Estimating Tobin's Q for Listed Firms in Korea (1980-2005): Comparing Alternative Approaches and an Experiment with Investment Functions

Ji Youn Kim *, Jooyoung Kwak, and Keun Lee

Tobin's Q is the most common measurement of firm value and performance. However, estimating Tobin's Q accurately is not easy. Researchers have used book values of debts or assets rather than the market values. We estimate Tobin's Q for listed firms in Korea from 1980 to 2005 based on replacement costs of assets as well as market values of debts and common and preferred stocks. We compare the estimates using the modified annual average depreciation rates and economic depreciation rates. In sum, we present and compare four alternative series of Tobin's Q measures. We then estimate investment functions with alternative Tobin's Q values as regressors to compare the reliability of alternative estimates. We find that the simple measure of using book values of both debts and assets is the most unreliable.

Keywords: Tobin's Q, Firm value, Replacement costs, Investment function, Korean firms, Business groups

JEL Classification: E22, L25, G34

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I. Introduction

Firm value (hereafter FV) calibrates the efficiency of signaling a firm's performance in the market, forecasts expected yields of investments, and assesses the realized efficiency of investments. Accordingly, scholars have improved the methodological precision in their estimates of FV. Currently, Tobin's Q ratio (aka Tobin's Q) (1969) is the most widely adopted measurement. This ratio constructs FV by using the ratio of market values of liabilities and stock to replacement costs of assets. The market value of a firm's assets is obtained from the sum of the market values of stock and liabilities. Replacement costs represent the amount it would cost to replace an asset at its current price.

However, calculating Tobin's Q accurately is not easy. The market values of stock and liabilities are difficult to estimate. Estimating replacement costs also requires consideration of various factors related to different types of assets, which complicates the computation. Therefore, many researchers tend to use book values rather than market values of liabilities and assets.

In several empirical studies, Tobin's Q has been adopted as a key independent or dependent variable (Morck *et al.* 1988; Lang and Stultz 1994; Baek *et al.* 2004; Kang *et al.* 2006; Kim 2009). However, because of the difficulty in computation, the ratio is frequently replaced by the market-to-book (M/B) ratio. This ratio is a simple method that divides the sum of market capitalization at year-end and the book value of liabilities by the book value of assets (Black *et al.* 2003; Drobetz *et al.* 2004; Yoon *et al.* 2005; Bae *et al.* 2008). Alternatively, Tobin's Q has been partially estimated, for example, by using either the market value of liabilities or the replacement costs of assets (Kang *et al.* 2004). However, even the partial estimation of Tobin's Q tends to be done only for specific periods. Despite its theoretical and empirical importance, very little attempt is done to estimate Tobin's Q over a long-term period, particularly in Korea. Given the limitations of this stream of research, this study aims to estimate an accurate Tobin's Q of Korean listed firms in the longest period possible.

Our estimation method follows Lindenberg and Ross (1981) and Hoshi and Kashyap (1990), who further developed the methodology of Tobin (1969). We compare existing methods and the differences in estimation results. We also make several important improvements, such as in the estimation of values of preferred stocks and replacement costs of assets.

We estimate the values of preferred stocks following Lindenberg and Ross (1981) and Summers (1981), and divide average dividends by average dividend ratio. This method is better than others because prices of preferred stocks are not easily available due to less frequent transactions.

Improvement in the estimation of the replacement costs of assets hinges on the method of calculating depreciation rates. Hong *et al.* (2007) use the economic depreciation rate to calculate the replacement costs of assets. The economic depreciation rate adopted by Hong *et al.* (2007) is similar to that used by Hyun and Pyo (1997) in their estimation of capital stocks. The economic depreciation rate is the depreciation rate determined at a specific point of time in the process of estimating capital stocks, and the same fixed values are then applied to entire firms and time periods. Therefore, the economic depreciation rate does not consider firm-specific differences or the possibility of changes over time. Therefore, we use the annual average depreciation rate, a new concept that considers accumulated depreciation when estimating replacement costs of assets.

With this new estimation approach, we use the data of the Korea Information Service (KIS) Value, which is typically used in empirical papers on Korean firms. Therefore, we have the estimated values of Tobin's Q for each listed firm from 1980 to 2005. The value of Korean firms changes during the time when year and industry effects are considered. However, we find that Tobin's Q remains below one on average during most of the period. Before 1997, the value of stand-alone firms is significantly greater than that of business groups. After 1997, the situation is reversed. In addition, our estimation of the investment function shows that, depending upon the estimation approach, the statistical significance of the coefficient of the Tobin's Q variable can vary, which indicates an imperative need to adopt more accurate values of Tobin's Q.

In section II, we review and compare the existing approaches. We illustrate several concepts used to estimate the FV of listed firms in Korea and summarize the methodological issues for FV estimation. In section III, we provide the results of the FV estimates using different approaches and discuss their implications. In section IV, we estimate the investment function using the different methods of Tobin's Q calculation to compare them. Finally in section V, we conclude this study.

II. Methodological Issues and Data

A. Defining Several Proxies and Variants of Tobin's Q

As discussed above, people tend to use the M/B ratio as a proxy for Tobin's Q. Let us call this ratio $MB1$, which is defined as follows:

$$MB1=\frac{\text{(market value of stock+book value of liabilities)}}{\text{book value of assets}}.$$

Then, a first improvement (or $MB2$) from $MB1$ replaces the book value of liabilities (debts) with the market values:

$$MB2=\frac{\text{(market value of stock+market value of liabilities)}}{\text{book value of assets}}.$$

However, both $MB1$ and $MB2$ are basically market-to-book ratios, the real Tobin's Q should use market values of both debts and assets, which is expressed as $TQ1$ as follows:

$$TQ1=\frac{\text{(market value of stock+market value of liabilities)}}{\text{replacement costs of assets}}.$$

In our terminology, $TQ1$ refers to the Tobin's Q estimated by taking the market capitalization of common stocks and preferred stocks measured at year-end. However, a problem with this approach is that many of the preferred stocks are not traded in the market. Therefore, in another method called $TQ2$, we estimate the value of the preferred stocks by dividing the dividends paid to the preferred stocks by the dividend ratio. In this method, we estimate the market values of both common and preferred stocks by multiplying the noted or estimated price at year-end by the number of issued shares. This estimation can be expressed as follows:

$$TQ2=\frac{\text{(market value of stock+market value of liabilities)}}{\text{replacement costs of assets}},$$

where market value of stocks=①+②,

①=(year-end price of common stocks×number of outstanding common stocks)

②=(dividend of the preferred stocks÷dividend ratio of the preferred stocks)×number of outstanding preferred stocks

*TQ*2 is better than *TQ*1 in terms of calculating the values of preferred stocks. Our *TQ*2 approach is the same as that used by Lindenberg and Ross (1981) and Summers (1981). They adopt a consistent approach in calculating the price of preferred stocks, that is, dividing the average dividends of preferred stocks by the Standard and Poors (S&P) average dividend ratio. This method is better than the others because prices of preferred stocks are not easily available due to less frequent transactions.

B. Methods to Estimate the Market Value of Stocks

In estimating the market value of stocks, common stocks are included and preferred stocks are only sometimes considered. The price of preferred stocks is unclear because of non-tradability or very low trading volume. Accordingly, Lindenberg and Ross (1981) and Summers (1981) obtain the price by dividing the dividends of preferred stocks by the S&P average dividend ratio. Therefore, we also divide the dividends of preferred stocks by the average dividend ratio of preferred stocks to calculate the price. Next, we multiply the number of both types of shares (common and preferred) by the matching prices. This process is how *TQ*2 is estimated in this study. By contrast, other studies simply use the market value of stocks from market capitalization at year-end for both common and preferred stocks.

C. Methods to Estimate the Market Value of Liabilities

We first consider the book value of liabilities from the total liabilities in the balance sheet. Then, the market value of liabilities can be calculated as the sum of (a), (b), (c), (d), and (e), which we explain below. The values of liabilities in the balance sheet or income statement are the book values at issuance, and thus they do not reflect time-varying factors, such as interest rate or price, which potentially affect the value of liabilities. Therefore, we categorize liabilities into non-interest-and interest-bearing debts. As the book values of non-interest-bearing debts are equivalent to their market values, we can use the book values directly and calculate the market values as follows:

Market value of non-interest-bearing debt **(a)**=book value of non-interest-bearing debt
=(total current liabilities-short-term borrowings-current portion of long-term liabilities)
+(total non-current liabilities-bonds-long-term borrowings).

