This section reviews previous literature on industrial competition. First, we examine the variation in entry and exit across countries and across industries. Second, we review the explanations on why entry and exit occurs. Third, we discuss whether entering producers and exits differ in their production and efficiency.

2.1. Variation in exit and entry rates

In many countries, entry and exit rates are quite significant, and vary greatly. For example, the entry and exit rates of many developed countries' manufacturing sectors were between 3 to 18 percent. Furthermore, the manufacturing market shares of these exiting and entering firms were between 1 to 7.4 percent. In contrast, Mexico (1984-1990) and Socialist Yugoslavia's (1952-1973) entry rates were around 1 percent (Grether, 1991; Estrin & Petrin, 1991). The Korean manufacturing sector in the 1990s showed much higher annual turnover rates (Joh, 2000), reaching entry and exit rates of 24.6 percent of 32.4 percent, respectively. Taiwan and Portugal exhibit even higher entry and exit rates. Moreover, the turnover rates of the UK exhibit great time variation.

Many have documented that turnover rates vary across industries as well as across countries. For example, Dunne, Roberts and Samuelson (1988), Yamawaki (1991), and Aw et al. (1997) show that turnover rates are different over industries in the US, Japan and Taiwan, respectively. See Geroski and Schwalbach (1991) for industrial differences of other countries. Dunne and Roberts (1991) show that inter-industry differences account for a majority of total turnover rates – almost 60-70 percent of total variation can be explained by inter-industry variation.

<Table 1> Annual Average Entry and Exit Rates across Countries

	Time Period	Entry		Exit		DATA
		Producers	Sales	Producers	Sales	
Belgium	1980-84	5.8	1.6 ^a	6.3	1.9 ^a	Plant data from 130 manufacturing sectors in 3-digit level
Canada ^b	1971-79	4.0	3.0	4.8	3.4	Plant data from 167 industries in 4-digit level
Chile	1979-86	9.1	3.6	13.8	4.6	Plant data from industries at 3-digit level
Columbia	1977-85	12.2	4.9	11.1	4.9	Plant data in manufacturing sector
Germany ^b	1983-85	3.8	2.8	4.6	2.8 ^a	Firm data from 183 industries in 4-digit level
Korea ^{b1}	1976-81	3.3	2.2	5.7	-	Firm data from 48 industries in 4-digit & 14 in 5-digit level
Korea ^{b2}	1983-93	12.8	6.5			Plant data from manufacturing sector
Korea ³	1990-98	14.4	4.1	17.7	5.4	Plant data from 590 manufacturing in 5 digit level
Moroco	1984-90	13.0	3.2	6.0	1.3	Firm data from manufacturing sector at 4-digit level
Norway	1980-85	8.2	1.1	8.7	1.0	Firm data from 80 industries in 4-digit level
Portugal ^b	1983-86	12.3	5.8 ^a	9.5	5.5 ^a	Plant data from 234 industries in 5-digit level
Taiwan ^b	1981-91	13.6	8.8			Firm data from manufacturing sector
UK	1974-79	6.5	2.9	5.1	3.3	Firm data from 114 industries in 3-digit level
UK ²	1983-84	18.3	7.4	11.5	5.1	Firm data from 95 industries
US ^b	1963-82	7.7	3.2	7.0	3.3	Firm data from 387 industries in 4-digit level
Yugoslavia	1952-74	0.77	-	0.18 ^c	-	Firm data from 13 industries in 3-digit level

Note: The exit and entry data for Chile are compiled from Tybout (1996), Columbia are from Roberts (1996), Korea¹ are from Jeong and Masson (1991), Korea² are from Chung (1999) recited from Tybout (2000), Korea³ are from this study, Moroco are from Haddad, de Melo and Horton (1996), Taiwan are from Aw, Chen and Roberts (1997), UK² are from Goreki (1991), US are from Dunne, Roberts and Samuelson (1988), and Yugoslavia are from Estrin & Petrin, (1991). Other countries are compiled from Cable and Schwalbach (1991).

^a By employment (figures for other countries are by sales).

^b Annualized five year rate

^c 4 year average exit rate during 1968-1971

2.2. Why entry & exit occur

Following Roberts and Tybout (1996), we can summarize existing explanations for why producers enter or exit an industry as three multi-level factors: macroeconomic effects, industrial characteristics, and producer specific factors. First, changes in macroeconomic conditions or trade policy cause cyclical fluctuations of demand. Second, changes in technology and demand patterns shift resources from contracting sectors to expanding sectors. In addition, producer specific factors also affect industry turnovers. Given the prevailing market conditions, efficient producers replace inefficient ones.

2.1.1. Macroeconomic factors

Macroeconomic factors such as GNP growth, unemployment or inflation rate can also affect firm entry and exit. Using US data, Highfield and Smiley (1987) examined the relationship between entry rate and cyclical economic conditions such as GNP growth, inflation and unemployment rate. Yamawaki (1991) also showed a positive relationship between GNP growth rate and net entry rate using data from the Japanese manufacturing sector. The Korean GNP growth rate fell to 5 percent in 1997 and contracted by 7 percent in 1998 after reaching high levels of nearly 8 percent per year between 1990 and 1995.² During the economic crisis, the unemployment rate rose from 3 percent in 1997 to 7 percent in 1998.³ As a result, plant birth rates fell from an average of 15 percent to 10 percent in 1997. Furthermore, plant death rates rose from an average of 17 percent to 25 percent in 1997.

2.1.2. Industrial factors

Using data from the US manufacturing sector, Dunne and Roberts (1991) show

² The source of the GNP growth rate is KDI, Major Indicators of the Korean Economy.

³ The source of the unemployment rate is KDI, Major Indicators of the Korean Economy, re-quoted

that industry turnover rates are highly correlated with the industry characteristics. For example, industry growth rates affect industrial turnovers. Consider the recycling and tobacco industry in Korea. The recycling industry, with high growth rates in the 1990s, exhibited high entry and exit rates of over 36 and 26 percent per year, respectively. In contrast, the tobacco industry showed a very low entry and exit rate of about 2 and 6 percent per year, respectively.

Inter-industry variation is related to industry characteristics such as demand growth, profit rates, capital cost requirements and technology, among others. Higher industry demand growth rates, expected industry profit rates and size of industry output tend to raise entry rates and reduce exit rates. Furthermore, as the technology in a new market typically is not yet standardized, R&D is likely to increase as producers compete to patent a standard that yields high profits. On the other hand, market concentration, sunk costs and research and development (R&D) activity often act as entry and exit barriers, and hence, they tend to reduce entry and exit rates.

Industry demand growth rate

Various events can cause a long-term shift in industry demand, such as new technology (e.g., invention of computers), environmental change (e.g., landfills reaching maximum capacity), population change (e.g., bubonic plague), government policy (e.g., tax breaks for automobile exports), preference change, etc. In response to a long-term shift in demand, producers must adapt. Consider for a moment the example of the recycling industry. Some producers face a growing demand (e.g., recyclable goods producers) while others face a shrinking market (e.g., disposable container producers). New producers may arise to capitalize on a relatively new and growing market. If possible, those in the shrinking market may switch over and join them, while others in the shrinking market may simply close business.

from the Ministry of Labor.

When industry demand grows, any additional output supplied to the market will depress prices at a slower rate. Growing industries can offer more opportunities for producers to enter, particularly in less profitable niches that dominant firms do not pursue. This reduces the asymmetry between incumbents' current prices and entrants' future prices, thereby reducing the entry barrier and increasing entry. So, a producer (especially a smaller one) can survive more easily as it does not affect dominant firms as much. Most studies have confirmed that higher industry growth increases firm entry.⁴ Increasing demand also allows weaker firms to survive if stronger firms cannot fully meet the new demand; so exits should fall. Jeong and Masson (1991), Sleuwaegen and Dehandschutter (1991) and Dunne and Roberts (1991) show that higher industry growth also reduces exits.

The recycling industry in Korea exemplifies such a long-term shift in demand. It has grown rapidly during the last several years. (All results in these three sections are computations of data from the Annual Mining and Manufacturing Survey.). Such rapid growth has resulted in a more than 600 percent increase in the number of plants. In 1990, there were only 32 plants, but by the end of 1998 there were a total of 203 plants. Output has increased by more than 1,100 percent between 1990 and 1998. In 1990, total output of the recycling industry was only 52,912 million won, but by the end of 1998, it had reached 572,057 million won. Both industry entry and exit rates were high, averaging 36 percent and 26 percent per year, respectively.

Expected profit rates

An industry with higher expected profit rates also increases the likely return on investment as well as allows weaker firms to survive. Thus, industries with higher

⁴ The US, Germany, Portugal, Belgium, Norway and Korea all show significant (except Norway) and positive relationships between industry growth rate and entry rate. A notable exception is the UK, where industry growth rate shows a negative effect on entry rate. See Goreki (1991) for the case of the UK, Fehr (1991) for Norway, Jeong and Masson (1991) for Korea, Sleuwaegen and Dehandschutter (1991) for Belgium, and Dunne and Roberts (1991) for the US case.

expected profits increase entries and reduce exits. Often, expected profit rates are measured via the price-cost margin. Many studies show that higher price-cost margins increase entries and reduce exits.⁵

Market concentration

Kessides (1991) argues that the threat of incumbents retaliating against entrants is more credible in concentrated industries. For example, incumbents can cut prices or increase their supply to punish entrants. The threat of such punishment raises the effective cost of entry. Likewise, fewer incumbents are more likely to engage in driving the entrant out as there is little room for free-riding. Baldwin (1993), Kessides (1991) and Fehr (1991) show that industry concentration was negatively related to firm entry in the Canadian, US and Norwegian manufacturing sectors, respectively.

