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A Flight to Q?: Firm Investment and Financing in Korea Before and After the 1997 Financial Crisis

Peter L. Rousseau [a, b, *] and Jong Hun Kim [a]

[a] Department of Economics, Vanderbilt University, Box 1819 Sta. B, Nashville, TN 37235

[b] National Bureau of Economic Research, Cambridge, MA 02138

Abstract

We examine investment behavior among exchange-listed Korean manufacturing firms before and after the 1997 financial crisis using firm-level panel data. We start with the standard Q-theory of investment, and then augment it by allowing for a sales accelerator and the possibility of cash constraints, categorizing firms based on their age, size and affiliation to an industrial conglomerate (i.e., *chaebol*). We find that Tobin's Q is a key and robust determinant of firm-level investment in a pooled sample for the period from 1992 to 2001, but that it became more important for small firms and less important for chaebol-affiliated firms after the crisis. Investment by chaebol firms also became more sensitive to the availability of internal cash balances after the crisis. We interpret this as reflecting a shift in the Korean economy to a stronger market orientation after the crisis and to a business climate in which the quality of potential projects became more important relative to capital market imperfections in determining the destination of investment funds.

JEL classification: F3; G11

Keywords: Financial crisis, investment demand, panel data GMM, financing constraints

[*] Corresponding author: Tel.: +1-615-343-2466; fax: +1-615-343-8495.
E-mail address: peter.l.rousseau@vanderbilt.edu (P.L. Rousseau).

1. Introduction

In 1997, Korea experienced its first financial crisis of the postwar period. The crisis, triggered by the collapse of the Korean won in December, led to widespread distress in both the financial and corporate sectors. Since then, Korean corporations have been required by law to keep their debt-to-equity ratios below 200 percent, and financial institutions have had to keep up with new regulations such as the Basle standards and be more diligent in identifying profitable projects for their funds.[1] A key question is whether the costs of external funding rose in the wake of these changes and forced some firms to pass up investment opportunities that could not be implemented with internal funds alone. If so, the apparent slowdown of Korea's economy after the crisis could be at least partially explained by supply-side factors. In this paper, data from before and after the 1997 East Asian financial crisis are brought to bear on this question.

Before the crisis, the Korean government exerted some control over the flow of funds from financial intermediaries to firms. Indeed, from the beginning of the nation's modern economic development, the government has held the power to channel funds to specific sectors through direct controls over the economic and managerial activities of financial intermediaries. Until the end of the 1980s, the beneficiaries had for the most part been large and well-established corporations in industries that required large fixed investments. As the government shifted its primary focus in the early 1990s from economic growth to the structure of the economy, however, and specifically to adjusting imbalances that had been created across industries by earlier interventions, it began to direct funds to less well-established firms of small and medium-size through policy loan programs and regulated interest rates. The result was a more balanced

[1] While a debt-to-equity ratio of 200 percent may already seem high for an exchange-listed firm, the average for listed manufacturing firms in Korea on the eve of the financial crisis was 329 percent. By 2001, the average had fallen to 119 percent.

allocation of loans across the distributions of firm ages and sizes, but also a tendency to provide resources to firms with less reliable information about the quality of their business plans.[2]

We explore what happened in this lending climate after the crisis struck in December 1997 and it became apparent that the government's policy had led to many delinquent or defaulting loans. Our evidence suggests that Korean banks, in response to the contraction in credit that immediately followed the crisis, began to evaluate potential loan applicants more intensely based on market criteria rather than less well-defined policy objectives, and that as foreign capital began to flow back into the country by late 1998, this new market orientation strengthened. Further, firms tended to invest more when they had good projects in the offing, rather than only when they had surplus cash. In other words, a firm's expected profitability, as measured by Tobin's Q, became a stronger force in the credit allocation process on both sides of the market.

The evidence is based on data for 418 Korean manufacturing firms covering the 10 years surrounding the crisis (1992-2001). As in earlier studies of the United States (Fazzari, Hubbard, and Petersen, 1988), Japan (Hayashi and Inoue, 1991), and the OECD countries (Kadapakkam, Kumar, and Riddick, 1998), we consider the role of Tobin's Q, cash, and sales as possible determinants of firm-level investment using modeling frameworks that capture neoclassical and sales accelerator mechanisms. Our specifications capture the dynamics of firms' adjustments to changing credit conditions using the generalized method of moments (GMM) estimator developed by Arellano and Bond (1991). We choose this technique because it is well-suited to our broad yet relatively short panel data set (see Judson and Owen, 1999).

To implement the idea of a financial hierarchy or "pecking order", we classify firms by

[2] See Dekle and Kletzer (2002) and Laeven (2002) for useful discussions of these policies.

age, size, and whether they are affiliated with large industrial conglomerates, or "*chaebols*". We suspected that 1) younger and smaller firms would be less well established and more constrained financially in terms of the availability of external funding opportunities than older, larger, and more established firms, and 2) chaebol-affiliated firms, which enjoyed preferential access to funding before the crisis, would be less financially constrained than non-affiliates afterwards.

We find that the nature of financing constraints changed among classes of manufacturing firms after the crisis. For younger and smaller firms, cash flows and the levels of cash balances and sales became less important, whereas the quality of investment opportunities, as measured by Tobin's Q, became a critical determinant of investment despite a lack of explanatory power before the crisis. For older firms, Q was a strong determinant of investment before and after the crisis, but cash and sales became less important afterwards. This suggests a "flight-to-quality" by lenders (see Bernanke, Gertler and Gilchrist, 1996) that we call a "flight-to-Q." In contrast to our second prior, we also find that chaebol-affiliated firms became *more* financially constrained after the crisis, with investment decisions more sensitive to their cash positions and sales. Like Borensztein and Lee (2002) before us, we posit that a loss of preferential access to credit, to which the government-imposed ceiling on debt-equity ratios played a potent role, combined with a traditionally low risk, low return tradeoff to render chaebols less desirable as loan customers in the more market-driven financial environment that emerged after the crisis.

Our work is most closely related to Laeven (2002), who examines similar dynamic models of investment for a smaller sample of listed Korean firms in the years leading up to the financial crisis (i.e., 1991-97). Our findings are not inconsistent with Laeven's for the pre-crisis period, but our focus on comparing the pre- and post crisis periods in the context of an event study differs substantially.

The analysis proceeds as follows. In Section 2, we summarize the theoretical underpinnings of our work and introduce the empirical specifications that we estimate. Section 3 describes the panel data set and firm classification system that we use. Section 4 presents estimates from a series of dynamic panel models of the firm-level investment decision, and we draw our conclusions together in Sections 5 and 6.