Second, given that interest-bearing debts must have different book values and market values, we obtain the market value of this type of debt by deriving the present values of interest payments and the principal, and then finding their sum. A typical financial statement (*e.g.*, KIS Value) does not distinguish the duration of interest payments (*e.g.*, long-term vs. short-term). Unless the duration of liabilities is considered, firms with more long-term debts than short-term debts are treated the same as those in the opposite debt structure. In such a situation, the market value of liabilities is likely to be biased. To solve this problem, we identify the length of liabilities duration from the share of interest payments for each type of liabilities over the total interest payments in the income statement. We take the CD interest rate, commercial bank interest rate, three-year bond interest rate, and LIBOR rate as a discount rate to calculate the market value of each interest-bearing debt. Our choice of these discount rates in calculating the market value of debt is based on Lindenberg and Ross (1981), Summers (1981), Hosh and Kashyap (1990), and Kim *et al.* (1996). These empirical works recommended these discount rates as the best market interest rate in calculating the present value of debt. Therefore, the following formula is used in our approach:

Short-term liabilities **(b)** = short-term borrowings + current portion of long-term borrowings
+ short-term borrowings in foreign currency + bank overdraft
+ short-term borrowings notes
+ short-term borrowings (shareholders, officials, employees)
+ short-term borrowings (related parties) + short-term borrowings (other).

Market value of short-term liabilities (b)

$$= \left[\frac{\text{interest expenses of short term liabilities} \left(= \frac{\text{short-term liabilities}}{\text{interest expenses}} \right) + \text{book value of short term liabilities}}{1+\text{CD interest rate}} \right].$$

Long-term domestic liabilities **(c)** = long-term borrowings
+ long-term borrowings (related parties)
+ long-term borrowings (shareholders, officials, or employees).

Market value of long-term domestic liabilities **(c)** = (*i*) + (*ii*).

$$(i)=\left[\frac{(\text{long-term domestic interest expenses}\left(=\frac{\text{long-term liabilities}}{\text{interest expenses}}\right)}{\text{commercial bank interest rate}}\right]\times\left[1-\frac{1}{(1+\text{commercial bank interest rate})^{3}}\right].$$

$$(ii)=\frac{\text{book value of long-term liabilities}}{(1+\text{commercial bank interest rate})^{3}}.$$

Bonds **(d)**:

Market value of bond **(d)**=(*iii*)+(*iv*)

$$(iii)=\left[\frac{\text{bond expenses}\left(=\frac{\text{bond}}{\text{interest expenses}}\right)}{\text{interest rate of 3 years bond}}\right]\times\left[1-\frac{1}{(1+\text{interest rate of 3 years bond})^{3}}\right].$$

$$(iv)=\frac{\text{bond book value}}{(1+\text{interest rate of 3 years bond})^{3}}$$

Long-term foreign liabilities **(e)**=long-term borrowings in foreign currency+overseas loans.

Market value of long-term foreign liabilities **(e)**=(*v*)+(*vi*).

$$(v)=\left[\frac{\text{interest expenses of long term foreign liabilities}\left(=\frac{\text{long-term foreign liabilities}}{\text{interest expenses}}\right)}{\text{LIBOR rate}+1.5\%}\right]\times\left[1-\frac{1}{(1+\text{LIBOR rate}+1.5\%)^{5}}\right].$$

$$(vi)=\frac{\text{book value of long-term foreign liabilities}}{(1+\text{LIBOR rate}+1.5\%)^{5}}.$$

D. Methods to Estimate the Replacement Costs of Assets

This study calculates the replacement costs for Tobin's Q as the sum of the replacement costs for quick assets, investment assets, inventory assets, intangible assets, and tangible assets. We use the current book value for quick assets and intangible assets, as their book values and replacement costs are considered equivalent, so we use the current data provided by the KIS Value. Valuation of investment assets varies depending on the time of evaluation of securities. Our study takes those reported in the KIS Value. Then, we follow Kim *et al.* (1996) and Hong *et al.* (2007) in estimating the replacement costs for inventory assets and tangible assets. Tangible assets consist of several items, including land, buildings, structures, machinery and equipment, vehicle and transportation equipment, tools, furniture and fixtures, and so on. We try two different approaches to estimate the replacement costs of assets. Tobin's Q measures estimated by these two methods are denoted as *TQ2_A* and *TQ2_B* because they are two variants of the *TQ2* defined above. The two approaches are explained in detail below. The main difference between the two is that method A uses the economic depreciation method and method B uses the annual average depreciation method.

Method A (*TQ2_A*): Assets other than tangible assets and inventory assets are measured using the current book value. First, the replacement costs of inventory assets are obtained from the changes in the book value, following either Equation (1) or (2).

If the change in the value of inventory assets is greater than or equal to zero, we use Equation (1) as follows:

$$Minv_t = Minv_{t-1} \times \left(\frac{p_t}{p_{t-1}} \right) + \Delta inv_t, \tag{1}$$

where

Δinv_t denotes the change in the value of inventory assets that is non-negative, that is,

$$\Delta inv_t = Binv_t - Binv_{t-1} \geq 0;$$

$Minv_t$ and $Minv_{t-1}$ denote the market values of the current and the previous inventory assets, respectively;

$Binv_t$ and $Binv_{t-1}$ denote the book values of the current and previous

inventory assets, respectively; and

P_t and P_{t-1} denote the current and previous price indices, respectively.

If the change in the value of inventory assets is less than zero, that is,

$\Delta inv_t = Binv_t - Binv_{t-1} < 0$, then we apply Equation (2).

$$Minv_t = (Minv_{t-1} + \Delta inv_t) \times \left(\frac{p_t}{p_{t-1}} \right). \quad (2)$$

Second, the replacement costs of tangible assets are obtained from Equation (3) or (4) for land and from Equation (5) for other assets. If the change in the value of land is non-negative, we use Equation (3).

$$Mland_t = Mland_{t-1} \times \left(\frac{p_t}{p_{t-1}} \right) + \Delta land_t, \quad (3)$$

where

$\Delta land_t$ denotes the change in the value of land, such as

$\Delta land_t = Bland_t - Bland_{t-1} \geq 0$;

$Mland_t$ and $Mland_{t-1}$ denote the current and previous market values of land, respectively;

$Bland_t$ and $Bland_{t-1}$ denote the current and previous book values of land, respectively; and

P_t and P_{t-1} denote the current and previous inflation rates, respectively, in the house price index.

If the change in the value of land is less than zero, that is, $\Delta land_t = Bland_t - Bland_{t-1} < 0$, then we use Equation (4).

$$Mland_t = \left\{ Mland_{t-1} \times \left(\frac{p_t}{p_{t-1}} \right) \right\} + (\Delta land_t \times g) \quad (4)$$

$$g = (1+p_{t-4})(1+p_{t-3})(1+p_{t-2})(1+p_{t-1})(1+p_t).$$

Third, for seven types of tangible assets other than land, the replacement costs are obtained as follows:

$$Mtanas_t = \left\{ Mtanas_{t-1} \times \left(\frac{p_t}{p_{t-1}} \right) + \Delta tanas + Dep \right\} \times (1 - \delta), \quad (5)$$

where

δ denotes the estimated economic depreciation rate (Hyun and Pyo 1997);

Dep denotes the accumulated depreciation for individual assets;

$Mtanas_t$ and $Mtanas_{t-1}$ denote the current and previous market values of tangible assets, respectively, other than land; and

$\Delta tanas$ denotes the change in the value of individual tangible assets other than land, which is calculated by using the current book value less the previous book value.

Method B (*TQ2_B*): The replacement costs of tangible assets and inventory are obtained using a similar process to that in method A. The only difference lies in how tangible assets are depreciated. In this method, tangible assets are depreciated by the annual average depreciation rate, as done by Kim *et al.* (1996). The annual average depreciation rate uses the change in the amount of accumulated depreciation for individual tangible assets and is expressed as follows.

$$\delta' = \frac{1}{n} \times \Sigma \left\{ \frac{Dep}{(Btanas_t + Dep)} \right\}. \quad (6)$$

where

δ' denotes the modified average depreciation rate;

Dep denotes the change in the amount of accumulated depreciation for each tangible asset;

$Btanas_t$ denotes the current book value of individual tangible assets; and

n denotes the number of firm-year observations.

