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Micro Dynamics of Entry, Exit, and Productivity Growth: Evidence from Korean Manufacturing Plants

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MANUFACTURING PLANTS

Preface

This study consists of two papers that examine the micro dynamics of plant entry, exit, and productivity in the Korean manufacturing sector. This study is motivated by the long standing wisdom that the growth process in a market economy inevitably requires gradual and constant reallocation of resources from less efficient producers to more efficient ones. As Schumpeter put it, "The fundamental impulse that keeps the capital engine in motion comes from the new consumers' goods, the new methods of production and transportation, the new markets… [The process] incessantly revolutionizes from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact of capitalism."

Using the plant level data from Korean manufacturing sector, both papers examine in its own way the relation between plant turnovers and productivity performance. However, the first paper focuses more on the patterns and determinants of entry and exit, while the second paper focuses more on the role of micro-level entry and exit on aggregate productivity growth. Overall, this study finds high plant turnover rate in Korea compared with most other countries. Also, the findings of this study mainly suggest that entry and exit are the resource reallocation process enhancing aggregate productive efficiency. While there have been empirical studies on this issue for several developing and developed countries, to the best of the authors' knowledge, no such study has been done based on plant level data from the Korean manufacturing sector.

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ENTRY, EXIT, AND AGGREGATE PRODUCTIVITY GROWTH: MICRO EVIDENCE ON KOREAN MANUFACTURING

Chin-Hee Han

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Abstract

Using the plant level panel data on Korean manufacturing during the period from

1990 to 1998, this study tries to assess the role of entry and exit in enhancing aggregate productivity, both qualitatively and quantitatively. The main findings of this study are summarized as follows. First, plant entry and exit rates in Korean manufacturing seem quite high: they are higher than in the U.S. or several developing countries for which comparable studies exist. Second, in line with existing studies on other countries, plant turnovers reflect underlying productivity differentials in Korean manufacturing, with the "shadow of death" effect as well as selection and learning effects all present. Third, plant entry and exit account for as much as 45 and 65 per cent of manufacturing productivity growth during cyclical upturn and downturn, respectively. The findings of this study show that the entry and exit of plants has been an important source of productivity growth in Korean manufacturing. Plant birth and death are mainly a process of resource reallocation from plants with relatively low and declining productivity to a group of heterogeneous plants, some of which have the potential to become highly efficient in future. The most obvious lesson from this study is that it is important to establish a policy or institutional environment where efficient businesses can succeed and inefficient businesses fail.

1. Introduction

Modern economic growth involves the continual process of resource reallocation among heterogeneous producers. Even in the same narrowly defined industry, it is common to observe new or expanding producers as well as exiting or contracting ones at business cycle or longer-run frequencies. Motivated by this observation, a growing number of studies try to assess the role played by resource reallocation in enhancing industry or aggregate productivity.[1]

In the existing literature that tries to understand the sources of growth of Korea and other East Asian countries, resource reallocation among heterogeneous producers as an inevitable part of the growth process has received little attention. For example, studies by Kim and Lau (1994), Young (1995), and Collins and Bosworth (1996), that provide the basis for the so-called Total Factor Productivity (TFP) controversy, mainly focus on the respective roles of productivity growth and input accumulation using country or industry level data. Even though it is well acknowledged that productivity growth is the ultimate driving force for raising standards of living, the studies based on aggregate data face limitations in terms of understanding how productivity growth occurs. This will be particularly true if aggregate productivity improvement takes place through a gradual process of resource reallocation among heterogeneous producers.

This study attempts to broaden our understanding of the micro dynamics of entry, exit, and productivity growth using the plant level data on Korean manufacturing. Specifically, this study has three objectives. The first objective is to document actual patterns of plant entry and exit. Next, the study aims to answer whether the plant turnover patterns reflect underlying productivity differentials among plants. In order to do this, this study examines the relative productivities of entering and exiting plants, both at a point in time and over time. Also, this study analyses whether plant productivity is persistent over time. The final objective of this study is to make a quantitative assessment of the contribution of resource reallocation to aggregate productivity growth. To do so, this study decomposes the total factor productivity growth in manufacturing into contributions from three components: productivity growth of continuing plants, entry and exit effect, and market share reallocation among continuing plants.

The theoretical framework of this paper is provided by the studies on industry dynamics with firm heterogeneity.[2] Motivated by the empirical evidence that smaller firms grow faster and are more likely to fail than large firms, Jovanovic (1982) provides the first industry equilibrium model where firm specific stochastic elements generate observed firm dynamics. In his model, firms are faced with uncertainty about their "true cost" and learn about their relative efficiency as they operate. The equilibrium leads to selection through exit and entry; the efficient firms grow and survive and the inefficient firms decline and fail. Hopenhayn (1992) provides a variant of Jovanovic's model where firms are faced with exogenous productivity shock and make decisions on when to exit the industry. He shows that there is simultaneous entry and exit in the long run stationary equilibrium with sufficiently small fixed cost. He also performs steady state comparative static analysis to examine how the structural characteristics of an industry, such as sunk entry costs, demand, and the productivity shock process, affect turnover and distribution of firms. He shows that high sunk entry costs lead to a lower turnover rate and a larger divergence between surviving and exiting firms, since the cost of entry acts to protect the incumbent firms, and exiting firms will endure low productivity for a longer period of time before exiting. He also provides conditions where the recent entrants have higher hazard rates and lower productivity than incumbent firms.

The existing empirical findings on the importance of exit and entry or market share reallocation among plants or firms are diverse. In the case of the U.S., Baily, Hulten, and Campbell (1992) find that while entry and exit plays a minor role, market share reallocation among existing plants are important in aggregate productivity growth. However, Olley and Pakes (1992) report that not only the share reallocation, but also entry and exit are important in the U.S. telecommunications equipment industry. Foster, Haltiwanger, and Krizan (1998) conclude that entry and exit plays a large role especially in the medium to long run.

The evidence on developing countries is also mixed. Griliches and Regev (1995) analyse Israeli data and find that the effect of entry, exit, and share reallocation explains a very small part of labour productivity growth. One interesting finding, however, is that there is a "shadow of death" effect; firms that will exit in the future have lower productivity performance several years earlier. Using Chilean panel data, Liu (1993) reports similar effects even though she does not attempt to quantify the contribution of entry and exit. Meanwhile, Aw, Chen, and Roberts (1997) find a significant role of entry and exit in total factor productivity growth in Taiwanese manufacturing industries. They claim that Taiwan's institutional environment, such as the manufacturing sector's dense network of subcontracting relationships and trading firms, combined with low capital intensity of much of the production, makes entry and exit of firms relatively easy and inexpensive, allowing the economy to rapidly exploit micro-level differences in productivity.

Even though it is hard to draw out a general conclusion on the importance of entry and exit as a process of enhancing aggregate productive efficiency, it is also true that these studies differ in various details that might affect the conclusion, as Foster, Haltiwanger, and Krizan (1998) point out. They emphasize that the measured contribution of such reallocation effects varies over time and across sectors, and is quite sensitive to measurement methodology. However, after performing sensitivity analysis on methodological details, they report that a large contribution from efficient entering plants displacing inefficient ones is a clear conclusion, especially when productivity changes are measured over five or ten year horizons. They also show that the large role of entry and exit is not just an artefact of longer run analysis, but also reflects entering plants displacing less productive exiting plants (selection) and entering plants becoming relatively productive over time (learning).

While a detailed summary of the results of this study will be presented at the end of the paper, it might be useful to give a brief overview of the findings of this study here. To begin with, most of the qualitative findings of this study are in line with those frequently reported for other countries. That is, this study documents that plant turnovers reflect underlying productivity differentials in Korean manufacturing, with the "shadow of death" effect as well as selection and learning effects all present. Also, there is a persistency in plant productivity. Thus, plant exit and entry, particularly birth and death, are mainly a process of resource reallocation from plants with relatively low and declining productivity to a group of heterogeneous plants, some of which have the potential to become highly efficient in future.

However, this study provides several findings that differ quantitatively from existing studies on other countries. Among others, plant entry and exit rates in Korean manufacturing seem quite high. Plants born during the past five-year period account for between 21.5 per cent and 26.2 per cent of manufacturing output. A roughly similar portion is attributable to the plants that will die within five years. These figures are higher than those found in the U.S. or several developing countries for which comparable studies exist. However, the importance of entry by birth in Korea is not as pronounced as in Taiwan.

The comparison of aggregate productivity decomposition between Korea and the U.S provides another interesting finding. Entry and exit plays an important role in aggregate productivity growth in Korea, while in the U.S., its role is more modest. In Korean manufacturing, the entry and exit effect accounts for about 45 per cent and 65 per cent in cyclical upturn and downturn, respectively. In the reasonably comparable study for the U.S., the entry and exit effects are at best below 40 per cent even in the cyclical downturn when the effect tends to get stronger. This seems to reflect not only fast overall productivity shifts and a high rate of plant turnover, but also the presence of strong learning effects in Korea as will be documented in this study. By contrast, market share reallocation plays a relatively minor role in Korea compared to the U.S., which, however, is not unique to Korean manufacturing. This is in line with other studies on several developing countries.

The remaining part of this paper will be organized as follows. The following section briefly describes the patterns of entry and exit. The next section will examine the relation between plant turnover and plant productivity. Section 4 will assess the contributions of resource reallocation to aggregate productivity growth. The results of these analyses will be discussed and compared with existing studies on other countries. The final section provides a summary of the empirical results of this paper and discusses the implications of this study. Finally, data and measurement of plant productivity will be described in the appendix.

2. Patterns of Entry and Exit in Korean Manufacturing

Utilizing the longitudinal aspect of the data set, continuing plant, birth, death, switch-in, and switch-out can be defined. For each year, birth is defined as the plant that first appears in the data set, and death is defined as the plant that disappears next year. Continuing plant is the one that stays within the five-digit industry and is not either birth or death. Switch-out plant is the one that moves out to another five-digit industry next year, and is not either birth or death. Similarly, switch-in plant is the one that moved into the industry from another five-digit industry.[3]

Table 1 summarizes the importance of plant births. Specifically, it shows what fraction of output or number of plants for each year is attributable to the plants that are grouped by plant age. In 1995, plants between zero and two years of age account for about 17.1 per cent of manufacturing output, while three to four-year-old plants account for about 9.1 per cent of manufacturing output. So, the fraction of manufacturing output in 1995 produced by plants less than five years old is as much as 26.2 per cent. In 1998, the contribution from those plants drops visibly to 21.5 per cent. This is due not only to the fall in birth rates, but also to the increase in the closing of young plants, reflecting severe economic recession. In terms of number of plants, the importance of births is even more dramatic. Depending on the year, plants less than five years old account for between 58.1 per cent and 67.5 per cent of manufacturing plants. The larger contribution of younger aged plants in terms of number of plants indicates that those plants are usually small ones.

The importance of births in Korea can be assessed by comparison across countries. Aw, Chen, and Roberts (1997) report, after examining nine manufacturing industries in Taiwan, that one to five year old firms account for approximately two-thirds of the number of firms in operation, and between one-third and one-half of each industry's production in 1991.[4] They also summarize similar statistics for other countries. Using data for Colombian manufacturing plants, Roberts (1996) finds that the combined market share of one to five year old plants varies between 18.3 per cent and 20.8 per cent depending on the year. With similar data for Chile, Tybout (1996) finds one to five year old plants account for 15.0 per cent to 15.7 per cent of manufacturing output. Using data for U.S. manufacturing firms, Dunne, Roberts, and Samuelson (1988) find the market share of one to five year old firms varies from 13.6 per cent to 18.5 per cent depending on the year. Thus, the importance of entry by birth in Korean manufacturing seems to be less pronounced than in Taiwan. However, entry by birth in

Korea seems to be more active than in the U.S. or several developing countries in Latin America.

The plant death rate is also high in Korean manufacturing, as shown in Table 2. In terms of output, depending on the year, between 13.4 per cent and 15.8 per cent of plants die within three years. Between 19.9 per cent and 24.1 per cent of a given year's output is produced by plants that will die within five years. The figures for deaths within five years in number of plants are again much larger than in output, indicating that the deaths are concentrated in small plants. In terms of number of plants, the fraction of plants that will survive more than five years is surprisingly as low as 36.1 to 47.4 per cent, depending on the year. Again, the fraction of plants that will survive more than five years in 1993 drops dramatically due to the high rate of plant closing in 1998.

The plant death rate among births is even higher than the death rate among all plants. Table 3 shows the distribution of a given year's output or number of plants according to the length of plant life, conditional on birth. The death rate of birth is much higher than the unconditional death rate, especially during the first three years of operation, which is in line with the theories of firm dynamics. In terms of number of plants, between 46.4 per cent and 55.9 per cent of births die within three years, depending on the year, which is much higher than the corresponding numbers in Table 2. In terms of output, the difference is even more striking, which seems to be natural since births are usually small ones. However, the death rate of births between three to four years of operation is not much different from the unconditional death rate. Thus, new plants seem more likely to fail especially during the first three years. This might be due, among others, to the low productivity of births at the beginning of operation, as will be discussed later. After five years, only between 24.0 per cent and 35.8 per cent of a given year's birth plants will still be operating. Even among birth plants, smaller ones die more frequently, which can be seen by comparing the shares of deaths in output and in number of plants.

Switch-ins, which is another type of entry, are also frequently observed in Korean manufacturing. In terms of output, 'switch-in' plants are almost as important as births. Table 4 shows that plants that switched into a five-digit industry for the past three years account for between 11.6 and 15.6 per cent of manufacturing output, depending on the year. In terms of number of plants, however, they comprise between 13.1 per cent and 15.3 per cent of plants. Plants that switched in during the past five years and survived produce between 18.3 per cent and 22.9 per cent of manufacturing output. Compared with births, switch-in plants are generally bigger in size.

Finally, switch-outs are also almost as important as deaths. Again, switch-out plants are larger than deaths in size. Plants that will switch out to another industry within three years account for between 8.8 per cent and 12.4 per cent of manufacturing output and between 13.1 per cent and 14.8 per cent of the number of plants, as shown in Table 5. Plants that will be operating in another five-digit industry within five years produce between 14.5 per cent and 16.3 per cent of a given year's manufacturing output.

3. Plant Productivity and Turnovers

Summary Measures of Productivity

The distribution of plant productivity, and its changes over time are summarized in Figure 1. Figure 1 shows the cross-sectional relative frequencies of plants along equal-length productivity intervals for three years. For both total manufacturing and all disaggregated industries presented here, there exists a large degree of heterogeneity in plant productivity, which provides the background for this type of micro-level analysis. The distribution of plant productivity moved rightward over time, suggesting that productivity growth is widespread among plants.

Table 6 provides an alternative summary of plant productivity distribution and its changes over time. It reports the quartiles of cross-sectional productivity distribution for total manufacturing and twelve disaggregated industries in 1990, 1994, and 1998. The table shows that there is a clear rightward shift in the productivity distribution over time. In the case of total manufacturing, the median plant experiences a productivity improvement of about 26 per cent over the 1990-98 period, which corresponds to an annual growth rate of about 3.2 per cent. Positive productivity growth is a common feature for the median plants for all twelve industries during 1990-98, although the growth rate varies substantially across industries. For instance, the Communication equipment and the transport equipment industries show the largest median plant productivity improvement of 68 per cent and 47 per cent, respectively, while the wood and pulp industry (2 per cent) and the food and beverages industry (10 per cent) show the lowest growth rates. Productivity growth rates by the median plant of the other industries range from 22 per cent to 33 per cent. The productivity growth of the median plant is accompanied by roughly similar growth rates of the 25th and 75th percentiles in each of the industries, indicating that the shape of the productivity distribution does not change much during the eight-year period.[5]

The discussion above suggests that plants are heterogeneous in terms of productivity levels. It also suggests that aggregate productivity growth involves the productivity improvement of most plants that are observed. However, this discussion does not shed light on the patterns of micro plant dynamics underlying the aggregate productivity change. In the previous section, it was shown that there is a substantial amount of entry and exit of plants even at annual frequencies. In addition, plants that stay in the market over a certain time interval could move across the productivity distribution. This suggests that the micro plant dynamics underlying Figure 1 might be very complex.

This paper does not attempt to characterize fully these complex plant dynamics. Instead, the focus below is on a subset of questions, using the data for Korean manufacturing, which have often been raised in the literature. A short list of those questions is as follows. Do plants exit because they are inefficient? Are entrants more or less productive, at the time of entry, relative to continuing plants or exits? How about switch-ins and switch-outs? How do surviving entrants perform in terms of productivity after entry? What is the pre-exit productivity performance of exiting plants like? How persistent is the productivity differential among plants? As these issues are considered, it is hoped that the question of whether the observed plant turnovers or, more broadly, resource reallocation among plants reflect underlying differences in productivity, and whether those differences are not an outcome of a transitory or random event [6], can be determined.