Mata (1991) also argues that the threat of punishment is proportional to entrant size. First, smaller entrants are less likely to significantly reduce incumbents' profits, and thus are less likely to face any retaliation. Second, actual retaliation harms large entrants more than small entrants. Birth plants tend to have fewer resources and less access to financing compared to switch-in plants. So switch-in plants are more likely than birth plants to be affected by market concentration.

Greater market concentration also reduces the likelihood of firm exits. In concentrated industries, producers can collude more easily (perhaps implicitly) to increase profitability. As a result, weaker firms have more leeway for survival. Baldwin's (1993) analysis of Canadian plants shows that high variance of demand and high market concentration increase entrant survival rates, and Jeong and Masson

⁵ The US, Germany, Portugal, Norway and Korea all show significant and positive relationships between price-cost margin and entry rate. Belgium and Japan show a negative impact. See Goreki (1991) for the case of the UK, Fehr (1991) for Norway, Jeong and Masson (1991) for Korea, Sleuwaegen and Dehandschutter (1991) for Belgium, Yamawaki (1991) for Japan and Dunne and Roberts (1991) for the US case. Sleuwaegen and Dehandschutter (1991) and Dunne and Roberts (1991) show that higher price-cost margins reduce exits.

(1991) shows that greater concentration reduced plant exits in Korea.

Sunk costs/capital requirements

Sunk costs impose an asymmetry on the incremental costs and risks faced by both an entrant and an incumbent. For the entrant, entering the market requires physical capital that lacks liquidity. In contrast, the incumbent has already made these purchases. Thus, the entrant's incremental costs include the sunk costs, which the incumbent has mostly incurred. Commitment to capital specificity (Dixit, 1980) and capital durability (Eaton and Lipsey, 1980) reduce the transferability of the capital. (Kessides [1991] notes that purchase of machines and equipment is often a sunk cost, but purchase of buildings typically is not.) Only part of capital investment can be recovered later through divestiture or liquidation. Note that fixed costs are not necessarily sunk costs. If the entrant's capital investment can be resold at no loss, then the effective cost of entry is zero.

Dunne and Roberts (1991) and Kessides (1991) both show that sunk costs reduced entry.⁶ Caves and Porter (1976), Eaton and Lipsey (1980), and Baumol et al. (1982) argue that high sunk costs also reduce exits. After the high initial sunk costs, a firm faces relatively low variable costs. Also, weak firms cannot reduce their losses by selling their unused, sunk capital. So, staying in the market will cost only slightly more than exiting. Incurring relatively low losses, weak firms are more likely to endure a few low demand periods while waiting for a period of high demand. However, some empirical studies have shown that higher sunk costs did not reduce exits.⁷

In imperfect financial markets, potential entrants may face a financial entry barrier of obtaining needed financing. As small entrants can commit fewer resources,

⁶ Both used capital divided by revenue to measure sunk costs.

⁷ Dunne and Roberts (1991) showed that sunk costs, as measured by capital divided by revenue, increased exits! They argue that variations in output, especially in low demand periods, might be responsible for this result. Not capitalizing on the distinction between fixed and sunk costs, Sleuwaegen and Dehandschutter (1991) showed that fixed costs did not significantly affect exits.

sunk costs should deter large entrants to a greater degree than small ones. Mata (1991) shows that sunk costs reduced the number of large entrants, but not that of small entrants.⁸ Sleuwaegen and Dehandschutter (1991) and Fehr (1991) both show that higher capital requirements reduced entry.

The availability of a second hand market and a rental market would increase potential divestiture and hence decrease sunk costs. Such a market increases the mobility of durable inputs among alternate uses and reduces the entrant's financial commitment. Storey and Jones (1987) argue that the existence of second hand markets is strongly related to small firm entry. Kessides (1991) finds that the availability of a rental market reduces the negative effect that capital investment has on entry.

R&D activity

R&D activity creates new technologies that may spur product differentiation or render existing technologies obsolete. With patents as an outcome of R&D activity, owners/users are able to lower the cross-price elasticity of demand by preventing other producers from producing substitute goods. Thus, these producers reduce effective competition. A shift in technology can force producers with existing technologies to exit. As a result, high R&D levels can increase exits as well. Acs & Audretsch (1988) show that R&D activity correlates with new patents and should reduce both entry and exit.

However, R&D can also contribute to opposite effects on entry and exit. Fehr (1991) notes that industries with rapid technological development (and industries in highly diversified industries) can create opportunities for product niches. Also, with spillover effects, new innovations can be exploited in plants spun off from the creator plant. The creator plant or former employees can start new plants. Or, the entire

⁸ Mata (1991) used 2 measures of sunk cost, average life of equipment and the ratio of new

plant may move into another more appropriate industry to put its innovation to use. So, high R&D levels in an industry can also increase births and switch-outs.

Partially due to these opposite effects of R&D, empirical studies have shown mixed results. Baldwin (1993) shows that high R&D increased entry in Canada but reduced their survival rates. In contrast, Fehr (1991) shows that R&D reduced entry by new plants of diversifying firms in Norway, but had no effect on new plants of new firms. Mata (1991) also showed that R&D had different effects in Portugal – it reduced small entrants, but did not affect large entrants. Meanwhile, R&D had no significant effect on entry in either Germany (Schwalbach, 1991) or in Belgium (Sleuwaegen & Dehandschutter, 1991). Sleuwaegen and Dehandschutter (1991) also show that R&D had no significant effect on exiting firms in Belgium.

2.3. Properties of entering and exiting producers

This section discusses the properties of entering and exiting producers, specifically size and performance and their relationships to one another.

2.3.1. Size

As discussed in the section above, entering and exiting producers are typically much smaller than continuing plants. Entering and exiting producers are smaller than switch-ins and continuing firms on average. Although entrants and exiting firms typically comprise about 6 percent of an industry's total firms, they are often small and produce only about 3 percent of the total output.

The small firm size may depend on the imperfect financial market that reduces the entering producers' access to financing. Since switch-in plants have operated in another industry, they should have more resources and more access to financing

equipment bought to total equipment.

compared to birth plants. Exiting producers also tend to have lower profits than continuing ones. Because exiting producers may reduce costs before their death in an effort to survive, they tend to be smaller than continuing producers.

2.3.2. Correlation among entry and exit

The rates of recent and current turnovers can affect producers. A large number of exits in the past year may open up many opportunities for new entrants to exploit. So, high switch-out and death rates would increase birth and switch-in rates. Today's entrant is often tomorrow's exit statistic. Over 30 percent of entrants in Colombia and over 40 percent of entrants in Chile exit within 2 years (Roberts, 1996; Tybout, 1996, respectively). In general, many studies have shown that entry and exit are highly correlated across industries (e.g., Dunne et al., 1989a, 1989b; Shapiro & Khemani, 1987).

2.3.3. Efficiency differences among producers

In a competitive market, inefficient producers lose customers to more efficient producers, and thus are unable to survive and are forced to exit, leaving behind the more efficient producers. The coke and refined petroleum product industry in Korea exemplifies this process. Industry output has steadily increased from 9.54 trillion won in 1990 to 18.6 trillion won in 1997 and to 14.5 trillion won in 1998 after the economic crisis. Following its peak level of 71 plants in 1993 (up from 53 in 1990), the number of plants has steadily declined to 56 in 1997 and 51 in 1998. During the nine-year period between 1990 and 1998, 8 percent of plants closed and 13 percent switched out into different industries. Despite the larger number of exiting firms, their total output share was extremely low (less than 1 percent of total industry output).

2.4. Consequence of entry and exit

Many studies have examined the effects of entry and exit, theoretically and empirically. Most have shown sizable entry and exit rates, but their effects on basic structural characteristics are unclear (Geroski et al., 1987; Dunne et al., 1989a, 1989b). However, many have documented that entry and exit increases efficiency. Turnover in Canada accounts for 20 percent of the productivity growth (Baldwin, 1993). Likewise, net entry significantly affects productivity in Chile (Tybout, 1996) and Morocco (Haddad, de Melo & Horton, 1996). In Columbia, entries and exits drastically change the market, as 20-30 percent of the existing firms turnover within 4 years (Roberts, 1996). Lastly, Olley and Pakes's (1996) analysis of the US telecommunications sector showed that productivity increased as turnover and market share changes among incumbents increased.

Short-term performance

Entering plants may enter an industry because they expect to perform better than current existing plants. With limited access to resources and financing, however, they are unable to build sufficient capacity to meet the economies of scale. On the other hand, switch-in producers are likely to be stronger, bringing experience from other industries. Therefore, they are less likely to die quickly and should have a negative effect on the death rate. Also, if a switch-in producer does not earn expected profits, it has other options including switching out to its original industry. With its flexible resources, a switch-in producer can also move to another industry with higher expected profits. So, switch-in producers are also more likely to switch out again. Meanwhile, dying plants likely exit because they perform poorly and are not earning sufficient profits. Switch-outs are profitable enough to move to another industry rather than dying, so they likely perform better than dying plants.

So, at a minimum, birth and switch-in plants should perform better than dying

plants. Birth plants usually lack experience unlike switch-in, switch-out and continuing plants. Therefore, birth firms are less likely to perform as well. Continuing plants generally perform the best, as they possess industry experience, and likely have outperformed exiting firms. In short, the following types of producers should show increasing levels of performance: death, birth, switch-in or switch-out, and continuing plants.