We further discuss the two methods as follows. First, in response to the report of Kim *et al.* (1996) that Korean firms, when conducting valuation on inventory assets, tend to adopt techniques, such as last-in first-out (LIFO) or the total averaging method, we adopt LIFO for our inventory valuation. We classify tangible assets other than inventory assets into land, building, structures, machinery and equipment, vehicle

and transportation equipment, tools and instruments, furniture and fixtures, and others. Whereas Kim *et al.* (1996) consider only four types, that is, land, building, structures, and other tangible assets, we identify the differences in depreciation costs by type of tangible asset. Accordingly, we calculate each type of tangible asset and add the measures. Whereas Kim *et al.* (1996) use the same price index of aggregated capital goods for all kinds of tangible assets, we follow Hong *et al.* (2007). We use different average price indices for different assets, such as general equipment, machines, vehicle and transportation equipment, and tools and instruments, and separate the producer price indices for building, structures, equipment, and other tangible assets. For land, we use house price indices published by the Ministry of Construction and Transportation.

We use the economic depreciation rates for tangible assets in method A, as estimated by Hyun and Pyo (1997). However, their economic depreciation rates are derived from the estimation of capital stocks in the 1980s. As this study examines the period between 1980 and 2005, the application of the economic depreciation rates in the 1980s to a later period is inappropriate. Moreover, we do not recommend using a single economic depreciation rate (although the rate is categorized by type of asset) for all firms without allowing for across-firm differences. To overcome this problem, method B uses the annual average depreciation rates, as suggested by Kim *et al.* (1996) and Hoshi and Kashyap (1990).

A problem with this approach is that negative depreciation rates can result when a smaller increase in accumulated depreciation (the *Dep* variable in Equation (6)) exists in the current year than in the previous year. Negative depreciation rates were actually obtained from many firms for many years before the crisis in 1997. Although divestiture (selling off assets on a large scale) provides a possible explanation, a question persists on whether Korean public firms were indeed selling off assets even before the Asian crisis in 1997. Although unused assets were undoubtedly disposed of after the crisis, Korean firms before the crisis had certainly overinvested. Kang and Shin (2004) argue that negative values may result because an accurate value of the depreciation rate for tangible assets cannot be known for each year. To remove negative values in the depreciation rates, Kang and Shin (2004) simply drop the years with smaller accumulated depreciation than the preceding year. This step is likely to result in the dropping of too many years and thus possibly lead to some bias in the process of obtaining the depreciation rate. Our alternative solution in method B is to use the amount of accumulated

depreciation itself rather than the change in the amount. This way, we can avoid the negative depreciation rates.

E. Data

To estimate the market value of the listed firms over a long period, we use the KIS Value database. From this database, we obtain annual values for stock prices, dividend payments for preferred stocks, dividend rates for preferred stocks, and the number of issued shares, which are all measured as of year-end. Data for liabilities is obtained from the KIS Value. We use total current liabilities, current long-term payable, short-term payable, non-current long-term payable, short-term borrowings in foreign currency, short-term advances from an affiliated company, other short-term payables, long-term borrowings, long-term advances from an affiliated company, *long-term* loans to officers, shareholders and employees, private loans, long-term borrowings in foreign currency, and loans. To obtain data on interest payments and discount rates (*e.g.*, interests on loan, certificates of deposit, corporate bonds with three years to maturity, and LIBOR), we refer to the income statements and statistical documents provided in *Monthly Bulletin* (*josa-tongge-wolbo*) published by the Bank of Korea and *Monthly Economic Bulletins* (*gyengje-tongge-wolbo*) published by the Ministry of Strategy and Finance.

The calculation of the replacement costs of assets uses such variables as quick assets, investments assets, inventory assets, intangible assets, and land; book values and accumulated depreciation rates for building, structures, general machinery and equipment, vehicle and transportation equipment, tools and instruments, and furniture and fixtures; book values of other tangible assets; and book values of total assets. We obtain these variables from the KIS Value. The housing price index is available from the Ministry of Construction and Transportation (*jiga-donghyang*). The producer price index, which reflects changes in the price of tangible assets, is available at the statistical database (http://ecos.bok.or.kr/) provided by Bank of Korea.

We compare the Tobin's Q of the firms affiliated with business groups with that of stand-alone firms. Group affiliation is identified from an official list of business groups prepared by the Fair Trade Commission in Korea available from 1987. We limit group affiliation to the top 30 business groups. Information on group affiliation before 1987 was taken from *Korea's Fifty Major Financial Groups* published by the Management Efficiency Research Institute (MERI 1986). Among the top groups, we

drop state-owned business groups or those without family control, such as POSCO or KEPCO. Delisted firms during the period are dropped. The sample consists of firms in the manufacturing sector only (codes 15 to 36 in the two-digit Korean SIC system, the 8^{th} KSIC).

III. Alternative Estimates of the Values of Listed Firms in Korea

A. Comparison of the Four Estimation Methods: MB1, MB2, TQ2_A, and TQ2_B

In this section, we summarize the four approaches, compare their findings, and propose the best approach for estimating FV. We do not report TQ1 here because TQ1 is not accurate in calculating the market values of preferred stocks, as explained above. Instead, we focus on TQ2 and split it into two methods, namely, TQ2_A and TQ2_B. The four approaches considered here are as follows:

*MB*1 = (market capitalization at year-end + book value of liabilities)/book value of assets.

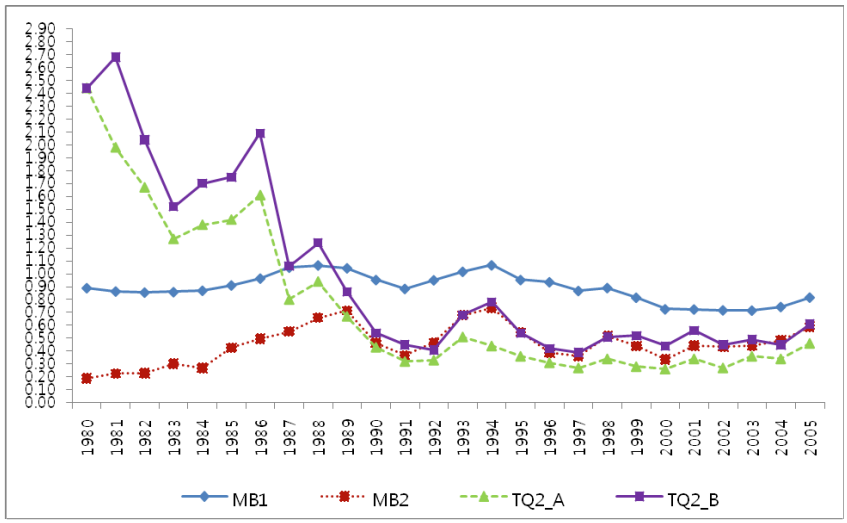
*MB*2 = (market capitalization at year-end + market value of liabilities)/book value of assets.

*TQ*2_*A* = {(the number of total outstanding shares*stock price at year-end) + (market value of liabilities)}/replacement costs of assets based on economic depreciation rates.

*TQ*2_*B* = {(the number of total outstanding shares*stock price at year-end) + (market value of liabilities)}/replacement costs of assets based on annual average depreciation rates.

Among the four approaches, *MB*1 uses the book values of liabilities and assets. The market value of stock is the market capitalization of common and preferred stocks. Therefore, the *MB*1 estimate should be closest to the value of 1, which is the case presented in Figure 1. However, this method may overestimate FV, as it does not use the market values of debts, unlike *MB*2. As shown in Figure 1, *MB*1 is always above *MB*2.

Then, we can say that the estimates by either method, *TQ*2_*A* or *TQ*2_*B*, are better than those by *MB*1 and *MB*2, as they consider market



1) $MB1 = \dfrac{(\text{market value of stock} + \text{book value of liabilities})}{\text{book value of assets}}$,

$MB2 = \dfrac{(\text{market value of stock} + \text{market value of liabilities})}{\text{book value of assets}}$,

and $TQ2 = \dfrac{(\text{market value of stock} + \text{market value of liabilities})}{\text{replacement costs of assets}}$

2) *TQ*2 is split into *TQ*2_*A* and *TQ*2_*B*, which differ in the use of depreciation rates. *TQ*2_*A* uses economic depreciation rates, whereas *TQ*2_*B* uses annual average depreciation rates and considers the differences across firms.