Productivity Differentials among Entering, Exiting and Continuing Plants

As the first step toward identifying the relationship between plant productivity and plant turnover patterns, productivity levels of continuing plants, entrants, and exiting plants at the time of entry and exit are compared. The productivity levels of switch-in and switch-out plants that might be different from birth and death are also examined. Table 7 shows the unweighted mean productivity levels of plants in total manufacturing that are observed at a given year for each of the five plant groups.

The main features of Table 7 can be summarized as follows. First, deaths in a given year are, on average, less productive than continuing plants in that year. Depending on the year, they are about 3 per cent to 6 per cent less productive than continuing plants. This result is consistent with the prediction by models of plant or firm heterogeneity that market selection forces sort out low-productivity plants from high-productivity plants. Also, this result is not unique to the Korean manufacturing data but is also reported by many studies for other countries.

Second, births are on average less productive than continuing plants in the first year they are observed. They are even less productive than deaths. In fact, the productivity of a typical birth plant is the lowest among all groups of plants in every year. Initial low productivity of birth plants relative to continuing plants or deaths is not consistent with the presence of the simple ‘vintage’ effect that new plants are more productive than older plants. However, it is not necessarily contradictory to the prediction of several recent models of plant dynamics, such as Jovanovic (1982) and Hopenhayn (1992). Potential entrants who are uncertain about their productivity but hold a positive outlook on their post-entry productivity performance—that is, who expect that they could catch up with the incumbents in terms of productivity sooner or later—might enter despite their initial low productivity. Of course, birth plants themselves are also heterogeneous in terms of productivity, as will be discussed later.

Initial low productivity of births relative to incumbents is also documented by other studies, although these studies differ from this study in relation to data and methodology. For example, Aw, Chen, and Roberts (1997), using firm level data on Taiwanese manufacturing industries, report that entrants in 1986 are, depending on industry, between 0.6 per cent and 6.9 per cent less productive than incumbent firms in the same year. Meanwhile, Foster, Haltiwanger, and Krizan (1998), using plant level data on U.S. manufacturing, and based on ten-year interval analysis, report that there is no statistical difference between continuing plants and entering plants in terms of multifactor productivity in 1987 (Table 10 of their study). However, the same table in their study indicates that the cohort of plants that entered during the past five-year period, rather than ten-year period, show lower productivity than continuing plants in 1987.[7]

Third, switch-in or switch-out plants have higher productivity than births or deaths, respectively. The productivity of those plants is roughly comparable to the continuing plants on average. Recalling our definition of plant groups, switch-in plants are distinguished from births in that they have a previous experience in another market defined at five-digit level. Thus, higher productivity of switch-ins relative to births is consistent with the idea that previous experience in a related market helps. It would not be surprising to find higher productivity of switch-outs relative to deaths, since switch-outs are distinguished from deaths in that they continue their operation for the next year at another market. The finding that switch-outs have productivity levels comparable to continuing plants seems to suggest that high productivity plants have mobility. However, it could also be consistent with the story that multi-product plants have both high productivity and mobility. High productivity could come from the possible spillovers generated by producing multiple related products, and mobility could come from, given the presence of sunk costs, the ease of changing product mix relative to restarting a business at an entirely new product market.

Fourth, each new cohort of birth is more productive than its previous cohorts. This fact conforms well to the presumption of recent Research & Development (R&D)-

based endogenous growth models, such as Grossman and Helpman (1991), that potential entrants receive externalities from previous innovation.

The above discussion suggests that observed patterns of plant turnovers reflect the underlying productivity differential. In order to examine the statistical significance of the productivity differential among plant groups, the results from dummy variable regressions are presented, which are similar to the regressions in Aw, Chen, and Roberts (1997). Table 8 reports the regression results using the pooled 1990-98 data. The measured plant level productivity is regressed on a set of dummy variables indicating whether the plant is a birth, switch-in, death, or switch-out, and year dummies (not reported). Thus, the estimated coefficients can be interpreted as the average productivity differential between each group of plants and continuing plants which is assumed to be common across years.

The regression for total manufacturing shows that the difference in productivity between continuing plants and each of the other groups of plants is statistically significant. Births and deaths are less productive than continuing plants by 6.3 per cent and 4.2 per cent, respectively. Switch-ins and switch-outs are statistically more productive than continuing plants, although the differences are small. The fifth column of Table 8 tests the hypothesis that there is no productivity differential between birth and death. The reported F-statistic shows that the hypothesis is rejected at usual significance level. The hypothesis that there is no productivity differential between births and switch-ins is also tested and is rejected. The hypothesis of there being no productivity differential between deaths and switch-outs is also rejected.

The same regression is run separately for each of the twelve industries. The estimated coefficients show that in every industry, births and deaths are significantly less productive than continuing plants. The productivity differential between births and continuing plants ranges from 3 per cent (medical and precision instrument industry) to 13 per cent (food and beverages industry). In the case of deaths, the differential is also the smallest at 2 per cent in the medical and precision instrument industry, and the largest at 10 per cent in the food and beverages industry. The hypothesis of there being no productivity differential between births and deaths is rejected at 1 per cent significance level in nine of the twelve industries.

The second and fourth columns in Table 8 reveal that the high productivity of switch-ins and switch-outs relative to continuing plants estimated for total manufacturing masks industry differences. It turns out that depending on the industry, the productivity of switch-ins and switch-outs can be either higher or lower than continuing plants. However, in all of the twelve industries, switch-ins and switch-outs are significantly more productive than births and deaths, respectively.

The analysis so far reveals that plant turnovers, especially entry by birth and exit by death, are not random events. In other words, the productivity of birth and death plants are more likely to be located at the lower part of the cross-sectional productivity distribution shown in Figure 1. In particular, the lower productivity of deaths relative to continuing plants indicates that market selection forces are at work as predicted by theoretical models of plant or firm dynamics. Market selection of low productivity plants from surviving high productivity ones is a process that enhances aggregate level productive efficiency.

Even though the lower productivity of births relative to continuing plants or even deaths is not inconsistent with the prediction of theoretical models, and often found for other countries, it could cast doubts on the positive role of exit and entry on aggregate efficiency gain. That is, it suggests that the *instantaneous* effect of resource reallocation by plant deaths and births on aggregate productivity growth might be very small or even negative, which might be true especially if the resources released by deaths are entirely used up by births. If this is the end of the story, then any positive role of plant turnovers on improvement of aggregate productivity measured at certain time intervals will be an accounting result arising from current births having higher productivity than past deaths.

However, this is not the end of the story. The literature points out that the benefits of resource reallocation by exit and entry are realized *over time*. First, an examination of the post-entry performance of entrants reveals that entrants are a heterogeneous group going through the process of market selection themselves. More importantly, it is frequently documented that the surviving members of entrants experience fast productivity improvement or rapid learning and catch up to the incumbents after a certain period following entry. In other words, plant exit and entry is a process of resource reallocation from inefficient plants to a group of heterogeneous plants, some of which have the potential to become highly efficient in future. Second, it has also been noted that exiting plants are less productive than continuing plants not just at the time of exit, but also for a certain period before exit. That is, there is a “shadow of death” effect. The productivity gap between exiting plants and continuing ones often widens over time before exit.[8] In other words, the process of plant productivity is not purely random but highly persistent over time, indicating the presence of plant-specific effects. Then, plant death or survival might reflect not just temporary misfortune but also plant-specific factors that will be fixed over time, such as managerial ability. Thus, post-entry and pre-exit performance of plants is discussed below, focusing on market selection, learning, and persistency of plant productivity using the data on Korean manufacturing.

Post-Entry Performance: Market Selection and Learning

The following section examines whether market selection forces sort out low productivity plants among births. In the sample, there are eight cohorts of birth according to birth year, 1991 to 1998. Focusing on a particular birth-year cohort has the advantage that possible age effect on survival is controlled for. Specifically, the focus is on whether plants that belong to 1991 birth cohort but die in 1993, for example, have lower productivity at the time of death than the other surviving members of the birth cohort. In order to do this, plant productivity is regressed on a set of year dummies (not reported), and a dummy variable denoting whether the plant died after birth within the sample period interacted with year dummies. Thus, the estimated coefficients denote the productivity differential between deaths and survivors at the time of death. The regression results for three birth cohorts are reported in Table 9.

The table clearly shows that for each birth-year cohort reported here, exiting plants have a lower productivity than surviving ones at the time of exit, even after controlling for the birth year. Also, the differences are highly significant. Depending on cohort year or death year, the deaths are less productive than surviving plants by about 3 to 6 per cent. Hence, the results strengthen the conclusion drawn earlier that markets sort out plants on the basis of productivity.

Next, the productivity performance of the surviving members of the entrants relative to continuing plants is examined. Figure 2 and Table 10 shows the average productivity of birth cohorts that survived until 1998 by birth year, in comparison with continuing plants in 1991 that also survived until 1998. Continuing plants have increased their productivity steadily and improved their average productivity by about 18 per cent during 1991-98. Each birth-year cohort starts with a productivity disadvantage relative to continuing plants at the entry year.

However, each birth cohort shows very rapid productivity improvement following entry, and catches up with continuing plants in terms of productivity levels after several years. The productivity differential between births and continuing plants at the time of entry ranges from 6 to 10 per cent depending on the birth year. In the second year after entry, the productivity differential narrows to only about 0 to 3 per cent. The productivity growth between the first and the second year by births is very large. It is between 6 per cent (1995 birth cohort) and 13 per cent (1994 birth cohort). In the third year after entry, the productivity level of births is roughly the same as, or even slightly higher than, continuing plants. The 1991 birth cohort in particular, which has the longest time series, maintains higher average productivity than continuing plants three years after entry. For some years, these differences are statistically significant. Similar conclusion also hold for the 1992 birth cohort, which is shown in Table 10. Thus, the results are clearly supportive of the presence of rapid learning by surviving members of births, especially during the first few years after entry.

Table 11 examines the convergence in productivity of surviving births to continuing plants for each of the twelve disaggregated industries. Specifically, it compares the average productivity levels of continuing plants and births as of 1991 that did not exit the five-digit level industry either by death or switch-out until 1998. The reported coefficients are the average productivity differentials between the two groups. Overall, the results indicate that the experiences of the twelve industries are consistent with the initial productivity disadvantage and subsequent learning of surviving births. The coefficients on the dummy variable for 1991 are negative and significant in most industries. However, the coefficients tend to become insignificant or turn positive as years go by.

Of course, the experiences of the twelve industries are diverse. In some industries, surviving births either catch up or overtake the continuing plants in productivity levels. For example, in the non-metallic mineral product industry and the machinery and equipment industry, the productivity advantage of surviving births over continuing plants is statistically significant. There are also industries, however, where the surviving births never catch up with continuing plants, such as the food and beverages and the communication equipment industries. Even in these industries, the productivity disadvantage of surviving births in later years is smaller than in earlier years.

The examination of post-entry performance of births using the plant-level Korean manufacturing data reveals the presence of both market selection and the learning process. Births are a heterogeneous group themselves, among which low productivity plants die over time. Surviving members of birth plants experience fast productivity improvement or rapid learning after entry, and catch up with continuing plants in productivity level within approximately three years. An examination of early year birth cohorts with longer time series reveals that those plants overtake continuing plants in productive efficiency in a relatively short period of time. These results are broadly consistent with those reported by studies on other countries. The present study provides strong support for the view that plant exit and entry is a process of resource reallocation from inefficient plants to a group of heterogeneous plants, some of which have the potential to become highly efficient in future.

Productivity Performance by Exiting Plants

So far it has been found that there are certain patterns of market selection and learning in the post-entry performance of births. In this section, another dynamic aspect of the data set is examined in order to understand the role of plant exit and entry on aggregate productivity growth: pre-exit performance of deaths.

Figure 3 and Table 12 show the time series of the average productivity of plants that existed in 1990, grouped by the death year cohort, in comparison with plants that survive throughout the sample period. As could be expected from the previous discussion, with the exception of the 1993 death cohort, the average productivity of each death cohort in the last year it is observed is the lowest among all cohorts. For example, the productivity of the 1997 death cohort is the lowest in 1997, and the productivity of the 1996 death cohort is the lowest in 1996, and so on. There are two additional points to be noted.

First, there is a significant productivity gap not only at the time of death but also for several years before death between each death cohort and the group that survive until 1998, even though each death cohort experiences productivity gain over time. This phenomenon suggests that plant deaths reflect underlying productivity differences that have existed for quite a period of time. In other words, those differences are not just an outcome of a random or transitory bad luck. To take the example of the 1997 death cohort, the productivity disadvantage relative to the surviving group is about 6.5 per cent in 1997. However, the productivity differential starts as early as 1990, when it is already as large as 3.7 per cent. Similar results hold for other death cohorts. Thus, plant deaths seem to reflect not only point-in-time productivity disadvantages around death, but also persistently bad productivity performance.

Second, the productivity differential between deaths and surviving plants tends to widen, especially during the period close to the death year. To take the example of the 1997 death cohort again, the productivity differential fluctuates between 3.5 and 4.7 per cent during 1990-96, but it rises to 6.5 per cent in 1997. Similar patterns are found for other death-year cohorts.

In order to examine whether the persistent and widening productivity gap before death reflects industry differences, the average productivity level of the 1997 death cohort is compared with the surviving group among the plants observed in 1990 for each of the twelve industries. Here, switching-out plants after 1990 were removed from both groups. Table 13 presents the regressions of productivity on a set of year dummies (not reported) and a dummy variable denoting the 1997 death cohort interacted with year dummies. Thus, the reported coefficient indicates the average productivity differential between the 1997 death cohort and the group of plants that survived until 1998.

Most coefficients reported in Table 13 are negative and frequently significant, consistent with the previous results in this study. The productivity of deaths is lower than survivors in 1997, and the differences are statistically significant at 5 per cent level in eight of the twelve industries. In the basic metals, and the machinery and equipment industries, it is significant at the 10 per cent level. Seven industries show productivity differences which are significant at the 5 per cent level in 1995 out of those eight industries. In addition, seven industries show significant productivity differentials as early as 1990. Finally, ten industries show a larger productivity differential in absolute terms in 1997 compared with 1995.

So far, pre-death productivity performance of death cohorts relative to surviving groups of plants has been examined, and large and persistent productivity differences have been observed. They often widen over time during the period close to death year. Such large and persistent productivity differences observed in Figure 3, however, might reflect not only whether or not plants survive, but also other factors that differ between survivors and deaths, such as plant age. In other words, younger plants are less productive and die more frequently than older plants. In order to control for this possible age effect on productivity and survival, pre-death performance of plants that are born in the same year was also examined.

Figure 4 reveals the pre-death productivity performance of the 1991 birth cohort that is further divided by the death year, in comparison with the 1991 births that survive until 1998. For comparison, the productivity performance of the 1991 continuing plants that survive until 1998 is also shown. As expected, the persistence of productivity differentials among the 1991 births is somewhat weaker than suggested by Figure 3. That is, the 1991 births that die before 1998 do not show noticeable productivity disadvantages in the early years after they commence operation compared with the surviving group. A notable feature is that in the first year of operation –1991- there is virtually no productivity differential among them, except for 1996 deaths. Moreover, for a few years after entry, the productivity differential between 1991 birth plants and 1991 continuing (and surviving until 1998) plants narrows over time.

However, as surviving members of the 1991 birth plants improve their productivity at a fast speed, the productivity gap begins to develop and persists over time. In addition, for each death-year cohort among 1991 births, the productivity disadvantage relative to the continuing group becomes the largest in the last year they are observed. Thus, even if the possible age effect on productivity and survival is controlled for, it still holds that plant deaths reflect a somewhat persistent productivity disadvantage that often widens during the period close to death.

If productivity differentials between deaths and survivors are persistent, then it is expected that the initial productivity of a plant at a point in time is correlated with whether that plant dies within a certain period or not. To examine this, plants in 1993 which belong to the group of continuing plants, births, or switch-ins were chosen. Then, these groups were further divided according to whether the plants survive until 1998. Table 14 shows the average productivity of each group, expressed as the difference from the productivity of continuing plants that died within five years, and statistical test results on equal productivity between survivors and deaths. Results are reported only for 1993 since the results for other years are qualitatively similar. Thus, the table shows any productivity differential between plants that survived more than five years and those that did not, conditional on 1993 status.

Within continuing plants, plants that survive until 1998 clearly have a higher productivity in 1993 than those that die before 1998. The average productivity differential for total manufacturing is about 4 per cent and it is statistically significant. Out of twelve disaggregated industries, ten industries show productivity differences that are statistically significant at the 1 per cent level.