Liu and Tybouts (1966) show that entrants in Columbia were 3 percent more productive than exiting plants, but 4 percent less productive than continuing plants. They also show that entrants in Chile were 7 percent more productive than exiting plants. Baldwin and Gorecki's (1991) study of Canadian manufacturing plants from 1970 to 1979 showed that entrants also performed better than exiting plants.⁹ Overall, entrants in Canada performed better than continuing plants as well. However, they did not perform as well as expanding continuing plants. Baldwin (1993) also found that entrants took market share away from continuing plants as well as exiting plants. For each additional 1 percent of market share taken by an entrant, 0.3 percent came from contracting plants and 0.67 percent came from exiting plants.

Long-term performance

Older producers should perform better than younger producers due to natural selection, industrial factors¹⁰ and learning. Baldwin's (1993) Canadian study also showed that as these entrants aged, they tended to increase their number of employees, output per employee and value-added per employee. Liu and Tybout (1996) likewise

⁹ Baldwin and Gorecki's measures included efficiency, productivity and employee pay. The efficiency ratings were as follows: exiting plants, 58 percent; new plants, 62 percent; and expanding continuing plants, 68 percent. Likewise, entrants were 24 percent more productive than contracting plants and 4 percent more productive than continuing plants. However, they were only 97 percent as productive as expanding continuing plants. Entrants also paid higher wages and salaries than exiting plants, but less than continuing plants did.

¹⁰ In Canada, industrial factors also significantly affected entrant performance (Baldwin, 1993). High industry growth increases the output of surviving entrants, while high market concentration reduces the output of surviving entrants.

showed that entrants in Chile and Columbia are initially inefficient and become more efficient over time. In both countries, first year entrants are not that much more productive than exiting plants, but their productivity rises quickly to the level of continuing plants if they survive for more than three years.

Meanwhile, exiting firms also showed early signs of their demise (Tybout's [1996] "shadow of death"). Exiting firms in Israel (Griliches & Regev, 1995) and exiting plants in Chile (Liu, 1993) showed lower current productivity than continuing firms. These firms' productivity also tended to decrease until they exited. (As Little, Mazumdar and Page [1987] and Pursell [1990] have shown, the Indian government policies that support failing firms have been grossly inefficient.)

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3. Data

This study uses a longitudinal data set covering 580 industries in 5-digit standard industry classifications. It includes data on 694,286 establishments during 1990-1998. The data are from the National Statistical Office's Annual Mining and Manufacturing Surveys. This study only used data on the manufacturing sector. For each establishment with five employees or more, the survey provides information on the input and output variables. The survey also includes the establishment date for each plant.

Over 83 percent of all plants are small, hiring less than 100 workers (See Table 1). Over 58 percent of all establishments hire 10 to 49 workers and produce less than 16 percent of the total output. Large plants with more than 200 workers produce more than 62 percent of the total output.

<Table 2> Mean Percentages of Plants and Their Output by Number of Employees, 1990-1998

(unit: %)

# of Employees	5-9	10-49	50-99	100-199	200-299	300-499	≥ 500
Plants	26.4	58.5	8.6	3.7	1.2	0.7	0.9
Output	2.2	15.7	9.5	10.5	6.6	7.4	48.1

3.1. Entry and Exit Status Variables

In our study, establishments or plants are classified as continuing, births, deaths, switch-ins or switch-outs. By comparing two adjacent years, a birth is defined as a plant present in a manufacturing sector with 5 or more employees or less than 5 employees and not existing in the previous years. Therefore, plant birth is the appearance of a plant in the database, either because it has just started up or it has met

the criterion of employing five workers. More specifically, a plant is considered a recent birth in 1991 if it exists in 1991 but has not been in manufacturing during the previous years. Similarly, a death is a plant that is present in a given year but not in the following years. Death plants drop out of the database, either because their number of workers has shrunk below five or because they shut down operations completely. Therefore, a plant death occurs in 1991 if it existed in 1991 but not afterwards. By construction, in the first year of the database, none of the plants are classified as a birth. Likewise, no plant is classified as a death in the last year.

The magnitude of entry and exit are measured both as a yearly total and as a yearly ratio. So, BIRTH TOTAL is the total number of births in a single year. SHARE is the ratio of the number of total plants of a particular status (e.g. births) in one year over the number of total plants in the previous year (e.g. BIRTH SHARE). For output and employment, entry and exit are measured as a percentage share of output or employment in entering or exiting plants over total output or employment. Entry rate can be defined either as a gross rate or net rate (e.g., Orr, 1974; Deutsch, 1975). The net rate is the difference between the entry rate and the exit rate. This study uses the gross rate.

Differences in inter-industry growth rates, technology, trade policies and industrial policies can change expected profits in an industry. Thus, some plants may shift their production capacity from one industry to another. Industry is defined at the five-digit level, the most detailed level available. A switch-in plant changes its primary product into the given industry. Meanwhile a switch-out plant changes its primary product out of the given industry. Switch-ins and switch-outs measure inter-industry resource reallocation. Like birth and death rates, switch-in and switch-out rates cannot be measured during the first and last year of the data, respectively.

Switch-in plants and switch-out plants differ from birth plants and dying plants in important ways. Switch-in plants have more experience (gained from other

industries) than birth plants. Thus, switch-in plants are likely to have better management ability, knowledge and access to financing. On the other hand, switch-out plants are likely to be stronger than dying plants because they do not close business. Some switch-out plants may move into a more profitable industry. So, switch-out plants may not necessarily be weaker than continuing plants.

3.2. Other variables

Plant performance is measured in the following ways: total product, employment, and value-added. Some variables used in this study to explain the occurrence of entry and exit include industry growth, market concentration, sunk costs, R&D intensity, GNP growth, number of plants and plant age.¹¹

GNP GROWTH and INFLATION measure the macro economic effects. The average GNP growth rate in the 1990s was 6.9 percent until the economic crisis in 1997. INFLATION is calculated as the percentage difference between two adjacent producer price indices. Since many have argued that the economic crisis has brought fundamental changes in the economic system, a time dummy variable, CRISIS, is introduced to measure the effect of the economic crisis.

INDUSTRY GROWTH is the percentage difference in industry output in consecutive years, measured for each of the five-digit industry levels.

EXPECTED PRICE-COST MARGIN is estimated by the ratio of the difference in total output and the sum of production costs and wage over total output because it is difficult to estimate the marginal cost of production,

¹¹While the theoretical effects of expected economic profit is clear, it is not included in the regression because profit can be considered as a performance variable that depends on the underlying market structure. Including structural variables such as Herfindahl index, industry growth rate, number of producers, required capital will affect the industry profit rate. underlying market structure

MARKET CONCENTRATION is computed using the Herfindahl index (sum of the square of each plant's market share). Khemani & Shapiro (1983) showed that four and eight concentration ratios were highly collinear with other variables. They reported that the Herfindahl index gave the best results.

CAPITAL EQUIPMENT is a proxy for sunk costs measured through the mean value of the physical assets of plants in each industry. Lack of data precludes an analysis of capital commitment (rental market for capital) or capital adaptability or transferability (e.g., second hand market, building vs. machinery, etc.). These analyses would improve our estimate of sunk costs.

R&D INTENSITY is measured by R&D expenditures over total output. It is difficult to argue how R&D activity affects industry turnovers. Although the magnitude or the degree of patents and innovation might be a better measure, as they can differentiate products from others, the data set does not include such information and R&D intensity is used instead.

LAG BIRTH, LAG SWITCH-IN, LAG SWITCH-OUT, and LAG DEATH are the respective rates of the past year. These variables predict whether earlier entry/exit rates affect current rates. The total number of plants in each industry also serves as a control for inter-industry differences. AGE is the number of years that a plant with 5 or more employees has been in continuous operation, up to and including the current year. Also, dummy variables will be used for each industry and for each class of turnover plant.

<Table 3> Summary of Industrial Characteristics

Variable	Mean	Standard deviation
Herfindahl index	1759.65	2066.26
Capital equipment	6400.10	42371.90
R&D intensity	0.0090	0.0194
Price-cost margin	0.1393	0.1199
Industry growth rate	1.6849	15.718

4. Patterns and Properties of Entry and Exit

The tabular analyses include summaries of the entry/exit rates, the impact of industry effects and plant performances.

4.1. Patterns of Entry and Exit

The Korean manufacturing sector shows substantially more entries and exits than do its US, Canada, and the European Community counterparts. In contrast to their entry and exit rates of about 6 percent, Korea's entry rate exceeded 24 percent and its exit rate exceeded 32 percent.

The number of plant births and deaths were both large. During 1990-1998, new plant births accounted for an average of 14.4 percent of the total number of plants each year. During the same period, 17.7 percent of all plants died. Like the developed countries in Europe and North America, birth plants and dying plants in Korea on average produce far less output than continuing plants. Continuing plants produce on average over 4 times more than both birth plants and dying plants.

Switch-ins and switch-outs also occur often. On average, 10.2 percent of all plants in a given industry moved from another industry. Meanwhile, 14.6 percent of all plants within an industry moved to another industry (possibly outside the manufacturing sector). Switching plants also tended to produce less output than continuing plants but more so than birth or dying plants. Both types of switching plants produced about 50 percent as much output as continuing plants. However, switching plants produced more than twice as much output as both birth and dying plants.

Deaths in one year seem to positively correlate with births in the following year. In 1994, the death rate was high, reaching 20 percent, with almost one out of five plants closed by the end of the following year. By the end of 1995, 17.1 percent of all

plants were new births. That pattern can be found again in 1998. Following a record high death rate during 1997 and 1998, the birth rate in 1998 is higher than average despite the unfavorable market conditions as described earlier.

4.1.1. Macroeconomic effects

As noted earlier, higher GNP generally increases profits and access to financing. So, higher GNP should increase entries and decrease exits. Switch-ins and switch-outs are already operating in other industries, so higher GNP should have a smaller effect on them.