2. Background and methodology

Conventional models of the firm-level investment demand emphasize expected profits and the cost of capital as important determinants. The standard Q-theory summarizes the neoclassical view by holding that Q, defined as the ratio of the market valuation of a firm to the replacement value of its assets, is a sufficient explanatory factor for investment demand. Other frameworks move beyond the frictionless economy and representative firm assumed by the neoclassical model to address the role of capital market imperfections, and particularly those rooted in informational asymmetries, on the investment decision. Among these, Fazzari, Hubbard and Petersen (FHP, 1988) introduces a modified version of the financial hierarchy model of Myers and Majluf (1984) that implies a "pecking order" starting with low-cost funding sources, such as retained earnings, and proceeding to higher-cost ones such as bank loans and new share issues.[3] Since internal and external financing are no longer perfect substitutes, firms do not issue shares unless the marginal Q for their new projects is sufficiently high. Thus, the financial structure of a firm is not as independent of its investment decision as Modigliani and Miller (1958) would suggest.

A large empirical literature has since emerged to investigate these models further. Hoshi,

[3] FHP describes the sources of this cost differential, which include transaction costs, tax advantages, agency problems, and distortions associated with financial distress.

Kashyap and Scharfstein (1991), using panel data from 145 Japanese manufacturing firms for the period from 1977 to 1982, find that liquidity is more important to independent firms than to those with strong ties to major banks. Hayashi and Inoue (1991) studied 687 manufacturing firms listed on the Tokyo Stock Exchange for the period from 1977 to 1986. After classifying firms into two categories, light and heavy industry, they found that the significance of cash flow for investment disappeared among firms in heavy industry from 1984 to 1986, which coincided with the period after Japan liberalized its capital markets. Similarly, Gallego and Loayza (2001), in a study of 79 listed Chilean companies from 1985 to 1995, conclude that investment became more responsive to Q and less tied to cash flow and debt in the 1990s, which is the period following the second wave of its financial liberalization. For Korea, Shin and Park (1999) classified 629 manufacturing firms by affiliation to a chaebol from 1990 to 1995 (i.e., before the crisis) and found that chaebol-affiliated firms were less constrained by internal funds than non-chaebol firms. Borensztein and Lee (2002) find that a firm's profit in the previous year became a key factor for procuring credit from financial intermediaries after the crisis, and that chaebol firms seem to have lost their preferential access to bank lending.

In our analysis, we start with a dynamic panel version of Hayashi's (1982) specification as a baseline.[4] This model is consistent with the Q-theory of investment under a linear and homogeneous profit function and an efficient stock market. The specification is

$$\left(\frac{I}{K}\right)_{it} = \alpha \cdot \left(\frac{I}{K}\right)_{i,t-1} + \beta \cdot Q_{it} + \eta_i + \Phi_t + \varepsilon_{it}, \qquad (1)$$

where *I/K* is the ratio of firm *i*'s investment in year *t* to its capital stock, with the latter measured at the beginning of the period, *Q* is Tobin's Q, also measured at the beginning of the period, the

[4] Hayashi (1982) estimated the time series version of equation (1) using aggregates from 1952 to 1978 as $\left(\frac{I}{K}\right)_t = c + \beta_1 Q_t + \varepsilon_t$.

Φ_t are dummy variables for years, and the η_i are firm-specific fixed effects.

Since the neoclassical model implies that *Q* is sufficient for explaining firm investment, adding other explanatory variables such as cash balances or sales should not significantly affect the regression if the model is correct. To test this, we estimate two variants of equation (1). First, we add cash balances and cash flows to the benchmark equation to test for the presence of financing constraints as follows:

$$\left(\frac{I}{K}\right)_{it} = \alpha \cdot \left(\frac{I}{K}\right)_{i,t-1} + \beta \cdot Q_{it} + \gamma \cdot \left(\frac{C}{K}\right)_{it} + \eta_i + \Phi_t + \varepsilon_{it}, \quad (2)$$

$$\left(\frac{I}{K}\right)_{it} = \alpha \cdot \left(\frac{I}{K}\right)_{i,t-1} + \beta \cdot Q_{it} + \gamma \cdot \left(\frac{C}{K}\right)_{it} + \delta \cdot \left(\frac{CF}{K}\right)_{it} + \eta_i + \Phi_t + \varepsilon_{it}, \quad (3)$$

where *C/K* is firm *i*'s cash balance at the beginning of period *t* and *CF/K* is firm *i*'s cash flow over period *t*, both as ratios to firm *i*'s capital stock at the beginning of the period.

Next, we add the current level of sales to examine whether the investment decisions of Korean firms conform to a simple acceleration principle[5]:

$$\left(\frac{I}{K}\right)_{it} = \alpha \cdot \left(\frac{I}{K}\right)_{i,t-1} + \beta \cdot Q_{it} + \gamma \cdot \left(\frac{C}{K}\right)_{it} + \xi \cdot \left(\frac{S}{K}\right)_{it} + \eta_i + \Phi_t + \varepsilon_{it}, \quad (4)$$

$$\left(\frac{I}{K}\right)_{it} = \alpha \cdot \left(\frac{I}{K}\right)_{i,t-1} + \beta \cdot Q_{it} + \gamma \cdot \left(\frac{C}{K}\right)_{it} + \delta \cdot \left(\frac{CF}{K}\right)_{it} + \xi \cdot \left(\frac{S}{K}\right)_{it} + \eta_i + \Phi_t + \varepsilon_{it}, \quad (5)$$

where *S/K* is the ratio of firm *i*'s sales in period *t* to the beginning-of-period capital stock.

Following Arellano and Bond (1991), we eliminate the firm-specific effect by

[5] Abel and Blanchard (1986) describe three possible sources of a sales accelerator. First, a firm is more likely to choose its current level of investment using forecasts of future sales that are based upon current and past sales. Second, both delivery lags on investment goods and the adjustment costs of putting them in place make firms either unable or unwilling to adjust their capital stocks immediately in response to changes in current sales. Finally, an order made in the current period may not appear as an investment on a firm's financial statements until some time later.

differencing equation (1):

$$\left[\left(\frac{I}{K}\right)_{it} - \left(\frac{I}{K}\right)_{i,t-1}\right] = \alpha\left[\left(\frac{I}{K}\right)_{i,t-1} - \left(\frac{I}{K}\right)_{i,t-2}\right] + \beta\left[Q_{it} - Q_{i,t-1}\right] + \tilde{\Phi}_t + \left[\varepsilon_{it} - \varepsilon_{i,t-1}\right]. \qquad (1')$$

Because the *(t-1)* component of the error term is potentially correlated with *(t-1)* component of the differenced lag of the investment rate, OLS may produce biased coefficient estimates for all of the right-hand side variables when, as is the case here, the time dimension of the panel is small. For this reason, we instrument for the difference of the lagged investment rate using its lagged levels in *t-2* and *t-3*, thus implementing Arellano and Bond's difference GMM estimator.

