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# Tobin's q for the Merging Firms in Korea

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**<Abstract>**

This study investigates whether mergers transactions are allocationally efficient using Tobin's q as a variable which summarizes the investment opportunities of firms The hypothesis is as follows acquiring firms' qs should be significantly higher than those of control firms, on average. Since the most of target firms are not listed companies, the relevant data to calculate q's are not available, and thus target firms are not included in the study.

After correcting for the bias which may result from choice-based sampling, a paired comparison t-test was employed to test the hypotheses.

Tobin's q-values for listed manufacturing firms for the period from 1981 to 1994 were generally very close to the equilibrium value of one--ranging from the low 90's to high 10's Responses to the market trend of q were not markedly different from each other. A paired comparison t-test showed that the average value of q values (when not adjusted to market responses) for the acquiring firms was significantly higher than the average value for control firms at significance level 0 1 However, the result was not significant when adjusted q values are used The behavior of acquirers is not consistent with the implications of allocationally efficient takeover markets

# 한국 합병기업의 토빈 q 특성

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**<요 약>**

본 연구는 1981년 부터 1995년 까지 행해진 우리나라 제조업의 기업합병이 배분의 효율성을 증대시키는 합리적인 동기하에서 이루어져 왔는지를 토빈의 q 를 이용하여 검증하였다 토빈의 q는 기업의 투자기회를 요약하는 대표적인 변수의 하나로 기업의 시장가치를 대체원가로 나눈 것이다 시장이 균형을 이룬다면 q값은 1이 된다 이러한 q이론을 이용하면, 기업합병을 행한 기업들의 q값이 표본기간동안 합병을 행하지 아니한 통제기업의 q보다 커야 효율적인 결정이라고 할 수 있으므로 이러한 가설을 대상으로 Paired t 검증을 실시하였다 T 검증을 실시하기 위해서는 여러 가지 가정이 필요하나, 그 중 가장 중요한 것이 표본의 독립성이다 그러나 본 연구와 같이 표본 선택이 독립적으로 이루어 질 수 없는 관찰연구(Observational Studies)에서는 편기가 발생한다 이러한 편기를 제거하기 위해 기업의 규모와 산업분류를 이용하여 유사한 기업을 선택하여 통제집단을 형성하였을 뿐만 아니라, 시장 전체의 q의 변화에의 민감도를 집단별로 파악하고 이의 영향분을 원래의 q에서 제거한 후, 이를 대상으로 T 검증을 실시하였다

우리나라 기업의 q값은 표본기간 동안 대체로 균형값인 1에 가까운 0 9와 1.1 사이에 분포되어 있었다 시장에의 민감도를 고려하지 않았을 때에는 0 1의 유의수준에서 실험집단인 합병기업의 q가 통제집단의 q보다 통계적으로 유의한 높은 값을 나타냈지만, 시장변화에의 민감도를 조정한 후에는 두집단의 차이는 없었다. 이러한 결과는 우리나라에서 행해진 기업합병은 배분의 효율성을 증대시키는 투자가 아니었음을 보여준다

자료의 부족으로 합병대상기업에 대한 분석을 실시하지 못한 것이 본 연구의 한계로 추후, 보완연구가 이루어 져야 할 것이다.


## Ⅰ. Introduction

Three different concepts of capital market efficiency appear in the literature--informational efficiency, allocational efficiency, and operational efficiency Allocational efficiency is most important Informational efficiency is a necessary, but not a sufficient, condition for allocational efficiency Allocationally efficient markets result in the best utilization of resources for shareholders, i e , pareto optimality [Blume and Friend, 1978, p 145]

Takeovers are recognized as an important method of achieving allocational efficiency Managements which do not maximize shareholders' wealth are potential targets for takeover bids In this sense, takeover activities can be viewed as a process of creative destruction [see Schumpeter, 1950].

It is unlikely that all takeover attempts improve economic efficiency Decisions to merge are up to shareholders. takeovers succeed only when a majority of shareholders approve Shareholders simply choose the highest offer [Jensen and Ruback, 1983, p 6] Manne's [Manne, 1965] interest in the "market for corporate control", has led to attempts to understand participants' motives, the impacts of merger announcements on the shareholders' wealth (both bidders and targets), the effects of takeover regulations on the profitability and probability of takeover bids, and the effects of various defensive strategies on shareholders' wealth.

Most studies focus solely on stock market returns to the shareholders of participating firms Studies estimate abnormal returns, using event-study methodologies, for successful and unsuccessful bidding and target firms around the announcement date of tender offers and mergers [Bradley, 1980, Bradley and Wakeman 1983, Asquith 1983, Eckbo 1983, Maalatesta 1983, Kaplan and Ruback 1995] to measure the wealth effects of takeover activities

Few studies examine financial characteristics of participating firms, other than returns. Monroe and Simkowitz [1971] concluded that targets are generally smaller, and targets have lower price earning ratios, lower dividend payout ratios, and lower equity growth. They suggeted that such characteristics may play a role in motivating mergers, although the exact nature of this role is unclear. Stevens [1973] studied the financial characteristics of acquired firms ; his results are inconsistent with those of Monroe and Simkowitz. He found liquidity to be important, but dividend payout ratio and PE ratio are not Harris, et al. [1982] examined financial statement variables and product market characteristics to determine whether these characteristics of acquired firms differ from those of non-acquired firms. They found product market characteristics not to be important, but size (small) and PE ratio (low) to be affected when a firm was acquired. In general, these studies do not give a consistent picture of acquired and acquiring firms, and do not give clearcut evidence favoring certain merger motives.

There are understandable reasons for these inconsistencies. The time periods of the studies were different, characteristics of acquired firms may change over time Many of the studies dealt with only either acquired firms or acquiring firms Takeovers are events involving two or more firms, studies which consider only one party may give erroneous impressions. Finally, most of the studies, implicity or explicity, attempt to test a particular theory of merger motives. This may affect variable selection and bias interpretations of the results. To alleviate these problems, a more general and multicausal model with control samples is needed

Kim, et al [1996] measured Tobin's q for the Korean Manufacturing firms Kim [1992] also measured q to analyze the relatioship between ownership structure and firm value Servaes [1995] used Tobin's q to analyze the gains from takeovers

This study investigates firm's external investments (obtaining control of other firms) to determine whether such decisions are consistent with optimal investment strategy which maximizes shareholders' wealth. Tobin's q represents a firm's investment opportunities Several studies [Hayashi 1982, Yoshikawa 1980] claim that Tobin's q theory of investment is equivalent to the neoclassical theory of investment, which includes adjustment cost The purpose of this study is to examine whether markets are allocationally efficient in terms of firms' investment behavior as measured by Tobin's q using case controlled methodology.