The aggregate information does not show a simple pattern between the macroeconomic shocks and plant turnover rates. However, the entry and death rates widely differ during severe economic contraction. The entry rate fell from above 24 percent to below 17 percent in 1997. Likewise, nearly one out of every four plants in 1997 died within a year.

4.2. Cross Sectional Differences in Entry and Exit Rates

The aggregate pattern shows that entry and exit rates are high in the manufacturing sector in Korea. This section shows how entry and exit patterns differ over industries.

The turnover and output contributions from different types of plants vary widely across industries (see Table 5).¹² After eight years, nearly 92 percent of the original plants in the tobacco industry can remain. On the other hand, less than 30 percent of plants in the computers & calculating equipment can remain. Likewise, continuing plants in the coke and refined petroleum products industry can contribute as

¹² The Appendix shows more detailed information, featuring year to year turnover rates as well.

<Table 4> Annual Percentage of Plants and Outputs by Category of Entry and Exit with GNP 1990-1998

(unit: %)

Year	GNP growth	Continuing		Entries						Exits					
				Births		Switch-ins		Sub total		Deaths		Switch-outs		Sub total	
		Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
1990	9.5									14.2	3.7	27.0	18.8	41.2	22.5
1991	9.1	42.3	69.3	14.8	4.3	15	11.7	29.8	16	15.9	4.4	12.0	10.3	27.9	14.7
1992	5.1	48.2	70.2	13.4	3.8	7.5	5	20.9	8.8	15.2	7.4	15.7	13.6	30.9	21
1993	5.8	44.0	70.9	18.8	6.4	9.3	9.5	28.1	15.9	16.7	4.9	11.2	8.3	27.9	13.2
1994	8.6	47.4	75.5	12.4	3.1	6.4	5.1	18.8	8.2	20.4	5.7	13.4	10.6	33.8	16.3
1995	8.9	46.0	74.7	17.1	4.0	8.9	6.9	26.0	10.9	16.6	5.5	11.4	8.9	28	14.4
1996	6.8	49.8	74.0	12.3	3.8	8.1	6.1	20.4	9.9	18.3	5.1	11.5	11	29.8	16.1
1997	5.0	44.0	71.9	10.1	3.7	6.5	7.4	16.6	11.1	24.5	6.2	14.9	10.8	39.4	17
1998	-6.7			16.2	3.9	19.7	11.4	35.9	15.3						
Mean		46.0	72.4	14.4	4.1	10.2	7.9	24.6	12.0	17.7	5.4	14.6	11.5	32.4	16.9

Note: The mean is a simple average over time.

<Table 5> Cumulative Percentages of Plant Entry and Exit Rates and Output Share by Industry during 1990-1998.^a

Industry	Continuing		Entry						Exit					
			Birth		Switch-Ins		Sub Total		Death		Switch-Outs		Sub Total	
	Plant	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
Food and beverages	65.6	79.4	10.3	3.0	6.0	5.9	16.3	8.9	10.2	3.5	7.9	8.2	18.1	11.7
Tobacco	91.9	95.6	0.7	2.1	1.4	0.0	2.1	2.1	4.1	2.3	2.0	0.1	6.1	2.4
Textiles	55.4	60.9	11.2	4.6	8.0	10.5	19.2	15.1	14.4	7.7	10.9	16.3	25.3	24.0
Apparel and fur	42.6	41.6	12.3	8.7	11.2	13.9	23.5	22.6	19.8	14.6	14.2	21.2	34.0	35.8
Leather	51.7	61.7	12.2	5.5	4.9	6.0	17.1	11.5	23.4	16.7	7.8	10.1	31.2	26.8
Wood and cork	58.0	68.0	11.6	6.1	5.2	5.5	16.8	11.6	17.3	11.7	7.8	8.6	25.1	20.3
Pulp and paper	57.8	77.3	11.1	3.6	7.0	5.9	18.1	9.5	14.4	5.2	9.8	8.0	24.2	13.2
Publishing and printing	39.5	60.7	16.5	7.4	10.1	9.4	26.6	16.8	18.7	9.0	15.3	13.4	34.0	22.4
Coke and refined petroleum	63.7	99.0	6.5	0.1	8.1	0.4	14.6	0.5	8.3	0.1	13.5	0.3	21.8	0.4
Chemical	55.8	77.3	11.0	2.7	9.6	8.5	20.6	11.2	10.5	1.9	13.2	9.7	23.7	11.6
Rubber and plastics	44.2	61.5	11.4	4.0	12.4	11.0	23.8	15.0	14.4	6.0	17.6	17.5	32.0	23.5
Non-metallic minerals	64.8	77.9	10.9	4.1	5.1	5.9	16.0	10.0	12.7	5.3	6.5	6.8	19.2	12.1
Basic metals	44.7	83.6	11.4	2.3	12.1	4.9	23.5	7.2	13.4	3.0	18.3	6.3	31.7	9.3
Metal assembling	42.1	55.4	15.2	6.6	10.5	12.5	25.7	19.1	17.7	8.7	14.5	16.9	32.2	25.6
Machinery	42.90	59.8	14.5	6.1	10.1	10.2	24.6	16.3	17.7	7.9	14.8	16.0	32.5	23.9
Office and calculating	29.6	60.0	17.4	2.9	14.0	24.0	31.4	26.9	19.5	4.1	19.5	9.0	39.0	13.1
Electrical machinery	43.1	66.3	14.2	5.0	11.3	10.4	25.5	15.4	16.5	6.4	15.0	11.9	31.5	18.3
TV and communication	46.6	78.4	12.9	3.7	9.2	6.2	22.1	9.9	15.9	2.6	15.4	9.1	31.3	11.7
Medical, precision and Optical	48.1	59.8	14.6	6.0	9.4	10.9	24.0	16.9	15.8	7.1	12.1	16.3	27.9	23.4
Motor cars and trailers	49.3	89.1	13.6	2.6	8.5	2.7	22.1	5.3	14.8	1.8	13.8	3.7	28.6	5.5
Other transport	49.2	88.2	13.9	1.2	9.6	3.5	23.5	4.7	13.2	1.7	14.1	5.4	27.3	7.1
Furniture	53.0	68.5	13.4	6.8	5.7	6.1	19.1	12.9	19.3	10.3	8.5	8.3	27.8	18.6
Recycling	37.1	60.4	27.9	19.4	8.5	4.6	36.4	24.0	16.3	8.4	10.2	7.3	26.5	15.7

^a While the information is presented at the two-digit level, switch-ins and switch-outs are measured at the five-digit level.

much as 99 percent of the total output. Or, they can contribute less than 42 percent, as in the apparel and furs industry. Birth, switch-in, switch-out, and death rates can vary from lows of around 1 percent, 1 percent, 4 percent, and 2 percent to highs of around 28 percent, 14 percent, 23 percent, and 19 percent, respectively. Similarly, all entry/exit plants' outputs can be as low as 0 percent. Meanwhile, these respective plants' outputs can be reach highs of around 19 percent, 24 percent, 17 percent and 21 percent, respectively.

The remainder of this section examines how specific factors affect industry turnover rates measured in producers and outputs. In particular, I focused on five factors: expected price-cost margin, industry growth, market competition, sunk costs and R&D activity.

4.2.1. Industry Growth

When industry demand grows, an entrant's added output depresses price at a slower rate. This reduces the asymmetry between the existing plants' lower current price and an entrant's higher future price. So, higher industry demand should raise entries. When demand grows, stronger plants may not fully supply the additional demand, allowing weaker plants to survive. Therefore, higher industry demand also reduces exits.

As expected, fast growing industries show both more turnover and more turnover output than slow growing industries (see Table 6). In particular, the fastest-growing industries quintile shows more turnover than the slowest for each plant status category. The turnover rate is 18 percent vs. 11 percent births, 11 percent vs. 10 percent switch-ins, 13 percent vs. 11 percent switch-outs and 19 percent vs. 14 percent deaths. The average difference in turnover output share between the fastest-growing industries quintile and the slowest is even greater. The figures are 11 percent vs. 2 percent for births, 12 percent vs. 5 percent for switch-ins, 14 percent vs. 5 percent for switch-outs and 10 percent vs. 2 percent for exits.

<Table 6> Comparison of Plants and Outputs in Industry Groups by Sales Growth Rate, 1990-1998

(unit: %)

Quintiles of Industries by Size	Continuing		Entries						Exits					
			Births		Switch-ins		Sub Total		Deaths		Switch-outs		Sub Total	
	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
Top 20%	39.7	54.2	17.7	10.7	10.5	12.1	28.2	22.8	19.3	9.5	12.8	13.5	32.1	23.0
20-40%	45.0	72.3	16.0	4.8	10.2	6.9	26.2	11.7	17.3	5.9	11.5	10.0	28.8	15.9
40-60%	49.0	68.1	14.4	4.9	9.4	9.2	23.8	14.1	16.3	5.7	11.0	11.9	27.3	17.6
60-80%	51.7	75.0	12.4	3.4	10.4	8.7	22.8	12.1	14.4	4.9	11.1	7.9	25.5	12.8
80-100%	55.5	86.7	10.9	1.6	9.7	4.7	20.6	6.3	13.5	2.0	10.5	5.0	24.0	7.0

industries quintile and the slowest is even greater. The figures are 11 percent vs. 2 percent for births, 12 percent vs. 5 percent for switch-ins, 14 percent vs. 5 percent for switch-outs and 10 percent vs. 2 percent for exits.

The above turnover is not limited to small fringe firms. Considering the large output changes produced by entrants and losing firms, the turnovers affect large plants as well. In the fastest growing industries quintile, turnover plants comprise more than 60 percent of the total number of plants and produce over 45 percent of the total output. So, resource reallocation occurs more often among fast growing industries.