When adding cash and/or sales to the baseline model as in (2) and (5), we also take first differences and estimate with GMM:

$$\Delta\left(\frac{I}{K}\right)_{it} = \alpha\left[\Delta\left(\frac{I}{K}\right)_{i,t-1}\right] + \beta\left[\Delta Q_{it}\right] + \gamma\left[\Delta\left(\frac{C}{K}\right)_{it}\right] + \tilde{\Phi}_t + \left[\varepsilon_{it} - \varepsilon_{i,t-1}\right] \qquad (2')$$

$$\Delta\left(\frac{I}{K}\right)_{it} = \alpha\left[\Delta\left(\frac{I}{K}\right)_{i,t-1}\right] + \beta\left[\Delta Q_{it}\right] + \gamma\left[\Delta\left(\frac{C}{K}\right)_{it}\right] + \delta\left[\Delta\left(\frac{CF}{K}\right)_{it}\right] + \tilde{\Phi}_t + \left[\varepsilon_{it} - \varepsilon_{i,t-1}\right] \qquad (3')$$

$$\Delta\left(\frac{I}{K}\right)_{it} = \alpha\left[\Delta\left(\frac{I}{K}\right)_{i,t-1}\right] + \beta\left[\Delta Q_{it}\right] + \gamma\left[\Delta\left(\frac{C}{K}\right)_{it}\right] + \xi\left[\Delta\left(\frac{S}{K}\right)_{it}\right] + \tilde{\Phi}_t + \left[\varepsilon_{it} - \varepsilon_{i,t-1}\right] \qquad (4')$$

$$\Delta\left(\frac{I}{K}\right)_{it} = \alpha\left[\Delta\left(\frac{I}{K}\right)_{i,t-1}\right] + \beta\left[\Delta Q_{it}\right] + \gamma\left[\Delta\left(\frac{C}{K}\right)_{it}\right] + \delta\left[\Delta\left(\frac{CF}{K}\right)_{it}\right] + \xi\left[\Delta\left(\frac{S}{K}\right)_{it}\right] + \tilde{\Phi}_t + \left[\varepsilon_{it} - \varepsilon_{i,t-1}\right]. \qquad (5')$$

While the Arellano-Bond estimator corrects for potential bias in the coefficient on the lag of the dependent variable (and thus the other coefficients as well), recent contributions to the econometrics and empirical investment literature by Erickson and Whited (2000, 2002) indicate that measurement error in Tobin's Q may still lead to inconsistent coefficient estimates. Measurement error arises because modern Q-theory (e.g., Lucas and Prescott, 1971) links investment with a firm manager's expectation of the marginal contribution of new capital goods to future profits (i.e., *marginal* Q), while empirically the investigator must usually work with the

ratio of the firm's market valuation to the replacement cost of its assets. Under constant returns and perfect competition, Hayashi (1982) showed that *marginal* Q is equivalent to *average* Q, which can be measured as the ratio of the manager's valuation of the firm's stock of assets to their replacement cost. This brings theory and implementation closer, yet financial markets must still be efficient for the manager's valuation of the firm to coincide with that of the market. To the extent that any of the above assumptions are violated, using standard market-based measures of Q may bias its coefficient in the specifications that we consider, with the bias generally downward. More importantly, under-estimating the coefficient on Q will tend to deliver over-estimates of the coefficients for the perfectly-measured regressors in the model, such as those on the cash variables.

To correct for possible measurement error in Q, Erickson and Whited (2002) develop a two-step GMM estimator that uses information contained in third and higher-order moments of the joint distribution of the observed regression variables. Concerned about the effects of measurement error on the statistical inferences that we would draw, we estimated the above regression equations with and without corrections for possible measurement error. Interestingly, we found that the corrected estimates of the coefficients on our cash and sales variables differed only minimally from the uncorrected ones, while the correction generated a wide spread of point estimates with large standard errors for the Q coefficients that depended on the number of higher-order moments used. Since our study draws inferences on Q based upon changes in its relative levels and statistical significance across the pre- and post-crisis periods, we believe that the cost of consistency in our particular application is very high in terms of precision and have chosen to present coefficient estimates that have not been corrected for potential measurement error in the tables that follow.

3. Data description and classification

Our primary sources of firm-level data are the annual members' reports published by the Korea Listed Companies Association (KLCA). These data are available in electronic format for 1997-2001, and we collected them from the print version of the 1997 KLCA yearbook for 1992-1996. The reports include information from balance sheets, income statements, and statements on distributions and cash flows for all firms listed on the Korea Stock Exchange (KSE), which listed 686 companies in 2001. We limit attention to exchange-listed firms in the manufacturing sector because of the greater credibility and consistency of the financial statements of listed firms than unlisted ones and the relatively smooth investment schedules of manufacturing firms compared to other sectors such as construction or service (see Hayashi and Inoue, 1991).[6] This gives us 418 firms with observations in the ten years surrounding the crisis.[7]

We construct a proxy for Tobin's Q as the ratio of market to book value of a firm's financial obligations.[8] Net cash flow is measured as the difference between the starting and ending cash balances over the calendar year. Similarly, net investment is measured as the difference between the starting and ending capital stocks in each year (i.e., not adjusted for

[6] We exclude firms listed on the Korea Securities Dealers' Automated Quotation System (KOSDAQ) for two reasons. First, KOSDAQ was officially established in 1996, one year before the financial crisis. Since our objective is to explore changes in the severity of financing constraints before and after the crisis, we prefer to use the same group of firms across the pre- and post-crisis periods. Second, most of the KOSDAQ-listed firms started up after the crisis and often as a result of government policies aimed at promoting small businesses.

[7] We limit the analysis to manufacturing firms that listed before 1996 and survived the crisis period. This comes at some cost in terms of sampling bias due to the financial crisis, which caused many firms to end their operations.

[8] Specifically, the numerator of Q is the sum of the market value of a firm's common stock (i.e., share price multiplied by number of shares) and its short and long-term liabilities. The denominator is the sum of the book value of a firm's common stock (i.e., shareholders' equity less intangible assets) and its short and long-term liabilities.

depreciation).[9] When used as explanatory variables, cash balances are measured at the start of the year and sales reflect gross receipts over the course of the year. We also include dummy variables for each year and for years when a firm shows net losses on its income statement or has a negative cash flow, but do not report them in the tables that follow. Even though these indicators turn out to be statistically insignificant nearly all of the time, we believe that it is important to control for them since investment is likely to be affected critically in firms that are suffering losses or having severe problems with cash flow.

To explore the effects of firm heterogeneity in the sample, we classify firms on three dimensions. The first two are in the spirit of FHP, who classified firms according to their retention practices. This classification was reasonable for FHP because the relatively stable dividend policies of the US firms included in the Value Line database allowed these authors to identify firms with the lowest payouts as those also most likely to face problems of asymmetric information. Firms in emerging markets generally have less stable dividend payments than their US counterparts, however, and fluctuations in these payments are more likely to reflect changes in industry fundamentals than informational problems.[10] For this reason, we choose to classify firms by their maturity and size rather than their dividend policies.