Within births, however, the initial productivity differential between survivors and deaths is not clear, even though the average productivity of the former is higher than the latter in many industries. The F-test statistics indicate that the difference is significant in only two of the twelve industries. This result is consistent with the previous result from Figure 4 that the first year productivity of births does not differ much across death-year cohorts. Similar results hold for switch-ins, which would not be surprising since both births and switch-ins are newcomers in a market defined at five digit industries.

At first sight, the observation that there is no clear initial productivity differential among births between survivors and deaths over a five-year period seems to run counter to the results of Aw, Chen, and Roberts (1997). For seven out of nine Taiwanese manufacturing industries, they find that there exists a significant productivity differential in 1986 among 1981-86 entrants between survivors and deaths over the subsequent five-year period. However, the two studies differ, among other factors, in that the average age of births in this study is only 0.5 years while average age of entrants in their study is about 2.5 years.

Motivated by this observation, the study examines whether there is a productivity differential among births several years after entry, depending on whether those plants survive or not over the subsequent period. Specifically, the productivity differential as of 1994 among 1991 births, between plants that survive until 1998 and those that do not is analysed. Table 15 indicates that the productivity differential is significant for total manufacturing. In addition, five out of 12 industries demonstrate clear productivity differentials among births between survivors and deaths. Thus, a comparison of the results in Table 14 and Table 15 suggests that even though there may not be a clear productivity differential within a birth-year cohort in the first year of their entry, the productivity differential arises over the years. This is also consistent with the results seen in Figure 4, where the surviving members of the 1991 birth cohort differentiate themselves from others in terms of productivity after several years after entry. Thus, the results found in this study for Korean manufacturing are not at odds with those for Taiwan.

In short, the patterns of plant survival or exit reflect productivity differentials at an earlier year in Korean manufacturing. In other words, plant death or survival might not be an outcome of random productivity shock, but reflect persistent productivity differentials.

Transition Matrix Analysis

In the preceding discussion, evidence has been presented that is consistent with market selection, learning, and persistence of plant productivity, by focusing on the *average* productivity differentials among various plant groups. However, there could be high productivity entrants as well as low productivity ones. The same can be said about exiting plants. Even among continuing plants, there might be movement of plants across productivity distribution over time. One useful way of summarizing the above features of the data and complementing the previous analysis is to rely on transition matrix analysis.

Transition matrices are set up for various time intervals, following the method used by Baily, Hulten, and Campbell (1992), but the focus is primarily on the five-year transition during 1990-95 period. The primary reason for this focus on the five-year transition is to make the results comparable to Baily, Hulten, and Campbell's study (1992), to identify any similarities or differences between the U.S. and Korean manufacturing.

In order to do this, the plants within each five-digit industry are ranked according to their relative productivity in each year and divided into quintiles. Then, for each quintile in 1990, the fractions of those plants which are in each quintile in 1995 in their own industry, and the fractions which have either died or switched out to another industry are calculated. Among the plants that are observed in 1995, there are also births and switch-ins during the period from 1990-95. The point in the productivity distribution where the births and switch-ins started can also be examined by calculating the fractions of those plants that are in each quintile in 1995. Table 16 shows the transition matrix which has been weighted by employment size as measured by number of workers. For entrants in 1995 and exits in 1990, the weights denote number of workers in the year they are observed. For continuing plants that are observed in both years, the weights are the average number of workers in the two years.

Starting from the first row of the table, of the plants that are in the top quintile in 1990, about weighted 28.5 per cent of them are again in the top quintile in 1995. However, the fractions of those plants that experience downward movement in relative productivity ranking decreases monotonically. The drop in the percentage moving rightward along the first row is so huge that only about 3 per cent of those plants were in the bottom two quintiles in 1995. Among the plants that are in the second quintile in 1990, 16.6 per cent of them stay in the second quintile, and roughly an equal fraction of them move up to the first quintile in 1995. However, the percentage decreases rapidly and monotonically moving off the diagonal to the right in the table.

When there is a persistency in productivity it is expected that the relative productivity rankings do not change much over time, and the diagonal numbers of the transition matrix tend to be bigger than off-diagonal ones. The discussion above suggests that plant productivity in Korean manufacturing is very persistent, especially in the top of the productivity distribution. Similar results are also reported for U.S. manufacturing by Baily, Hulten, and Campbell (1992).

However, the persistency is less visible in the middle and bottom of the productivity distribution. Of the plants that are in the third quintile in 1990, only about 7.7 per cent stay in the same quintile. In this case, about 28.7 per cent move up to the top two quintiles, while only about 10.1 per cent move down to the bottom two quintiles in 1995. There is somewhat lower persistency also in the bottom two quintiles in 1990. Most of those plants either move up in the productivity distribution or exit the industry by switch-out or death. Especially in the case of bottom quintile in 1990, a weighted 12.7 per cent move into the third quintile, while only 6 per cent stay in their own quintile in 1995. Of course, a huge fraction of them (68.7 per cent) exit the industry, either by switch-out or death.

The unweighted transition matrix for the period 1990-95 is also calculated, which is reported in Table 17, where the numbers denote percentages in terms of number of plants. In the unweighted matrix, all of the diagonal numbers are bigger than off-diagonal numbers. In this case again, however, the persistency is marked in the top of the productivity distribution.

Based on the U.S. manufacturing data, Baily, Hulten, and Campbell (1992) report that there is not much evidence of a systematic plant ‘vintage’ effect. In our data, the systematic evidence in favour of a plant vintage effect is hard to find as well. If plant vintage effect is present, then it is expected that older plants move down the productivity distribution over time. Among the plants in the second quintile in 1990, more of them move up to the first quintile than down to the third quintile. In the third quintile again, there are by far more plants that moved up than those that moved down over time.

The transition matrix also shows the percentage of plants for each quintile in 1990 that exit their own industry. As expected, the percentage of death conditional on the 1990 productivity quintile gets higher going down the productivity quintiles. In the top quintile, about 22.6 per cent of the plants, weighted by employment, die within five years, while as much as 43.5 per cent die in the bottom quintile during the same period. If the unweighted matrix is considered, the same pattern exists but the numbers become higher. Even in the top quintile, about 46.0 per cent do not exist after five years, while in the bottom quintile, the corresponding number is as large as 57 .0 per cent. A larger percentage of deaths in the unweighted matrix indicates that plants that die during the period are usually small ones. One interesting observation here is that there are many high productivity deaths that are small in size. A similar result is reported by Baily, Hulten, and Campbell (1992) for the U.S.

The percentages of switch-outs are roughly even across 1990 productivity quintiles. In fact, the weighted matrix shows that the switch-outs are more frequent in the top and bottom of the productivity distribution. Both high productivity plants and low productivity one are more likely to move to another industry. The unweighted matrix shows, however, that in terms of number of plants, high productivity plants are more likely to switch out than low productivity plants. As discussed before, it is not clear whether this phenomenon reflects the general mobility of high productivity plants, or the advantage of multi-product plants coming from the technological spillovers and the ease of entry by changing product mix.

The transition matrix also shows the relative productivity of entrants during 1990-95. Here, births and switch-ins that die during the period are not in the sample. Thus, the entrants in the sample are relatively successful ones that partly went through the process of market selection and learning, with average experience in the industry of 2.5 years. The table shows that both switch-ins and births are moderately concentrated in the high productivity quintiles. Relatively high productivity of births does not contradict the previous result that births have lower productivity than continuing plants in the first year they are observed. In fact, as already indicated in Figure 2, it does not take many years in Korean manufacturing for the surviving births to catch up with continuing plants in terms of productivity. Thus, it would not be surprising to find higher productivity of birth relative to continuing ones, which has gone through market selection and experienced learning for 2.5 years on average. Meanwhile, in terms of number of plants, the births are slightly concentrated on the lower quintiles. This implies that birth plants in the top productivity quintiles are bigger in size by 1995 than those in the bottom quintiles.

Transition matrices for various time periods are also examined. Since the results are not much different from the five-year transition matrix discussed here, all of them are not presented. However, even in the eight-year transition matrix (1990-98) reported in Appendix B, a moderate degree of persistency in productivity can be observed. Of course, a shorter period transition matrix tends to show stronger persistency. Also, a longer period transition matrix shows a larger selection and learning effect of successful births.

So far, the transition matrices of plant relative productivity has been analysed, and the results - which are similar to those for the U.S. manufacturing - have been discussed. However, it may be useful to summarize this section by pointing out several aspects of the Korean data that apparently differ from Baily, Hulten, and Campbell (1992). First, even though the data are consistent with persistency of productivity, the degree of persistency seems to be weaker in Korea than in the U.S. To take one example, a weighted 60.8 per cent of the plants in the top quintile in 1972 are again in the top quintile in 1977, while only 14.9 per cent of them move down to the second quintile, in the U.S. manufacturing (Table 3 of Baily, Hulten, and Campbell (1992)). However, the corresponding numbers are 28.5 and 13.4, respectively, in Korean manufacturing.

Second, the fractions of entrants and exits are much larger in Korea than in the U.S, during the five-year interval. In Baily, Hulten, and Campbell (1992), only 11.2 per cent of the bottom quintile in 1972 either switch out (5.5 per cent) or die (5.7 per cent), while the corresponding number is as large as 68.7 per cent (25.3 per cent for switch-outs and 43.5 per cent for deaths) in Korea. Plant turnovers are much more frequent in Korean manufacturing than in the U.S.

Finally, the time it takes for surviving entrants as a group to become as productive as continuing plants seems to be somewhat shorter in Korean manufacturing than in the

U.S. For example, in the case of Korea, weighted 25.6 per cent of births during 1990-95 are in the top quintile, and only 16.5 per cent of them are in the bottom quintile in 1995. However, the corresponding numbers for the U.S. are 20.8 per cent and 29.3 per cent, respectively: low productivity entrants are the largest even at the five-year interval. This might be related to both the high frequency of death by unproductive plants and fast learning in Korea.

4. Exit, Entry and Aggregate Productivity Growth

In this section, the effect the entry and exit of plants, or more broadly, the resource reallocation among plants has on aggregate productivity growth is explored. In order to do this, first, the level of industry total factor productivity in year t is defined as follows.

$$\ln TFP_t = \sum_i q_{it} \ln TFP_{it},$$

where q_{it} is the market share of the ith plant in five-digit level industry and $\ln TFP_{it}$ is plant total factor productivity calculated as described in Appendix A. Then, the industry TFP growth rate between year t and t-τ is

$$\Delta TFP_t = \sum_i q_{it} \ln TFP_{it} - \sum_i q_{it-\tau} \ln TFP_{it-\tau}.$$

Following Baily, Hulten, and Campbell (1992), the industry TFP growth can be decomposed as follows.

$$\Delta TFP_t = \sum_{i \in S} q_{it-\tau} \Delta \ln TFP_{it} + \sum_{i \in S} (q_{it} - q_{it-\tau}) \ln TFP_{it} + \sum_{i \in N} q_{it} \ln TFP_{it} + \sum_{i \in X} q_{it-\tau} \ln TFP_{it-\tau}, \quad (1)$$

where S, N, and X denote the set of continuing plants that operate in both year t and t-τ, entrants, and exits during the period, respectively. Among the entrants, there are births and switch-ins. Similarly, there are deaths and switch-outs among the exits. Thus, the first term in equation (1) represents the "within" component that comes from the improvements in each plant separately, weighted by initial shares in the industry. The second term represents the share effect or the contribution from changes in the output shares.[9] The last two terms represent the contribution of entrants and exits, respectively. The net effect of the entrants and exits will reflect any differences in the levels of productivity between the groups and any differences in the output shares.

Table 18 shows the results of the decomposition for Korean manufacturing for the two periods of 1990-95 and 1995-98. The manufacturing-average figure weights each five-digit industry result by its share of nominal gross output, averaged over the beginning and end years of the period. The results for twelve disaggregated industries are presented in Appendix B. The sample period is divided into the two distinct sub-periods as above for the following reasons. First, the literature suggests that the relative contribution of each of the components varies systematically over the business cycle (for example, Baily, Hulten, and Campbell 1992 and Foster, Haltiwanger, Krizan 1998). The first five-year period is intended to capture the patterns observed in the cyclical upturns, even though it does not exactly coincide with the officially reported one.[10] The second reason for dividing the sample period as above is to focus on five-year changes, which will make the results more comparable to other results in the literature.

To begin with, the TFP growth in Korean manufacturing is as high as 23.0 per cent during 1990-95, or roughly 4.6 per cent per annum, but is only 4.7 per cent during 1995-98 (about 1.5 per cent per annum). Thus, the measured TFP growth shows well-known pro-cyclicality.

Overall, the decomposition yields strikingly different results between the two sub-periods of cyclical upturn and downturn. The contribution from the 'within' effect is 13.2 per cent during 1990-95, accounting for as much as about 60 per cent of manufacturing TFP growth. However, the 'within' effect falls to slightly below zero during 1995-98. The larger role of the 'within' effect in aggregate TFP growth during the period of cyclical upturns is consistent with the results for the U.S. manufacturing reported by Baily, Hulten, and Campbell (1992) and Foster, Haltiwanger, and Krizan (1998).

The effect of entry and exit on aggregate TFP growth in Korea is very large. It is as large as 10.5 per cent (2.1 per cent per annum) during the period 1990-95, accounting for more than 40 per cent of manufacturing average TFP growth during the same period. The effect of entry and exit also falls in 1995-98 cyclical downturn to about 3.1 per cent (1.0 per cent per annum). The diminished effect of entry and exit during this period suggests that the productivity improvements of the entrants also slowed down together with the overall productivity slowdown. However, in percentage terms, the effect of entry and exit rises during the downturn of 1995-98 period: it accounts for more than 65 per cent of the manufacturing aggregate TFP growth. Thus, entry and exit plays a greater role in aggregate productivity growth in cyclical downturns.

Again, this cyclical pattern is consistent with the results for the U.S. manufacturing, provided by Foster, Haltiwanger and Krezan (1998). After performing various sensitivity analyses, they report that while the contribution of net entry is sensitive to time period, the pattern is regular in the sense that the contribution of net entry is greater in cyclical downturns. In addition, they also report that the contribution of net entry is robust to the alternative measurement method. This suggests that the large role of entry and exit and its greater role in downturns found in this paper are not likely to result from the use of a particular decomposition methodology.

The contribution of market share reallocation among the continuing plants also varies over the periods. During 1990-95, this share effect is negative even though it is small in magnitude. However, during the downturn of 1995-98, the share effect turns positive at 1.8 per cent. In terms of percentage contribution, it accounts for about 38 per cent of manufacturing TFP growth during that period. It helps offset the productivity decline of the continuing plants between 1995 and 1998. The greater contribution of reallocation among continuing plants during the period of cyclical downturn accords well again with the results for the U.S. manufacturing reported by Baily, Hulten, and Campbell (1992) and Foster, Haltiwanger and Krezan (1998).

Taken together, the above discussions suggest that the role of resource reallocation in aggregate productivity growth, by entry and exit or by market share reallocation among continuing plants, tends to be greater during cyclical downturns. During the period 1995-98, the entry and exit and share effect together explains virtually all of the aggregate TFP growth. In the case of Korean manufacturing, the role of entry and exit seems to be particularly large. Even though the entry and exit effect is smaller, and the share effect is bigger during 1995-98 compared with the previous five-year period, the former effect is still larger than the latter.

While the cyclical pattern of each component of aggregate TFP growth in Korean manufacturing is quite similar to the U.S., the relative importance of each component seems very different between the two countries, controlling for the cyclical factors. Table 19 compares the decomposition results of this study with two of the studies for the U.S., namely, Baily, Hulten, and Campbell (1992) and Foster, Haltiwanger, and Krizan (1998), which are reasonably comparable to this study in terms of methodology and data. The second column of Table 19 shows that the relative contribution of the 'within' effect for Korea is quite similar to that shown for the U.S. by Foster, Haltiwanger and Krizan (1998) in both business upturns and downturns. The 'within' effect reported by Baily, Hulten, and Campbell (1992) seems to be bigger than this study in absolute terms, indicating that it is cyclically more volatile than this study's.

However, the relative contribution of the entry and exit effect in Korean manufacturing is larger than the U.S., regardless of the business condition. In Korean manufacturing, the entry and exit effect accounts for about 45 per cent and 65 per cent in cyclical upturns and downturns, respectively. In the case of the U.S., the entry and exit effects from both studies are at best below 40 per cent even in the cyclical downturn when the effect tends to get stronger.[11] The larger role of entry and exit in Korean manufacturing seems to reflect not only fast overall productivity shifts and a high rate of plant turnover, but also the strong learning effect documented in this paper.