# Ⅱ. The Theory of Investment

## 2.1 Neoclassic Theory

Haavelmo [1960], Lerner [1944], and Witte [1963] argue that there is no investment demand schedule for an individual firm With constant prices, competitive markets, and small enough firms, firms can adjust instantaneously to the desired stock of capital, which is constant Therefore, investment is always equal to the amount of depreciation, and there is no investment function as such In other words, capital is adjusted to the desired level of capital stock instantaneously at the initial time, and kept constant over the planning horizon (see [Haavelmo 1960, p 263])

Jorgenson [1967] contended "it is possible to derive a demand function based on purely neoclassical considerations" He obtained the investment demand schedule by changing prices for investment goods over time Thus, investment changes over time depending on the time path of price Tobin [1967, p 157] argues that the basic tenet of the Lerner-Haavelmo argument, instantaneous adjustment to desired capital stock is unchanged in Jorgenson's model, Jorgenson's model would also give constant investment over time if constant prices are assumed

The earlier version of the neoclassical approach developed by Jorgenson derives the optimal capital stock under constant returns to scale and exogenously given output To obtain an investment schedule, a distributed lag function for net investment is employed This approach was criticized for its inability to determine the rate of investment , rather, it relied on an ad hoc stock adjustment mechanism [Hayashi 1982, p 213] Employing a distributed lag function for investment implicitly assumes that some sort of adjustment costs are needed to change capital stock This leads to the explicit inclusion of adjustment cost in the neoclassical theory of investment

Jorgenson and others [Gould 1968, Lucas and Prescott 1971, Treadway 1969, Uzawa 1969] worked to improve investment theory of firms Adjustment costs were explicitly included in the firm's optimization problem Including a convex adjustment cost function allows optimal investment to be uniquely determined and constant over time as the capital stock monotonically approaches the long-run desired level (as time approaches infinity)

An alternative is the q theory suggested by Tobin [Tobin 1967, Tobin and Brainard 1977] where the rate of investment is a function of q, the ratio of the market value (MV) of the new additional investment goods to their replacement costs (RC) Yoshikawa [1980] and Hayashi [1982] have shown that the neoclassical theory of investment with adjustment costs is equivalent to Tobin's q theory

## 2.2 Tobin's q Theory of Investment

Tobin [1969] claimed that the rate of investment is related to q, the value of capital relative to its replacement costs. In equilibrium, each firm should have a q value of one If a firm has value of q above one, then the firm should expand investment in excess of requirements for replacement and normal growth. The essential insight underlying Tobin's q theory of investmentis that, in a taxless world, firms invest so long as each dollar spent purchasing capital raise the market values of the firms by more than one dollar, a q below one should discourage investment.

An important characteristic of the q theory of investment is that it can be derived by assuming that firms face adjustment costs and make investment and output decisions to maximize market value. In other words, the modified neoclassical theory of investment with adjustment costs and the q theory of investment are equivalent Lucas and Prescott [1971] were the first to recognize this. Yoshikawa [1980] showed that the optimal rate of investment is the rate for which q-1 equals the marginal cost of installment under the assumptions of static expectation and the constant return-to-scale technology Hayashi [1982] shows the equivalence of the two theories of investment in a more general model

## 2.3 Microeconomic Foundations for q

Following Hayashi [1982, p 214], consider a firm maximizing the present value of future after-tax net receipts

$$W(O) = \int_0^{\infty} R(t) \exp\left[ - \int_0^{t} r(s) ds \right] dt \tag{1}$$

where r(s) is the nominal discount rate, R(t) is profits after tax plus depreciation tax deductions minus purchases of investment goods plus investment tax credits, and

$$R(t) = [1 - u(t)]\pi(t) + U(t) \int_0^{\infty} D(x, t-x) u(t-x) I(t-x) dx - [1 - i(t)] u(t) I(t) \tag{2}$$

where $\pi(t)$ is profits before tax at t, U(t) is the corporate tax rate, D(x, t-x) is depreciation allowance per dollar of investment for tax purposes on assets of age x according to the tax code that was in effect at time t-x, u(t) is the price of investment goods, I(t) is investment, and i(t) is the rate of investment tax credit

Profits, $\pi(t)$, are defined as

$$\pi(t) = p(t) F[K(t), L(t)] - w(t) L(t) \tag{3}$$

where p(t) and w(t) are the prices of output and factor inputs at time t F is a production function K(t) and L(t) are capital stock and the vector of variable factor inputs, respectively

The capital accumulation constraint is

$$\dot{K} = \psi(I, K; t) - \delta K \tag{4}$$

In this formulation, I units of gross investment do not necessarily turn into capital only $\psi \times 100$ percent of investment does $\psi$ is assumed to be increasing and concave in I

The firm's problem is to maximize equation (1) subject to the capital accumulation constraint (4). By substitution, equation (1) can be reduced to

$$W(O) = \int_0^{\infty} [(1-u)\pi - (1-\imath - z)uI]\exp[-\int_0^t rds]dt +$$

$$\int_0^{\infty} [U(t)[\int_{-\infty}^{0} D(t-v, v)U(v)I(v)dv]\exp[-\int_0^t rds]]dt \tag{5}$$

where $Z(t) = \int_0^{\infty} u(t+x)d(x,t)\exp[-\int_0^x r(t+s)ds]dx.$

The second term in equation (5) represents the present value of current and future tax deductions attributable to past investments, referred to as A(O) Since A(O) is independent of current and future decisions by the firm, the optimization problem is equivalent to maximizing the first term in (5) with respect to I and L subject to equation (4) The production function is not constrained in Hayashi's treatment The maximum principle approach is adopted to solve the problem

The first order conditions for optimality are [Hayashi, 1982, p. 217]

$$\pi_L = 0 \tag{6}$$

$$(1-\imath-Z)u = \lambda \Psi_I \tag{7}$$

$$\dot{\lambda} = (r + \delta - \Psi_k) - (1-u)\pi_k \tag{8}$$

$$\lim \lambda(t)k(t)\exp(-\int_0^t rds) = 0 \tag{9}$$

where $\lambda$ is the shadow price for constraint (4) Equation (6) is the marginal productivity condition Equation (8) states that $\lambda$ is the present value of additional future profits that are due to one additional unit of current investment Equation (7) can be rewritten as follows

$$(1-i)u+(1-\psi_I)=\lambda+Zu \quad (7')$$

Here, the first term of the LHS of equation (7') is the acquistition price of new investment goods from the viewpoint of the firm. The second term of the LHS of (7') represents adjustment costs associated with investment. The second term of the RHS of equation (7') is the present value of tax deductions due to one unit of current investment Thus, (7') states that, in equilibrium, the marginal benefit of installing one unit of new investment goods is equal to the marginal cost of doing so.

Tobin's q can be defined as follows.

$$\text{marginal } q=\lambda/u=q_m \quad (10)$$

$$\text{average } q=w/uK=q. \quad (11)$$

Using these definitions, equations (7) and (8) can be rewritten as [Hayashi, 1982, p 217]

$$1/\psi_1=q_m/(1-i-z) \quad (7'')$$

$$\dot{q}_m=(r+\delta-\hat{u}-\psi_k)q_m-(1-u)\pi_k/u \quad (8')$$

where $\hat{u}=u/u$ Solving (7'') for I to obtain the optimal investment rule

$$I=a(q,K;t) \quad (12)$$

where $\widetilde{q_m}$, modified qm, is defined as qm/(1-i-Z). "All the information about the demand curve for the firm's output and the production function that are relevent to the investment decision is summarized by qm" [Hayashi, p. 218] Hayashi also shows that if the installation function, $\psi$, is linearly homogeneous in I and K, then (12) is reduced to $I/K=\beta(\widetilde{q_m}, t)$.