Specifically, we first classify firms by dividing the sample into two groups based on the median of the sample age distribution. It turned out that "young" firms were those that listed on or after August 1, 1987, while "old" firms were those listing from the time of the KSE's founding in March of 1956 through July 31, 1987. Classifying by age allows us to identify firms

[9] The capital stock includes land as well as other property and equipment. We include land because it is a scarce and especially important input in Korea.

[10] Using companies in eight emerging market markets over the period from 1980 to 1990, Aivazian, Booth and Cleary (2003) find that it is more difficult to predict dividend changes for companies in a number of emerging markets than for a sample of 100 US companies.

that are likely to be less well established and therefore less known to potential investors than older ones. If we are correct, young firms would regularly face the types of informational problems that lead to financial constraints. Fig. 1 shows the sample distribution of firms by year of exchange listing.[11]

Using the same general reasoning, we also classify firms by size, with "small" firms defined as those with total assets below the sample median of 144.5 billion constant 2000 won (with nominal values deflated by producer prices). Small firms usually make investments of smaller absolute size than those of larger firms, and thus do not enjoy the same scale economies as large firms in issuing securities directly. This means that small firms often need to either accept high cost loans from financial intermediaries or have adequate cash on hand to implement new projects. Fig. 2 shows the sample distribution of firms by size.

The final classification is based on whether or not a firm is affiliated with a Korean industrial conglomerate or *chaebol*. We obtained a list of chaebol firms from the annual announcements of the Korean Fair Trade Commission (FTC). The FTC updates their ranking of the top 30 chaebol-firms annually, listing them by size.

Table A.1 in the Appendix includes cross tabulations of firms by age, size, and chaebol affiliation.

4. Empirics

We begin by estimating the baseline equations (1) to (5) for the full panel of 418 manufacturing firms over the period from 1992 to 2001. Next, we divide the panel into two periods, covering the pre-crisis (1992-96) and post-crisis (1997-2001) years, and compare the

[11] Note that a military coup in December 1979 and the accompanying martial law that remained in effect until January 1981 had a sobering effect on entrepreneurship, with the number of listed firms falling in each year from 1979-83 and with no new firms in our sample for 1981 and 1982.

Fig.1. Sample frequency distribution of firms by age (based on date of initial KSE listing).

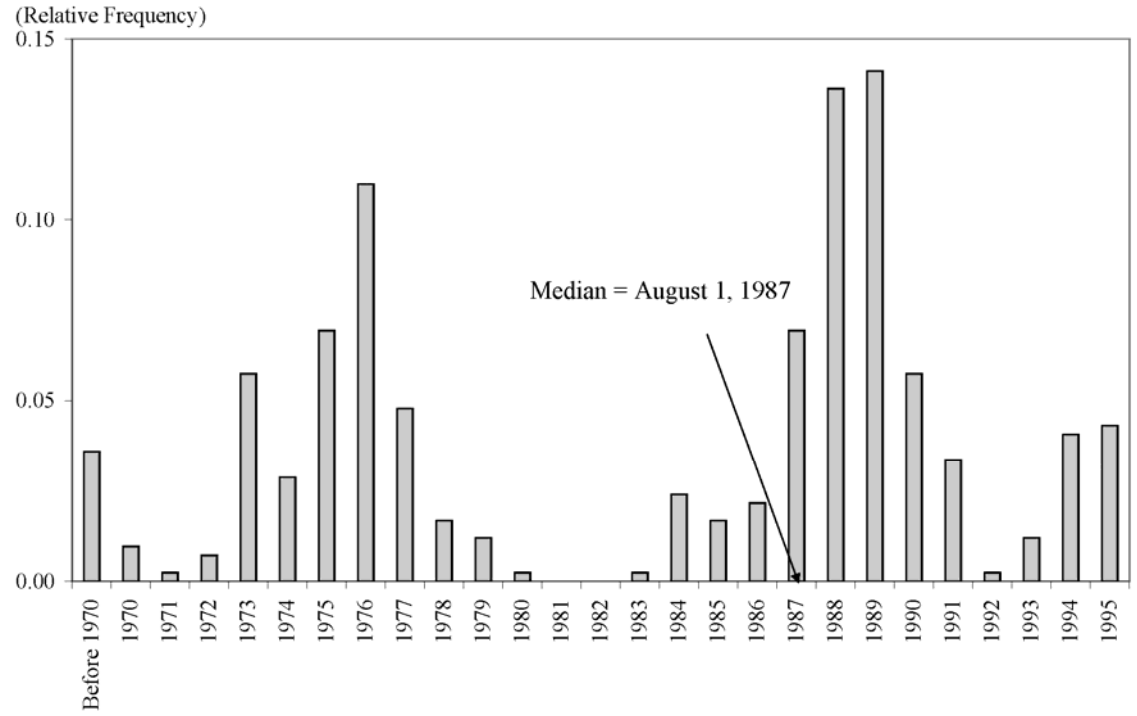
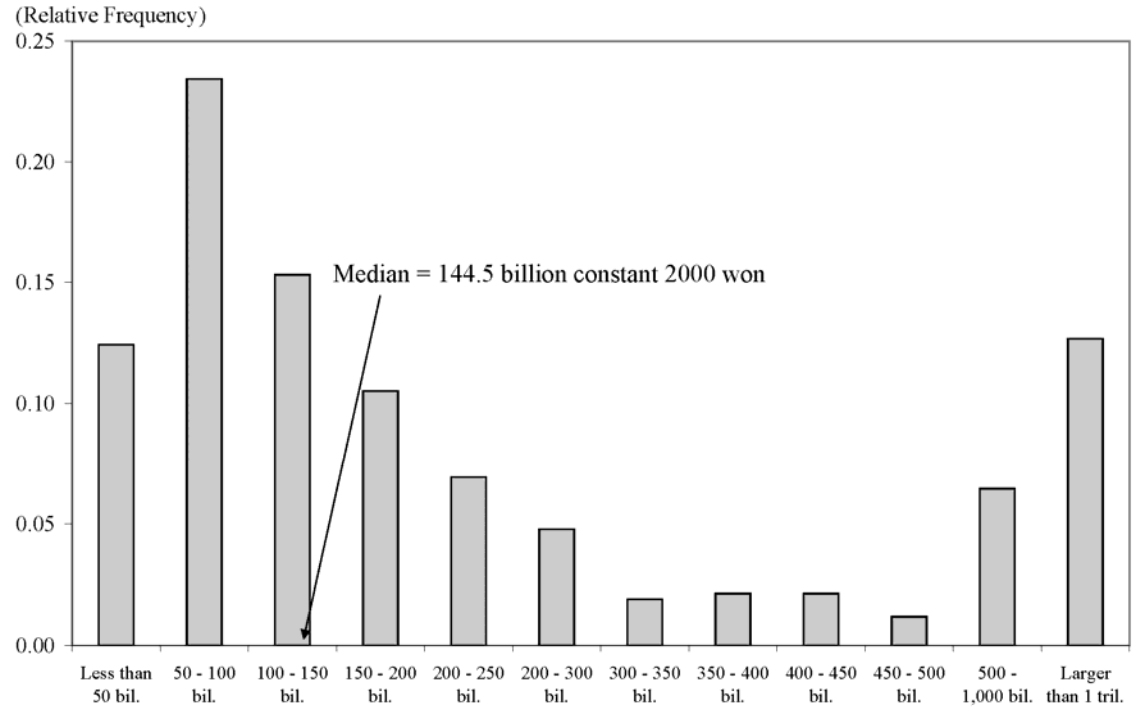


Fig. 2. Sample frequency distribution of firms by size (based on total assets).



results with those obtained from the baseline and under the three different classification schemes. This allows us to evaluate changes in the statistical importance of various determinants of firm level investment after the financial crisis.