4.2.2. Expected Price-cost Margin

Table 7 summarizes the effect of price-cost margin on industry entry and exit rates. Despite the argument that high return allows weaker firms to survive, the table does not show strong differences across industries. However, this empirical result is not unique. Yamawaki (1991) has showed that the effect of price-cost margin on the net entry rate was not significant in Japan, using 135 industries in the manufacturing sector over 1979 and 1984.

4.2.3. Market Concentration

Higher market concentration increases the likelihood that existing plants can collude effectively. Since they can collude both to increase profitability and to retaliate against entrants, even less efficient firms are more likely to survive and potential entrants are less likely to enter. Thus, higher market concentration should reduce entry and exit, particularly for switch-ins.

As Table 8 shows however, market concentration does not change the ratio of birth and death rates measured in plant shares while such rates measured in output ratio are lower. In contrast, market concentration increases switch-outs and switch-ins. These results suggest that in more concentrated industries less efficient producers tend

<Table 7> Comparison of Plants and Outputs in Industry Groups by Price-cost Margin, 1990-1998

(unit: %)

Quintiles of Industries by Size	Continuing		Entries						Exits					
			Births		Switch-ins		Sub total		Deaths		Switch-outs		Sub Total	
	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
Top 20%	53.6	79.5	12.7	3.5	7.2	4.6	19.9	8.1	15.4	4.0	11.1	8.4	26.5	12.4
20-40%	47.9	62.9	13.5	5.2	9.0	10.9	22.5	16.1	17.0	7.6	12.6	13.4	29.6	21.0
40-60%	46.6	67.0	13.1	4.9	9.8	8.6	22.9	13.5	16.3	6.4	14.2	13.2	30.5	19.6
60-80%	48.6	72.1	12.7	4.1	9.3	7.6	22.1	11.7	16.1	5.3	13.2	10.9	29.3	16.2
80-100%	51.6	81.2	12.7	2.8	8.9	6.2	21.6	9.0	14.8	3.1	12.0	6.7	26.8	9.8

<Table 8> Comparison of Plants and Outputs in Industry Groups by Herfindahl Index, 1990-1998

(unit: %)

Quintiles of Industries by Size	Continuing		Entries						Exits					
			Births		Switch-ins		Sub Total		Deaths		Switch-outs		Sub Total	
	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
Top 20%	42.5	77.8	12.7	2.1	10.9	8.5	23.6	10.6	15.4	2.1	18.5	9.5	33.9	11.6
20-40%	45.5	85.0	13.8	2.0	10.4	4.8	24.2	6.8	14.9	2.0	15.4	6.2	30.3	8.2
40-60%	49.0	73.6	12.6	3.8	9.6	7.6	22.2	11.4	15.0	4.4	13.8	10.6	28.8	15.0
60-80%	46.8	67.7	13.0	4.9	9.8	8.6	22.8	13.5	16.0	5.9	14.4	12.9	30.4	18.8
80-100%	50.9	64.3	12.9	6.1	8.3	8.8	20.1	14.9	16.5	9.1	11.3	11.6	27.8	20.7

to choose not to close out but to switch out to other industries. Relatively speaking, plants with experience in other industries are in better position to enter more concentrated market than new birth plants without experience.

These results differ from Jeong and Masson's (1991) analyses of the Korean business cycle during 1977-1981.¹³ They have found that market concentration does not deter entry but reduces exit of firms.

4.2.4. Sunk costs

Sunk costs impose an asymmetric cost and risk on a possible entering plant compared to an existing plant. Because new plants are difficult to access the capital market for various reasons, it can deter entry by new birth. However, switch-in plants are likely to have more capital from earlier operation in another industry. They are also likely to have greater access to financing. Therefore, they are less subject to financial market imperfection, and hence sunk costs should have a smaller effect on switch-in plants.

When sunk cost is high and variable or fixed cost is relatively low, a less efficient plant can stay in the industry. Less efficient plants in industries with high sunk cost might choose between closing out and to switch out. Because switch-out plants can often use their accumulated capital again in the new industry the capital requirement is less likely to be a sunk cost to them. As a result, the capital equipment ratio proxy for sunk cost should have a smaller effect on switch-outs.

Table 9 shows the expected results. Higher capital equipment ratios reduce both births and deaths in terms of plant numbers. The effect negative effect on birth and death is much stronger when turnover rate is measured by output share. On the

¹³ They use 48 four-digit and 14 five-digit industries.

<Table 9> Comparison of Plants and Outputs in Industry Groups by Capital Equipment Ratio, 1990-1998

(unit: %)

Industry Size Quintiles	Continuing		Entries						Exits					
			Births		Switch-ins		Sub Total		Deaths		Switch-outs		Sub Total	
	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
Top 20%	53.2	87.3	11.5	2.0	9.7	4.2	21.2	6.2	11.6	1.8	14.0	4.7	25.6	6.5
20-40%	51.4	67.9	12.4	4.4	9.2	10.2	21.6	14.6	14.1	5.1	12.9	12.5	27.0	17.6
40-60%	47.5	64.6	13.5	5.1	9.5	9.3	23.0	14.4	16.1	6.3	13.3	14.7	29.4	21.0
60-80%	49.4	60.6	13.5	6.4	7.9	9.1	21.4	15.5	17.3	10.3	11.9	13.6	29.2	23.9
80-100%	45.5	48.7	13.6	8.3	8.8	11.4	22.4	19.7	19.6	14.1	12.5	17.6	32.1	31.7

other hand, the capital equipment ratio shows smaller effects on switch-ins and switch-outs. In the quintile of industries with the highest capital equipment ratios, turnover output is less than 13 percent. In the lowest quintile, turnover output exceeds 52 percent. Therefore, resource reallocation occurs more often among industries with low capital equipment ratios and those with low sunk costs.

4.2.5. R&D Intensity

Patents and innovation can be a better proxy than R&D intensity that measures how R&D activity affect industry turnover as they differentiate products. However, because of the lack of such information, R&D intensity is used. Moreover, it is difficult to predict how the R&D activity affect turnover because it depends on the magnitude and importance of innovation as Reinganum (1983) argues. When R&D produces major innovation and imitation is difficult, R&D can reduce entry and increase exit. New innovation can replace the existing technology used by incumbents. A successful incumbent can monopolize its output market while unsuccessful producers are forced to choose between close outs and switch outs. At the same time, new birth is difficult to enter the market that is dominated by successful incumbent.

When R&D generates spillover effects of technology and/or product niches, it can create room for entrants to exploit. So, high R&D can also increase entry. Existing plants, in particular, may act more swiftly than potential new entrants in exploiting these niches by switching into the industry. Likewise, existing plants with high R&D are more likely to develop innovation better used in a different industry and thus switch out. Therefore, high R&D can increase entry and exit.

Table 10 shows that high R&D intensity increases both entry and exit rates. In addition, it increases switch-ins and switch-outs as well. However, high R&D intensity does not have a clear monotonic effect on any type of turnover output share. The third quintile group of industries show the highest turnover rates in entry and exit both

<Table 10> Comparison of Plants and Outputs in Industry Groups by R&D Investment, 1990-1998

(unit: %)

Quintiles of Industries by Size	Continuing		Entries						Exits					
			Births		Switch-ins		Sub Total		Deaths		Switch-outs		Sub Total	
	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
Top 20%	44.5	75.9	13.9	3.6	10.2	7.7	24.1	11.3	16.0	3.3	15.4	9.5	31.4	12.8
20-40%	47.1	77.9	13.5	3.3	9.6	6.2	23.1	9.5	16.1	4.3	13.7	8.3	29.8	12.6
40-60%	46.9	65.7	12.9	4.9	10.9	9.8	23.8	14.7	15.5	6.6	13.8	13.0	29.3	19.6
60-80%	51.6	74.3	13.0	3.7	7.0	6.3	20.0	10.0	17.4	6.0	10.9	9.7	28.3	15.7
80-100%	57.8	73.8	11.1	4.2	7.4	6.9	18.5	11.1	14.2	6.0	9.5	9.0	23.7	15.0

measured in output shares. While it is difficult to argue that overall property of R&D activity in the economy, the high entry and exit rate suggests that R&D activity produces minor innovations rather than major innovations.

4.3. Plant Differences

The section above shows differences in entry and exit rates across industries. Now, we focus on whether plant characteristics affect turnovers as well. Two types of plant characteristics are reviewed in this section. One is size measured by number of employees and the other is the size of sunk costs measured by the assets and the capital equipment ratio.

4.3.1. Size

Birth plants are expected to employ fewer workers than continuing plants as they have limited access to Korea's imperfect financial market. In contrast, since switch-in plants are likely to have financing access similar to that of continuing plants, they need not be smaller than continuing plants.

Plant size can affect producer's ability to survive. Smaller plants tend to have lower profits than larger plants, making them more vulnerable to unfavorable market conditions. With a small number of employees, smaller plants have less room for reducing costs while large plants can often reduce their labor force and size in an effort to survive. Therefore, small plants are more likely to die than large ones. However, smaller plants are less likely to switch-out than larger plants. Larger plants with more human resources are more likely to adapt to a new industry than plants with less human resources. Compared to small plants, larger plants are more likely to switch out. In short, smaller plants are more likely to die, but less likely to switch out.

In order to examine the effect of plant size on turnover, I classify plants into five quintile groups depending on the size of their employees in each five-digit industry level.

Therefore, each quintile group includes top 20% plants in each and every industry.