## 2.4 Applications of Tobin's q

Tobin's q has been used as an explanatory variable to evaluate the monopoly status of a firm Lindenberg and Ross [1981] used q to assess the monopoly rents of a firm Smirlock et al. [1984] also used q to examine the empirical relationship between firm rents and market structure. Chappell and Cheng [1984] considered whether q signals favorable opportunities for a firm to make acquisitions All of these studies found q useful in measuring a firm's monopoly power and for evaluating the profitable investment opportunities available.

Hasbrouck [1985] studied differences in the financial characteristics of target and non-target control firms using multivariate logit analysis. Control firms were selected by matching using either size or industry groupings The variable used as explanatory variables were q, size of firm, total financial leverage, long-term financial leverage, current liquidity and net current liquidity Hasbrouck's results indicate that target firms are characterized by low q ratios and, to a lesser extent, high liquidity Servaes [1995] also used Tobin's q to estimate the gains from takeovers

# Ⅲ. Methodology

## 3.1 Hypothesis

The main hypothesis of this study is that markets are allocationally efficient Since a firm's opportunity to invest is summarized by Tobin's q, q can be used to evaluate whether markets are allocationally efficient High q firms should invest [Chappel and Cheng 1984, Hayashi 1982] and low q firms should divest [Hite and Owers 1983, Miles and Rosenfeld 1983, Shipper and Smith 1983] to better allocate the resources of a society Implications of Tobin's q theory of investment provide the following research hypothesis

Ho There will be a significant difference in the q's of acquiring and control firms, which are not involved in the market for corporate control

## 3.2 Measurement of Tobin's q

Theoretically, Tobin's marginal q is related to the firm's rate of investment [Hayashi, p 218] Direct measurement of Tobin's marginal q is not possible Tobin's average q is used as a proxy of the marginal q Even though marginal q is theoretically appropriate, the use of average q to explain investment has been supported by Tobin and Brainard [1977, p 243] and average q has been used frequently in empirical work

For each sample firm, Tobin's q is calculated for the takeover year using the most recently preceding year in which financial information is available.

Tobin's q for the control firm is calculated for the calendar year corresponding to that of the sample firm Differences in fiscal years between firms are ignored

3 2 1 Market Values (MV)

The market value of a firm is the sum of the market values of the common stock, preferred stock, and debts Multiplying recorded year-end common stock prices and preferred stock prices by the numbers of shares outstanding respectively, market values of common $MV_t(cs)$ and preferred stock $MV_t(ps)$ can be calculated easily

MV of debt is difficult to obtain from book value data. The market value of debts depends on the maturity distribution of the firm's debts, interest payments and the appropriate discount rate. Lindenberg and Ross [1981] provided an approximation method which may be useful for the U S. firms where the maturity of debt is generally longer than those of Korean firms Lindenberg and Ross's approximation method did not consider the diverse kinds of debt. To calculate the maket value of debts more realistic, the method adopted in Kim et. al [1996] was used in this study

To estimate the maket value of debts, debts are classified into short term debts and long term debts Short term debts are divided again into two parts, interest bearing debts and non-interest bearing debts like accounts payables. The book value of non-interest bearing short term debts ($BV_t(nibstd)$) are used as the proxy for the market value, under the assumption that the risk of the debt is negligible and the time to maturity is just around the corner

The market value of interest bearing debts was calculated by following method.

First, total interest payment for the year t are classified into short term debt interests, domestic long term debt interests and overseas long term interest payments, by assuming that interest payments are proportional to their book value of the debts

The market value of short term interest bearing debt is obtained by discounting the sum of interest payment and the book value of the debt at the current interest rate of Certificate of Deposit

$$MV_t(ibstd) = (Interest_t(ibstd) + BV_t(ibstd)) \frac{1}{(1+r)} \quad (13)$$

$MV_t(ibstd)$ is market value of interest bearing short term debt at time t Interestt(ibstd) means interest payment estimated by interest bearing short term debt at time t $BV_t(ibstd)$ is the book value of interest bearing short term debt at time t r is the interest rate of Cd at time t.

The market value of domestic long term debt ($MV_t(dltd)$) are calculated by discounting the interest payments ($Interest_t(dltd)$) at the current interest rate of bank loans (i) under the assumption that the long term debt is 3 year ordinary annuity.

$$MVt(dltd) = Interest_t(dltd)\left(1 - \frac{1}{(1+i)^3}\right)i^{-1} + BV_t(dltd)) \frac{1}{(1+i)^3} \quad (14)$$

Since the amount of interest payment and the interest rate on bonds are available in the data, the market value of bonds are calculated as below The present value of bond formular can be used to calculate the market value of bonds The time to maturity was assumed as 3 years

$$MV_t(bond)=Interest_t(bond)\ (1-\frac{1}{(1+k)^3})\circ k^{-1}+BV_t(bond))\ \frac{1}{(1+k)^3} \quad (15)$$

The market value of overseas long term debts ($MV_t(oltd)$) was obtained by using similar method described before But the time to maturity was assumed as 5 years and the appropriate discount rate are London Inter Bank Offer Rate+1 5% (s)

$$MV_t(oltd)=Interest_t(oltd)(\ 1-\frac{1}{(1+s)^5})\cdot s\text{-}1+BV_t(oltd))\cdot \frac{1}{(1+s)^5} \quad (16)$$

Total market value at time t, MVt, is defined as

$$MV_t=MV_t(cs)+MV_t(ps)+BV_t(nibstd)+MV_t(ibstd)+MV_t(dltd)+MV_t(bond)+(MV_t(oltd) \quad (17)$$

3 2 2 Replacement Cost (Hereafter, RC)

RC is defined as "the dollar outlay needed to purchase the current prouductive capacity of the firm at minimum cost and with the most modern technology available" [Lindenberg and Ross 1981, p 12]. Therefore, not only inflation but technological advances and real depreciation must be considered to determine RC However, underdeveloped market for used capital goods and no objective ways to evaluate the technological advances of individual capital asset are two major difficulties to assess the replacement cost of firm's asset correctly

Firm assets fall into three broad categories plant and equipment, inventories, and other assets Other assets include liquid assets such as cash and marketable securities, and not liquid assets like buildings and land Liquid assets such as cash and intangible fixed asset are assumed to have replacement cost equal to book value. Investment assets are mostly marketable securities Thus, the replacement cost of the investment assets can be obtained by adjusting the price changes.