4.1. Investment equations for the pooled sample

Table 1 reports the pooled regression results for Eqs. (1)-(5) for 1992-2001. In the first column the coefficient on Q is positive and statistically significant at the 5 percent level when it enters the specification alone, which is consistent with standard Q-theory. Adding cash balances to the specification (Eq. 2) yields statistically significant coefficients for both cash balances and Q, suggesting that constraints on internal financing may also have played a role in firm-level investment decisions. The third column (Eq. 3) indicates that cash balances at the start of a year and cash flows over that year are both statistically significant when entered into the investment equation together. The last two columns add the ratio of current sales to the capital stock to the specification in a "sales accelerator" formulation. In Eq. 4, Q and cash balances remain statistically significant at the 5 percent level and the coefficient on sales is positive and significant at the 10 percent level. When cash flows are added in Eq. 5, however, its coefficient is not significant. This may reflect collinearity between sales and the two cash variables, as suggested by their high correlations.[12] Hansen tests do not reject the over-identifying restrictions imposed by the instrument set in any of the specifications, and there does not appear to be any

[12] The correlation between sales and cash balances in our sample is 0.43, and that of sales and cash flows is 0.52. Since the stock of cash also seems to perform better than cash flow in our investment regressions when each enters the specification alone, we limit the presentation in our subsequent tables to Eqs. (1) – (4). This reflects the intuition behind Blinder's (1988) comment on FHP, which suggests that liquidity constraints should pertain to stocks of potential resources rather than flows. For example, a low current cash flow may not constrain acquisitions of capital for a firm with a large accumulated stock of cash.

Table 1
Investment GMM regressions with pooled sample, 1992–2001[a]

Equation No.	(1)	(2)	(3)	(4)	(5)
I/K_{t-1}	0.052**	0.048**	0.047**	0.050**	0.051**
	(0.024)	(0.023)	(0.023)	(0.023)	(0.022)
Q	0.158**	0.162**	0.153**	0.123**	0.123**
	(0.055)	(0.057)	(0.056)	(0.047)	(0.048)
C/K		0.139*	0.214**	0.188**	0.154*
		(0.077)	(0.063)	(0.063)	(0.081)
CF/K			0.134**		-0.071
			(0.033)		(0.071)
S/K				0.057*	0.063**
				(0.033)	(0.029)
N	2,837	2,833	2,833	2,833	2,833
Hansen test	0.465	0.271	0.249	0.238	0.236
AR(2) test	0.218	0.225	0.275	0.361	0.335

[a] The table reports one-step GMM results for equations (1) to (5) as described in Section 2 of the text. The dependent variable is the ratio of investment expenditures to the capital stock. *T*-statistics based on robust standard errors appear in parentheses beneath the coefficient estimates. The last two rows report *p*-values for the Hansen test of the over-identifying restrictions and the Arellano-Bond AR(2) test for higher-order serial correlation. * and ** denote statistical significance at the 10 and 5 percent levels respectively.

Table 2
Investment GMM regressions with pooled sample, pre- and post-crisis[a]

Equation No.	(1)	(2)	(4)	(1)	(2)	(4)
	Pre-crisis period (1992-1996)			***Post-crisis period (1997-2001)***		
I/K_{t-1}	0.040	0.040	0.040	0.056*	0.053*	0.053*
	(0.036)	(0.036)	(0.032)	(0.029)	(0.030)	(0.029)
Q	0.393**	0.390**	0.249	0.141**	0.145**	0.115**
	(0.186)	(0.182)	(0.158)	(0.051)	(0.053)	(0.044)
C/K		0.415**	0.093		0.105*	0.152**
		(0.130)	(0.137)		(0.064)	(0.063)
S/K			0.221**			0.043*
			(0.050)			(0.026)
N	763	763	763	2,074	2,070	2,070
Hansen test	0.412	0.286	0.307	0.382	0.254	0.211
AR(2) test	NA	NA	NA	0.818	0.813	0.959

[a] See note for Table 1. The AR(2) test cannot be computed for the pre-crisis period since we used the first two observations for each firm to define the investment rate and its lag for the GMM estimation.

evidence of higher-order serial correlation in the residuals.[13] Table 2 considers the periods before and after the financial crisis separately. The results are in many respects similar to those obtained over the full sample period, but there are subtle differences. For example, Q remains statistically significant at the 5 percent level except in the regression that includes sales in the pre-crisis period (Eq. 4), and the size of the coefficient on sales is much larger in the pre-crisis period than after the crisis. Measured at the sample means of S/K, the elasticity of the investment rate with respect to sales is about 0.10 in the pre-crisis period and 0.01 in the post-crisis period (i.e., a one percent change in S/K is associated with about a 0.1 percent change in the investment rate before the crisis and 0.01 percent change afterwards). This suggests that the sales accelerator was potentially quite strong in the pre-crisis period but weakened later. Also notable is that the coefficients on Q (and the implied elasticities of investment) are smaller and the coefficients on lagged investment are larger for 1997-2001, suggesting greater persistence in the investment decision after the crisis.

Overall, the similarities across the two periods seem to outweigh the differences. It would not be appropriate to conclude, however, that the patterns of corporate financing were unaffected by the crisis. Indeed, we will show that the pooling of data in Tables 1 and 2 masks important effects of the crisis on certain classes of firms. We turn to these issues next.

4.2. Firm age and the investment decision

Table 3 shows estimation results when we classify firms by their maturity. We define "young" firms as those listing on the KSE after August 1, 1987, which corresponds to the median age of firms in our sample, to obtain 209 young companies and 209 older ones. The results

[13] First order serial correlation is expected in the differenced GMM model because the errors share a common component across adjacent time periods. Higher-order autocorrelation, however, indicates that some lags of the dependent variable may be endogenous and thus bad instruments.