Table 11 shows that smallest quintile group consists of more new births and dying plants than larger quintile group. As the plant labor force increases, the death rate falls and the switch-out rate rises. In other words, smaller plants are more likely to die while larger plants are more likely to switch out. In the smallest quintile group, around 20% of plants are new birth and 25% of the all plants in the group will die in the following year. On the other hand, in the largest quintile group, 6.2% of plants are new birth and 9.2% will die in the following year. In contrast, largest quintile group has the highest switch-ins and outs. While the smallest quintile group has 17.4% of switch ins and outs combined, the largest group has 25%.

Depending on the size of plants, the performance of the each entry and exit plants vary. Among the small plants, new birth and death do not seem to produce less than continuing plants while those among large plants appear to produce much less than continuing plants. For example, in the largest group, a new birth plant produces on average around 32% of a continuing plant, and a death plant produces 28% of a continuing plant. However, in the smallest group a new birth plant produces on average around 73% of a continuing plant, and a death plant produces 66% of a continuing plant. Switch-ins and outs also show similar phenomenon. Yet, larger switch-in plants are less competitive with large continuing plants with respect to output. In contrast, small switch-in plants are more competitive with small continuing plants. In the largest labor force quintile, the average output of switch-in plants is only 56 percent of continuing plants' average output. In the smallest quintile however, it is 89 percent. This result means large switch-in plants may suffer from inefficiencies more than small switch-in plants.

Overall, turnover occurs most often in the smallest plants, accounting for nearly 62 percent of the plants and over 54 percent of the output. So, resource reallocation occurs more often among small plants.

<Table 11> Industry Turnovers by the Number of Employees, 1990-1998

(unit: %)

Quintiles of Plants by Size	Continuing		Entries						Exits					
			Births		Switch-ins		Sub Total		Deaths		Switch-outs		Sub Total	
	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
Top 20%	59.4	76.9	6.2	2.5	10.0	7.3	16.2	9.8	9.2	3.3	15.2	10.0	24.4	13.3
20-40%	53.2	73.0	10.4	5.2	9.6	6.7	20.0	11.9	12.9	6.8	13.9	8.3	26.8	15.1
40-60%	49.2	67.3	13.3	8.3	9.1	7.0	22.4	15.3	15.3	8.9	13.2	8.5	28.5	17.4
60-80%	45.3	57.5	16.0	11.5	8.6	8.2	24.6	19.7	18.0	12.6	12.1	10.2	30.1	22.8
80-100%	38.1	45.8	19.5	17.2	7.7	8.2	27.2	25.4	25.0	20.0	9.7	8.8	34.7	28.8

4.3.2. Size of Capital

In addition, I also classify plants into five quintile groups depending on the size of their assets and capital equipment ratios in each five-digit industry level. While asset size and capital equipment ratio can measure the size of the plants just like the number of employees, plant size can also be correlated to the magnitude of sunk costs. Unlike the number of employees, assets and capital investment are more closely related to sunk costs as they become difficult to recover the value committed to the assets. Moreover, with the lack of information provided by the currently available data set as to whether certain capital has been purchased and sold in the second hand market, it is reasonable to assume that the assets and capital equipment ratios measures sunk cost that each plant paid upon entry. If the sunk cost affects only large entrants as Marta (1991) argues, plants with different capital equipment ratios will exhibit different turnover rates. This analysis can provide important implications for the role of investment cost.

Table 12 summarizes the effects of sunk cost on turnover. Panel A shows the effect of asset size, and Panel B shows that of capital equipment ratio on turnover. Both panels show very similar results. In both cases, the birth and death rates are lower in the group of plants with the largest assets or capital ratio. In particular, when the rate is measured by the percentage of output, the birth and death rate is small. On the other hand, the share of producers is not as small as the output share. This result suggests that plants are less likely to enter by creation or exit by death when they face high sunk cost. Instead, entry and exit in that group take the form of switch-ins from other industry or switch-outs. While it is not clear at all from this observation, the high level of switch-ins and switch-outs suggest that capital used in one industry might be more valuable than selling in second hand market.

These consistent results imply that the largest plants have few births and deaths, but more switch-ins and switch-outs.

<Table 12> Turnovers by the Size of Sunk Cost, 1990-1998

(unit: %)

Quintiles of Plants by Size	Continuing		Entries						Exits					
			Births		Switch-ins		Sub Total		Deaths		Switch-outs		Sub Total	
	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output

Panel A: Sunk cost is measured by the size of assets

Top 20%	58.9	77.1	6.6	2.6	10.4	7.3	17.0	9.9	9.4	3.2	14.7	9.8	24.1	13.0
20-40%	54.2	72.6	9.8	4.8	10.0	6.8	19.8	11.6	12.3	6.6	13.7	9.2	26.0	15.8
40-60%	49.6	69.2	12.4	6.8	9.2	6.7	21.6	13.5	15.7	8.8	13.0	8.5	28.7	17.3
60-80%	44.9	56.8	15.2	10.8	8.5	8.7	23.7	19.5	19.4	13.3	12.0	10.4	31.4	23.7
80-100%	37.5	46.2	21.3	17.9	6.9	7.5	28.2	25.4	23.7	18.8	10.6	9.6	34.3	28.4

Panel B: Sunk cost is measured by capital ratio over labor

Top 20%	54.2	76.8	9.8	3.1	10.3	7.5	20.1	10.6	12.6	3.2	13.2	9.4	25.8	12.6
20-40%	53.2	74.6	10.5	3.6	9.8	7.2	20.3	10.8	13.2	5.0	13.3	9.6	26.5	14.6
40-60%	50.0	75.0	12.0	3.5	9.0	6.5	21.0	10.0	15.8	5.5	13.2	9.5	29.0	15.0
60-80%	46.7	70.5	14.0	5.0	8.5	6.5	22.5	11.5	18.1	7.8	12.6	10.2	30.7	18.0
80-100%	41.1	54.5	19.1	11.5	7.3	8.6	26.4	20.1	20.8	13.3	11.7	12.2	32.5	25.5

4.4. Performance

To measure the short run effects of new entrants, we calculated the magnitudes of their value-added contributions, total outputs and industry employment. Their overall contribution to the economy is quite large, especially in employment. Table 13 summarizes the results. The data show that plants that are less than one-year old account for 5.3 percent of value-added, 5 percent of outputs, and 8.8 percent of employment. Plants 1 to 2 years old and 2 to 3 years old show similar value-added contributions and outputs. However, their contribution to the annual total employment has been declining over time. Relative to the entire Korean economy as a whole, each cohort of entrants' value-added and outputs remain stable, but they hire relatively fewer employees.

Table 14 shows in a greater detail that the aggregated employment by new entrants has been decreasing over time. Compared to the employment level in the initial year of entry, it shows how the employment level has changed by the entry cohort. In all the entry cohorts, employment has decreased from the second year after entry. The long run effect also shows that on average total employment by new entrants drops to the half of the initial employment level five years after entry.

4.4.1. Death Rate of Entrants

While developed countries show that entrants and exits amount to less than 3 percent and 3.5 percent respectively, the stable and more significant contribution by entrants in Korea is interesting. How do entrants manage such stable significant contribution? There are two possibilities. One is that most entrants can survive and produce the same level of output. This possibility is opposite to most cases that show that entrants are small and disappear quickly. Second, surviving plants rapidly increase their output to compensate for dying entrants.

<Table 13> Contribution by New Entrants

(unit: %)

Birth Year	Less than 1 year old		1-2 years old			2-3 years old			
	Value-added	Outputs	Employment	Value-added	Outputs	Employment	Value-added	Outputs	Employment
1991	5.3	5.1	9.1						
1992	5.0	4.7	8.0	5.8	5.6	8.1			
1993	8.9	8.0	12.7	4.9	4.6	6.9	5.1	5.1	6.7
1994	4.6	4.4	8.4	8.4	7.6	10.5	4.5	4.5	6.2
1995	5.3	4.9	9.4	4.3	4.2	6.6	9.0	7.6	9.1
1996	4.8	4.7	8.0	5.8	5.7	9.0	4.2	4.2	6.0
1997	4.4	4.5	6.9	5.2	4.9	7.1	5.0	5.3	8.0
1998	4.1	4.0	7.3	4.0	4.1	6.2	4.9	4.7	6.4
Mean	5.3	5.0	8.8	5.5	5.2	7.8	5.5	5.2	7.1

<Table 14> Post Entry Aggregate Employment over Time

(unit: %)

Birth year	Years after entry							
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8
1991	100.0	84.3	70.1	64.1	56.2	50.2	43.9	36.5
1992	100.0	86.1	79.2	67.7	62.1	51.9	42.3	
1993	100.0	84.4	72.1	63.4	54.7	43.1		
1994	100.0	77.1	69.3	56.9	45.3			
1995	100.0	93.0	76.9	57.9				
1996	100.0	82.0	64.7					
1997	100.0	78.8						

Table 15 and 16 show death rates of new entrants. Table 15 summarizes how many new entrants have died out over time compared to the total plants and output of each birth year. In their first year, 27 percent of new entrants disappeared on average. In the second year, another 17 percent of entrants died. In the third year, around 12 percent of additional plants died. Within the first 3 years after entry around 55 percent of new entrants disappear on average. This rate is slightly higher compared to the death rates of Columbia and Chile.

The comparison between the ratio of dying producers and that of output implies that those dying plants are the relatively smaller ones among entrants. Although the ratio varies widely over time, on average plants that die within a year produce around 73% of other entrants' average product. Plants that close out later years show more output than those that close out soon after the entry. Plants that are still alive after 5 years show their on average output was much larger than the average output of their entry cohort. These results suggest that plants are heterogeneous in terms of their efficiency and their survival chance from their birth.

Similarly, Table 16 shows a age composition of dying plants in each year. On average, almost 30 percent of all plants that die each year are less than 1 year old. However products by these plants amount to 18.5% of output by all dying plants. This again suggests that plants dying young are smaller than those dying old.