However, the necessary data to adjust this price change were not available in the KIS-FAS data Thus, book values of investment assets were regarded as market values as a matter of convenience

Since most of Korean firms use LIFO or average method as inventory valuation method, the replacement cost of the inventory may be quite different from the book value To obtain the replacement costs of inventory, following method was used

The book value of inventory for the beginning year, 1980, was assumed to be the replacement cost The replacement cost of inventory $RC_t$(Inventory) for the next year was calculated by the following equation [Kim et al., 1996, 162-164] ,

$$RC_t(Inventory)=RC_{t-1}(Inventory)\ (\frac{p_t}{p_{t-1}})+(BV_t(inventory)-BV_{t-1}(inventory)) \quad (18)$$

where pt represent industrial goods wholesale price index at t. If the book value of inventory is decreased for the year t, then the following equation was used to obtain the replacement cost of inventory, i.e.,

$$RC_t(\text{Inventory}) = (RC_{t-1}(\text{Inventory}) + BV_t(\text{inventory}) - BV_{t-1}(\text{inventory})) \cdot \left(\frac{p_t}{p_{t-1}}\right) \qquad (18')$$

The replacement cost for building, plant and equipment was estimated by the following method. First, average rate of depreciation per year, $\delta$, was estimated by using the data from 1980 to 1994.

$$\delta = 1/14 \cdot \Sigma(\text{depreciation}_t/(\text{building}_t + \text{depreciation}_t)) \qquad (19)$$

Second, the replacement costs of building and plant for the year 1980 were assumed to be equal to the book values of the assets, i.e., $RC_0(\text{building}) = BV_0(\text{building+building in construction})$.

Third, the replacement cost for the later years ($RC_t(\text{building})$) was calculated by the following equation.

$$RC_t(\text{building}) = \left[RC_{t-1}(\text{building}) \cdot \left(\frac{p_t}{p_{t-1}}\right) + \Delta BV_t(\text{building+building in construction}) + \text{depreciation}_t\right] \cdot (1-\delta) \qquad (20)$$

where pt denotes construction goods wholesale price index at time t. The replacement cost for equipment ($RC_t(\text{equipment})$) adopted same method used in estimating $RC_t(\text{building})$. The only difference is that capital goods wholesale price index was used as pt.

Because land is not a depreciable asset, unlike building, the replacement cost for land ($RC_t(\text{land})$) is estimated by a little different method as used in obtaining $RC_t(\text{building})$. $RC_t(\text{land})$ was estimated by the following equation,

$$RC_t(\text{land}) = RC_{t-1}(\text{land}) \cdot \left(\frac{p_t}{p_{t-1}}\right) + \Delta BV_t(\text{land}) \qquad (21)$$

where $\Delta BV_t(\text{land})$ means difference in book values of land from year t-1 to t and pt is the land price index. If it is negative, it means that there was sale of some land at time t. if this occurs, the land was assumed to be sold after 5 years of possession since acquisition. That is to say, the growth rate of land price for the past 5 years were calulated and then $RC_t(\text{land})$ was adjusted using following equation,

$$RC_t(land)=RC_{t-1}(land)\cdot\left(\frac{p_t}{p_{t-1}}\right)+\Delta BV_t(land)\cdot g \qquad (21')$$

where g means the average growth rate of land price for the past 5 years from t
Total replacement cost for the firm, $RC_t$, at t year is defined as followings

$$RC_t=BV_t(cash)+BV_t(investment\ assets)+BV_t(intangible\ fixed\ assets)+$$
$$RC_t(inventory)+RC_t(building)+RC_t(land)+RC_t(equipment) \qquad (22)$$

Tobin's q at time t, qt, is defined as following,

$$q_t=\frac{MVt}{RCt}. \qquad (23)$$

3.2.3 Average Tobin's q for the Korean Manufacturing firms

Tobin's qs were calculated for the Korean manufacturing firms for the period from 1981 to 1994 Table 1 shows yearly average, standard deviation, minimum and maximum values of tobin's q, along with the number of firms included in the calculation

Table 1 Yearly Average Tobin's q

| Obs | Variable | N | Minimum | Maximum | Mean | Std Dev |
|---|---|---|---|---|---|---|
| 467 | Q81 | 188 | 0 4722490 | 1 6240420 | 0 8682284 | 0 1614307 |
| | Q82 | 190 | 0 4370530 | 2 2395550 | 0 9160687 | 0 2344650 |
| | Q83 | 192 | 0 0053730 | 3 4896920 | 0 9349144 | 0 3237022 |
| | Q84 | 207 | 0 1928150 | 3 3041120 | 0 9284990 | 0 3191584 |
| | Q85 | 216 | 0 2441000 | 3.0030650 | 0 9205730 | 0 2930601 |
| | Q86 | 223 | 0 3515910 | 6.8764300 | 1 0096517 | 0 4953175 |
| | Q87 | 253 | 0 3897730 | 4.9158660 | 1 0695588 | 0 3850062 |
| | Q88 | 325 | 0 3881280 | 5.4846840 | 1 0731516 | 0 3998882 |
| | Q89 | 402 | 0 3384350 | 5.1860300 | 0 9643037 | 0 3647544 |
| | Q90 | 431 | 0 2772210 | 5 7429090 | 0 9884571 | 0 3516289 |
| | Q91 | 440 | 0 2467550 | 5.2122900 | 0 8228942 | 0 3007502 |
| | Q92 | 434 | 0 3476200 | 2.6359640 | 1.0200990 | 0 3009730 |
| | Q93 | 431 | 0.3190450 | 2.3247370 | 0 9791058 | 0 2450918 |
| | Q94 | 424 | 0 1635700 | 3 5988370 | 1 1723922 | 0.3919135 |

Yearly average values of Tobin's qs were very close to the equilibrium value of one, ranging from the lowest value 0.86 in 1981 to the highest 1.17 in 1994. Table 1 shows that the years, 1986, 1987, 1988 and 1994 when stock market was in boom were characterized by high q values. On the other hand, the years, 1990 and 1991, when the stock market was in bust exhibited relatively low q values. Yearly average value of Tobin's q by industry groupings are shown in Appendix A

## 3.3 Test of Hypotheses

To test the hypotheses that experimental firms' Tobin's q is significantly higher than those of control firms, the paired comparision t-test for the matched samples (adjusted for bias) was employed.

The most important assumtion of the t-test concerns two independent random samples [Edward 1967]. The problem is how to perform the t-test without having two independent random samples Other assumptions of the t-test concern the population distributions of the variables It is assumed that both samples (experimental and control) are from populations in which Tobin's qs are normally distributed and their population variances are equal Moderate departures from these two assumptions are known to have little effect on the validity of the test [Edwards, 1967, p 214].

3.3.1 Effects of Violation of the Two Independen Random Samples t-test Assumption

When there are two independent random samples, the mathematical representation of the Tobin's q data on the experimental and control group could be as follows

$$q_j^{ex} = m + \theta + e_j^{ex} \tag{24a}$$

$$q_j^{co} = m + e_j^{co} \tag{24b}$$

where m represents a parameter for the average level of Tobin's q in the control group. $\theta$ denotes the average effect attributable only to the experimental group of firms, Thus, the mean of Tobin's q for the experimental group is $m+\theta$ The variables $e_j^{ex}$ and $e_j^{co}$ are random variations which differ from one firm to another, both are assumed to have an expected value of zero.