Table 3
Investment GMM regressions by median age, pre- and post-crisis[a]

	Young			**Old**		
Equation No.	(2)	(3)	(4)	(2)	(3)	(4)
			Pre-crisis period (1992-1996)			
I/K_{t-1}	0.043*	0.047**	0.031	0.105**	0.104**	0.112**
	(0.025)	(0.023)	(0.023)	(0.048)	(0.049)	(0.051)
Q	0.035	0.068	-0.093	1.009**	0.998**	0.895**
	(0.196)	(0.154)	(0.159)	(0.327)	(0.319)	(0.294)
C/K	0.285**	0.640**	0.072	0.690**	0.757**	0.130
	(0.128)	(0.256)	(0.111)	(0.172)	(0.304)	(0.354)
CF/K		0.485*			0.081	
		(0.251)			(0.316)	
S/K			0.287**			0.192**
			(0.102)			(0.026)
N	364	364	364	399	399	399
Hansen test	0.820	0.962	0.824	0.602	0.597	0.363
			Post-crisis period (1997-2001)			
I/K_{t-1}	0.093**	0.094**	0.082*	0.053	0.050	0.050
	(0.042)	(0.042)	(0.045)	(0.034)	(0.034)	(0.034)
Q	0.074**	0.074**	0.055**	0.465**	0.423**	0.376**
	(0.031)	(0.031)	(0.024)	(0.118)	(0.113)	(0.120)
C/K	0.138**	0.128**	0.084*	0.097	0.176	0.156
	(0.060)	(0.059)	(0.049)	(0.087)	(0.146)	(0.123)
CF/K		-0.030			0.134	
		(0.044)			(0.103)	
S/K			0.087**			0.031
			(0.018)			(0.026)
N	1,042	1,042	1,042	1,028	1,028	1,028
Hansen test	0.054	0.065	0.229	0.899	0.898	0.860
AR(2) test	0.583	0.580	0.361	0.574	0.550	0.551

[a] See note for Table 1.

indicate that Q is significant for the "old" (i.e., more established) firms both before and after the crisis, whether or not we include sales in the specification. For younger firms, Q is not a significant determinant of investment in the pre-crisis period but becomes significant afterwards. Interestingly, the cash position of an older firm, which is significant in Eq. 2 and Eq. 3 before the

crisis, is not significant after the crisis. Even the level of sales loses its impact on investment for the older firms after the crisis. For younger firms, cash balances and/or sales are statistically significant determinants of investment in both periods.

The rising importance of Q for younger firms in the post-crisis years may reflect greater risks associated with doing business in Korea after 1997, and a reluctance to implement an idea whose quality was not already implicitly reflected in a firm's market price. In other words, the quality of the business plan, rather than the amount of excess cash, became the prime mover for investment. This seems reasonable since many of Korea's young and less established firms had been targets of stimulatory government programs before the crisis but were targeted less afterwards. For the older firms, where the coefficient on Q was significant in both sub-periods, we note that past investment decisions, as reflected in the lag of the investment rate, became a less important determinant of current investment after the crisis. It therefore appears that pure "inertia" was becoming an increasingly less valid reason for more established firms to withhold dividends from their shareholders.

Table 4 examines whether our estimated sensitivities of investment to cash balances, cash flows, and sales are robust to imposing a common error structure and common coefficients on Q and lagged investment across the pre- and post-crisis periods. We do this by adding an intercept shifting dummy variable for the post-crisis period (i.e., POST) to our regression equations for young and old firms, along with interactions between POST and C/K, CF/K, and S/K, and then estimating for each group over the full 1992-2001 period. In these formulations, the estimates on the interaction terms indicate how much the coefficients on the corresponding non-interacted terms changed after the crisis.

The findings in Table 4 are similar to those obtained in Table 3 for the divided sample.

Table 4
Investment GMM regressions by median age, 1992-2001[a]

Equation No.	(2)	(3)	(4)	(2)	(3)	(4)
		Young			**Old**	
I/K_{t-1}	0.073**	0.082**	0.075**	0.067**	0.063**	0.073**
	(0.031)	(0.030)	(0.030)	(0.031)	(0.031)	(0.034)
Q	0.073**	0.075**	0.048*	0.533**	0.497**	0.449**
	(0.034)	(0.034)	(0.027)	(0.113)	(0.109)	(0.116)
C/K	0.207**	0.422**	0.075	0.611**	0.572**	0.277
	(0.090)	(0.157)	(0.093)	(0.201)	(0.226)	(0.219)
CF/K		0.378*			-0.101	
		(0.195)			(0.197)	
S/K			0.159**			0.133**
			(0.051)			(0.021)
Post × C/K	-0.048	-0.212*	0.023	-0.505**	-0.390*	-0.115
	(0.081)	(0.113)	(0.099)	(0.202)	(0.220)	(0.204)
Post × CF/K		0.361**			0.243	
		(0.183)			(0.201)	
Post × S/K			-0.052			-0.100**
			(0.036)			(0.029)
Post	-0.097**	0.051	0.154	0.171**	0.127*	0.407**
	(0.046)	(0.087)	(0.135)	(0.070)	(0.073)	(0.100)
N	1,406	1,406	1,406	1,427	1,427	1,427
Hansen test	0.048	0.055	0.088	0.955	0.953	0.869
AR(2) test	0.413	0.945	0.905	0.620	0.580	0.852

[a] See note for Table 1. The variables Post × C/K, Post × CF/K, and Post × S/K represent interactions of the respective cash balance, cash flow, and sales variables with a dummy variable set to unity for 1997 through 2001. POST is a simple dummy variable set to unity for 1997-2001.

For example, C/K is positive and statistically significant for young firms in Eq. (2) of Table 4, just as it was for both the pre- and post-crisis periods in the separate regressions of Table 3. At the same time, the interaction of C/K and POST is not significant in Table 4. This leads to the consistent inference that cash balances mattered for investment in young firms both before and after the crisis. Similar inferences obtain for the sales variable (S/K) in Eq. (5) across Tables 3 and 4 for younger firms. For older firms, the right panel of Table 4 indicates that both cash and sales became significantly less important determinants of investment after the crisis, which is

Table 5
Investment GMM regressions by quartile age, pre- and post-crisis[a]

Equation No.	Youngest 25% (2)	Youngest 25% (3)	Youngest 25% (4)	Oldest 75% (2)	Oldest 75% (3)	Oldest 75% (4)
			Pre-crisis period (1992-1996)			
I/K_{t-1}	0.212**	0.160**	0.185**	0.013	0.032	0.022
	(0.087)	(0.071)	(0.065)	(0.034)	(0.026)	(0.030)
Q	0.046	0.058	-0.039	0.556**	0.525**	0.412*
	(0.117)	(0.094)	(0.057)	(0.260)	(0.240)	(0.224)
C/K	0.266*	0.466**	0.115	0.511**	0.913**	0.105
	(0.140)	(0.088)	(0.130)	(0.139)	(0.345)	(0.195)
CF/K		0.241**			0.552	
		(0.031)			(0.356)	
S/K			0.165**			0.225**
			(0.048)			(0.059)
N	155	155	155	608	608	608
Hansen test	0.143	0.063	0.053	0.074	0.125	0.068
			Post-crisis period (1997-2001)			
I/K_{t-1}	0.112*	0.111*	0.096	0.038	0.038	0.041
	(0.064)	(0.065)	(0.065)	(0.030)	(0.030)	(0.030)
Q	0.114**	0.117**	0.080*	0.156**	0.147**	0.127**
	(0.046)	(0.046)	(0.043)	(0.071)	(0.067)	(0.059)
C/K	0.285**	0.315**	0.243**	0.085	0.128*	0.135**
	(0.112)	(0.119)	(0.100)	(0.059)	(0.071)	(0.066)
CF/K		0.041			0.085**	
		(0.071)			(0.042)	
S/K			0.069**			0.039
			(0.019)			(0.027)
N	520	520	520	1,550	1,550	1,550
Hansen test	0.707	0.715	0.683	0.294	0.266	0.261
AR(2) test	0.294	0.283	0.391	0.303	0.301	0.439

[a] See note for Table 1.

consistent with the separate regressions in Table 3.