4.4.2. Surviving Entrants' Performance Over Time

As a group, new entrant contribution measured by value-added and output remains stable over time. But, most new entrants are vulnerable and subject to exit risks. Within a year, 27 percent of newborn plants died. Within three years, over 55 percent died.

How does each entrant cohort manage its contribution despite such a high hazard rate? In order to answer this question, this section investigates the performance of surviving entrants over time.

<Table 15> Death Rate of New Entrants Over Time

(%)

Birth Year	Years after entry														Alive in 1998	
	0-1		1-2		2-3		3-4		4-5		5-6		6-7			
	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-Ducts	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-Ducts
1991	23.4	16.3	15.2	17.1	10.1	8.6	10.0	8.4	6.2	4.5	5.7	4.1	6.0	4.6	23.2	36.4
1992	20.1	19.7	13.7	10.0	13.8	8.5	8.2	5.8	7.2	5.1	8.4	6.8			28.6	44.3
1993	28.7	18.9	17.3	9.9	10.3	7.7	8.8	5.9	9.3	5.7					25.6	51.9
1994	32.6	29.8	13.4	10.5	10.5	8.2	12.0	8.7							31.6	42.9
1995	23.0	17.2	17.8	12.5	17.8	13.7									41.3	56.5
1996	27.3	18.8	24.3	13.3											48.5	67.9
1997	33.8	17.1													66.2	82.9

<Table 16> Distribution of Closing Plants according to Birth

(%)

Birth	1991		1992		1993		1994		1995		1996		1997	
	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-ducts	Plants	Pro-ducts
In or before 1990	71.6	81.2	58.8	75.1	32.5	49.1	30.3	44.9	26.1	52.7	20.1	40.5	18.3	40.5
1991	28.4	18.8	19.1	12.5	10.0	10.9	8.1	8.3	5.8	4.9	4.7	4.8	3.8	3.6
1992			22.1	12.5	12.2	9.2	9.6	8.7	7.0	5.4	5.4	6.2	4.7	5.8
1993					45.2	30.8	22.8	15.2	15.6	12.5	12.1	9.8	9.5	7.1
1994							29.2	22.8	14.7	9.4	10.4	8.3	9.0	7.4
1995									30.7	15.2	22.1	13.4	16.6	12.2
1996											25.1	17.2	17.4	11.1
1997													20.9	12.4
SUM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Compared to the initial average performance, each entry cohort improves its value-added and product. Table 17 summarizes the ratio of performance after entry. Panel A, Panel B and Panel C measured performance by average value-added, product and employment, respectively. In the second year, average value-added and product increase more than 40 percent. Value-added has almost tripled and output has increased by 400 percent in five years. The entrant cohort of 1997 birth year appears to be an exception. New entrants' value added and output in their second year has increased 18% compared to their initial year. Since they faced serious economic downturn, their average value added and product has not increased as fast as other entrant cohorts. However, the rapid growth despite unfavorable macro economic environment suggests that entrants with huge growth potentials survive.

On the other hand, the average employment by surviving entrants did not increase as quickly as it exceeded initial employment by no more than 64 percent. These results suggest that labor productivity of surviving plants increase fast over time.

4.4.3. Closing Firms' Performance over Time

What caused the failure of plants? Are dying plants inferior to continuing or surviving ones? Among new entrants, are there any differences among them? In order to answer these questions, I have examined whether closing plants' performance is different from continuing ones.

Among new entrants, continuing plants and closing ones are selected. Then, closing plants are arranged in terms of years before their death. Compared to the mean value of product and number of workers among continuing plants, the mean value of closing plants was calculated for each group depending on the number years left.

Table 18 shows that closing plants' performance is lower than that of continuing firms on average. Plants that are closed immediately after their birth show much lower performance than continuing ones. In their final year, closing plants'

<Table 17> Surviving Entrants' Performance over Time 1990-1998

(unit: %)

Birth Year	Years after entry							
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8
Panel A: average value-added over time compared to the time of entry								
1991	100	153.3	186.0	250.4	341.3	411.0	489.6	516.9
1992	100	128.3	168.2	228.7	292.5	344.9	349.1	
1993	100	150.0	238.1	276.2	323.6	350.2		
1994	100	149.7	209.4	240.6	319.5			
1995	100	156.8	182.7	198.7				
1996	100	148.6	182.8					
1997	100	118.1						
Panel B: average product over time compared to the time of entry								
1991	100	153.9	191.6	250.7	338.7	416.1	536.1	561.0
1992	100	130.0	176.1	240.4	304.0	371.8	366.7	
1993	100	147.7	223.1	274.1	347.7	370.4		
1994	100	156.9	217.5	254.3	361.5			
1995	100	163.2	210.3	221.2				
1996	100	148.1	186.5					
1997	100	116.4						
Panel C: average employment over time compared to the time of entry								
1991	100.0	107.8	111.9	121.6	135.7	144.0	151.9	158.5
1992	100.0	103.5	114.7	126.0	137.8	140.3	147.2	
1993	100.0	113.1	129.5	140.6	156.0	163.8		
1994	100.0	110.9	124.2	129.2	140.3			
1995	100.0	116.9	127.7	135.5				
1996	100.0	111.1	128.0					
1997	100.0	112.7						

<Table 18> Dying Plants' Performance compared to Continuing Plants

		Year of birth						
		1991	1992	1993	1994	1995	1996	1997
1 year before death	Product	40.4	65.8	33.8	55.5	38.8	88.5	40.1
	Worker	73.5	92.0	62.3	77.7	64.7	71.8	64.8
2 years before death	Product	75.9	49.9	35.5	60.8	44.2	83.0	
	Worker	101.8	73.7	57.2	75.2	67.0	65.8	
3 years before death	Product	72.8	65.0	57.5	70.9	54.1		
	Worker	76.6	74.5	69.3	73.5	67.5		
4 years before death	Product	73.3	75.1	53.9	74.0			
	Worker	74.8	81.7	61.0	75.2			
5 years before death	Product	80.5	103.3	50.3				
	Worker	77.2	82.4	59.2				
6 years before death	Product	91.4	112.3					
	Worker	88.0	78.2					
7 years before death	Product	86.4						
	Worker	67.8						

average product amounts to only 45 percent of that of continuing plants. Moreover, plants that are closed in imminent years also have lower output share. This implies that lower performance was one of the major sources of plant deaths.

However, there are exceptions. Some plants with several years of operating experience that were closed in 1997 and 1998 showed almost as high as or higher performance than continuing ones. For example, plants born in 1991 but that died

during the economic crisis show that their output ratio reached over 91 percent of that of continuing plants. Moreover, plants born in 1992 but that died in 1997 show that their average output ratio was even greater than that of continuing plants, 112 percent. Therefore, it is difficult to say that the cause of closure during this period was purely performance related. While future studies will provide more explanations for this finding, the result suggests that factors other than performance affect firm exit as well.

5. Regression Results

While the above tables show the impacts of each turnover-contributing factor, they have not controlled for the effects of other contributing factors. In this section, using the regression analyses, I test the effects of macroeconomic conditions, changes in demand, and industry characteristics on industry performance. Then, I also test whether entrants and exits have varying plant performance.

5.1. Turnover Determinants

The birth, switch-in, switch-out and death rates are modeled with separate regressions for each plant status. Regression uses the number of plants in each entry and exit status over the number of continuing plants. Explanatory variables for both sets of regressions include INDUSTRY GROWTH, MARKET CONCENTRATION, CAPITAL EQUIPMENT, R&D INTENSITY, GNP GROWTH, INFLATION, ENTRY OR EXIT OF PREVIOUS YEAR and TOTAL PLANTS.

In addition to the industry-specific effects captured in the above explanatory variables, other industry-specific properties also affect industry turnovers. Orr (1974) provides a long list of these variables. They include scale economies, slope of the long-run average cost curve generated by plants below the minimum efficient scale, impact of entry on factor prices, degree of excess productive capacity, industry demand elasticities, marketing arrangements, product specialization indices and marketing and advertising expenditures. Khemani & Shapiro (1983) also identify regional industries affected by high transportation costs. Gilbert (1989) notes the possible impact of consumer switching costs as entry barriers. Note that other variables including network economies (Gilbert, 1989), government policies (Jeong & Masson, 1991) and domestic vs. foreign ownership (Orr, 1974) are not incorporated into this model. These

omissions should be considered when interpreting the results.

Effects of macro factors

High GNP growth rates encourage both high birth numbers and rates in the market. But they reduce switch-in rates in the market. Surprisingly, switch-out rates increase. A 1 percent rise in GNP growth, on average, increases the birth rate by 3.3 percent and reduces the switch-in rate by 3.2 percent. High inflation rates also encourage births but reduce other turnover rates. The crisis dummy shows results consistent with the expectation that the economic crisis lowers entry while it increases the exit rates. The crisis dummy takes 1 for 1997 and 1998, and 0 otherwise. The crisis dummy variable further reduces birth rates and increases death rates. It accounts for a 16.9 percent reduction in the birth rate, 19.3 percent reduction in the switch-in rate, and a 74 percent and 96.2 percent increase in the death rate and switch-out rate, respectively

Effects of industry characteristics

Industry growth is an entry-facilitating factor. Both new births and switch-ins rise in industries with high demand growth rates. A 1 percent rise in the industry growth rate, on average, increases the birth rate by 8.7 percent and switch-in rate by 13.3 percent. On the other hand, the industry growth rate affects exit rates on a much smaller scale, 0.58 percent of death rates and 2.1 percent of switch out rates.