FIGURE 1

TREND OF TOBIN'S Q OF KOREAN FIRMS: FOUR APPROACHES

values of both debts and assets. Estimates by both *TQ*2 methods show that Tobin's Q measures are stable and well below 1 or around 0.6 during most of the period except the mid-1980s, when they show some unstable fluctuation caused by the higher volatility of stock prices during this period. The market value of stocks grew fast from the early 1980s, reaching its highest in 1986, and then it fell sharply in 1987.[1]

[1] In Figure 1, the trend of *TQ*2s shows a strong fluctuation during the long periods. The reasons for this fluctuation are as follows. First, only *TQ*2s reflect the market value of asset as well as stock and debt of individual firms. Therefore, we can see a rapid downward slope of *TQ*2s because the measurements reflect the replacement cost of assets using depreciation rate. Second, the Korean economy experienced a fast and high growth rate since the1960s. During these periods, stock value of firms increased rapidly. The trend is indicated in Figure 2-A. After the 1990s, stock value shows a downward slope that reflects the overinvestment of business group affiliates.

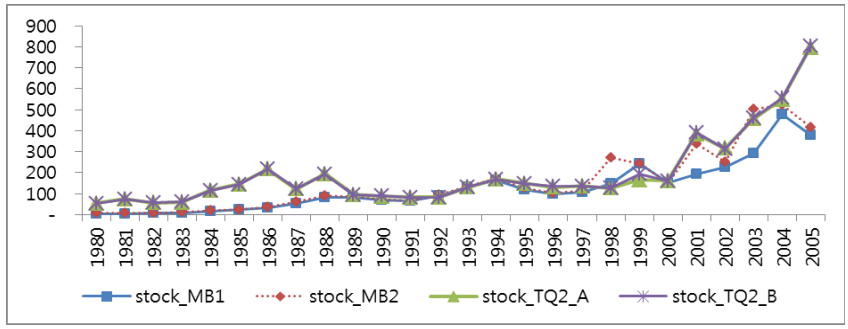


FIGURE 2-A
COMPARISON OF AVERAGE STOCK VALUE BY APPROACH (UNIT: TRILLION WON)

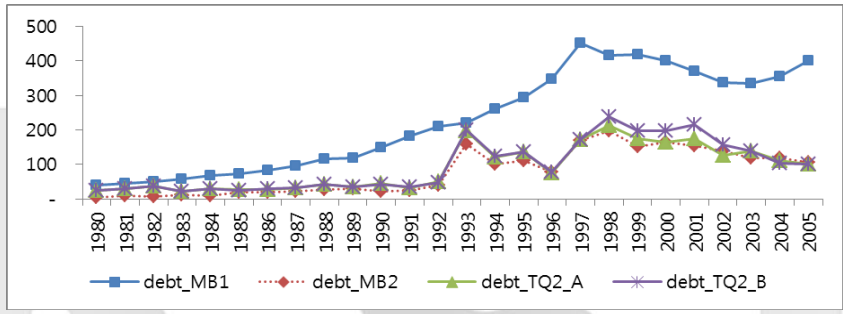


FIGURE 2-B
COMPARISON OF AVERAGE LIABILITIES VALUE BY APPROACH (UNIT: TRILLION WON)

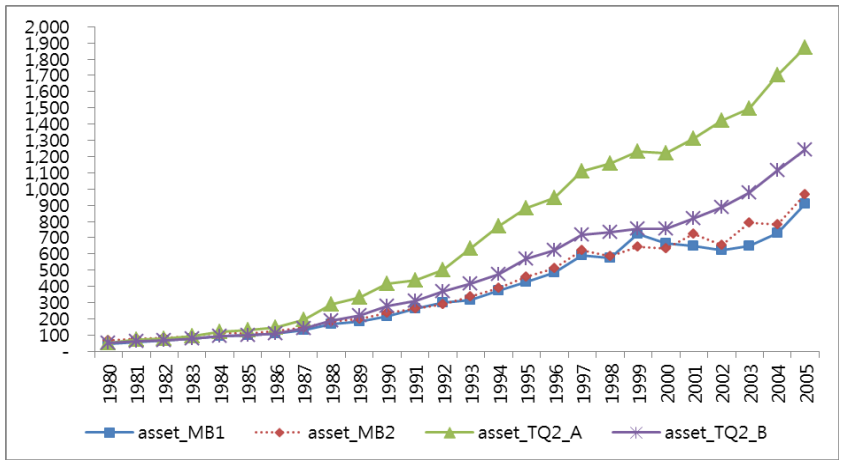


FIGURE 2-C
COMPARISON OF AVERAGE ASSET VALUE BY APPROACH (UNIT: TRILLION WON)

Figures 2-A, 2-B, and 2-C present the annual average values of stocks, liabilities, and assets, across the four methods, respectively. No fluctuation in values of debts or assets is shown, but a fluctuation exists in stock values as measured by the two *TQ*2 methods.[2]

Of the two methods, *TQ*2_*A* and *TQ*2_*B*, the latter is the better choice. In Figure 1, the estimates using the *TQ*2_*A* approach are always and consistently the lowest since 1990. This result is due to the use of the *TQ*2_*A* method of an economic depreciation rate, which tends to overestimate the value of replacement costs of assets.[3] This observation is clearly shown in Figure 2-C, where the replacement costs of assets estimated by *TQ*2_*A* are greater and increase faster than other estimates. As discussed above, *TQ*2_*A* applies a single economic depreciation rate derived at a specific point in time to all firms. Therefore, it does not accommodate across-firm differences, which leaves its methodological accuracy open to question.

B. Comparison between Chaebol and Non-Chaebol Firms

Table 1 compares the values of group affiliates and stand-alone firms across the four alternative methods. Except *MB*1, three of the approaches show that, before the crisis in 1997, stand-alone firms have a slightly higher FV than group affiliates. However, the situation is reversed after the crisis and is particularly distinct in the results of *TQ*2_*B* compared with those of *TQ*2_*A*.

Table 2 provides more details about the FV estimates using the *TQ*2_*B* method for the whole sample and according to chaebol and non-chaebol firms. For stand-alone firms, the mean and median of FV are higher than those of group affiliates until 1984 at both 1% and 5% significance levels. After 1984, the mean and median differences between the FV of

[2] The stock values of *MB*1 and *MB*2 refer to the market value of stock from market capitalization at year-end for both common and preferred stocks, respectively. Therefore, the time trend of the two measures must be the same during the periods. However, the trends are different in Figure 2-A, especially in the latter part of the time trends. Figures 2-B and 2-C also indicate a similar pattern. The reason is that samples are different because some samples are dropped as outliers according to the approach. If we compare only the samples with all the four different measurements, we can see the same time trend using the approach. We report the result in the Appendix (Figures 2-A, 2-B, and 2-C).

[3] The economic depreciation rate takes a fixed percentage of the declining balance method. Therefore, depreciation is exponential and has a constant rate of δ.