The above model assumes that $q_j^{ex}$ and $q_j^{co}$ are drawn from populations having the same mean m To ensure that this assumption holds, two independent random samples are needed If samples are drawn independently and randomly, this simple model will be a good representation of the data What is crucial in the t-test is whether $\theta$ is zero or not If $\theta$ is significantly different from zero, Tobin's qs in the experimental firms are said to be significantly different from those of control firms

The simple estimate of $\theta$ is $\bar{d} = \bar{q}^{ex} - \bar{q}^{co}$ If equation (24) is assumed, then $\bar{d} = \theta + \bar{e}^{ex} - \bar{e}^{co}$ and $E(\bar{d}) = \theta$. If $e_j^i$ is normally and independently distributed, then d is also normal with population mean $\theta$ and standard deviation of $\sigma\sqrt{\frac{2}{n}}$ Estimates of $\sigma^2$, $s^2$, can be made from the pooled within-group mean square, where

$$s^2(2(n-1)) = \sum_j (q_j^{ex} - \bar{q}^{ex})^2 + \sum_j (q_j^{co} - \bar{q}^{co})^2 \tag{25}$$

and the quantity $(\bar{d} - \theta)/s\sqrt{\frac{2}{n}}$ will follow a t distribution with 2(n-1) degrees of freedom [Cochran 1983, pp 25-26)

It is impossible to get independent random samples. For this study, a more realistic model is used as followings [Cochran, pp. 25~26]

$$q_j^{ex} = m_{ex} + \theta + e_j^{ex} \tag{26a}$$

$$q_j^{co} = m_{co} + e_j^{co} \tag{26b}$$

with $E(e_j^{ex}) = E(e_j^{co}) = 0$ as before In this model, $m_{ex}$ is not assumed to be equal to $m_{co}$ since samples are not independent and random $\bar{a}$ will be as follows

$$\bar{d} = \bar{q}^{ex} - \bar{q}^{co} = e + (m_{ex} - m_{co}) + (\bar{e}^{ex} - \bar{e}^{co}). \tag{27}$$

The expected value of $\bar{d}, E(\bar{d})$, is $\theta + (m_{ex} - m_{co})$ which is different from $\theta$.

The quantity $(m_{ex} - m_{co})$ denotes bias If bias exists, the level of the test changes [Cochran, p 26] If the exact amount and the direction of bias are known a priori, there is no problem It is rare to be cartain about the direction and the amout of bias in observational studies, let alone to have estimates completely free from bias The problem is to keep the bias small enough that the implications are not misinterpreted [Cochran, p. 29]

### 3.4 Possible Sources of Bias

Bias is the difference between population means for the two groups of firms'

Tobin's q Tobin's q may be influenced by numerous other factors, there is likely to be at least one confounding variable differing systematically between populations. This stsyematic difference results in the difference in population means, reducing the validity of statistical tests Controlling undesirable effects of confounding variables can reduce bias Characteristics of firms (financial ratios, dividend policy, industry) may affect Tobin's q values Considering all possible confounding variables is impossible. Fortunately, as in equilibrium asset pricing models, a few variables seem to capture a major portion of the bias Three variables were considered as the major confounding variables affecting values for Tobin's q: industry, size, and responsiveness to market trend

## 3.5 Techniques to Reduce Bias

There are two principal techniques to reduce bias [Cochran], matching and adjustment in analysis. The two approaches can be decribed by considering the influence of a confounding variable x which has a linear influence on q as follows.

$$m = a + bx \tag{28}$$

Matching reduces bias by selecting $x_{ex}$ and $x_{co}$ such that they are about equal. Analysis adjustment handles bias by estimating b and subtracting $b(\bar{x}_{ex} - \bar{x}_{co})$ from $\bar{d}$, *i.e.*, $\bar{d}' = \bar{d} - b(\bar{x}_{ex} - \bar{x}_{co})$ The difference lies in the stage where confounding is handled In matching, confounding variables are treated at the planning stage Adjustment handles confounding during analysis.

3.5.1 Matching

Each member of the experimental group has a partner in the control group, where partners are within defined limits(explained later) in the values for confounding variables In other words, matching is used to make two groups of firms resemble each other in certain respects so that the two groups of firms have closer population means. Industry and size were controlled by matching

3.5.2 Adjustments for Market Trend

When the b's in (28) differ between groups, matching cannot be employed Thus, market trend should be adjusted for during analysis (as is done when calculating risk-adjusted, abnormal returns). Lindenberg and Ross [1981] devised adjustment methods which run regressions for each firm in the sample. The important issue is how two groups of firms (experimental and control) differ in their responsiveness to the general trend of market collectively, not individually.

Further, many firms had insufficient data for regression
The adjustment was done by running the following two regressions

$$q_{tj}^{ex} = a_{ex} + b_{ex}( \bar{q}_{t^m} - \bar{q}_{t^{ex}}) + e_{tj}^{ex} \qquad j=1 \cdots n \tag{29a}$$

$$q_{tj}^{co} = a_{co} + b_{co}( \bar{q}_{t^m} - \bar{q}_{t^{co}}) + e_{tj}^{co} \qquad j=1 \cdots n \tag{29b}$$

where $q_{tj}^{ex}$ and $q_{tj}^{co}$ are the values of Tobin's q for the jth firm in the experimemtal and control group, respectively, at year t, where t denotes the prior calendar year when a firm in the experimental group announces its plans for a takeover Only one value of Tobin's q is calculated for each firm in the samples.

$\bar{q}_{t^m}$, $\bar{q}_{t^m}$ and $\bar{q}_{t^{co}}$ are calculated as follows

$$\bar{q}_{t^{ex}} = \frac{1}{n(t)} \sum_j q_{tj}^{ex},\ \bar{q}_{t^{co}} = \frac{1}{n(t)} \sum_j q_{tj}^{co} \text{ and } \bar{q}_{t^m} = \frac{1}{2n(t)} \sum_i \sum_j q_{tj}^{i}. \tag{30}$$

The quantity $b_i( \bar{q}_{t^m} - \bar{q}_{t}\ )$ represents the variation in q caused by the general trend of the market The value $a_i$ represents as a long run value of Tobin's q for the ith group The difference $\bar{q}^{ex} - \bar{q}^{co}$ is

$$\bar{q}^{ex} - \bar{q}^{co} = a_{ex} - a_{co} + \sum_t b_{ex}( \bar{q}_{t^m} - \bar{q}_{t^{ex}}) \frac{n(t)}{n} \tag{31}$$

$$- \sum_t b_{co}( \bar{q}_{t^m} - \bar{q}_{t^{co}}) \frac{n(t)}{n} + \bar{e}^{ex} - \bar{e}^{co}.$$

It follows that

$$E( \bar{q}^{ex} - \bar{q}^{co}) = a_{ex} - a_{co} + \sum_t b_{ex}( \bar{q}_{t^m} - \bar{q}_{t^{ex}}) \frac{n(t)}{N} \tag{32}$$

$$- \sum_t b_{co}( \bar{q}_{t^m} - \bar{q}_{t^{co}}) \frac{n(t)}{N}.$$

After estimating $b_{ex}$ and $b_{co}$, $\bar{d} = \bar{q}^{ex} - \bar{q}^{co}$ can be adjusted,

$$\bar{d}' = \bar{d} - [\ \hat{b}_{ex} \sum_t ( \bar{q}_{t^m} - \bar{q}_{t^{ex}}) \frac{n(t)}{n} - \hat{b}_{co} \sum_t (q_t^m - q_t^{co}) \frac{n(t)}{N} ]. \tag{33}$$