As noted earlier, R&D may not have a simple, single effect on the turnover rates. While R&D does not affect the entry rates, it significantly raises the death rates. R&D-supported innovations' effect of making current technology obsolete may explain R&D's positive effect on the death rate.

Market concentration reduces both entry and exit rates. However, its effects on births and deaths are not significant, while its negative effect on switch-ins is significant. This difference may come from the size of the entrants because switch-ins

are usually larger than birth plants. Mata (1991) argues large entrants face more potential retaliation than small entrants do.

As expected, capital requirement (a proxy for sunk costs) reduced the entry rates, suggesting its role as an entry barrier. Moreover, it also reduced exit rates, suggesting that higher sunk costs reduce exits as Caves and Porter (1976), Eaton and Lipsey (1980) and Baumol et al. (1982) argue.

Plant level differences

Exit rates in the previous year should open opportunities and increase entry rates in the current year. On the other hand, some studies have shown that entrants often exit quickly. So, entry rates should also predict exit rates. In particular, switch-in plants are likely to switch out again.

As expected, the birth rate increases with higher exit rates in the past year. A 1 percent rise in the previous year's switch-out and death rates increases the birth rate by 0.29 percent and 0.23 percent, respectively. As argued earlier, higher switch-out and death rates in the previous year may open opportunities for new plants. The switch-in rate shows a negative relationship with the past year's switch-out and a positive relationship with death rates. A 1 percent rise in the past year's switch-out rates lowers the switch-in rates by 0.30 percent, while that of death rates increases the switch-in rates by 0.38 percent. The death rate shows a small but significant positive relationship with the past year's births. A 1 percent rise in the past year's birth rates raises the death rate by 0.013 percent. Similarly, the switch-out rate shows a negative relationship with the past year's births and a positive relationship with switch-ins. A 1 percent rise in the past year's birth rates lowers the switch-out rate by 0.030 percent while that of the switch-in rate increases switch-out rate by 0.043 percent. As discussed earlier, these results suggest that plants that changed their primary business are more likely to switch to another industry.

Table 19 and 20 summarize the results using the number of turnovers and turnover rates, respectively.

5.2. Plant Performance

Plant performance is measured via two outcome variables: TOTAL PRODUCT, and LABOR PRODUCTIVITY. Explanatory variables include a dummy variable for each type of entry and exit plant. Other explanatory variables include INDUSTRY GROWTH, MARKET CONCENTRATION, SUNK COSTS, and R&D INTENSITY. Moreover, in order to examine the long-term performance after the entry, plant AGE is included. To account for unobserved industry-specific effects and unobserved time-specific effects, the above regressions include industry dummies and time dummies as well.

Industry characteristics such as market concentration decrease total output and labor productivity. As basic economics theory demonstrates, producers in a concentrated market choose their profit maximizing output level higher than the output level in a concentrate market, *ceteris paribus*. Lower output in concentrated market is similar to the Canadian case in Baldwin (1993). In addition, Producers in industries with capital equipment ratio exhibit higher performance. However, R&D intensity in the industry does lower the product over labor. Industry growth does not affect the firm performance.

Plant performance differences

As discussed earlier, the following plants are expected to show increasing levels of performance: dying, birth, switch-in or switch-out, and continuing plants. As expected, dying, birth and switch-out plants, on average, performed worse than continuing plants. Furthermore, the Wald tests show that performance differences among dying, birth, and switch-out and switch-in plants are also significant in all three models.

<Table 19> Regression Results on the Determinants of Industry Turnover Numbers
(using within unit estimation when the industry and time fixed effects are controlled for)

	Births	Switch-ins	Deaths	Switch-outs
GNP growth	1.5785 (6.43)	-0.5130 (-3.53)	-8.1609 (-4.18)	-5.859 (-6.10)
Inflation rate	1.9132 (9.81)	0.3812 (3.31)	5.3774 (3.73)	4.3318 (6.11)
Crisis dummy	-9.2032 (-7.88)	-5.8824 (-8.32)	-13.0663 (-1.65)	-21.4776 (-5.51)
Industry growth rate	0.5138 (1.44)	0.6556 (3.14)	0.0378 (0.53)	0.1007 (2.89)
Log size	-0.7801 (-0.82)	-0.1868 (-0.32)	-1.8810 (-1.77)	0.2378 (0.46)
Market concentration	-0.0007 (-1.30)	-0.0008 (-2.41)	0.0007 (1.18)	-0.0008 (-2.60)
R&D	6.3462 (0.26)	-12.8445 (-0.86)	11.7417 (0.43)	13.0156 (0.97)
Lag birth			0.3033 (16.58)	0.0820 (9.14)
Lag switch-in			-0.1433 (-5.02)	0.0728 (5.21)
Lag switch-out	0.4315 (11.95)	0.0350 (1.66)		
Lag death	-0.0984 (-5.66)	0.1754 (17.32)		
Continuing plants	0.0146 (1.09)	-0.0526 (-6.36)	0.2471 (16.33)	0.0088 (1.19)
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
# of observations	3,295	3,129	3,163	3,138
R ²	0.9084	0.8435	0.9384	0.9200

<Table 20> Regression Results on the Determinants of Industry Turnover Rates
(using within unit estimation when the industry and time fixed effects are controlled for)

	Births	Switch-ins	Deaths	Switch-outs
GNP growth	0.0327 (3.65)	-0.0313 (-2.13)	0.1207 (1.90)	0.2304 (2.76)
Inflation rate	0.0317 (4.49)	-0.0048 (-0.42)	-0.0889 (-1.90)	-0.1543 (-2.40)
Crisis dummy	-0.1687 (-3.95)	-0.1953 (-2.72)	0.7718 (3.00)	1.0010 (2.83)
Industry growth rate	0.0874 (6.70)	0.1331 (6.29)	0.0058 (2.37)	0.0209 (6.33)
Log size	-0.0755 (-2.17)	-0.1353 (-2.27)	-0.1511 (-4.22)	-0.1449 (-3.01)
Market concentration	-0.00004 (-1.82)	-0.0001 (-2.72)	-0.00002 (-1.16)	-0.00001 (-0.60)
R&D	0.9398 (1.06)	1.1248 (0.74)	2.3688 (2.56)	2.1016 (1.67)
Lag birth			0.0126 (2.02)	-0.0297 (-3.49)
Lag switch-in			-0.0292 (-3.69)	0.0430 (3.97)
Lag switch-out	0.2298 (10.27)	-0.2963 (-7.89)		
Lag death	0.2898 (11.00)	0.3783 (8.66)		
Continuing plants	-0.0022 (-5.15)	-0.0025 (-3.31)	-0.0026 (-5.52)	-0.0027 (-4.14)
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
# of observations	3,295	3,129	3,109	3,087
R ²	0.5849	0.3076	0.4860	0.4252

When performance is measured through total output and labor productivity, birth plants outperformed than dying plants. Birth plants, in turn, performed worse than switch-out plants and switch-out plants performed worse than switch-in plants. Switch-in plants performed significantly worse than continuing plants.

In addition, plant age also predicted better performance, suggesting a natural selection process or learning effects. Also, positive and significant effects of age on performance implies that entrants performance is initially inefficient but improves over time as other studies in Baldwin (1993) and Liu and Tybout (1996) show. The result implies that overall efficiency will improve as resources are moved from dying plants to new births.

< Table 21> Regressions Comparing Turnover Plant Performances with Continuing Plants

	Log Shipments	Shipments/labor
Dying plants	-0.5536 (-117.65)	-10.7690 (-36.14)
Birth plants	-0.3418 (-57.65)	-7.1450 (-19.03)
Switch-out plants	-0.0569 (-9.93)	-3.6143 (-9.96)
Switch-in plants	-0.0492 (-7.31)	-2.8481 (-6.69)
Plant age	0.1745 (151.18)	2.7050 (37.25)
Industry growth	0.0024 (1.14)	0.3267 (0.25)
Market concentration	-0.00002 (-3.71)	-0.0018 (-6.29)
Capital ratio	0.0019 (14.71)	0.4054 (48.47)
R&D intensity	-0.2955 (-1.59)	-32.2754 (-2.74)
Industry dummies	Yes	Yes
Year Dummies	Yes	Yes
# of observations	558,854	558,854
R ²	0.6128	0.2438

6. Conclusion

This study has shown that macro-effects, industry characteristics and previous' years turnover rates affect industry current turnover rates and outputs at the plant level differently. When industry-fixed effects are controlled for, GNP growth and inflation rates encourage birth rates. While industry specific growth rates increase industry turnover rates, sunk costs reduce them. The paper also finds that turnover rates of the previous year have an affect on the current year turnover rates.

The study also finds that the performance of entrants and dying plants is lower than that of continuing plants. Moreover, new births show higher labor productivity and outputs than dying plants. We also find that the performance of surviving entrants has improved over time. Such observation implies that turnovers improve efficient resource allocation as entrants use resources released from closing plants and their performance improves over time. In short, industry entry and exit is an important 'creative destruction' process for an economy to maintain and improve its efficiency.

Entry and exit information at the establishment level, not the firm level, was used in this study. While many establishments belong to multi-plant firms, some do not. Multi-plant firms' decisions on entry and exit in and from each industry will be different from those by single plant firms. Examination of how the entry and exit rates differ between these two groups, and whether industry characteristics affect turnovers in a similar way, would be an interesting topic to study.

In addition, the performance of entrant and exiting plants can be measured by efficiency, as in Baldwin (1993), or by productivity, as in Aw, Chen, and Roberts (1997). While criticizing the shortcomings of total factor productivity, Baldwin (1993) has proposed an efficiency measure as the ratio of actual output to potential output. Since total factor productivity is widely used, a future study can use both measures.

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