TABLE 1

COMPARISON OF TOBIN Q'S BY APPROACH AND FIRM TYPE

Year	*MB*1		*MB*2		*TQ*2_*A*		*TQ*2_*B*	
	Stand-alone firms	Group affiliates	Stand-alone firms	Group affiliates	Stand-alone firms	Group affiliates	Stand-alone firms	Group affiliates
1980	0.873	0.935	0.203	0.164	2.754	1.628	2.754	1.628
1981	0.849	0.899	0.252	0.192	2.266	1.264	3.059	1.710
1982	0.840	0.891	0.258	0.189	2.009	1.027	2.450	1.253
1983	0.856	0.874	0.337	0.204	1.416	0.750	1.684	0.954
1984	0.860	0.906	0.282	0.237	1.472	1.056	1.804	1.345
1985	0.888	1.003	0.443	0.367	1.477	1.192	1.790	1.578
1986	0.939	1.054	0.520	0.424	1.604	1.649	2.042	2.270
1987	1.024	1.134	0.571	0.495	0.794	0.823	1.061	1.076
1988	1.051	1.135	0.651	0.688	0.927	0.974	1.229	1.295
1989	1.029	1.118	0.723	0.679	0.710	0.506	0.911	0.666
1990	0.938	1.032	0.470	0.432	0.438	0.377	0.554	0.493
1991	0.866	0.972	0.368	0.357	0.318	0.316	0.456	0.407
1992	0.937	1.019	0.478	0.416	0.346	0.289	0.416	0.379
1993	1.004	1.081	0.703	0.575	0.540	0.412	0.714	0.566
1994	1.063	1.088	0.788	0.504	0.473	0.346	0.851	0.515
1995	0.949	0.978	0.575	0.417	0.369	0.305	0.576	0.409
1996	0.941	0.922	0.410	0.293	0.321	0.255	0.439	0.358
1997	0.863	0.897	0.371	0.317	0.290	0.209	0.415	0.293
1998	0.895	0.871	0.509	0.559	0.339	0.358	0.507	0.528
1999	0.817	0.816	0.429	0.503	0.281	0.296	0.526	0.508
2000	0.728	0.723	0.330	0.369	0.262	0.265	0.440	0.438
2001	0.711	0.801	0.421	0.549	0.325	0.413	0.536	0.650
2002	0.696	0.885	0.406	0.645	0.262	0.308	0.430	0.535
2003	0.689	0.937	0.406	0.682	0.358	0.400	0.475	0.561
2004	0.714	1.035	0.452	0.757	0.332	0.393	0.440	0.497
2005	0.812	0.899	0.583	0.667	0.453	0.554	0.600	0.711

Sources: Authors

1) $MB1 = \dfrac{(\text{market value of stock} + \text{book value of liabilities})}{\text{book value of assets}}$,

$MB2 = \dfrac{(\text{market value of stock} + \text{market value of liabilities})}{\text{book value of assets}}$,

and $TQ2 = \dfrac{(\text{market value of stock} + \text{market value of liabilities})}{\text{replacement costs of assets}}$

2) *TQ*2 is split into *TQ*2_*A* and *TQ*2_*B*, which differ in the use of depreciation rates. *TQ*2_*A* uses economic depreciation rates, whereas *TQ*2_*B* uses annual average depreciation rates and considers the differences across firms.

TABLE 2

ESTIMATION OF TOBIN Q'S OF KOREAN FIRMS (METHOD: *TQ2_B*)

Year	All					Stand-alone (non-chaebol) firms					Group affiliates (chaebol)					diff (mean)	diff (median)
	N	mean	median	s.d.	e.o.	N	mean	median	s.d.	e.o.	N	mean	median	s.d.	e.o.		
1980–2005	5277	0.794	0.43	1.041	0.201	4233	0.807	0.425	1.061	0.213	1044	0.744	0.443	0.953	0.147	0.063**	-0.018
1988–1997	2189	0.616	0.39	0.663	0.197	1708	0.643	0.412	0.687	0.22	481	0.52	0.339	0.561	0.101	0.123***	0.073***
1994–1997	969	0.531	0.347	0.529	0.191	761	0.568	0.367	0.563	0.215	208	0.395	0.3	0.347	0.092	0.173***	0.068***
1998–2001	1055	0.507	0.314	0.506	0.187	864	0.502	0.303	0.511	0.197	191	0.533	0.345	0.483	0.136	-0.031	-0.042**
1980	105	2.443	1.551	2.357	0.25	76	2.754	1.94	2.399	0.232	29	1.628	0.73	2.065	0.293	1.126**	1.209***
1981	107	2.681	1.529	2.741	0.225	77	3.059	2.082	2.767	0.181	30	1.71	0.731	2.456	0.318	1.349***	1.352***
1982	108	2.04	1.422	1.891	0.217	71	2.45	1.777	1.973	0.22	37	1.253	0.872	1.445	0.213	1.197***	0.905***
1983	106	1.519	1.205	1.15	0.243	82	1.684	1.456	1.208	0.248	24	0.954	0.772	0.685	0.226	0.73***	0.684***
1984	113	1.698	1.355	1.298	0.221	87	1.804	1.452	1.402	0.223	26	1.345	1.159	0.789	0.212	0.458**	0.293
1985	124	1.745	1.482	1.239	0.19	98	1.79	1.627	1.252	0.197	26	1.578	1.28	1.197	0.161	0.212	0.347
1986	131	2.092	2.005	1.419	0.181	102	2.042	1.981	1.412	0.184	29	2.27	2.289	1.455	0.171	-0.228	-0.308
1987	147	1.064	0.585	1.086	0.174	112	1.061	0.584	1.078	0.182	35	1.076	0.603	1.125	0.146	-0.015	-0.019
1988	177	1.243	0.691	1.253	0.157	138	1.229	0.663	1.279	0.164	39	1.295	0.834	1.17	0.133	-0.066	-0.171
1989	205	0.858	0.618	0.768	0.17	160	0.911	0.664	0.81	0.188	45	0.666	0.514	0.562	0.1	0.245**	0.151
1990	204	0.542	0.392	0.454	0.215	162	0.554	0.4	0.465	0.232	42	0.493	0.362	0.41	0.143	0.061	0.038
1991	208	0.445	0.309	0.391	0.227	162	0.456	0.306	0.408	0.253	46	0.407	0.323	0.325	0.115	0.049	-0.017
1992	201	0.407	0.314	0.304	0.256	152	0.416	0.323	0.32	0.293	49	0.379	0.283	0.249	0.109	0.037	0.04
1993	225	0.68	0.429	0.658	0.17	173	0.714	0.457	0.68	0.199	52	0.566	0.345	0.568	0.055	0.148*	0.112
1994	240	0.777	0.525	0.744	0.143	187	0.851	0.589	0.787	0.165	53	0.515	0.334	0.487	0.054	0.336***	0.255***
1995	240	0.539	0.367	0.464	0.184	187	0.576	0.39	0.495	0.211	53	0.409	0.328	0.301	0.07	0.167***	0.062
1996	233	0.422	0.346	0.32	0.244	183	0.439	0.353	0.344	0.271	50	0.358	0.32	0.205	0.123	0.081**	0.033
1997	256	0.391	0.241	0.402	0.19	204	0.415	0.269	0.422	0.206	52	0.293	0.208	0.296	0.119	0.122***	0.061
1998	258	0.51	0.328	0.505	0.181	213	0.507	0.315	0.51	0.193	45	0.528	0.341	0.482	0.118	-0.021	-0.027

(Table 2 Continued)

TABLE 2
(CONTINUED)

Year	All					Stand-alone (non-chaebol) firms					Group affiliates (chaebol)					diff (mean)	diff (median)
	N	mean	median	s.d.	e.o.	N	mean	median	s.d.	e.o.	N	mean	median	s.d.	e.o.		
1999	259	0.522	0.333	0.535	0.196	210	0.526	0.335	0.543	0.205	49	0.508	0.331	0.501	0.155	0.017	0.005
2000	269	0.44	0.251	0.454	0.18	222	0.44	0.25	0.465	0.187	47	0.438	0.253	0.405	0.145	0.002	-0.002
2001	269	0.557	0.377	0.524	0.19	219	0.536	0.322	0.523	0.204	50	0.65	0.556	0.523	0.123	-0.114*	-0.234**
2002	264	0.445	0.326	0.383	0.219	226	0.43	0.303	0.375	0.221	38	0.535	0.434	0.427	0.208	-0.105*	-0.131**
2003	277	0.487	0.318	0.444	0.204	237	0.475	0.298	0.452	0.21	40	0.561	0.461	0.392	0.167	-0.087	-0.163***
2004	272	0.446	0.312	0.36	0.223	241	0.44	0.296	0.368	0.228	31	0.497	0.409	0.291	0.184	-0.057	-0.114**
2005	279	0.611	0.444	0.482	0.207	252	0.6	0.426	0.489	0.215	27	0.711	0.575	0.399	0.129	-0.111*	-0.15**

1) N denotes the number of observations in each period or year.
2) e.o. denotes the ratio of the outlier elimination and is obtained from dividing the number of eliminated outliers by the total number of observations in each period or year. We eliminate the outliers in each period or year, following Hadi (1994). The default rate is p=0.05, and each outlier criterion is given as $(n-k+1)/2$, where n is the number of observations and k is the number of variables.
3) diff(mean)=mean(stand-alone firms)-mean(group affiliates)
4) diff(median)=median(stand-alone firms)-median(group affiliates)
5) Differences are examined using the t-test and the Wilcoxon rank-sum test. Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.
6) A positive (negative) value in the mean and median differences indicates that the TQ2 of stand-alone (non-chaebol) firms is higher (lower) than that of group affiliates (chaebol) firms.

stand-alone firms and that of group affiliates decrease. Then, from 1989 to 1997, the mean FV of stand-alone firms far exceeds that of group affiliates. Although the business group and its affiliates play an active role in the development of the Korean economy during the periods, we can interpret that the market participants negatively evaluated their overinvestment and the circular ownership structure on their firm value. This phenomenon is equal to the negative effect of Korean business group affiliates on firm value, as pointed out by Ferris *et al.* (2003).