By contrast, the relative contribution of the share effect in Korea is smaller than in the U.S., although there is also a cyclical pattern. Even in the downturn of the period 1995-98, when the share effect tends to get larger, the share effect, 0.38, is much smaller than the corresponding figures for the U.S. In the U.S., the share effect accounts for most of the manufacturing productivity growth. However, the relatively minor role of the share effect is frequently reported by studies on developing countries, such as Taiwan, Israel, Chile and Colombia.[12]

To summarize, the cyclical patterns of the contributions from within, entry and exit, and share effects in Korean manufacturing mirrors those found for U.S. manufacturing. However, in terms of the relative importance of each component, the results for Korea differ from the U.S. Among others, entry and exit plays an important role in aggregate productivity growth in Korea, while in the U.S., its role is more modest. To the contrary, the aggregate productivity growth attributable to market share reallocation is smaller in Korea than in the U.S., where much of the productivity growth comes from efficient plants getting bigger. However, the relatively minor role of the share effect is not unique to Korean manufacturing, but is frequently reported for developing countries.

5. SUMMARY AND CONCLUDING REMARKS

In this study, the micro dynamics of entry, exit, and productivity growth has been examined using the plant level data on Korean manufacturing. In order to do this, the patterns of plant entry and exit has been documented, the relation between plant productivity and turnovers has been analysed, and the contribution from plant turnovers or resource reallocation among producers to the aggregate productivity change has been assessed. The following summarizes the main findings of this study.

First, there is a large amount of resource reallocation going on in Korean manufacturing through plant births, deaths, switch-ins and switch-outs. Plants born during the past five-year period account for between 21.5 per cent and 26.2 per cent of manufacturing output. A roughly similar portion is attributable to the plants that will die within five years. They account for a much larger fraction of the total number of manufacturing plants, indicating that those plants are usually small ones. Switch-ins and switch-outs are almost as important as births and deaths, respectively, in terms of output contribution. Those plants are on average bigger in size than births and deaths. A cross-country comparison of plant birth rates indicates that the turnover rate in Korean manufacturing is higher than in the U.S. or several developing countries for which comparable studies exist. However, the importance of entry by birth in Korea is not as pronounced as in Taiwan.

Second, an examination of the data on Korean manufacturing reveals that plant turnovers reflect systematic differences in underlying productivity, as found in many other countries. Deaths are on average less productive than continuing plants, consistent with the prediction by models of plant or firm dynamics that market selection forces sort out low-productivity plants from high-productivity plants. Births are less productive than not only continuing plants but also deaths in the first year they are observed. However, the productivity levels of switch-ins and switch-outs are higher than births or deaths and comparable to continuing plants.

The post-entry performance of births shows the presence of both market selection and the learning process. Births are a heterogeneous group themselves, among which low productivity plants die over time. Surviving members of births experience rapid productivity improvement or learning, especially during the first few years after entry, and catch up with continuing plants in productivity level in approximately three years.

Meanwhile, deaths are less productive than continuing plants not just at the time of death but also for a certain period before death. In other words, plant deaths on average reflect not just temporary misfortune but persistent productivity disadvantage, which seems to indicate the existence of plant-specific effects on plant productivity.

In order to examine whether the persistent productivity differential between deaths and survivors arises from the age differential, that is, younger plants are less productive and die more frequently than older plants, the pre-death performance of plants in the same birth-year cohort is also examined. As expected, the persistence of productivity differentials between survivors and deaths within the same birth-year cohort is somewhat weaker. Particularly in the early years of after starting operations, there is not a noticeable productivity differential between survivors and deaths within births. However, as surviving members of births improve their productivity at a rapid pace, the productivity gap begins to develop and persists over time.

Recognizing the possibility that the analysis based on the average productivity differential might mask the diversity that exists within the same plant categories, transition matrices are also used in this study. Similar to the results reported by Baily, Hulten, and Campbell (1992) for the U.S., the persistence of productivity is noticeable especially in the top of the productivity distribution. In addition, while the plants in low productivity quintiles are more likely to die within five years, there are many high productivity deaths that are small in size. Likewise, the diversity in productivity is present for other plant groups.

A comparison of transition matrices between Korea and the U.S., however, reveals not only similarities but also differences. First, the degree of persistency is somewhat weaker in Korea than in the U.S. This may be partly due to the fact that there is a higher percentage of young plants that show weaker persistency in productivity in Korea, as has already been documented. Second, the fractions of entries and exits are much larger in Korea than in the U.S. Although the sources of cross-country variations of the turnover rate are not yet well understood, this might be related to factors such as differences in the growth rate, the pace of structural change of the economy and the development of the financial market. Third, the time it takes for surviving entrants as a group to become as productive as continuing plants seems to be somewhat shorter in Korea. This might be related to both high frequency of death by unproductive plants and fast learning in Korea.

Finally, the productivity growth in manufacturing is decomposed into the 'within' effect, the entry and exit effect, and the share effect for the periods of 1990-95 and 1995-98. It is found that the cyclical patterns of the contribution from each component in Korea are very similar to those found for the U.S. That is, the resource reallocation effect, or in other words, the entry and exit effect and the share effect, plays a larger role during cyclical downturns. During 1995-98, for example, the combined effect of entry and exit and market share reallocation more than explains away the aggregate productivity growth in manufacturing.

However, in terms of the relative importance of each component, the results for Korea differs from the U.S. Among others, entry and exit plays an important role in aggregate productivity growth in Korea while, in the U.S., its role is more modest. This seems to reflect not only fast overall productivity shifts and a high rate of plant turnover, but also a strong learning effect in Korea as documented in this paper. By contrast, market share reallocation plays a relatively minor role in Korea. This finding, however, is not unique to Korean manufacturing but in line with other studies on several developing countries.

Taken together, the evidence presented in this study confirms that the entry and exit of plants has been an important source of productivity growth in Korean manufacturing. Plant birth and death are mainly a process of resource reallocation from plants with relatively low and declining productivity to a group of heterogeneous plants, some of which have the potential to become highly efficient in future. Thus, much of the benefit from the resource reallocation by entry and exit on aggregate productivity growth will be realized over time, even though the instantaneous gain might be small.

The most obvious lesson from this study is that it is important to establish a policy or institutional environment where efficient businesses can succeed and inefficient businesses fail. In other words, policies that hinder the processes of entry and exit of businesses are likely to be inefficient. Considering the persistently low and declining productivity of deaths, and the rapid learning opportunities of births as documented in this paper, the cost of such policies is likely to be very large.

This point would be particularly relevant for Korea, which is at present going thorough a process of large-scale corporate sector restructuring. Maintaining exit barriers for firms simply because they are large is highly likely to make matters worse. The evidence of this study suggests that even though the cost of such policies might not be evident momentarily, it will show up and grow over time in the form of foregone aggregate efficiency gain. Of course, removing all entry and exit barriers *per se* is not likely to guarantee that the outcome is efficient when there are market imperfections for a variety of reasons.[13] However, the existence of market failures or poor institutions would not justify maintaining barriers to entry and exit, especially if the creative destruction process is an inescapable and essential element of improving the aggregate productive efficiency.

NOTES

1. For a recent survey of empirical literature in this vein, see Tybout (1996), Caves (1997), and Foster, Haltiwanger, and Krizan (1998).
2. The theoretical framework of this type of study is also related to recent endogeneous growth models of learning by doing or creative destruction, such as Stokey (1988), Grossman and Helpman, (1991), Aghion and Howitt (1992), Young (1991). For a detailed survey of the theoretical underpinnings, see Tybout (1996) and Foster, Haltiwanger, and Krizan (1998).
3. However, the plant classification depends on the time interval of the analysis. For example, in the five-year transition matrix that will be discussed below, births could be many years old.
4. This paragraph heavily borrows from Aw, Chen, and Roberts. Explicit quotation will be omitted.
5. In fact, the interquartile range increases slightly during the 1994-98 period for most industries. However, this phenomenon is largely due to the rapid rightward shift of the 75th per centile relative to 25th per centile in 1998.
6. The question of persistency in productivity is related to the question of what is the source of the productivity differential among plants. In this paper, however, we do not pursue this question in detail. For a brief review of the theoretical literature on reasons for heterogeneity in plant-level and firm-level outcomes, see Baily, Hulten and Campbell (1992), Davis and Haltiwanger (1998) and Foster, Haltiwanger and Krizan (1998). Baily, Hulten and Campbell also examine this issue empirically in detail.
7. They report, however, that in terms of labour productivity, entering plants have lower productivity than continuing plants even at ten-year intervals.
8. See Liu (1993) for evidence on Chilean manufacturing.
9. The second term can be further decomposed into between-plant component and cross term, as shown in Foster, Haltiwanger, and Krizan (1998). They point out that when there are random measurement errors in output, it will generate an upward bias in the

correlation between productivity growth and output growth, making the cross term spuriously high in the output-weighted industry productivity growth decomposition. In this paper, the between-plant and cross term are combined into the share effect term as in Baily, Hulten, and Campbell (1992) in order to make the results comparable to theirs.

10. The Statistical Office defines 1989 and 1993 as cyclical troughs and 1992 and 1996 as cyclical peaks. Nevertheless, the business conditions improved significantly over the 1990-95 period as a whole so that the decomposition results during this period are expected to show overall patterns observed in upturns, which seems be supported by our results.
11. The two studies differ in their assessment of the importance of the entry and exit effect. Baily, Hulten, and Campbell (1992) conclude that even though there is an apparent cyclical pattern, the net effect of entry and exit is not great because the relative productivities of the entrants are not much different from the relative productivities of the exits. By contrast, Foster, Haltiwanger, and Krizan (1998) conclude that the contribution from the replacement of less productive exiting plants with more productive entering plants over a five or ten year horizon is large, not only due to the overall productivity change, but also due to the selection and learning effect.
12. See Aw, Chen, and Roberts (1997), Griliches and Regev (1995), Liu and Tybout (1996) for results on Taiwan, Israel, and Chile and Colombia, respectively.
13. Market imperfections can arise for the following reasons, as discussed in Haltiwanger (2000). First, there might be externalities involved in innovation activity. In creative destruction models, such as those in Aghion and Howitt (1992) and Grossman and Helpman (1991), agents do not internalize the impact of their decisions on others so that the resulting pace of creative destruction and, hence, the rate of aggregate growth may not be optimal. Second, Caballero and Hammour (1996) emphasize that the specific investments that firms and workers make combined with contracting difficulties in the formation of production units can disrupt the timing and volatility of creative destruction, and hamper the pace of renovation in the economy. Third, and related to the second, markets may be incomplete due to a missing insurance and contingent claim market, as Haltiwanger (2000) points out. He argues further that the inability of losers in the reallocation process to insure against idiosyncratic risks can be a source of distortion. That is, barriers to the reallocation process can emerge through a variety of interventions in product, labour, trade, and credit markets that are rationalized in terms of protecting against the potential losses to those that would be adversely affected in the reallocation process.
14. Good, Nadiri, and Sickles (1996) succinctly summarize the usefulness of chaining multilateral productivity indices. While the chaining approach of the Tornqvist-Theil index, the discrete Divisia, is useful in time series applications, where input shares might change over time, it has severe limitations in cross-section or panel data where there is no obvious way of sequencing the observations. To the contrary, the hypothetical firm approach allows one to make transitive comparisons among cross-section data, while it has an undesirable property of sample dependency. The desirable properties of both the chaining approach and the hypothetical firm approach can be incorporated into a single index by the chained-multilateral index number approach.

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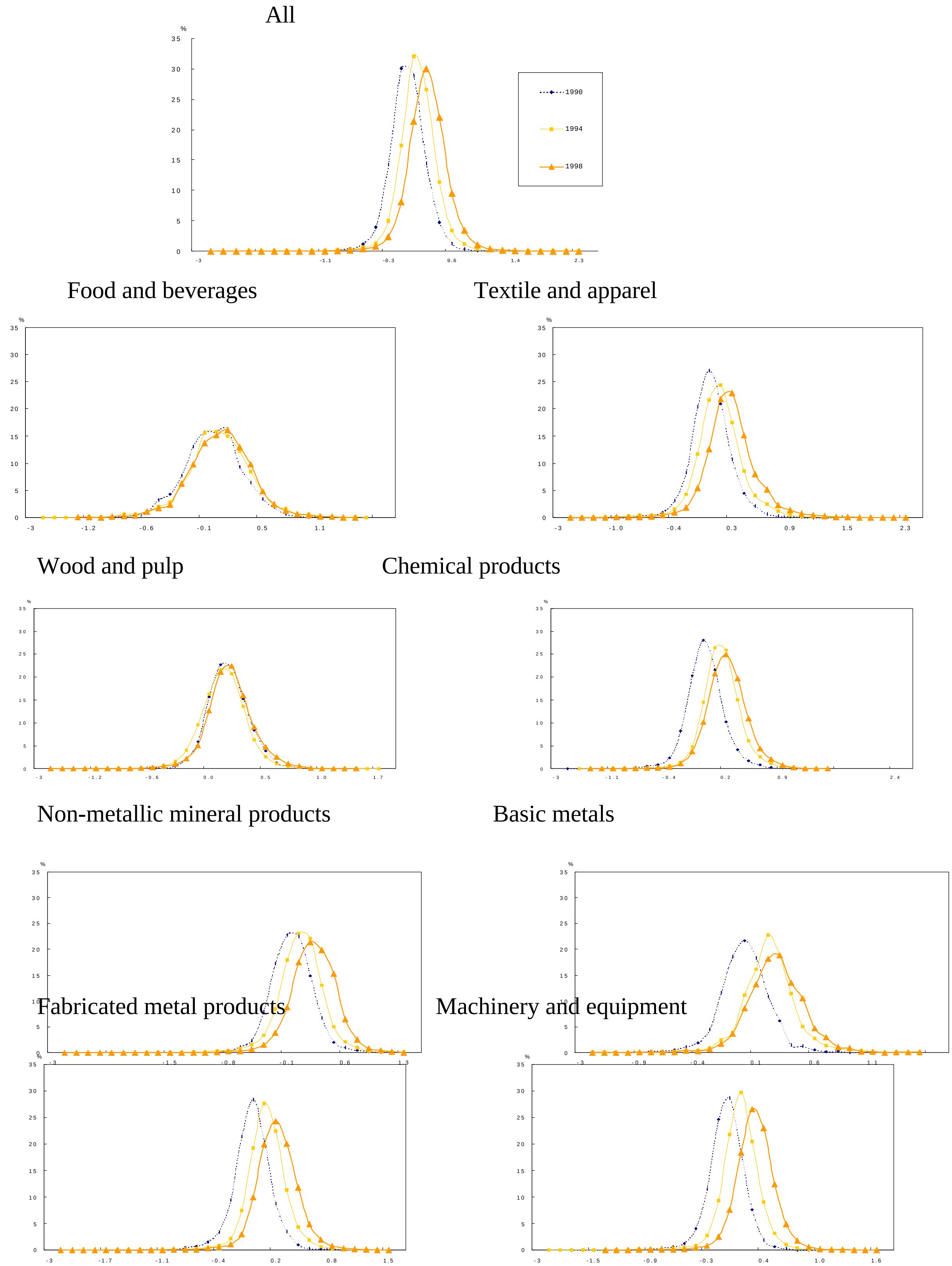
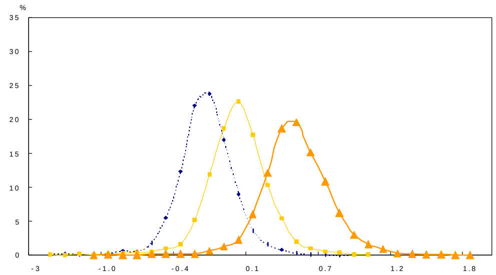
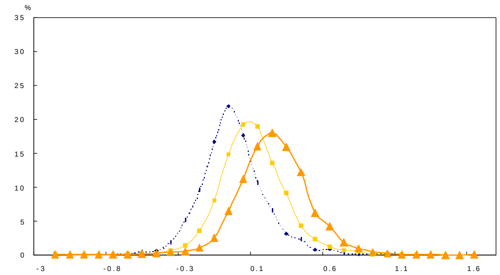
Figure 1. Plant Productivity Distribution and its Changes over Time