To check the robustness of the regressions in Table 3 to our split of the sample at the median firm age, we repeated them using the youngest 25 percent and counting the remaining 75 percent among the old. Table 5 shows that the coefficient estimates are similar to those obtained with the split at the median. For example, Q is a significant determinant of investment for young

firms in the post-crisis period only, just as before. The main differences are that lagged investment is more important for the young firms in the pre-crisis period and the coefficient on cash balances is larger in the post-crisis period for the 25 percent sample than when the split occurs at the median. The latter result suggests that problems of asymmetric information and financing constraints became even more severe after the crisis for the very youngest firms in our sample. Indeed, the elasticity of investment with respect to cash balances (evaluated at the sample means of I/K and C/K) in the post-crisis period was 0.71 for the youngest 25 percent and 0.23 for the youngest 50 percent.

Comparing the results in Tables 3-5 with those in Table 2, it appears that stratifying the sample by firm age uncovers potentially important differences in the determinants of investment that were masked in the pooled analysis, particularly an increased role for Q among younger firms after the crisis.

4.3. Firm size and the investment decision

The standard asymmetric information framework suggests that classifying firms by size could also be an appropriate way to evaluate the role of possible cash constraints on investment (e.g., Blinder, 1988; Kadapakkam, Kumar, and Riddick, 1998). In practice, this is not easy to implement as sharply as we might like in our sample of exchange-listed firms. This is because most of the truly "small" firms in Korea are not listed on the organized exchange, and any data available for them are likely to be less reliable than data for larger firms. This means that the smallest enterprise in our sample is still quite large relative to most unlisted ones. If size is indeed related to independent financial strength, however, we should still expect to see investment affected by it.

To explore this possibility, Table 6 reports the same regressions as in Table 3, but with

Table 6
Investment GMM regressions by size, pre- and post-crisis[a]

	Smaller 50%			**Larger 50%**		
Equation No.	(2)	(3)	(4)	(2)	(3)	(4)
			Pre-crisis period (1992-1996)			
I/K_{t-1}	0.031	0.033	0.032	0.114**	0.116**	0.091*
	(0.029)	(0.026)	(0.027)	(0.052)	(0.051)	(0.053)
Q	0.165	0.180	0.026	0.973**	0.954**	0.736**
	(0.199)	(0.166)	(0.167)	(0.311)	(0.305)	(0.266)
C/K	0.266**	0.823**	0.024	0.791**	0.847**	0.296
	(0.125)	(0.338)	(0.114)	(0.163)	(0.179)	(0.303)
CF/K		0.680**			0.084	
		(0.322)			(0.124)	
S/K			0.326**			0.170**
			(0.097)			(0.021)
N	368	368	368	395	395	395
Hansen test	0.767	0.943	0.621	0.398	0.422	0.526
			Post-crisis period (1997-2001)			
I/K_{t-1}	0.029	0.027	0.028	0.084*	0.089**	0.092**
	(0.027)	(0.027)	(0.026)	(0.044)	(0.043)	(0.043)
Q	0.081**	0.078**	0.064**	0.469**	0.450**	0.267*
	(0.036)	(0.035)	(0.031)	(0.126)	(0.124)	(0.137)
C/K	0.085	0.104*	0.123**	0.499**	0.987**	0.265
	(0.056)	(0.057)	(0.061)	(0.206)	(0.270)	(0.214)
CF/K		0.036			0.580**	
		(0.029)			(0.191)	
S/K			0.029			0.163**
			(0.019)			(0.053)
N	1,034	1,034	1,034	1,036	1,036	1,036
Hansen test	0.402	0.443	0.429	0.138	0.098	0.030
AR(2) test	0.195	0.201	0.197	0.451	0.225	0.150

[a] See note for Table 1.

firms classified this time into two groups based on their total assets. We do this by computing the mean of a company's total real assets over the 10-year period of our study, and then using the cross sectional median of these means to define 209 smaller firms and 209 larger ones. The evidence of a flight-to-Q is not quite as strong as we found when classifying firms by age, yet the coefficients on Q are once again statistically significant at the 5 percent level for both groups

after the financial crisis and not significant for smaller firms before the crisis. Further, Eq. (5) indicates that cash balances matter more than sales for smaller firms in the post-crisis period, while sales dominated before the crisis began.[14]

We conclude that the existing data are consistent with our main hypothesis, namely that financial resources migrated after the 1997 crisis to firms whose quality was better known to investors. In other words, cash and other balance sheet quantities mattered less in the midst of a "flight-to-Q".

4.4. Chaebol affiliation and the investment decision

In this section we consider whether the financial crisis affected the availability of funds for firms affiliated with large industrial conglomerates (i.e., chaebols). As noted earlier, chaebol firms are members of well-established and presumably well-diversified business groups, and as such we might have expected the crisis, with of course a few important exceptions, to affect them less severely, and perhaps to have even moderated some of our earlier results with pooled samples of older and larger firms. To test this, we divided the sample into chaebol and non-chaebol firms and ran our earlier regressions once again with the new sub-samples.[15]

Table 7, which reports the findings, shows that previous investment is a statistically

[14] We also estimated specifications for each size class with the same post-crisis dummy variables and interaction terms reported in Table 4. Our findings were consistent with those from the separate pre- and post-crisis samples. In particular, cash balances were more important for small firms before the crisis and sales became more important afterwards, while cash and sales were statistically significant determinants of investment for larger firms both before and after the crisis.

[15] After dividing the sample, we found that 75 companies had chaebol affiliations before the crisis and 52 after, while only 45 companies remained chaebol-affiliated over the full 1992-2001 sample period. The decline seems mainly due to the bankruptcies of several of these companies around the time of the crisis. (e.g., Kia, Hanra, Hanbo and New-Core in 1997; Jinro, Hanil and Geopyung in 1998; Daewoo, Hae-Tae and Shinho in 1999).