However, after the crisis, when corporate structuring was undertaken to some degree, the mean and median of group affiliates exceeded those of stand-alone firms. Since 2001, the median market value of the group affiliates, using any approach, has been greater at the 1% or 5% significance levels. We attribute this change to substantial improvements in performance and the market value of group affiliates as a result of corporate restructuring. Aside from Tobin's Q, group affiliates have outperformed stand-alone firms in short-term monthly stock market returns (AR, abnormal returns), long-term rate of return (HPR, holding period return), or rate of operating profits (Lee, Kim, and Lee 2010).

IV. Experiment on Investment Function Estimation Using All Four Methods

The existing literature uses Tobin's Q as an important variable in estimating investment function. In this section, we use alternative estimates of TQ to determine how they act as determinants of investment functions. We specify a regression model based on several papers that estimate investment functions, including Scharfstein and Stein (1998), Kim (2002), Carpenter and Guariglia (2003), Hong *et al.* (2007), and Choo *et al.* (2009).

$$Ginv_{it}=\beta_0+\beta_1 Ginv_{i(t-1)}+\beta_2 tq_{i(t-1)}+\beta_3 indtq_{i(t-1)}+\beta_4 CF_{i(t-1)} +dksic+v_t+v_i+u_{it}\wedge(1). \tag{7}$$

The variables in Equation (7) are illustrated as follows: $Ginv_{it}$ denotes the investment rate of firms ($Ginv_{it}=I_{it}/K_{i(t-1)}$); the denominator and numerator denote the previous book value of non-current assets and the change in non-current assets plus depreciation costs, respectively. The previous value of Tobin's Q obtained from each approach is considered as $tq_{i(t-1)}$ and the previous median industrial Tobin's Q is con-

sidered as $indtq_{i(t-1)}$ in Equation (7). The liquidity of individual firms could affect the investment plan, as explained by Durnev *et al.* (2004). Hong and Ahn (2000) observe that if a large amount of free cash flow is available in a firm with loose corporate governance, a tendency to over-invest may occur. Through their research, they show that the cash flow of the chaebol increases and enables managers to invest more aggressively. To examine the effects of cash flow on investments based on these existing results, we define cash flow as net income plus depreciation costs ($CF_{i(t-1)}=CF_{it}/K_{i(t-1)}$). An industry dummy (*dksic*) is added and coded from 16 to 36 according to the Korean SIC code (the 8^{th} edition), and a year dummy (v_t) is given and coded from 1991 to 1996.[4] We construct our dataset for a balanced panel over the period between 1990 and 1996 and from 2001 to 2005 to check for any difference in pre- and post-crisis periods. We run both random effect and fixed effect models, but the random effect model is rejected by the Hausman test. Therefore, we report the results with the fixed effect model. To take care of possible serial correlation problem in panel data, we run the balanced two-step GMM method by using Arellano-Bond dynamic panel data estimation, which is supposed to control auto correlation between dependent variable and the main regressor. The proxy variables for *TQ* include *MB*1, *MB*2, *TQ*2_*A*, and *TQ*2_*B*. Between the fixed and GMM methods, we would give a bit more weight to the results of the latter.

Table 3 shows the estimates of investment function using *MB*1, *MB*2, *TQ*2_*A*, and *TQ*2_*B*. The pre-crisis period of the 1990s shows different coefficients among alternative measures of Tobin's Q. In the fixed results, *MB*1 and *MB*2 are significant. In the GMM results, only *MB*1 is positive and significant, whereas the other three measures are not significant. In general, we confirm different performances as a predictor of investment between the *TQ* measures (*MB*1 or *MB*2) using the book values of debts or stocks and the measures (*TQ*2_*A* and *TQ*2_*B*) using the market values of both debts and stocks.

The above results are telling. First, the *MB* series may not be reliable, as the results may not reflect the market value of either debt or assets. The significance of *MB* estimates in the 1990s does not seem to suggest that it is a good estimate of *TQ* and a reliable predictor of investment.

[4] Kim (2010) uses control ownership disparity as an explanatory variable to analyze how the ownership structure affects investment. From the result, he suggests that the ownership control disparity does not affect the corporate decision on investment.

TABLE 3

ESTIMATION OF INVESTMENT FUNCTIONS: BALANCED PANEL (1990-1996)

Ginv_*t*	Fixed effect				Two-step GMM			
	*MB*1	*MB*2	*TQ2_A*	*TQ2_B*	*MB*1	*MB*2	*TQ2_A*	*TQ2_B*
_cons	-0.1090	0.1921***	0.0309	0.0188	0.0307	0.2139***	0.1621***	0.1542***
	(-0.50)	(3.65)	(0.43)	(0.26)	(0.18)	(0.04)	(0.06)	(0.06)
*Ginv*_1	-0.0411	-0.0569*	-0.0612*	-0.0589*	0.0859***	0.0874**	0.0876**	0.0871**
	(-1.24)	(-1.70)	(-1.84)	(-1.77)	(0.03)	(0.04)	(0.03)	(0.03)
*tq*_1	0.4156***	0.0486*	0.0051	0.0090	0.2924**	0.0008	-0.0230	-0.0123
	(5.51)	(1.80)	(0.13)	(0.31)	(0.12)	(0.02)	(0.03)	(0.02)
*ind_tq*_1	-0.1179	-0.0050	0.3609***	0.3042***	-0.1520	-0.0061	0.1274	0.1064
	(-0.51)	(-0.08)	(3.07)	(3.29)	(0.11)	(0.03)	(0.13)	(0.12)
*CF*_1	0.5918***	0.6566***	0.7117***	0.7194***	0.4590***	0.4555***	0.4564***	0.4677***
	(5.24)	(5.78)	(6.26)	(6.31)	(0.12)	(0.14)	(0.13)	(0.12)
Hausman	71.60	52.84	50.16	50.10				
Prob>chi2	0.0000	0.0000	0.0000	0.0000				
Wald chi2					117.46	73.7	73.32	73.89
Prob>chi2					0.000	0.000	0.000	0.000
Arellano-Bond test for AR(1)					**0.000**	**0.000**	**0.000**	**0.000**
Arellano-Bond test for AR(2)					**0.076**	**0.102**	**0.111**	**0.112**
Hansen test					0.407	0.388	0.421	0.399

Notes: 1) Year dummy and industry dummy are included. Dataset consists of 1,022 firm-year observations.
2) Parentheses in the fixed effect model denote *t* or *z*-statistics of the coefficients; parentheses in the two-step GMM model denote the corrected standard error of the coefficients.
3) Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and * respectively.

Rather, it reflects that Korean firms in the 1990s borrowed heavily to pay for their excessive investment. In other words, the higher value of debts in the 1990s is reflected by the higher value of *MB*, and it turns out to be correlated with the investment financed by the heavy debts. Furthermore, given that the Korean capital market in the 1990s was far from "efficient," considering Tobin's Q is not significant in investment functions makes more sense, which is the case with other estimates of *TQ2_A* or *TQ2_B*.