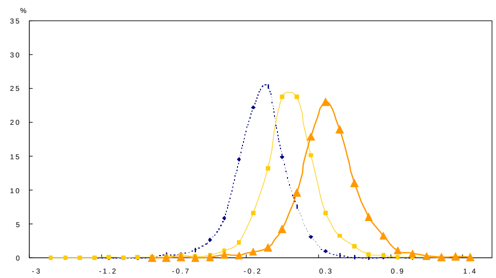
Communication equipment



Medical and precision instrument



Transport equipment



Others

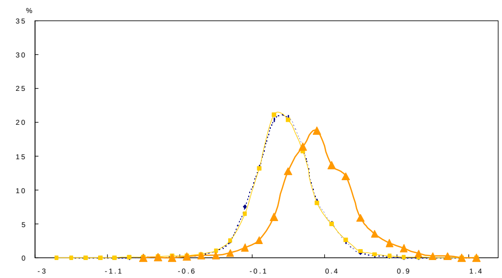


Figure 2. Post-entry Productivity Performance of Surviving Births

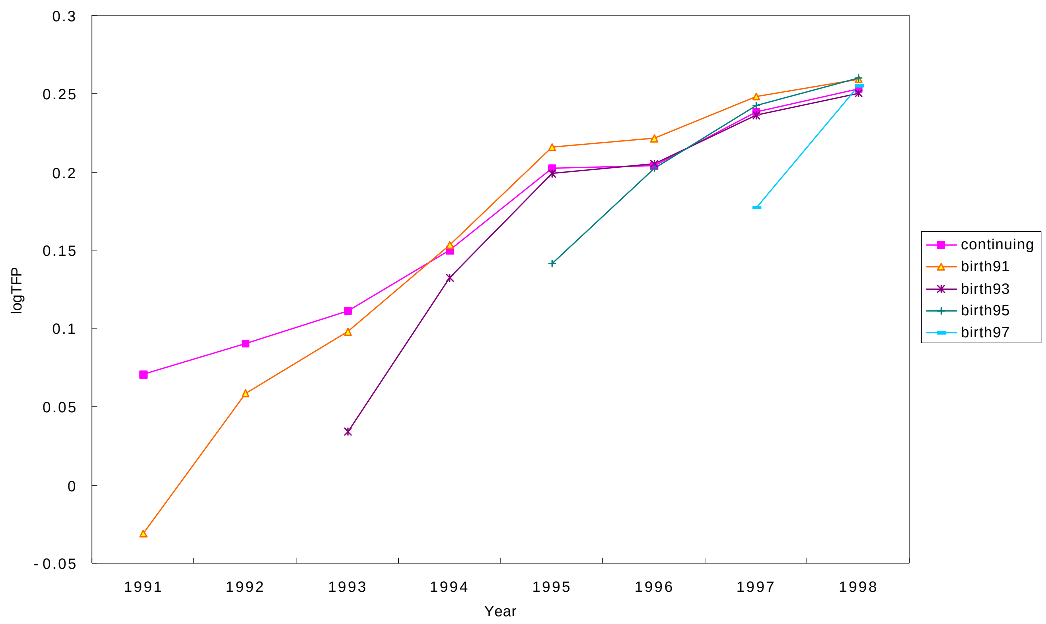


Figure 3. Pre-Exit Productivity Performance of Deaths

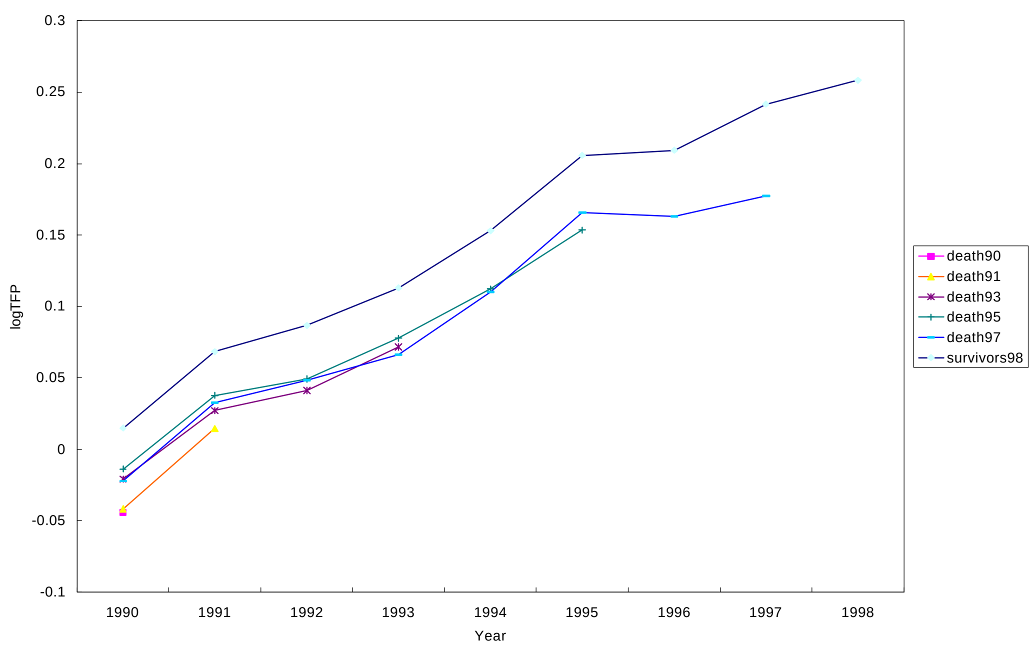


Figure 4. Pre-exit Productivity Performance of Deaths among 1991 Births

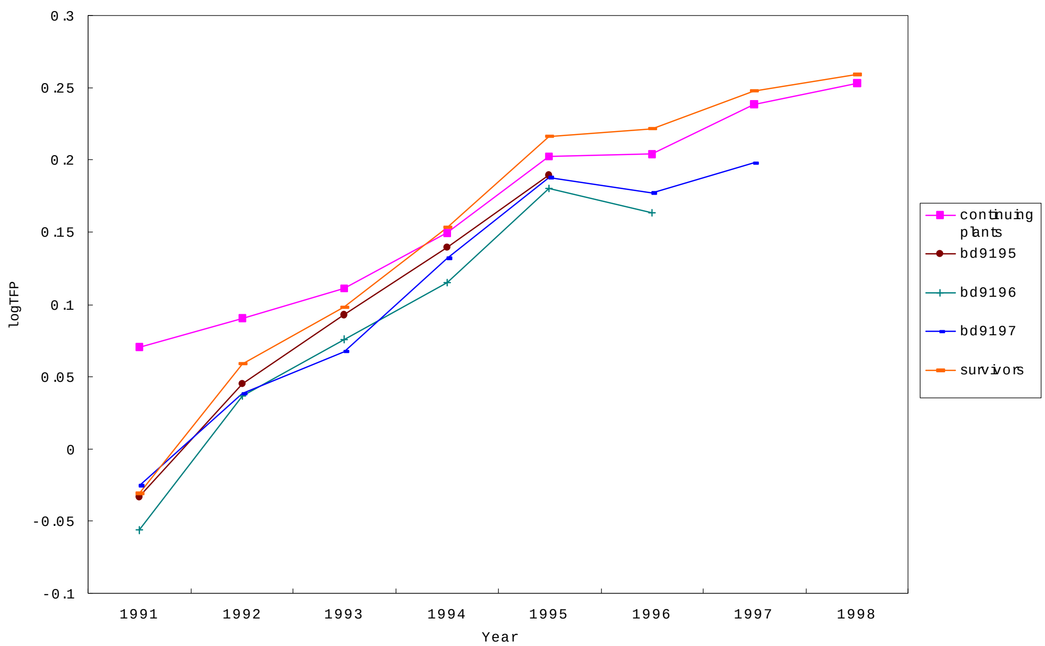


Table 1. Contribution of Plant Births

(Unit : %)

Year	Under 5 years						Over 5 years	
	1-3		4-5		Total			
	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output
1995	53.32	17.13	14.22	9.09	67.54	26.22	32.46	73.78
1996	47.60	15.36	18.68	11.11	66.29	26.46	33.71	73.54
1997	45.40	14.77	18.67	10.63	64.08	25.40	35.92	74.60
1998	39.45	12.77	18.63	8.68	58.08	21.45	41.92	78.55

Table 2. Contribution of Plant Deaths

(Unit : %)

Year	Within 5 years						Survive more than 5 years	
	1-3		4-5		Total			
	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output
1990	36.85	13.36	15.71	6.48	52.57	19.85	47.43	80.15
1991	37.41	14.52	17.11	7.62	54.52	22.14	45.48	77.86
1992	39.28	15.08	16.72	7.77	56.00	22.85	44.00	77.15
1993	43.71	14.92	20.23	9.13	63.93	24.05	36.07	75.95

Table 3. Contribution of Exits within Births

(Unit : %)

Year	Within 5 years						Survive more than 5 years	
	1-3		4-5		Total			
	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output
1991	47.41	40.15	16.84	13.51	64.25	53.65	35.75	46.35
1992	46.38	36.03	17.10	12.20	63.49	48.23	36.51	51.77
1993	55.90	38.58	20.06	12.75	75.96	51.33	24.04	48.67

Table 4. Contribution of Switch-Ins

(Unit : %)

Year	Within 5 years						Before 5 years	
	1-3		4-5		Total			
	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output
1995	13.09	12.61	5.16	5.72	18.25	18.33	-	-
1996	13.92	11.57	4.47	7.30	18.39	18.88	2.44	3.28
1997	15.32	15.60	4.47	7.29	19.78	22.89	3.44	4.62

Table 5. Contribution of Switch-outs

(Unit : %)

Year	Within 5 years						After 5 years	
	1-3		4-5		Total			
	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output	Number of plants	Current Output
1991	14.29	12.36	3.80	3.92	18.09	16.28	2.61	4.60
1992	14.82	10.90	3.46	5.24	18.29	16.14	2.20	1.60
1993	13.08	8.79	4.47	5.68	17.55	14.47	-	-

Table 6. Distribution of Plant Productivity by Industry

	1990	1994	1998
Total	43,259	72,286	62,462
25th percentile	-0.153	-0.017	0.099
Median	-0.018	0.117	0.245
75th percentile	0.122	0.254	0.399
Food and beverages	1,929	3,359	3,303
25th percentile	-0.170	-0.111	-0.103
Median	0.012	0.065	0.085
75th percentile	0.190	0.258	0.274
Textiles and apparel	4,470	8,548	6,840
25th percentile	-0.112	-0.029	0.083
Median	0.012	0.108	0.226
75th per centile	0.143	0.252	0.384
Wood and pulp	5,622	8,857	7,147
25th percentile	0.005	0.069	0.022
Median	0.126	0.203	0.146
75th percentile	0.258	0.335	0.286
Chemical products	6,090	7,958	7,835
25th percentile	-0.150	0.049	0.097
Median	-0.019	0.175	0.236
75th percentile	0.109	0.308	0.390
Non-metallic mineral products	2,066	3,965	3,036
25th percentile	-0.170	-0.057	0.077
Median	-0.022	0.090	0.233
75th percentile	0.131	0.237	0.406
Basic metals	1,761	1,868	1,878
25th percentile	-0.120	0.094	0.137
Median	0.003	0.217	0.270
75th percentile	0.132	0.341	0.420
Fabricated metal products	4,234	8,490	7,604
25th percentile	-0.188	-0.026	0.073
Median	-0.065	0.096	0.211
75th percentile	0.058	0.221	0.357
Machinery and equipment	10,078	15,623	14,520
25th percentile	-0.167	-0.001	0.157
Median	-0.046	0.117	0.284
75th percentile	0.075	0.233	0.416
Communication equipment	1,555	3,243	2,742
25th percentile	-0.347	-0.116	0.309
Median	-0.228	0.015	0.452
75th percentile	-0.097	0.149	0.618
Medical and precision instruments	634	1,375	1,710
25th percentile	-0.142	-0.035	0.098
Median	-0.042	0.091	0.233
75th percentile	0.090	0.227	0.380
Transport equipment	2,593	3,450	3,319
25th percentile	-0.246	-0.034	-0.223
Median	-0.128	0.076	0.343
75th percentile	-0.023	0.190	0.472
Others	2,227	5,523	2,528
25th percentile	-0.083	-0.078	0.125
Median	0.043	0.040	0.265
75th percentile	0.173	0.171	0.437

Note: The figures in the first rows for each industry denote the number of plants.

Table 7. Average Productivity of Plant Groups, 1990-1998

	Continuing	Entry		Exit		Total
		Birth	Switch in	Death	Switch out	
1990	-0.005			-0.044	-0.026	-0.016
1991	0.046	-0.031	0.041	-0.003	0.050	0.026
1992	0.061	-0.005	0.061	0.018	0.068	0.046
1993	0.087	0.030	0.096	0.051	0.101	0.072
1994	0.132	0.056	0.141	0.101	0.144	0.118
1995	0.190	0.132	0.199	0.150	0.202	0.174
1996	0.197	0.143	0.208	0.160	0.214	0.185
1997	0.239	0.177	0.252	0.182	0.245	0.218
1998	0.256	0.200	0.267			0.249

Note: Unweighted averages.

Table 8. Relative Productivity of Plant Groups by Industry

	Birth (a)	Switch-in(b)	Death (g)	Switch-out(d)	F-Statistics		
					$a = g$	$a = b$	$g = d$
All	-0.063 (0.001)	0.007 (0.001)	-0.042	0.006 (0.001)	325.1	2598.1	1599.2

			(0.001)				
Food and beverages	-0.127	-0.009	-0.098	-0.019	10.8	140.7	75.5
	(0.007)	(0.008)	(0.007)	(0.007)			
Textile and apparel	-0.075	0.019	-0.026	0.015	154.3	404.3	100.2
	(0.003)	(0.004)	(0.003)	(0.004)			
Wood and pulp	-0.052	-0.001	-0.040	-0.006	15.8	183.5	114.0
	(0.003)	(0.003)	(0.002)	(0.003)			
Chemical Products	-0.086	-0.016	-0.067	-0.021	28.4	349.9	202.9
	(0.003)	(0.003)	(0.003)	(0.003)			
Non-metallic mineral Products	-0.088	0.055	-0.083	0.035	0.8	321.5	258.5
	(0.005)	(0.007)	(0.004)	(0.007)			
Basic metals	-0.084	-0.003	-0.052	-0.014	21.8	129.0	39.7
	(0.006)	(0.006)	(0.005)	(0.005)			
Fabricated metal Products	-0.056	0.008	-0.034	0.015	55.4	338.8	249.6
	(0.003)	(0.003)	(0.002)	(0.003)			
Machinery and Equipment	-0.050	-0.003	-0.031	-0.001	87.5	387.0	211.3
	(0.002)	(0.002)	(0.002)	(0.002)			
Communication equipment	-0.088	-0.018	-0.060	-0.010	22.5	105.8	74.5
	(0.005)	(0.006)	(0.005)	(0.005)			
Medical and precision Instruments	-0.029	0.019	-0.024	0.023	0.5	32.1	34.7
	(0.006)	(0.007)	(0.006)	(0.007)			
Transport equipment	-0.071	-0.008	-0.044	0.006	37.2	144.1	123.7
	(0.004)	(0.005)	(0.004)	(0.004)			
Others	-0.042	0.005	-0.035	0.010	2.4	54.1	69.0
	(0.004)	(0.006)	(0.003)	(0.005)			

Note: Numbers in the parenthesis are standard errors

Table 9. Market Selection among Birth Cohorts

	Births- 1991	Births - 1993	Births - 1995
Deaths - 1992	-0.065 (0.005)		
Deaths - 1993	-0.044 (0.004)		
Deaths - 1994	-0.036 (0.004)	-0.042 (0.003)	
Deaths - 1995	-0.032 (0.004)	-0.032 (0.003)	
Deaths - 1996	-0.048 (0.004)	-0.030 (0.003)	-0.053 (0.003)
Deaths - 1997	-0.038 (0.003)	-0.044 (0.002)	-0.039 (0.002)

Note: Numbers in the parenthesis are standard errors.