In the regressions (29), b's are assumed stationary over time

# Ⅳ. Data and Results

## 4.1 Sample Design

Two groups of sample firms, experimental and control firms, were selected

Merging firms were selected by identifying mergers occurred during the periods from 1981 to 1995. Public announcement information from Korean Stock Exchange, the periodical "Securities Market" issued by KSE and the data from the Committee for fair trade were searched to identify the merger cases and the public announcement date As a result, seventy six mergers were identified. To obtain the homogeniety of the data, only manufacturing firms are selected as sample firms Among them, only 39 firms which has q value in the preceding year of the merger announcement are selected as final sample firms When a firm engages in several merger transactions, only the first merger case is included in the sample. Since the purpose of this study is to examine if there is any difference in Tobin's q between acquring firms and control firms which are not merging, the q value of year preceding merger announcement date is the most meaningful. A list of the acquiring firms and the target firms, along with the merger announcement date is presented in Appendix B. Appendix B shows that there were not many mergers in the 80's, but the number of mergers are increasing in the 90's Considering the sample year, the earliest one, included in case of multiple mergers, the number of mergers in the 90's would be increased

## 4.2 Control Firms

Control firms are selected to match each member of the experimental group. To qualify as a control, a firm could not be involved in a takeover for the whole sample period Control firms of acquirers were selected by using KIS-FAS data which had the same industry code code (first Two-digit number) and were of similar size in terms of sales and total asset

At first, Two-digit industry codes were used If no control satisfying the general criteria was found, an one-digit industry code was used When several firms had the same industry code, size was employed to choose the match. Size was measured by total assets and sales--plus or minus 10 percent for the experimental firm (caliper matching). If no firm was within the 10 percent for the experimental firm, the range was increased in 10 percent steps up to 50 percent (the same industry code) Above 50 percent, the industry code was relaxed to find a control (see Appendix C)

Originally seventy-six firms were included in the sample. When a manufacturing industry restriction was applied, twenty-four firms were lost, leaving fifty-two Of these fifty-two, six acquiring firms merged more than once Only one merger for each acquirer was included in the sample leaving forty-six Seven firms were deleted because of missing information needed to calculate Tobin's q The final sample consisted of thirty-nine firms in each of two sample groups Only these firms were included in the paired-comparison t-test

## 4.3 Result

4.3.1 Observed Tobin's q Values for sample firms

Tobin's q's were calculated for each sample firm Table 2 shows yearly average q's for the two different groups at the time of merger announcement year Equal weight is given to each of the sample firms to get the group averages When market value was used, the results are similar to that of the equal weight case. The average Tobin's q at the year of merger announcement for acquirers and control has a 0 1011 difference

Table 2 Yearly Average q values for Experimental and Control Firms

| Year | Experimental firms | Control firms |
|---|---|---|
| 81 | 0 8155130 | 0 8478260 |
| 84 | 0 8301660 | 0 7246255 |
| 85 | 0 9617357 | 0 7547380 |
| 86 | 0 9285650 | 0 6148300 |
| 87 | 0 5779445 | 0 6888585 |
| 88 | 2.2891060 | 0.9031160 |
| 89 | 0 9301920 | 0 7266210 |
| 90 | 1 1680502 | 1 1483438 |
| 91 | 0 9885362 | 0 9159905 |
| 92 | 0 8001080 | 0.8284755 |
| 93 | 1 1547749 | 1 1753211 |
| 94 | 0 9870442 | 0 9116320 |
| 95 | 1 1317690 | 0 9324088 |

To adjust q for the differences in the responsiveness of $\bar{q}_t$ to market trend, $\bar{q}^m$ and $\bar{q}^1$ and $\bar{q}^2$ are calculated, where $\bar{q}^m$ is the proxy of Tobin's q for the market at time t, and $\bar{q}^2$ and $\bar{q}^1$ are the averages of Tobin's q for two sample groups An adjustment regression (equation 34) for each of two sample groups was run using the individual and average q-values calculated above

$$q^1_{tj} = a^1 + b^1(\bar{q}_{t^m} - \bar{q}_{t^1}) + e^1_{tj} \qquad j=1 \cdots n \tag{34}$$

where $q^1_{tj}$ is the q-value of firm j in sample group I at year t, and t denotes the merger announcement year. The regressions were run using equally-weighted averages (eight adjustment regressions). The estimated coefficients for two groups are presented in Table 3 under the heading Experimental and Control Group

Table 3 Result of Adjustment Regressions

A: Experimental Group

| Variable | Parameter Estimate | Standard Error | T for $H_0$ Parameter=0 | Prob > \|T\| |
|---|---|---|---|---|
| Intercept | 0 987580 | 0.05664871 | 17.433 | 0.0001 |
| Slope | -1.030185 | 0.23559217 | -4 373 | 0.0001 |

B: Control Group

| Variable | Parameter Estimate | Standard Error | T for $H_0$ Parameter-0 | Prob > \|T\| |
|---|---|---|---|---|
| Intercept | 0 982888 | 0.03933911 | 24.985 | 0 0001 |
| Slope | -0 887628 | 0 21844806 | -4.063 | 0.0002 |

The intercepts, which can be viewed as long run values for q's, for the two different groups were all significant at the 01 level, regardless of which adjustment regression was used Between the two groups, there is no difference in constant. The constants for both Experimental and control group are slightly less than the long run equilibrium value of one, i e., 0.98.

The slope coefficients were negative in both of the adjustment equations. There do not seem to be marked differences in the responsiveness to the market changes among the four groups. Both of the slope coefficients were significant at the .01 significance level The null hypothesis of b=o should be rejected. This result means that the paired comparision t test should be performed after adjusting q values the difference in market responsiveness of two groups

4.3.2 Hypotheses Tests

A paired comparison t-test was employed to test the hypotheses that merging firms' q values are significantly different from their control group. The estimated variance of the differences between two paired mean values, $S^2_{\bar{D}}$, is calculated as follows.

$$S^2_{\overline{D}} = S^2_{\overline{q_1}} + S^2_{\overline{q_2}} - 2r_{q1q2}S^2_{\overline{q_1}}S^2_{\overline{q_2}} \tag{35}$$

where $r_{q1q2}$ is the correlation coefficient between q1 and q2 If rq1q2 is positive, then the standard error of the difference between two means is reduced--increasing the t-value

In an allocationally efficient market, experimental firm q-values (on average) should be larger than those of control firms The results of paired t test are presented in Table 4 The t-values were not significant at all in the 0 05 level There were no significant differences in Tobin's q between acquiring firms and related control firms When q values are not adjusted, the t-value was significant at the 0 1 level But when adjusted q value are used in the test, the mean difference in q between two grops is 0 01, T value was 0 25 Thus it can be concluded that there is no evidence to support the hypothesis that the average q-value of the experimental group was higher than that of control firms

Table 4 Results of paired t test

| | Mean | Std Error | T | Prob>\|T\| |
|---|---|---|---|---|
| Adjusted | 0 0104231 | 0 0402707 | 0 2588256 | 0.7975 |
| Unadjusted | 0 1011067 | 0 0508695 | 1 9875676 | 0 0541 |

## 4.4 Comparison to Related Studies.

4 4 1 Chappell and Cheng

The results of the paired comparison t-test, the statistically not different q values for two groups, indicates merging firms are not characterized by high q values in Korea This would not be consistent with a value maximizing process This result is not consistent with the results of Chappell and Cheng [1984], who studied the relationship between the percentage of assets acquired by mergers and several financial variables, including q, by using Tobit analysis

Chappell and Cheng estimated Tobit equations for each period from 1971 to 1978 The dependent variable used was the percentage of assets acquired by merger to the book value of firm's total assets in the year preceding merger Leverage, profitability, liquidity, growth, firm size, and q were used as independent variables Among them, q and profitability were found to be important explanatory variables

The methodology employed in this study is a case-controlled methodology in which control firms were matched by size and industry classification. Only q-value was used in this study, because theoretically, q summarizes all investment opportunities of a firm.