The results for the 2000s or the post-crisis period are different from the results of the 1990s. This finding makes more sense. In other words, in the fixed effect results, the coefficients of *MB*2, *TQ2_A*, and *TQ2_B* are all positive and significant, whereas those of *MB*1 are not at all significant in this time. The most important thing is that the significance of the coefficient of *TQ2_B* is only in the GMM results. This finding implies

TABLE 4

ESTIMATION OF INVESTMENT FUNCTIONS: BALANCED PANEL (2001-2005)

Ginv_*t*	Fixed effect				Two-step GMM			
	*MB*1	*MB*2	*TQ2_A*	*TQ2_B*	*MB*1	*MB*2	*TQ2_A*	*TQ2_B*
_cons	0.0670	-0.0713**	0.1029***	0.0950***	-0.0098	0.0019	0.0362*	0.0351
	(0.33)	(-2.03)	(3.42)	(3.04)	(0.06)	(0.04)	(0.02)	(0.02)
*Ginv*_1	-0.1931***	-0.1904***	-0.1934***	-0.1916***	0.0378*	0.0259	0.0374*	0.0377**
	(-5.22)	(-5.22)	(-5.28)	(-5.23)	(0.02)	(0.02)	(0.02)	(0.02)
*tq*_1	0.0098	0.0543**	0.0950**	0.0840***	-0.0197	0.0242	0.0302	0.0324*
	(0.15)	(2.09)	(2.59)	(2.99)	(0.04)	(0.02)	(0.02)	(0.02)
*ind_tq*_1	-0.0143	0.3444***	-0.2997***	-0.2114***	0.0814	0.1039	-0.0589	-0.0468
	(-0.05)	(3.99)	(-3.32)	(-2.99)	(0.08)	(0.13)	(0.05)	(0.04)
*CF*_1	0.0044	0.0104	0.0182	0.0141	0.0508	0.0406	0.0510	0.0465
	(0.08)	(0.21)	(0.36)	(0.28)	(0.05)	(0.05)	(0.04)	(0.04)
Hausman	156.27	175.56	177.77	182.35				
Prob>chi2	0.0000	0.0000	0.0000	0.0000				
Wald chi2					29.15	33.80	29.30	30.33
Prob>chi2					0.000	0.000	0.000	0.000
Arellano-Bond test for AR(1)					**0.005**	**0.006**	**0.004**	**0.004**
Arellano-Bond test for AR(2)					**0.319**	**0.370**	**0.297**	**0.296**
Hansen test					0.744	0.805	0.772	0.782

Notes: 1) Year dummy and industry dummy are included. Dataset consists of 1,080 firm-year observations.
2) Parentheses in the fixed effect model denote *t* or *z*-statistics of the coefficients; parentheses in the two-step GMM model denote corrected standard error of the coefficients.
3) Statistical significance at the 1%, 5%, and 10% levels is denoted by ***, **, and * respectively.

the superiority of the *TQ2_B* estimates or at the least the inferiority of the *MB*1 estimates. In estimating the investment function that uses the two-step GMM method, *MB*1 is proved to be a biased estimator because the estimator does not satisfy the AR test.[5]

In the 2000s, after the IMF-imposed reform, Korean firms substantially reduced their debts and became more cautious in investment, as verified by Lee, Kim, and Lee (2010) and Choo *et al.* (2009). As the market may have become more efficient than before, the significance of Tobin's Q as a determinant of corporate investment is sensible. During the post-crisis period, cash flow is not significant, consistent with the idea that capital markets function better than before. Investments are less conditional on the cash flow of firms but are more conditional on the prospects of firm values represented by Tobin's Q (in this case *TQ2_B*). In terms of robustness tests, on the basis of both fixed effect and GMM results, we

[5] Other estimators, *TQ2_A*, and *TQ2_B*, as well as *MB*2 satisfy the AR test.

confirm the significance of *TQ*2_*B* and the insignificance of *MB*1. Therefore, these results imply that *MB*1 is not a reliable measure of Tobin's Q or firm value and that *TQ*2_*B* is more reliable. Thus, we achieve progress in differentiating the relative usefulness among the four alternatives of Tobin's Q, although other aspects or methods may be used to compare them.

V. Summary and Concluding Remarks

This study uses several approaches to estimate the values of firms in the Korean stock market to find substantially different results depending on the methods.

First, the estimates using *MB*1, which is the simplest market-to-book value ratio, are close to one, as expected. However, the pattern and results are different from those of other approaches because book values often deviate sharply from market values of both debts and replacement costs of assets. In comparison, the *MB*2 estimates, which use the market values of debt, are substantially lower than the *MB*1 estimates because the market value of liabilities is significantly lower than the book value of liabilities. However, the limitation of *MB*1 and *MB*2 is that both use book values of assets, whereas *TQ*2_*A* and *TQ*2_*B* reflect the actual replacement costs of assets. We consider *TQ*2 to be superior to *TQ*1 in terms of calculating the value of preferred stocks. Our *TQ*2 approach is the same method used by Lindenberg and Ross (1981) and Summers (1981). They adopt a consistent approach of calculating the price of preferred stocks, which is dividing the average dividends of preferred stocks by the S&P average dividend ratio. Of the two methods in the *TQ*2 approach, we deem the B (*TQ*2_*B*) method to be better because it considers the differences in depreciation rate for different types of assets, although it is a matter subject to a rigorous test and interpretation.

As another way to differentiate the reliability of alternative estimates of Tobin's Q, we conduct the estimation of investment functions. This experiment reveals the weakest reliability of the crude measure or *MB*1, as well as the better performance of *TQ*2_*B*, as a determinant of corporate investment. However, we consider this result with caution, as the relative superiority between *TQ*2_*A* and *TQ*2_*B* may only be marginal.

Given the relative inferiority of *MB*1 estimates, we re-interpret the trend of firm values in Korea. One of the important findings is that *MB*1 tends to overestimate the trend of Tobin's Q in Korea. For example,

for the 10 years period from 1996 to 2005, the *MB*1 estimates tend to range over 0.7, whereas the other estimates show *TQ* mostly below 0.6. From 1991 to 2005, these three estimates suggest that the values of the listed manufacturing firms in Korea tended to be highest in the mid-1990s but plummeted to the bottom in 1997. Yet after the crisis, they all recovered as the Korean firms went through corporate restructuring and improved in efficiency, resulting in the FV bouncing back. Before the crisis in 1997, stand-alone firms had a slightly higher FV than group affiliates. However, this situation reversed after the crisis. It is particularly distinct in the results of *TQ*2_*B*, consistent with Lee, Kim, and Lee (2010).

In general, Tobin's Q is still lower than one, and the average Tobin's Q of Korean firms is lower than that of American companies (Lee 2013 Ch. 5). This finding implies that a considerable number of the listed manufacturing firms in Korea fail to recover the replacement costs of assets. Further studies should examine what causes this unsatisfactory performance. The question on the presence of the Korean discount, which could have caused Korean firms to be undervalued compared with those in more advanced economies, also remains.

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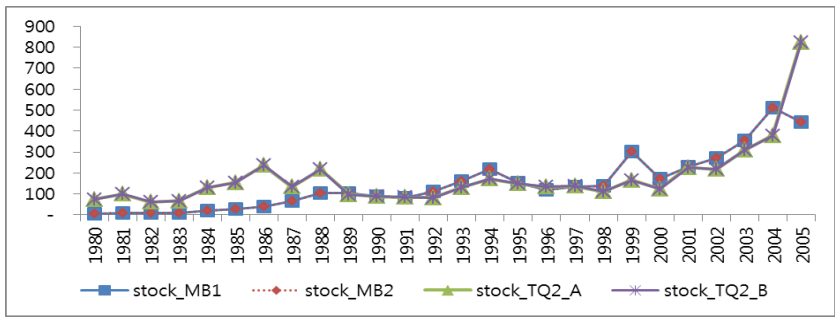
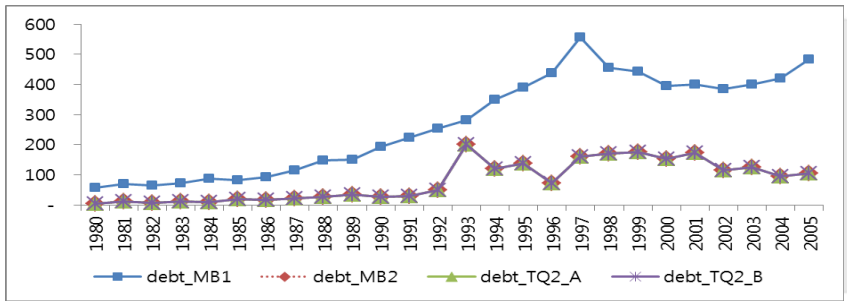
Appendix Figure 2-A

COMPARISON OF AVERAGE STOCK VALUE BY APPROACH (UNIT: TRILLION WON)