Table 10. Productivity Performance of Surviving Births Relative to Continuing Plants

	1991	1992	1993	1994	1995	1996	1997	1998
Continuing Plants	0.071	0.091	0.111	0.150	0.202	0.204	0.238	0.253
Births-1991	-0.031	0.059	0.098	0.153	0.216	0.221	0.248	0.259
Births-1992		0.006	0.090	0.150	0.219	0.219	0.246	0.263
Births-1993			0.034	0.132	0.199	0.206	0.236	0.250
Births-1994				0.057	0.190	0.209	0.247	0.261
Births-1995					0.142	0.203	0.242	0.260
Births-1996						0.149	0.241	0.270
Births-1997							0.177	0.255
Births-1998								0.200

Table 11. Productivity Performance of Surviving Births by Industry

	Births - 1991							
	1991	1992	1993	1994	1995	1996	1997	1998
Food and beverages	-0.238 (0.037)	-0.122 (0.036)	-0.138 (0.038)	-0.088 (0.038)	-0.116 (0.042)	-0.036 (0.040)	-0.103 (0.036)	-0.119 (0.035)
Textile and apparel	-0.136 (0.023)	0.009 (0.023)	0.019 (0.023)	0.005 (0.022)	0.037 (0.022)	0.038 (0.022)	0.021 (0.023)	0.013 (0.022)
Wood and pulp	-0.091 (0.019)	-0.045 (0.019)	-0.016 (0.019)	0.015 (0.019)	0.002 (0.019)	-0.003 (0.019)	-0.004 (0.019)	-0.014 (0.019)
Chemical Products	-0.168 (0.024)	-0.097 (0.024)	-0.051 (0.024)	-0.030 (0.024)	-0.005 (0.024)	-0.039 (0.024)	-0.025 (0.024)	-0.026 (0.023)
Non-metallic mineral Products	-0.095 (0.020)	0.036 (0.020)	0.041 (0.020)	0.063 (0.020)	0.065 (0.020)	0.048 (0.020)	0062 (0.020)	0.08 (0.02)
Basic metals	-0.161 (0.041)	0.014 (0.044)	0.018 (0.044)	0.040 (0.043)	0.059 (0.044)	0.037 (0.044)	0.053 (0.043)	0.071 (0.043)
Fabricated metal Products	-0.034 (0.022)	0.011 (0.022)	0.013 (0.022)	0.009 (0.023)	0.034 (0.023)	0.054 (0.023)	0.021 (0.023)	0.018 (0.022)
Machinery and Equipment	-0.062 (0.015)	-0.016 (0.015)	-0.007 (0.015)	0.010 (0.015)	0.023 (0.015)	0.037 (0.015)	0.032 (0.015)	0.021 (0.014)
Communication equipment	-0.105 (0.041)	-0.083 (0.037)	-0.065 (0.040)	-0.085 (0.031)	-0.024 (0.036)	-0.037 (0.029)	-0.045 (0.029)	-0.060 (0.029)
Medical and precision Instruments	-0.034 (0.042)	-0.043 (0.043)	-0.021 (0.042)	0.038 (0.048)	-0.012 (0.040)	0.013 (0.050)	0.010 (0.039)	0.011 (0.038)
Transport equipment	-0.016 (0.027)	-0.053 (0.029)	-0.014 (0.032)	-0.009 (0.028)	0.004 (0.032)	-0.004 (0.029)	0.004 (0.030)	-0.011 (0.029)
Others	-0.033 (0.031)	-0.006 (0.031)	-0.003 (0.031)	0.045 (0.023)	0.060 (0.025)	0.045 (0.024)	0.009 (0.031)	-0.014 (0.028)

Note: Numbers in the parenthesis are standard errors.

Table 12. Pre-Exit Productivity Performance of Deaths relative to Survivors

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Deaths - 1990	-0.044								
Deaths - 1991	-0.042	0.015							
Deaths - 1992	-0.033	0.022	0.027						
Deaths - 1993	-0.021	0.027	0.041	0.072					
Deaths - 1994	-0.027	0.032	0.048	0.079	0.107				
Deaths - 1995	-0.014	0.038	0.049	0.078	0.112	0.154			
Deaths - 1996	-0.021	0.034	0.046	0.072	0.117	0.164	0.156		
Deaths - 1997	-0.022	0.033	0.048	0.066	0.110	0.166	0.163	0.177	
Survivors until 1998	0.015	0.068	0.087	0.113	0.153	0.206	0.209	0.242	0.258

Table 13. Pre-Exit Productivity Performance of Deaths relative to Survivors by Industry

	Year							
	1990	1991	1992	1993	1994	1995	1996	1997
Food and Beverages	-0.153 (0.039)	-0.161 (0.038)	-0.118 (0.031)	-0.105 (0.037)	-0.120 (0.032)	-0.124 (0.041)	-0.118 (0.039)	-0.209 (0.035)
Textile and Apparel	0.007 (0.021)	-0.015 (0.018)	-0.014 (0.018)	-0.029 (0.017)	-0.017 (0.017)	0.001 (0.017)	0.002 (0.017)	-0.053 (0.018)
Wood and Pulp	-0.015 (0.016)	-0.014 (0.016)	-0.033 (0.016)	-0.079 (0.016)	-0.053 (0.016)	-0.040 (0.015)	-0.033 (0.016)	-0.066 (0.015)
Chemical Products	-0.099 (0.024)	-0.080 (0.025)	-0.090 (0.026)	-0.099 (0.025)	-0.087 (0.025)	-0.070 (0.025)	-0.077 (0.025)	-0.099 (0.024)
Non-metallic Mineral Products	-0.067 (0.025)	-0.039 (0.020)	-0.080 (0.020)	-0.066 (0.020)	-0.055 (0.020)	-0.054 (0.020)	-0.075 (0.020)	-0.086 (0.019)
Basic Metals	-0.082 (0.036)	-0.145 (0.037)	-0.107 (0.037)	-0.110 (0.037)	-0.077 (0.037)	-0.061 (0.037)	-0.065 (0.037)	-0.073 (0.036)
Fabricated Metal Products	-0.065 (0.020)	-0.066 (0.020)	-0.049 (0.020)	-0.030 (0.021)	-0.022 (0.021)	-0.023 (0.021)	-0.022 (0.020)	-0.029 (0.019)
Machinery and Equipment	-0.031 (0.014)	0.006 (0.15)	-0.017 (0.015)	-0.001 (0.015)	-0.023 (0.015)	-0.034 (0.015)	-0.035 (0.015)	-0.025 (0.014)
Communication Equipment	-0.048 (0.041)	-0.070 (0.042)	-0.032 (0.041)	-0.052 (0.044)	-0.059 (0.031)	-0.092 (0.041)	-0.085 (0.030)	-0.094 (0.030)
Medical and Precision Instruments	-0.049 (0.068)	-0.064 (0.048)	-0.082 (0.058)	-0.041 (0.053)	-0.056 (0.055)	-0.073 (0.046)	-0.055 (0.053)	-0.045 (0.045)
Transport Equipment	-0.075 (0.026)	-0.102 (0.028)	-0.110 (0.028)	-0.112 (0.029)	-0.076 (0.028)	-0.068 (0.028)	-0.055 (0.028)	-0.088 (0.028)
Others	-0.019 (0.027)	-0.041 (0.027)	-0.073 (0.028)	-0.048 (0.029)	-0.030 (0.019)	-0.023 (0.019)	-0.030 (0.020)	-0.069 (0.027)

Note: Numbers in the parenthesis are standard errors.

Table 14. 1993 Productivity Differential between Deaths and Survivors

	Continuing plants that survived (α)	Births that died (b_1)	Births that survived (b_2)	Switch-ins that died (g_1)	Switch-ins that survived (g_2)
All	0.038	-0.039	-0.033	0.017	0.040
Food and beverages	0.080	-0.115	-0.039	0.091	0.026
Textile and apparel	0.025	-0.058	-0.044	0.020	0.041
Wood and pulp	0.037	-0.001	0.004	0.048	0.071
Chemical products	0.060	-0.070	-0.030	-0.028	0.022
Non-metallic mineral Products	0.088	-0.053	-0.061	-0.025	0.133
Basic metals	0.053	-0.071	-0.055	0.031	-0.006
Fabricated metal Products	0.027	-0.033	-0.032	0.020	0.035
Machinery and Equipment	0.005	-0.055	-0.048	-0.007	0.004
Communication equipment	0.057	-0.074	-0.081	-0.024	0.066
Medical and precision Instruments	0.048	0.000	0.031	0.034	0.074
Transport equipment	0.037	-0.042	-0.043	0.008	0.040
Others	-0.007	-0.035	-0.038	0.005	-0.020

Test results of productivity difference

	(α > 0)	($b_1 = b_2$)	($g_1 = g_2$)
All	13.1	1.8	14.5
Food and beverages	4.9	6.7	1.8
Textile and apparel	3.0	0.8	1.1
Wood and pulp	4.5	0.2	1.7
Chemical products	7.2	9.6	10.0
Non-metallic mineral Products	8.7	0.1	14.3
Basic metals	3.2	0.4	1.4
Fabricated metal Products	3.2	0.0	0.9
Machinery and Equipment	0.8	0.8	1.2
Communication equipment	3.3	0.1	6.6
Medical and precision Instruments	2.7	1.6	1.2
Transport equipment	3.3	0.0	1.5
Others	-0.5	0.0	0.6

Note: The first column in the lower panel shows t-statistics and the second and the third columns show F-statistics.

Table 15. 1994 Productivity Differential between Deaths and Survivors among 1991 Births

	1991 Births that died before 1998	1991 Births that survived until 1998
All	0.126 (0.004)	0.027 (0.006)
Food products and Beverages	0.070 (0.033)	0.016 (0.042)
Textile and Apparel	0.160 (0.012)	-0.022 (0.018)
Wood and pulp	0.199 (0.010)	0.036 (0.016)
Chemical Products	0.174 (0.013)	0.037 (0.018)
Non-metallic mineral Products	0.080 (0.015)	0.084 (0.021)
Basic metals	0.212 (0.025)	0.048 (0.035)
Fabricated metal Products	0.112 (0.011)	0.034 (0.017)
Machinery and equipment	0.133 (0.008)	-0.001 (0.012)
Communication equipment	0.005 (0.015)	0.033 (0.024)
Medical and precision Instruments	0.105 (0.028)	0.027 (0.040)
Transport equipment	0.103 (0.014)	0.042 (0.020)
Others	0.057 (0.011)	0.037 (0.019)

Note: Numbers in the parenthesis are standard errors.

Table 16. Five-year Transition Matrix of Relative Productivity Rankings: weighted by employment

(Unit : %)

	Top 20	20-40	40-60	60-80	80-100	Switch-out during 1990-95	Death during 1990-95
Top 20	28.53	13.42	5.98	1.96	1.06	26.45	22.61
20-40	16.74	16.59	10.23	5.23	1.68	23.20	26.33
40-60	12.09	16.65	7.66	6.16	3.91	20.26	33.26
60-80	4.49	5.95	5.91	6.57	4.74	30.04	42.31
80-100	3.06	4.09	12.68	5.40	6.02	25.27	43.48
Switch-in during 1990-95	28.28	24.52	19.81	16.64	1074	0.00	0.00
Birth and alive During 1990-95	25.63	22.09	18.90	16.91	16.47	0.00	0.00

Table 17. Five-year Transition Matrix of Relative Productivity Rankings: number of plants

(Unit : %)

	Top 20	20-40	40-60	60-80	80-100	Switch-out during 1990-95	Death during 1990-95
Top 20	11.55	7.16	5.06	3.05	1.84	25.35	45.98
20-40	6.73	6.96	6.61	4.65	2.68	25.32	47.05
40-60	4.43	5.64	6.17	5.74	3.75	24.10	50.17
60-80	3.15	4.18	4.71	5.74	4.76	24.02	53.44
80-100	2.28	3.17	3.83	4.95	7.04	21.70	57.03
Switch-in during 1990-95	20.25	21.56	20.51	20.47	17.20	0.00	0.00
Birth and alive During 1990-95	19.84	19.25	19.69	20.06	21.15	0.00	0.00

Table 18. Decomposition of Total Factor Productivity Growth in Korean Manufacturing

	Total	Within Effect	Entry and Exit	Share Effect
1990-1995	0.230	0.132	0.105	-0.007
	(1.00)	(0.57)	(0.46)	(-0.03)
1995-1998	0.047	-0.001	0.031	0.018
	(1.00)	(-0.02)	(0.65)	(0.38)

Note : Decomposition is based on the methodology by Baily, Hulten, and Campbell (1992).
Numbers in the parenthesis are the relative contributions.

Table 19. Comparison of Productivity Decompositions between Korea and the U.S.

Source	Data	Period	MFG Total (%)	Relative Contribution from		
				Within Effect	Entry and Exit	Share Effect
Upturn						
This Study	Korea	1990-95	23.0	0.57	0.46	-0.03
Baily, Hulten, and Cambell (1992)	U.S.	1982-87	15.6	0.87	-0.07	0.20
Foster, Haltiwanger, And Krizan (1998)	U.S.	1982-87	7.3	0.52	0.14	0.33
Downturn						
This Study	Korea	1995-98	4.7	-0.02	0.65	0.38
Baily, Hulten, and Cambell (1992)	U.S.	1977-82	2.4	-0.46	0.40	1.06
Foster, Haltiwanger, And Krizan (1998)	U.S.	1977-82	2.7	-0.09	0.25	0.84

Note: The figures from Foster, Haltiwanger, and Krizan are those based on methodology modified from Baily, Hulten, and Campbell (1992).

Appendix A. Data and Measurement of Plant Productivity

Data

This study uses the unpublished plant-level data from the Annual Report on Mining and

Manufacturing Survey (Survey henceforth) during the period 1990-98. The Survey covers all plants with five or more employees in mining and manufacturing industries and contains information on outputs and inputs that are necessary to calculate plant-level total factor productivity. In this paper, the focus is on the manufacturing sector. Plant codes are consistently followed over time so that it is possible to identify which plants first appeared in the data set and which plants disappeared. In addition, the industry code for each plant allows one to identify which plants moved to another industry.

Since the Survey covers only those plants with five or more employees, there may be observations that intermittently appear in the data set within our sample period. Even though the Statistical Office conducts a census on all plants every five years, it was not possible to incorporate the information on plants with less than five employees into this analysis because they apply entirely different plant coding systems to those plants. Since most of the results of this study do not change qualitatively on the inclusion or the exclusion of those borderline observations, which accounts for about 15 per cent of the total number of plants, it was decided not to discard those observations. The inescapable cost of such a decision is that inaccurate exit and entry status might be assigned to those observations around intermittent period, even though an attempt was made to try to correct this problem as far as possible.

Measurement of Plant Level Productivity

Plant productivity using the chained-multilateral index number approach was estimated, as developed in Good (1985) and Good, Nadiri, and Sickles (1996) and employed in Aw, Chen, and Roberts (1997). It uses a separate reference point for each cross-section of observations and then chain-links the reference points together over time as in the Tornqvist-Theil index. The reference point for a given time period is constructed as a hypothetical firm with input shares that equal the arithmetic mean input shares and input levels that equal the geometric mean of the inputs over all cross-section observations. Thus, the output, inputs, and productivity level of each firm in each year is measured relative to the hypothetical firm at the base time period. This approach allows one to make transitive comparisons of productivity levels among observations in a panel data set.[14]

Specifically, the productivity index for firm i at time t in the study is measured in the following way.

$$\ln TFP_{it} = (\ln Y_{it} - \overline{\ln Y_t}) + \sum_{t=2}^{t} (\overline{\ln Y_t} - \overline{\ln Y_{t-1}})$$

$$- \left\{ \sum_{n=1}^{N} \frac{1}{2} (S_{nit} + \overline{S_{nt}})(\ln X_{nit} - \overline{\ln X_{nt}}) + \sum_{t=2}^{t} \sum_{n=1}^{N} \frac{1}{2} (\overline{S_{nt}} + \overline{S_{nt-1}})(\overline{\ln X_{nt}} - \overline{\ln X_{nt-1}}) \right\},$$

where Y, X, S, and TFP denote output, input, input share, TFP level respectively, and symbols with an upper bar are corresponding measures for hypothetical firms. The subscripts t and n are indices for time and inputs, respectively. In this study, the year 1990 is the base time period.

As a measure of output, the gross output of each plant in the Survey deflated by the producer price index at disaggregated level is used. As a measure of capital stock, the average of the beginning and end of the year book value capital stock in the Survey deflated by the capital goods deflator is used. As a measure of labour input, the number of workers, which includes paid employees (production and non-production workers), working proprietors and unpaid family workers is used. Here, an allowance is made for the quality differential between production workers and all the other type of workers. The labour quality index of the latter is calculated as the ratio of non-production workers' and production workers' average wage of each plant, averaged again over the entire plants in a year. As a measure of intermediate input, the "direct production cost" in the Survey is used. However, the intermediate input to output ratio calculated this way is much lower than corresponding figures in the Input-Output Table probably due to the direction cost in the Survey does not include much of the purchased services, such as insurance, transportation, communication, advertising costs, for example. Thus, the amount of the intermediate inputs of all plants by the same proportion is adjusted such that the manufacturing aggregate intermediate input to output ratio becomes equal to the corresponding figure from the Input-Output Table. The estimated intermediate input is again deflated by the intermediate input price index.

A constant returns to scale is assumed so that the sum of factor elasticities equals to one. Labour and intermediate input elasticities for each plant are measured as average cost shares within the same plant-size class in the five-digit industry in a given year. Thus, factor elasticities of plants are allowed to vary across industries and size classes and over time. Here, plants are grouped into three size classes according to the number of employees: 5-50, 51-300, and over 300.