4.4.2 Hasbrouck

Hasbrouck [1986] sought to discern differences in financial characteristics between targets and non-targets. Hasbrouck also attempted to determine the causal mechanism for the differences, whether firm-specific or industry-related. Target firms are found to have low q-ratios and high current financial liquidity. Hasbrouck also found the attributes giving rise to the differences in q were firm-specific, while those giving rise to the liquidity differences were industry related The methodology employed in Hasbrouck's study was a multinomial logit analysis with case-control sample selection methods in which control firms were matched by either size or industry classifications.

This study employed a paired comparison t-test, while Hasbrouck used a t-test for a difference between means When the assumption of two random independent samples is not satisfied, a paired comparison test for matched samples is recommended [Edwards 1967]

The essential difference between Hasbrouck's and this study was the handling of size and industry effects. In this study, size and industry effects were removed by selecting control firms matched by both industry and size In other words, only firm-specific effects of q-values matter in this study.

## V. Summary and Conclusions

This study investigates whether mergers transactions in Korea are allocationally efficient using Tobin's q as a variable which summarizes the investment opportunities of firms. The hypothesis is as follows: acquiring firms' q's should be significantly higher than those of control firms, on average Since most of target firms are not listed companies, the relevant data to calculate q's are not available, thus target firms are not included in the study

After correcting for the bias which may result from choice-based sampling, a paried comparison t-test was employed to test the hypotheses.

Tobin's q-values for listed manufacturing firms for the period from 1981 to 1994 were generally very close to the equilibrium value of one--ranging from the low 90's to high 1 0's Responses to the market trend of q were not markedly different from each other. A paired comparison t-test showed that the average value of q values (when not adjusted to market responses) for the acquiring firms was significantly higher than the average values for control firms at significance level 0 1 But, the result was not significant when adjusted q values are used. The behavior of acquirers is not consistent with the implications of allocationally efficient takeover markets Thus, Hayashi's claim [1982, p. 218] that all the investment opportunities of a firm are summarized by q was not empirically supported in this study.

The rejection of the hypothesis may result from the failure to distinguish between two types of mergers, voluntary mergers with purely economic motives and unvoluntary mergers, considering the fact that many mergers in Korea are Government or parent company initiated activities Another limitation of this study is that target firms are not included in the analysis due to lack of data Further researches which correct above limitations are needed.

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Appendix A. Yearly Average Tobin's q by ındustry

| Ind. Code | q81 | q82 | q83 | q84 | q85 | q86 | q87 | q88 | q89 | q90 | q91 | q92 | q93 | q94 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1500 | 0 900 | 0.932 | 0.932 | 0 890 | 0 898 | 0.954 | 1.016 | 0 912 | 0.752 | 0 853 | 0 718 | 0 928 | 0.840 | 1.016 |
| 1700 | 0 841 | 0.770 | 0.773 | 0.789 | 0.804 | 0 821 | 0.851 | 0 804 | 0 728 | 0 817 | 0 722 | 0 896 | 0 809 | 0.917 |
| 1800 | 0 783 | 0 880 | 0 866 | 0.850 | 0.907 | 1 018 | 1 036 | 1 064 | 0 922 | 1 025 | 0 890 | 1 232 | 1.129 | 1 148 |
| 1900 | 0 877 | 0.986 | 1.387 | 1 351 | 1 122 | 2.335 | 1 971 | 1.704 | 1.283 | 1 362 | 1.065 | 1 104 | 1 117 | 1 392 |
| 2000 | 0.913 | 1 071 | 1.108 | 1 014 | 0.930 | 0 912 | 0 975 | 0 987 | 0 905 | 0 870 | 0 719 | 0 728 | 0 916 | 0 996 |
| 2100 | 0 948 | 0 950 | 0.934 | 1 003 | 0 877 | 0.971 | 1.069 | 1 119 | 0 845 | 1 001 | 0 794 | 0 944 | 0 931 | 1 337 |
| 2200 | | | | 1.150 | 0 799 | 0 986 | 1.145 | 1 239 | 0 835 | 1 097 | 1.029 | 1 378 | 1 216 | 1 652 |
| 2300 | | | | 1.372 | 1.197 | 1 425 | 1 208 | 1.445 | 1 253 | 1 092 | 0.914 | 1 134 | 1 147 | 1 493 |
| 2400 | 0.850 | 0.945 | 1.016 | 1 006 | 0.993 | 1.037 | 1 166 | 1 163 | 0 984 | 1 024 | 0 819 | 1 091 | 0 980 | 1.163 |
| 2500 | 0 864 | 1 016 | 1 030 | 0.962 | 0.987 | 1 047 | 1 087 | 1 050 | 0.930 | 0 870 | 0 765 | 0 981 | 0 991 | 1 082 |
| 2600 | 0 822 | 0.935 | 0.858 | 0.804 | 0 789 | 0.839 | 0 879 | 0 888 | 0.865 | 0 827 | 0.724 | 0 909 | 0 825 | 0 979 |
| 2700 | 0 790 | 0 839 | 0.891 | 0.858 | 0.808 | 0 875 | 0.950 | 0 992 | 0 986 | 0.918 | 0 773 | 0 939 | 0 960 | 1 121 |
| 2800 | 0 845 | 0.885 | 0 834 | 0.848 | 0.846 | 0 925 | 1.009 | 1.122 | 0 981 | 1.177 | 0 908 | 1 174 | 1 043 | 1 221 |
| 2900 | 0 925 | 1 009 | 0 996 | 0 992 | 0.978 | 1 050 | 1.143 | 1.142 | 1 186 | 1.106 | 0.986 | 1 066 | 0 992 | 1 238 |
| 3000 | | | | | | | | 1 316 | 1.256 | 1 299 | 1 002 | 1 556 | 1 232 | 1 598 |
| 3100 | 0 850 | 0 948 | 0 948 | 0 973 | 0.987 | 1 045 | 1 015 | 1 133 | 0.987 | 1 042 | 0.867 | 1 101 | 1 099 | 1 214 |
| 3200 | 0 934 | 0 899 | 0 907 | 0.997 | 1.009 | 1 143 | 1 191 | 1 165 | 1 079 | 1.059 | 0.864 | 1 057 | 1 103 | 1 408 |
| 3300 | 0.705 | 0 704 | 0 873 | 0 789 | 0 979 | 0 987 | 1 085 | 1 076 | 1 000 | 0 931 | 0 750 | 0 827 | 1 169 | 1 386 |
| 3400 | 1 035 | 1 063 | 0 876 | 0.929 | 1 033 | 1 125 | 0 996 | 1 191 | 1 080 | 0.989 | 0 868 | 0 941 | 0 981 | 1 072 |
| 3500 | 1 003 | 0 966 | 1 179 | 1 005 | 0 986 | 1 195 | 1 579 | 1 626 | 2 231 | 1 307 | 1 133 | 1 027 | 1 242 | 1 195 |
| 3600 | 0 871 | 0 975 | 0 899 | 0 836 | 0 868 | 0 969 | 1 045 | 0 915 | 1 010 | 0 958 | 0 838 | 1 013 | 1 054 | 1 227 |