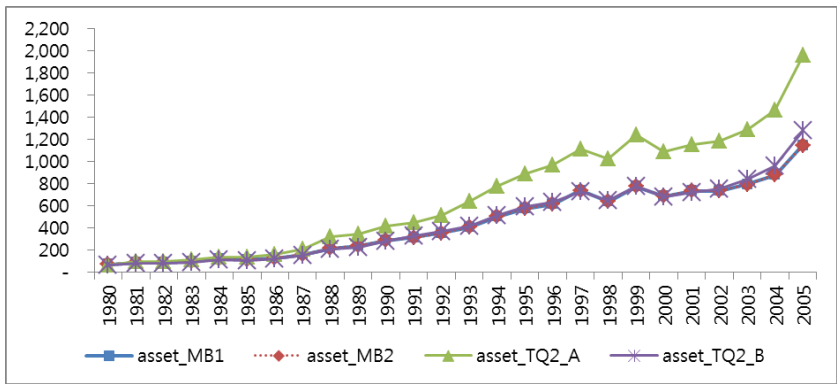
Appendix Figure 2-B

COMPARISON OF AVERAGE LIABILITIES VALUE BY APPROACH (UNIT: TRILLION WON)



Appendix Figure 2-C

COMPARISON OF AVERAGE ASSET VALUE BY APPROACH (UNIT: TRILLION WON)



References

Back, J., J. Kang, and K. Park. "Corporate Governance and Firm Value: Evidence from the Korean Financial Crisis." *Journal of Financial Economics* 71 (No. 2 2004): 265-313.

Bae, S., T. Kwon, and J. Lee. "Corporate Diversification, Relatedness, and Firm Value; Evidence from Korean Firms." *Asia-Pacific Journal of Financial Studies* 37 (No. 6 2008): 1025-1064.

Bank of Korea. Articles in Monthly Bulletin, Monthly issues.

_____. Statistical Database (Available at: http://ecos.bok.or.kr/).

Black, B., H. Jang, and W. Kim. Does Corporate Governance Affect Firms' Market Values? Evidence from Korea, Stanford Law and Economics Online Working Paper, No. 23, 2003.

Carpenter, E., and A. Guariglia. Cash flow, Investment, and Investment Opportunities: New Tests using UK Panel Data, Discussion Paper, Univ. of Nottingham, 2003.

Choo, K., K. Lee, K. Ryu, and J. Yoon. "Explaining Changing Performance of the Business Groups Over a Longer Period: The Case of Chaebols before and after the Crisis in Korea." *Economic Development and Cultural Change* 57 (No. 2 2009): 359-386.

Drobetz, W., A. Schilhofer, and H. Zimmermann. "Corporate Governance and Expected Stock Return: Evidence from Germany." *European Financial Management* 10 (No. 2 2004): 267-293.

Durnev, Art, Randall Morck, and Bernard Yeung. "Value-Enhancing Capital Budgeting and Firm-Specific Stock Return Variation." *Journal of Finance* 59 (No. 1 2004): 65-105.

Ferris, S., Kim, A., Kitsabunnarat, P. "The Cost (and Benefits?) of Diversified Businessgroups: The Case of Korean Chaebols." *Journal of Banking and Finance* 27 (No. 2 2003): 251-273.

Hadi, A. "A Modification of a Method for the Detection of Outliers in Multivariate Samples." *Journal of the Royal Statistical Society*, Series B (Methodological) 56 (1994): 393-396.

Hayashi, F., and T. Inoue. "The Relation between Firm Growth and Q with Multiple Capital Goods: Theory and Evidence from Panel Data on Japanese Firms." *Econometrica* 59 (1991): 731-753.

Hong Jang Pyo and Ahn Hyeon Hyo "Agency Problems and Overinvestment in the Korean Chaebol Firms." *Seoul Journal of Economics* 13 (No. 2 2000): 185-210.

Hong, K., J. Lee, and Y. Lee "Investment by Korean Conglomerates before

and after the Crisis." *Japan and the World Economy* 19 (No. 3 2007): 347-373.

Hoshi, T. and A. Kashyap "Evidence on Q and Investment for Japanese Firms." *Journal of The Japanese and International Economics* 4 (No. 4 1990): 371-400.

Hyun, J., and H. Pyo "Estimation of the Depreciation Rate of Tangible Fixed Assets: Comparison of the Capital Stock Approach and the Microeconomic Approach." *Proceedings of Panel Discussions for the Analysis of the Korean Economy* 3 (1997): 154-181 (in Korean).

Hyun Jong Kim "An Empirical Study on the Effect of Financial Structure on Investment: Does Debt Covenant Shrink Corporate Investment?" *Seoul Journal of Economics* 23 (No. 2 2010): 283-320.

Kang, H., K. Park, and H. Jang. "Determinants of Family Ownership: The Choice between Control and Performance." *Asia-Pacific Journal of Financial Studies* 35 (No. 6 2006): 39-75.

Kang, W., and H. Shin. "The Effects on Korean Listed Firms' M/B and Tobin's Q of the Revaluation of Assets after the Korean Financial Crisis." *Journal of Money & Finance* 9 (2004): 115-156 (in Korean).

Kim, C. "Corporate Social Responsibility and Firm Value." *Asia-Pacific Journal of Financial Studies* 38 (2009): 507-545.

_____. "Is the Investment of Korean Conglomerates Inefficient?" *Korean Economic Review* 18 (No. 1 2002): 5-24.

Kim, K., W. Kim, S. Park, and T. Jang. Estimation of Tobin's Q: Korean listed firms, Proceedings of Panel Discussions for the Analysis of the Korean Economy 2 (1996): 147-175, (in Korean).

Korea Fair Trade Commission (KFTC), Top 30 Business Groups Lists and the Affiliates, Annual issues.

Korea Information Service (KIS), KIS Value Database.

Lang, L., and R. Stultz. "Tobin's q, Corporate Diversification, and Firm Performance." *Journal of Political Economy* 102 (1994): 1248-1280.

Lee, J., Y. Lee, and J. Yoo. "Investment Inefficiency of Korean Conglomerates." *Journal of Korea Money and Finance* 6 (2001): 21-36, (in Korean).

Lee, K., J. Kim, and O. Lee. "Long-term Evolution of the Firm Value and Behavior of Business Groups: Korean Chaebols between Weak Premium, Strong Discount, and Strong Premium." *Journal of The Japanese and International Economies* 24 (No. 3 2010): 412-440.

Lee, Keun. *Schumpeterian Analysis of Economic Catch-up*. Cambridge: Cambridge Univ. Press, 2013.

Lee, K., K. Ryu, C. Rhee, S. Yi, D. Ahn, K. Choo, J. Kim, H. Kim, M.

Jung, and Y. Kim. *Evolution of the firms in Korea since 1945, Vol. I: Construction of the database for the 1976-2005 period and descriptive analysis.* Seoul: Seoul National University Press, 2007. (in Korean)

Lindenberg, E., and S. Ross. "Tobin's q ratio and industrial organization." *Journal of Business* 54 (No. 1 1981): 1-32.

Management Efficiency Research Institute. Korea's Fifty Major Financial Groups, HankookIlbo, 1986. (in Korean)

Ministry of Construction and Transportation, Reports on Housing Price Index (jiga-donghyang), Annual issues.

Ministry of Strategy and Finance, Monthly Economic Bulletins, Monthly issues.

Modigliani, F., and M. Miller. "The Cost of Capital, Corporation Finance and the Theory of Investment." *American Economic Review* 48 (No. 3 1958): 261-297.

Morck, R., A. Shleifer, and R. Vishny. "Management Ownership and Market Valuation: An Empirical Analysis." *Journal of Financial Economics* 20 (1988): 293-315.

Scharfstein, D., and J. Stein. "The Dark Side of Internal Capital Markets: Divisional Rent-seeking and Inefficient Investment." *Journal of Finance* 55 (No. 6 1998): 2537-2564.

Summers, L. "Taxation and Corporate Investment: A q-theory Approach." *Brookings Papers Economic Activity* (No. 1 1981): 67-127.

Tobin, J. "A General Equilibrium Approach to Monetary Theory." *Journal of Money, Credit, and Banking* 1 (No. 1 1969): 15-29.

Yoon, B., and J. Oh. "Korean Case Studies on Corporate Governance and Firm's Performance, Value and Market Returns." *Asia-Pacific Journal of Financial Studies* 34 (2005): 227-263.