Appendix B. Supplementary Tables

Table B-1. Eight-year Transition Matrix of Relative Productivity Rankings: weighted by employment (Unit : %)

	Top 20	20-40	40-60	60-80	80-100	Switch-out During 1990-98	Death During 1990-98
Top 20	15.89	9.95	5.98	2.40	1.02	27.02	37.75
20-40	9.96	12.66	6.70	6.15	1.84	22.49	40.21
40-60	8.54	14.87	4.46	3.99	2.86	16.97	48.31
60-80	3.27	4.48	3.04	4.26	2.91	23.57	58.47
80-100	2.00	8.81	2.69	2.95	3.76	19.74	60.04
Switch-in during 1990-98	33.57	23.00	20.33	13.85	9.24	0.00	0.00
Birth and alive During 1990-98	25.48	21.98	19.41	18.09	15.03	0.00	0.00

Table B-2. Eight-year Transition Matrix of Relative Productivity Rankings: number of plants (Unit : %)

	Top 20	20-40	40-60	60-80	80-100	Switch- out during 1990-98	Death during 1990-98
Top 20	6.41	4.65	3.59	2.27	1.57	17.78	63.73
20-40	4.10	4.43	3.84	3.15	2.21	18.23	64.04
40-60	2.96	3.47	3.36	3.32	2.47	15.90	68.53
60-80	1.95	2.54	2.76	3.18	2.90	15.42	71.24

80-100	1.30	1.78	2.19	2.90	3.78	13.49	74.56
Switch-in during 1990-98	20.17	21.41	20.93	20.52	16.97	0.00	0.00
Birth and alive During 1990-98	20.20	19.46	19.78	20.01	20.54	0.00	0.00

Table B-3. Decomposition of Productivity Growth by Industry

	Total	Within Effect	Entry and Exit	Share Effect
Food and beverages				
1990-1995	0.158	0.098	0.043	0.017
1995-1998	-0.054	-0.062	-0.008	0.016
Textile and apparel				
1990-1995	0.160	0.046	0.107	0.008
1995-1998	0.076	0.017	0.010	0.070
Wood and pulp				
1990-1995	0.026	-0.001	0.071	-0.049
1995-1998	-0.012	-0.026	-0.016	0.030
Chemical products				
1990-1995	0.153	0.090	0.087	-0.025
1995-1998	-0.114	-0.145	0.027	0.005
Non-metallic mineral Products				
1990-1995	0.260	0.086	0.177	-0.004
1995-1998	0.025	-0.005	-0.025	0.056
Basic metals				
1990-1995	0.222	0.169	0.100	-0.047
1995-1998	0.003	-0.004	-0.023	0.030
Fabricated metal products				
1990-1995	0.245	0.082	0.204	-0.045
1995-1998	0.057	0.006	-0.003	0.055
Machinery and equipment				
1990-1995	0.228	0.090	0.161	-0.024
1995-1998	0.137	0.074	0.086	-0.023
Communication				
1990-1995	0.520	0.328	0.119	0.073
1995-1998	0.178	0.051	0.095	0.032
Medical and precision Instruments				
1990-1995	0.258	0.126	0.128	0.005
1995-1998	0.070	0.022	0.030	0.019
Transport equipment				

1990-1995	0.264	0.225	0.053	-0.014
1995-1998	0.183	0.135	0.051	-0.003
Others				
1990-1995	0.141	0.025	0.129	-0.014
1995-1998	0.152	0.038	0.009	0.113

MICRO-DYNAMICS OF INDUSTRIAL COMPETITION: EVIDENCE FROM KOREAN MANUFACTURING PLANTS

Sung Wook Joh

MICRO-DYNAMICS OF INDUSTRIAL COMPETITION: EVIDENCE FROM KOREAN MANUFACTURING PLANTS

Abstract

This paper examines the dynamic industrial competitive process in Korea through an analysis of the determinants and consequences of industry turnover. 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 the data of 694,286 establishments from 580 industries between 1990 and 1998, this paper shows that the turnover rate in Korea is one of the highest among all countries in the world examined in various studies. Statistical analysis indicates 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 (such as industry growth rate, capital requirement, and market concentration) and producer specific factors (efficiency) affect industry turnover rates and performance at the plant level differently. The paper also shows the continual replacement of inefficient producers by efficient producers. In addition, the paper also notes that the performance of entrants and dying plants is lower than that of continuing plants. Moreover, birth plants show better performance than dying plants. The paper also finds that the performance of surviving entrants has improved while that of dying plants has deteriorated over time. Such an observation provides an important implication. Since entrants use resources released from closing plants, and their performance improves over time, turnovers will improve efficient resource allocation.

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 1999, its subsidiaries and sub-contractors also went out of business. As a result, many workers lost their jobs. Firms still rely on high debt leverage while experiencing losses, and thus, more failures are expected to occur during the process of corporate restructuring. Due to 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 over whether these failing firms should be saved? Or, should they be allowed to fail?

Other countries' experiences suggest that government policies supporting failing firms to maintain jobs have been grossly inefficient (for example, 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 a 'creative destruction' process is argued to increase the 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 this, first, there is a need to understand the patterns of the dynamic industrial competitive process, and why entry and exit occurs. Then, the empirical evidence that such a process is likely to increase efficiency needs to be documented.

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. The Korean manufacturing sector shows higher entry and exit rates compared to other countries. New plant births account for an average of 14.4 per cent of the total number of plants each year. During the same period, 17.7 per cent of all plants died. When including plants that change their primary business, the total entry and exit rates exceeds 24.6 per cent and 32.4 per cent, 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. Gross National Product (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 also explain industry turnover rates. Industries with high demand growth facilitate industry turnover. 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 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. Since 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, 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 – will be reviewed. Then, the Korean data and methodology are discussed in section 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, the patterns and properties of the entry and exit process are examined. A more extensive statistical analysis of the data is conducted in section 5. Section 6 concludes.

2. Literature Review

This section reviews the previous literature on industrial competition. First, the variation in entry and exit across countries and across industries is examined. Second, the explanations on why entry and exit occurs are reviewed. Third, the issue of whether entering producers and exits differ in their production and efficiency is discussed.

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 are between 3 to 18 per cent in the 1970s and 1980s. Furthermore, the manufacturing market shares of these exiting and entering firms are between 1 to 7.4 per cent. In contrast, Mexico (1984-1990) and Socialist Yugoslavia's (1952-1973) entry rates are around 1 per cent (Grether, 1991; Estrin & Petrin, 1991). On the other hand, Portugal exhibits high entry (12.3 per cent) and exit rates (9.5 percent). Aw, Chen and Roberts (1997) find that Taiwan's entry rate is high, reaching 13.6 per cent. Moreover, the turnover rates of the U.K. exhibit great time variation. The Korean manufacturing sector in the 1990s shows much higher annual turnover rates, reaching entry and exit rates of 24.6 per cent of 32.4 per cent, respectively. Taiwan and Portugal exhibit even higher entry and exit rates, respectively.

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 from183 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 the manufacturing sector
Korea[3]	1990-98	14.4	4.1	17.7	5.4	Plant data from 590 manufacturing firms in 5 digit level
Morocco	1984-90	13.0	3.2	6.0	1.3	Firm data from the 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
U.K.	1974-79	6.5	2.9	5.1	3.3	Firm data from 114 industries in 3–digit level
U.K.[2]	1983-84	18.3	7.4	11.5	5.1	Firm data from 95 industries
U.S.[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). The data for Columbia, Korea[1], Korea[2] are compiled from Roberts (1996), from Jeong and Masson (1991), from Chung (1999) recited from Tybout (2000), respectively. Korea[3] data are from this study. The data for Morocco are taken from Haddad, de Melo and Horton (1996). The data for Taiwan, U.K.[2], the U.S., and Yugoslavia are from Aw, Chen and Roberts (1997), from Goreki (1991), from Dunne, Roberts and Samuelson (1988), and from Estrin & Petrin, (1991), respectively. Data for 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

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, Chen and Roberts (1997) show that turnover rates are different over industries in the U.S., Japan and Taiwan, respectively. Geroski and Schwalbach (1991) report industrial differences of other countries. Dunne and Roberts (1991) note that inter-industry differences account for a majority of total turnover rates – almost 60-70 per cent of total variation can be explained by inter-industry variation.

Why entry & exit occurs

Following Roberts and Tybout (1996), the existing explanations for why producers enter or exit an industry can be summarized 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.

Macroeconomic factors

Macroeconomic factors such as GNP growth, unemployment or inflation rate can also affect firm entry and exit. Using U.S. data, Highfield and Smiley (1987) study the relationship between entry rate and cyclical economic conditions such as GNP growth, inflation and unemployment rate. Yamawaki (1991) also reports 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 per cent in 1997 and contracted by 7 per cent in 1998 after reaching high levels of nearly 8 per cent per year between 1990 and 1995.[15] During the economic crisis, the unemployment rate increased from 3 per cent in 1997 to 7 per cent in 1998.[16] As a result, plant birth rates show a decline from an average of 15 per cent to 10 per cent in 1997. Furthermore, plant death rates also reveal a decline from an average of 17 per cent to 25 per cent in 1997.

Industrial factors

Using data from the U.S. manufacturing sector, Dunne and Roberts (1991) indicate 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, exhibits high entry and exit rates of over 36 and 26 per cent per year, respectively. In contrast, the tobacco industry shows a very low entry and exit rate of about 2 and 6 per cent 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, research & development (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 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 (for example, invention of computers), environmental change (such as landfills reaching maximum capacity), population change (for instance, the bubonic plague), government policy (like tax breaks for automobile exports), preference change, and so on. In response to a long-term shift in demand, producers must adapt. If the example of the recycling industry is taken again, some producers face a growing demand (such as recyclable goods producers) while others face a shrinking market (such as 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.

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.[17] 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 534 per cent increase in the number of plants, from 32 in 1990 to a total of 203 plants in 1998. Output increases by more than 981 per cent between 1990 and 1998. In 1990, total output of the recycling industry is only 52,912 million won, but by the end of 1998, it reaches 572,057 million won. Both industry entry and exit rates are high, averaging 36 per cent and 26 per cent 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 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.[18]

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) demonstrate that industry concentration is negatively related to firm entry in the Canadian, U.S. 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 therefore 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. Moreover, Jeong and Masson (1991) show that greater concentration reduces 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. However, it should be noted 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 reduce entry.[19] Caves and Porter (1976), Eaton and Lipsey (1980), and Baumol, Panzer and Willig (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 periods of low demand while waiting for a period of high demand. However, some empirical studies have shown that higher sunk costs do not reduce exits.[20]

In imperfect financial markets, potential entrants may face a financial entry barrier of obtaining needed financing. As small entrants can commit fewer resources, sunk costs should deter large entrants to a greater degree than small ones. Mata (1991) shows that sunk costs reduces the number of large entrants, but not that of small entrants.[21] Sleuwaegen and Dehandschutter (1991) and Fehr (1991) both show that higher capital requirements reduce 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 an 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 of capital investment 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 or 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) find 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. Alternatively, the entire 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) finds that high R&D increases entry in Canada, but reduces the survival rates of plants. In contrast, Fehr (1991) reveals that R&D reduces entry by new plants of diversifying firms in Norway, but has no effect on new plants of new firms. Mata (1991) also shows that R&D has different effects in Portugal – it reduces the number of small entrants, but does not affect large entrants. Meanwhile, R&D has 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 has no significant effect on exiting firms in Belgium.

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.

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 per cent of an industry's total number of firms, they are often small and produce only about 3 per cent of the total output.

This 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 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.

Correlation between 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 per cent of entrants in Colombia and over 40 per cent 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).

Efficiency differences among producers

In a competitive market, inefficient producers lose customers to more efficient producers, and therefore, are unable to survive. Consequently, they are forced to exit, leaving behind the more efficient producers. The coke and refined petroleum product industry in Korea typifies this process. Industry output has shown a steady increase from 9.54 trillion won in 1990 to 18.6 trillion won in 1997. Output then shows a decrease 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 suggests a steady decrease from 56 in 1997 and 51 in 1998. During the nine-year period between 1990 and 1998, 8 per cent of plants closed and 13 per cent switched out into different industries. Despite the larger number of exiting firms, their total output share is extremely low (less than 1 per cent of total industry output).

Consequence of entry and exit

Many studies have examined the effects of entry and exit, theoretically and empirically. Most have shown sizeable 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 entries and exits increase efficiency. Turnover in Canada accounts for 20 per cent 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 per cent of the existing firms' turnover within 4 years (Roberts, 1996). Lastly, Olley and Pakes' (1996) analysis of the U.S. telecommunications sector finds that productivity increases as turnover and changes in the market share among incumbents increase.

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 probably 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 are likely to 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 are likely to 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) report that entrants in Columbia are 3 per cent more productive than exiting plants, but 4 per cent less productive than continuing plants. They also show that entrants in Chile are 7 per cent more productive than exiting plants. Baldwin and Gorecki's (1991) study of Canadian manufacturing plants from 1970 to 1979 demonstrates that entrants also perform better than exiting plants.[22] Overall, entrants in Canada perform better than continuing plants as well. However, they do not perform as well as expanding continuing plants. Baldwin (1993) also finds that entrants divert market share away from continuing plants as well as exiting plants. For each additional 1 per cent of market share taken by an entrant, 0.3 per cent came from contracting plants and 0.67 per cent came from exiting plants.

Long-term performance

Older producers should perform better than younger producers due to natural selection, industrial factors[23] and learning. Baldwin's (1993) Canadian study also shows that as these entrants age, they tend to increase their number of employees, output per employee and value-added per employee. Liu and Tybout (1996) likewise show 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 hint at 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) show lower current productivity than continuing firms. These firms' productivity also tends to decrease until they exit. (As Little, Mazumdar and Page (1987), and Pursell (1990) discuss, the Indian government's policies that support failing firms have been grossly inefficient.)

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 for the period 1990-1998. The data are from the National Statistical Office's Annual Mining and Manufacturing Surveys. This study only uses 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 93 per cent of all plants are small, hiring less than 100 workers (See Table 2). Over 58 per cent of all establishments hire 10 to 49 workers, and produce less than 16 per cent of the total output. Large plants with more than 200 workers produce more than 62 per cent of the total output.

Table 2. Mean Percentages of Plants and Their Output by Number of Employees 1990-1998

(unit: %)

Number 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

Variables

Entry/exit plant statuses are further specified into births, switch-ins, switch-outs, and deaths. Other industry characteristic variables are likewise further detailed.

Exit and entry status variables

In this 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 exists 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 (for example, births) in one year over the number of total plants in the previous year (for example, 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. The 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 polices and industrial policies can change expected profits in an industry. Thus, some plants may shift their production capacity from one industry to another. The 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. Therefore, 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.

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.[24]

GNP GROWTH and INFLATION measure the macro economic effects. The average GNP growth rate in the 1990s was 6.9 per cent 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 resulted in 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,

MARKET CONCENTRATION is computed using the Herfindahl index (sum of the square of each plant's market share). Khemani & Shapiro (1983) find that four and eight concentration ratios are highly collinear with other variables. They report that the Herfindahl index gives 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 (such as the second hand market, building vs. machinery and so on). These analyses would improve this study’s 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 and exit rates, the impact of industry effects and plant performances.

Patterns of Entry and Exit

The Korean manufacturing sector seems to have substantially more entries and exits than its counterparts in the U.S., Canada, and the European Community. In contrast to their entry and exit rates of about 6 per cent, Korea's entry rate exceeds 24 per cent, and its exit rate exceeds 32 per cent.

The number of plant births and deaths are both large. During 1990-1998, new plant births account for an average of 14.4 per cent of the total number of plants each year. During the same period, 17.7 per cent of all plants die. 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 per cent of all plants in a given industry move from another industry. Meanwhile, 14.6 per cent of all plants within an industry move to another industry (possibly outside the manufacturing sector). Switching plants also tend to produce less output than continuing plants, but more output than birth or dying plants. Both types of switching plants produce about 50 per cent of the output of continuing plants. However, switching plants produce 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 per cent, with almost one out of five plants closing down by the end of the following year. By the end of 1995, 17.1 per cent of all plants are shown to be new births. That pattern can be seen again in 1998. Following a record high death rate during 1997 and 1998, the birth rate in 1998 is higher than average despite the unfavourable market conditions as described earlier.

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 per cent to below 17 per cent in 1997. Likewise, nearly one out of every four plants in 1997 died within a year.

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

(unit: %)

		Continuing		Entries						Exits					
				Births		Switch-ins		Sub total		Deaths		Switch-outs		Sub total	
Year	GNP growth	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.

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).[25] For example, after eight years, nearly 92 per cent of the original plants in the tobacco industry remain. On the other hand, less than 30 per cent of plants in the computers & calculating equipment remain. Likewise, continuing plants in the coke and refined petroleum products industry contribute as much as 99 per cent of the total output. In contrast, they contribute less than 42 per cent in the apparel and furs industry. Birth, switch-in, switch-out, and death rates can vary from a low level of around 1 per cent, 1 per cent, 4 per cent, and 2 per cent respectively, to a high level of around 28 per cent, 14 per cent, 23 per cent, and 19 per cent, respectively. Similarly, the outputs of all entry/exit plants' can be as low as 0 per cent. Meanwhile, these respective plants' outputs can also reach highs of around 19 per cent, 24 per cent, 17 per cent and 21 per cent, respectively.