* 1500 Foods & Beverages — 1700 Textıles
1800 Wearıng Apparel & Fur Artıcles — 1900 Tannıng & Dressıng of Leather
2000 Woods &Products of Wood & Cork — 2100 Pulp, Paper & Paper Products
2200 Publıshıng, Prıntıng & Reproductıon of Record Medıa
2300 Refıned Petroleum Products — 2400 Chemıcals & Chemıcal Products
2500 Rubber & Plastıcs Products — 2600 Other Non-Metalıc Mıneral Products
2700 Basıc Metals — 2800 Fabrıcated Metal Products
2900 Machınery & Equıpment
3000 Office, Accounting & Computıng Machınery
3100 Electrıcal Machinery & Apparatus
3200 Radıo, Televısıon & Communıcatıon Equıpment & Apparatus
3300 Medıcal Precısıon & Optıcal Instruments, Watches & Clock
3400 Motor Vehıcles, Traılers & Semı-Traılers
3500 Other Transport Equıpment
3600 Furnıture' Manufacturing N E C.

Appendix B Acquirers and Target firms*

| Announcement date** | Acquirer | co code*** | Target |
|---|---|---|---|
| 810424 | 대한전선 | 66000 | 대한종합건설 |
| 810909 | 서통 | 48030 | 서통화학 |
| 840427 | 동양제과 | 18720 | 동양종합상사 |
| 840523 | 만호제강 | 54090 | 부국제강 |
| 850104 | 제일제당 | 18520 | 동립산업 |
| 850307 | 동양시멘트 | 50540 | 동양종합산업 |
| 850318 | 백화양조 | 21010 | 백화산업 |
| 850403 | 세풍(한국합판) | 35110 | 세대제지 |
| 861117 | 대한방직 | 26540 | 대한종합개발 |
| 870410 | 전방 | 26520 | 전일섬유 |
| 871012 | 동양나이론 | 28500 | 원미섬유공업 |
| 880630 | 남선물산 | 28610 | 한일섬유공업 |
| 890814 | 해태제과 | 18700 | 해태음료 |
| 900430 | 한일방직 | 26560 | 한일염직 |
| 900519 | 경인에너지 | 44530 | ㈜성운물산 |
| 901222 | 삼양식품 | 18000 | 삼양판지공업 |
| 900903 | 한진중공업 | 69000 | 부산수리조선소 |
| 900210 | 동부화학 | 37100 | 영남화학 |
| 910920 | 한국전자 | 64540 | 태석디스플레이테크 |
| 911214 | 천광산업 | 19540 | 천광요업 |
| 910308 | 풍산 | 55040 | 풍산특수공업 |
| 911205 | 진로종합식품 | 16000 | 진로위스키 |
| 920124 | 금성사 | 64010 | 금성부품 |
| 921216 | 대한모방 | 27520 | 동아견직 |
| 930630 | 공성통신 | 64280 | A V코리아 |
| 930831 | 삼풍 | 31580 | 캠브리지멤버스 |
| 931008 | 쌍용중공업 | 61200 | 승리기계제작소 |
| 931224 | 동방유량 | 16500 | 풍진 |
| 931016 | 태평양 | 42000 | 태평양프랑세아 |
| 931115 | 인켈 | 64080 | 인켈테크놀리지 |
| 930820 | 대동 | 60030 | 한국대동전자공업 |
| 940421 | 대우중공업 | 59000 | 대우조선공업 |
| 940630 | 대일화학 | 73010 | 대일특수필림 |
| 940730 | 한화 | 43000 | 골든벨상사 |
| 941209 | 봉신중기 | 60570 | 봉신산업 |
| 950605 | 코오롱 | 28530 | 고려나일론 |
| 950912 | 한국마벨 | 64670 | 한화통신 |
| 950914 | 한일합섬 | 28520 | 한일레져개발 |
| 950103 | LG전자 | 64010 | 금성통신 |

* Name of the firms are presented in Korean

** First two digits are year, second two digits mean month and last two digits are Dates

*** Old company codes are used here

Appendix C. Acquirers and matched Control firms*

| Announcement date ** | Acquirers | Control Firms |
|---|---|---|
| 911205 | 진로종합식품 | 보해양조 |
| 931224 | 동방유량 | 빙그레 |
| 901222 | 삼양식품 | 농심 |
| 850104 | 제일제당 | 미원 |
| 890814 | 해태제과 | 롯데제과 |
| 840427 | 동양제과 | 크라운제 |
| 911214 | 천광산업 | 신촌사료 |
| 850318 | 백화양조 | 샘표식품 |
| 870410 | 전방 | 경방 |
| 861117 | 대한방직 | 동일방직 |
| 900430 | 한일방직 | 동국방직 |
| 921216 | 대한모방 | 경남모직 |
| 871012 | 동양나이론 | 고합 |
| 950914 | 한일합섬 | 제일합섬 |
| 950605 | 코오롱 | 선경인더 |
| 880630 | 남선물산 | 남양 |
| 930831 | 삼풍 | 성도어패 |
| 850403 | 세풍(한국합판) | 신풍제지 |
| 900210 | 동부화학 | 이수화학 |
| 931016 | 태평양 | 고려화학 |
| 940730 | 한화 | 한국티타 |
| 900519 | 경인에너지 | 쌍용정유 |
| 810909 | 서통 | 삼영화학 |
| 850307 | 동양시멘트 | 한일시멘 |
| 920819 | LG전자 | 동서산업 |
| 840523 | 만호제강 | 고려제강 |
| 910308 | 풍산 | 동국제강 |
| 940421 | 대우중공업 | 동양물산 |
| 930820 | 대동 | 쌍용정공 |
| 941209 | 봉신중기 | 대경기계 |
| 931008 | 쌍용중공업 | 한화기계 |
| 950103 | 금성사 | 대우전자 |
| 931115 | 인켈 | 아남전자 |
| 930630 | 공성통신 | 새한정기 |
| 910920 | 한국전자 | 맥슨전자 |
| 950912 | 한국마벨 | 나우정밀 |
| 810424 | 대한전선 | LG전선 |
| 900903 | 한진중공업 | 현대미포 |
| 940630 | 대일화학 | 모나미 |

* Name of the control firms are presented in Korean.

** First two digits are year, second two digits mean month and last two digits are Dates.