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	
	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output	Plants	Output
Food and beverages	65.6	794.	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 trailors	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.

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

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 quintile of the fastest-growing industries shows more turnover than the slowest for each plant status category. The turnover rate is 18 per cent and 11 per cent for births, 11 per cent and 10 per cent for switch-ins, 13 per cent and 11 per cent for switch-outs, and 19 per cent and 14 per cent for deaths for the top quintile and the lowest quintile respectively. The average difference in turnover output share between the fastest-growing industries quintile and the slowest is even greater. The figures are 11 per cent compared to 2 per cent for births, 12 per cent compared to 5 per cent for switch-ins, 14 per cent compared to 5 per cent for switch-outs, and 10 per cent compared to 2 per cent for exits.

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

(unit: %)

Quintiles of Industries by Sales Growth rate	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

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 quintile of the fastest growing industries, turnover plants comprise more than 60 per cent of the total number of plants, and produce over 45 per cent of the total output. So, resource reallocation occurs more often among fast growing industries.

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. Using the data for 135 industries in the manufacturing sector over 1979 and 1984, Yamawaki (1991) shows that the effect of price-cost margin on the net entry rate is not significant in Japan.

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

(unit: %)

Quintiles of Industries by Price-Cost Margin	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

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. In this way, higher market concentration should reduce entry and exit, particularly for switch-ins.

However, as Table 8 indicates, 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 to choose not to close out but to switch out to other industries. Relatively speaking, plants with experience in other industries are in a better position to enter more concentrated markets than new birth plants without experience.

These results differ from Jeong and Masson's (1991) analysis of the Korean business cycle during 1977-1981, [26] in which they find that that market concentration does not deter entry but reduces exit of firms.

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

(unit: %)

Industry 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%	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

Sunk costs

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

When sunk costs are high and variable, or fixed costs are relatively low, a less efficient plant can stay in the industry. Less efficient plants in industries with high sunk costs might choose between closing-out or switching-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 of the comparison of plants and outputs in industry groups by capital equipment ratio. Higher capital equipment ratios reduce both births and deaths in terms of plant numbers. The negative effect on birth and death is much stronger when turnover rate is measured by output share. On the 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 per cent. In the lowest quintile, turnover output exceeds 52 per cent. Therefore, resource reallocation occurs more often among industries with low capital equipment ratios and those with low sunk costs.

R&D Intensity

Patents and innovation can be a better proxy than R&D intensity to measure how R&D activity affects industry turnover as they differentiate products. However, because of the lack of such information, R&D intensity is used. Moreover, as Reinganum (1983) argues, it is difficult to predict how the R&D activity affects turnover because it depends on the magnitude and importance of innovation. 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 closing out and switching out. At the same time, new birth is difficult in a market that is dominated by a 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 also 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 has the highest turnover rates in entry and exit, in terms of output shares. While it is difficult to determine the overall properties 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.

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

(unit: %)

Industry 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

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

(unit: %)

Quintiles of Industries	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

Plant Differences

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

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 access to financing similar to that of continuing plants, they need not be smaller than continuing plants.

Plant size can affect a producer's ability to survive. Smaller plants tend to have lower profits than larger plants, making them more vulnerable to unfavourable market conditions. With a small number of employees, smaller plants have less room for reducing costs while larger plants can often reduce their labour force and size in an effort to survive. Therefore, smaller plants are more likely to die than larger plants. 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, plants are classified into five quintile groups depending on the size of their employees in each five-digit industry level. Therefore, each quintile group includes the top 20 per cent of plants in each and every industry.

Table 11 shows that that smallest quintile group consists of more new births and dying plants than larger quintile group. As the plant labour 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 per cent of plants are new births, and 25 per cent of the all plants in the group will die in the following year. On the other hand, in the largest quintile group, 6.2 per cent of plants are new births, and 9.2 per cent will die in the following year. In contrast, the largest quintile group has the highest switch-ins and outs. While the switch-in and switch-out rate combined is 17.4 per cent in the smallest industry quintile, the corresponding figure for the largest group is 25 per cent.

Depending on the size of plants, the performance of each entry and exit plant varies. Among the small plants, new birth and death plants do not seem to produce less than continuing plants. On the other hand, new birth and death plants 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 per cent of the level produced by a continuing plant, and a death plant produces 28 per cent of the level produced by a continuing plant. However, in the smallest group, a new birth plant produces on average around 73 per cent of the amount produced by a continuing plant, and a death plant produces 66 percent of the amount produced by a continuing plant. Switch-ins and outs also display a 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 labour force quintile, the average output of switch-in plants is only 56 per cent of the average output of continuing plants'. However, in the smallest quintile, it is 89 per cent. This result means larger switch-in plants may suffer from inefficiencies more than small switch-in plants.

Overall, turnover occurs most often in the smallest plants, which accounts for nearly 62 per cent of the plants and over 54 per cent 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 of Employees	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

Size of Capital

In addition, plants are also classified into five quintile groups depending on the size of their assets and capital equipment ratios in each five-digit industry level. While number of employees as well as asset size and capital equipment ratio can measure the size of the plants, 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 it can 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 measure the sunk costs that each plant paid upon entry. However, if as Marta (1991) argues, the sunk cost affects only large entrants, 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 costs on turnover. Panel A indicates the effect of asset size, and Panel B shows the effect of capital equipment ratio on turnover. Both panels reveal 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 costs. Instead, entry and exit in that group takes the form of switch-ins from other industries or switch-outs. While it is not clear at all from this observation, the high level of switch-ins and switch-outs suggests that capital used in one industry might be more valuable than selling in the 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 Costs, 1990-1998

(unit: %)

Quintiles of Plants	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 the capital ratio over labour														
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

Performance

To measure the short run effects of new entrants, the magnitudes of the value-added contributions of the new entrants, total output and industry employment are calculated. Their overall contribution to the economy is quite large, especially in employment. Table 13 summarizes the results. The data shows that plants that are less than one-year old account for 5.3 per cent of value-added, 5 per cent of output, and 8.8 per cent of employment. Plants that are between one to two years old, and two to three 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 output remains stable, but they hire relatively fewer employees.

Table 14 reveals in 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 half of the initial employment level five years after entry.

Table 13. Contribution by New Entrants

(unit: %)

	Less than 1 year old			1-2 years old			2-3 years old		
Birth Year	Value-added	Output	Employment	Value-added	Output	Employment	Value-added	Output	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: %)

	Years after entry							
Birth year	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						

Death Rate of Entrants

While developed countries show that entries and exits amount to less than 3 per cent and 3.5 per cent respectively, the stable and more significant contribution by entrants in Korea is interesting. How do entrants manage such stable and 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.

The death rates of new entrants are given in Tables 15 and 16. Table 15 summarizes how many new entrants have died out over time compared to the total plants and output of each birth year. For example, 23.4 per cent of birth plants born in 1991 died within a year. In 1992, 20.1 per cent of birth plants died within a year. Between 1991 and 1997, on average 27 per cent of new entrants disappeared within a year. Similarly, the number of plants that die in the second year can be estimated. 15.2 per cent of birth plants born in 1991 die in their second year. 13.7 per cent of new entrants in 1992 die in their second year. Between 1991 and 1997, on average 17 per cent of all entrants die in the second year. Around 12 per cent of additional plants died in the third year. Within the first 3 years after entry, on average, around 55 per cent of new entrants disappear. 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. According to Table 15, among all birth plants born in 1991, 23.4 per cent die within a year. Those plants produce around 16.3 per cent. Therefore, in 1991, a representative birth plant that died within a year produces 0.697 per cent of output. In other words, it produces only 69.7 per cent of the average output of all birth plants. Similarly, in 1992, a birth plant that dies within a year produces 0.98 per cent of output, reaching 98 per cent of the average output of all birth plants. Although the ratio varies widely over time, on average, plants that die within a year produce around 73 per cent of other entrants' average product. Plants that close out in later years produce more output that those that close out soon after the entry. Plants that are still alive after 5 years produce output levels 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 the age composition of dying plants in each year. In 1991, 28.4 per cent of closing plants are born in the same year. Those plants that die within a year after birth produce 18.8 per cent of the total output produced by all death plants in 1991. In 1992, 22.1 per cent of death plants are born in the same year. They produce about 12.5 per cent of the total output produced by death plants. In 1993, 45.2 per cent of deaths are born in the same year, and produce about 30.8 per cent of the total output by death plants. On average, almost 30 per cent of all plants that die each year are less than 1 year old. They produce 18.5 per cent of the output by all dying plants. This again suggests that plants dying young are smaller than those dying old.

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

Surviving Entrants' Performance Over Time

As a group, the contribution of new entrants measured by value-added and output remains stable over time. But, most new entrants are vulnerable and subject to exit risks. According to Table 15, 27 per cent of newborn plants die within a year. Within three years, over 55 per cent die. 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.

Compared to the initial average performance, each entry cohort improves its value-added and product. Table 17 summarizes the ratio of performance after entry using a first year as a base year. Panels A, Band C measure performance by average value-added, product and employment, respectively. In Panel A, the first year-value added of the entrant cohort of each birth year is normalized to be 100. The average value added is 153.3 for the plants that survive their second year after being born in 1991, and is 128.3 for the plants born in 1992. Between 1991 and 1997, plants that survive their second year display on average, more than 40 per cent increases in value-added. Plants that survive 5 years after entry almost triple their value-added since their births. Similarly, average output by surviving entrants has increased rapidly. Birth plants that survive their second year reach on average, output levels of 145.2 compared to the normalized level of 100 in their first year, showing more than a 45 per cent increase. Moreover, output increases by 400 per cent 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 increases by 18 per cent and 16 per cent respectively, compared to their initial year. These figures are lower than the average growth rates. Since the birth plants in 1997 faced a serious economic downturn, their average value added and output has not increased as fast as other entrant cohorts. However, the rapid growth despite unfavourable macro economic environment suggests that entrants with huge growth potential survive.

On the other hand, the average employment by surviving entrants does not show any rapid increases. For example, for plants born in 1991 that survive in later years, the level of employment does not increase as fast as value added or output. On average, birth plants that survive their second year employ 110.9 compared to 100 in their first year. As Panel C shows, the highest level of employment is 163.8 - by plants born in 1993 and which have survived their fifth year. Therefore, on average, employment by the surviving plants exceeds initial employment by no more than 64 per cent. These results suggest that labour productivity of surviving plants increases fast over time.

Table 17. Surviving Entrants' Performance over Time 1990-1998

(unit: %)

Birth	Years after entry							
Year	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						

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, the question of whether closing plants' performance is different from continuing ones is examined.

Among new entrants, continuing plants and closing plants 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 is 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 close immediately after their birth demonstrate much lower performance than continuing ones. In their final year, closing plants' average product amounts to only 45 per cent of that of continuing plants. Moreover, plants that close in imminent years also have a lower output share. This implies that lower performance is one of the major sources of plant deaths.

However, there are exceptions. Some plants with several years of operating experience that had closed in 1997 and 1998 show almost as high as, or higher performance than continuing plants. For example, for plants born in 1991 but which had died during the economic crisis, their output ratio reached over 91 per cent of that of continuing plants. Moreover, plants born in 1992 but which died in 1997 show that their average output ratio of 112 per cent was even greater than that of continuing plants. Therefore, it is difficult to say that the cause of closure during this period is 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.

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						

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, the effects of macroeconomic conditions, changes in demand, and industry characteristics on industry performance are tested. Then, the issue of whether entrants and exits have varying plant performance is also tested.

Turnover determinants

The birth, switch-in, switch-out and death rates are modelled with separate regressions for each plant status. Regression uses the number of plants in each entry and exit status over the total number of 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. It should also be noted that other variables including network economies (Gilbert, 1989), government policies (Jeong & Masson, 1991) and the relations between domestic and 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. However, they reduce switch-in rates in the market. Surprisingly, switch-out rates increase. A 1 per cent rise in GNP growth, on average, increases the birth rate by 3.3 per cent, and reduces the switch-in rate by 3.1 per cent. 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 per cent reduction in the birth rate, 19.5 per cent reduction in the switch-in rate, and a 77.18 per cent and 100.10 per cent 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 per cent rise in the industry growth rate, on average, increases the birth rate by 8.7 per cent, and the switch-in rate by 13.3 per cent. On the other hand, the industry growth rate affects exit rates on a much smaller scale - 0.58 per cent of death rates and 2.1 per cent 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-in plants are usually larger than birth plants. Mata (1991) argues that large entrants face more potential retaliation than small entrants.

As expected, capital requirement (a proxy for sunk costs) reduce the entry rates, suggesting that it plays a role as an entry barrier. Moreover, it also reduces exit rates, suggesting that higher sunk costs reduce exits. This is in line with the arguments of Caves and Porter (1976), Eaton and Lipsey (1980) and Baumol, Panzer and Willig (1982).

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

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

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)		
Total 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
Number 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)		
Total 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
Number of observations	3,295	3,129	3,109	3,087
R^2	0.5849	0.3076	0.4860	0.4252

Modelling plant performance

Plant performance is measured through two outcome variables: TOTAL PRODUCT and LABOUR 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, plant characteristics such as PLANT SIZE and AGE are also 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 industry growth, market competition, high capital equipment ratio and R&D intensity all tend to increase total output and labour productivity, Since plants in a concentrated market have market power, they choose their profit maximizing output, which is above the minimum average cost. On the other hand, since competitive industries produce maximum output at the minimum production cost at equilibrium, higher market concentration should reduce output. Likewise, R&D differentiates products and reduces effective competitiveness, and hence should also increase plant output. In contrast, increasing capital per person increases labour productivity, so output should also increase, *ceteris paribus*.

Differences in Plant performance

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, perform 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. However, their relative performance depends on the performance measures used.

Due to limited access to financing, birth plants are smaller. Controlling for size and other factors, birth plants perform worse than dying plants when performance is measured using output level. This implies that birth plants have difficulties building a large enough capacity to meet the economies of scale. When performance is measured using output, dying plants, in turn, perform worse than switch-out plants, and switch-out plants perform worse than switch-in plants. Switch-in plants perform significantly worse than continuing plants.

On the other hand, when performance is measured using shipments or labour ratio or profitability, both types of plants have lower performance than continuing plants. Moreover birth plants show better labour productivity and profit rate than dying plants. In addition, plant age also predicted better performance, suggesting a natural selection process or the presence of learning effects. The remaining variables do not show any unexpected effects.[27] These results imply 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/labour
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
Number of observations	558,854	558,854
R^2	0.6128	0.2438

6. SUMMARY AND 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. Despite frequently made theoretical arguments and other countries' experiences, the price-cost margin does not appear to affect entry or exit except for the number of switching plants. The paper also finds that turnover rates of the previous year have an effect on the current year's 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 labour productivity and profit rates than dying plants. The paper also notes that the performance of surviving entrants shows improvement over time. Such an observation implies that turnovers improve efficient resource allocation as entrants use resources released from closing plants and their performance improves over time.

Entry and exit information at the establishment level, not the firm level, is 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. An 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 entering 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) proposes 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.

NOTES

1. The source of the GNP growth rate is: Korea Development Institute (KDI), Major *Indicators of the Korean Economy.*

2. The source of the unemployment rate is KDI, *Major Indicators of the Korean Economy*, re-quoted from the Ministry of Labour.

3. The U.S., 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 U.K., where industry growth rate show a negative effect on entry rates. See Goreki (1991) for the case of the U.K., Fehr (1991) for Norway, Jeong and Masson (1991) for Korea, Sleuwaegen and Dehandschutter (1991) for Belgium, and Dunne and Roberts (1991) for the U.S. case.

4. The U.S., 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 U.K., 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 U.S. case. Sleuwaegen and Dehandschutter (1991) and Dunne and Roberts (1991) report that higher price-cost margins reduce exits.

5. Both use capital divided by revenue to measure sunk costs.

6. Dunne and Roberts (1991) state that sunk costs, as measured by capital divided by revenue, increases 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) suggest that fixed costs do not significantly affect exits.

7. Mata (1991) uses 2 measures of sunk cost, average life of equipment and the ratio of new equipment bought to total equipment.

8. Baldwin and Gorecki's measures include efficiency, productivity and employee pay. The efficiency ratings are as follows: exiting plants, 58 per cent; new plants, 62 per cent; and expanding continuing plants, 68 per cent. Likewise, entrants are 24 per cent more productive than contracting plants, and 4 per cent more productive than continuing plants. However, they are only 97 per cent as productive as expanding continuing plants. Entrants also pay higher wages and salaries than exiting plants, but less than continuing plants do.

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

10. While 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.

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

12. They use 48 four-digit and14 five-digit industries.

13. Market concentration shows a significant positive effect on log shipments. However, this is reversed when the model includes industry-specific effects.

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