Table 7
Investment GMM regressions by affiliation, pre- and post-crisis[a]

	Chaebol-affiliated			Not affiliated		
Equation No.	(2)	(3)	(4)	(2)	(3)	(4)
			Pre-crisis period (1992-1996)			
I/K_{t-1}	0.254**	0.271**	0.192**	0.034	0.037	0.036
	(0.070)	(0.094)	(0.081)	(0.033)	(0.028)	(0.029)
Q	2.038**	1.972**	1.625**	0.229	0.217	0.105
	(0.539)	(0.420)	(0.479)	(0.177)	(0.162)	(0.151)
C/K	1.164**	1.913**	0.382	0.389**	0.696**	0.082
	(0.444)	(0.390)	(0.324)	(0.130)	(0.227)	(0.139)
CF/K		1.070**			0.402*	
		(0.297)			(0.223)	
S/K			0.319**			0.214**
			(0.067)			(0.052)
N	148	148	148	615	615	615
Hansen test	0.527	0.696	0.334	0.180	0.443	0.442
			Post-crisis period (1997-2001)			
I/K_{t-1}	0.129**	0.143**	0.201**	0.043	0.041	0.042
	(0.054)	(0.054)	(0.061)	(0.032)	(0.032)	(0.031)
Q	0.371	0.349	-0.041	0.132**	0.128**	0.105**
	(0.237)	(0.241)	(0.204)	(0.049)	(0.048)	(0.041)
C/K	1.808**	2.167**	1.196**	0.096	0.132*	0.139**
	(0.632)	(0.695)	(0.599)	(0.060)	(0.068)	(0.059)
CF/K		0.421**			0.067**	
		(0.204)			(0.034)	
S/K			0.600**			0.039
			(0.069)			(0.024)
N	260	260	260	1,810	1,810	1,810
Hansen test	0.207	0.235	0.114	0.450	0.408	0.438
AR(2) test	0.710	0.832	0.491	0.830	0.829	0.942

[a] See note for Table 1.

significant determinant of current investment for chaebol firms, both before and after the crisis, while it is never significant for non-chaebol firms. This is probably due to the chaebols' continued control over many of Korea's heavy industries, which are more capital intensive and require more persistent investment than light-industry firms that comprise a large part of the non-

chaebol category. In comparing the panels on the left side of the table, we also find that the effect of cash balances on investment among chaebol firms is much stronger in the post-crisis regime than before the crisis, while the coefficient on Q becomes smaller and no longer statistically significant after the crisis.

These results are the opposite of those found when we compared older firms with younger ones in Tables 3-5, and present something of a puzzle since most chaebol firms would generally be among the larger listed firms in Korea. Further, the coefficient on cash balances for chaebol firms after the crisis (with an elasticity with respect to investment of 0.704 when measured at the sample mean of C/K) is much larger than that of non-chaebol firms (with an elasticity of 0.302). This is also the opposite of what we found when comparing older and younger firms. This suggests that chaebol firms faced a different financial environment in the post-crisis period than a typical well-established Korean firm.

Table 8 examines the robustness of these changes in the cash and sales sensitivities of investment among chaebol and non-chaebol firms to imposing (as in Table 4) a common error structure and common coefficients on Q and lagged investment across the pre- and post-crisis periods, while including a dummy variable for the post-crisis period and its interactions with cash and sales. Once again the increased sensitivity of chaebol investment to cash and sales is apparent, with large and positive (but not statistically significant) coefficients on the cash and cash flow interaction terms and a positive and significant coefficient on the sales interaction term. At the same time, both cash and sales became less important for the non-affiliated firms after the crisis, with negative and statistically significant interaction terms.

Why, then, did the crisis affect the chaebol affiliates more emphatically than non-chaebol firms in terms of tightening cash constraints, and why did their investment decisions become

Table 8
Investment GMM regressions by affiliation, 1992-2001[a]

Equation No.	(2)	(3)	(4)	(2)	(3)	(4)
	Chaebol-affiliated			**Not affiliated**		
I/K_{t-1}	0.143**	0.167**	0.181**	0.041*	0.042*	0.055**
	(0.051)	(0.047)	(0.051)	(0.025)	(0.025)	(0.025)
Q	0.765**	0.735**	0.398	0.140**	0.133**	0.109**
	(0.280)	(0.266)	(0.254)	(0.051)	(0.049)	(0.043)
C/K	1.275**	1.789**	0.516	0.292**	0.427**	0.128
	(0.514)	(0.488)	(0.389)	(0.093)	(0.140)	(0.101)
CF/K		0.612*			0.238	
		(0.363)			(0.168)	
S/K			0.417**			0.127**
			(0.065)			(0.030)
Post × C/K	0.574	0.687	0.549	-0.186**	-0.259**	0.029
	(0.599)	(0.680)	(0.462)	(0.088)	(0.116)	(0.093)
Post × CF/K		0.197			-0.139	
		(0.529)			(0.158)	
Post × S/K			0.108*			-0.081**
			(0.061)			(0.028)
Post	0.259*	0.318**	-0.070*	-0.041	0.016	0.246
	(0.149)	(0.157)	(0.176)	(0.052)	(0.069)	(0.087)
N	408	408	408	2,425	2,425	2,425
Hansen test	0.347	0.389	0.255	0.492	0.431	0.407
AR(2) test	0.501	0.809	0.559	0.308	0.484	0.949

[a] See note for Table 4.

increasingly dependent on the level of internal funds? One explanation, supported by evidence in Borensztein and Lee (2002), suggests that chaebol-affiliated firms lost their preferential access to external financing after the financial crisis.

Of course, we have already noted that chaebol-affiliated firms are likely to be also among the oldest and largest in our sample, and Table A.1 in the Appendix bears this out. This suggests that some of our earlier results for older and larger firms could be driven by the chaebol firms in our sample, leading us mistakenly to attribute differences in the investment elasticities of Q, cash, and sales across the pre- and post-crisis periods to "old" and "large" effects rather than the apparent "chaebol" effect observed in Table 7. For this reason, we check the robustness of our

Table 9
Investment GMM regressions by median age excluding chaebols, pre- and post-crisis[a]

	Young			Old		
Equation No.	(2)	(3)	(4)	(2)	(3)	(4)
			Pre-crisis period (1992-1996)			
I/K_{t-1}	0.044*	0.045**	0.035	0.083	0.083	0.097
	(0.022)	(0.022)	(0.021)	(0.051)	(0.052)	(0.061)
Q	-0.062	-0.016	-0.181	0.854**	0.855**	0.754**
	(0.191)	(0.142)	(0.154)	(0.352)	(0.344)	(0.312)
C/K	0.288**	0.621**	0.078	0.625**	0.622**	0.077
	(0.129)	(0.258)	(0.111)	(0.178)	(0.312)	(0.398)
CF/K		0.464*			-0.004	
		(0.255)			(0.355)	
S/K			0.280**			0.184**
			(0.110)			(0.025)
N	320	320	320	295	295	295
Hansen test	0.801	0.934	0.988	0.751	0.751	0.670
			Post-crisis period (1997-2001)			
I/K_{t-1}	0.080	0.081	0.064	0.047	0.043	0.044
	(0.053)	(0.053)	(0.055)	(0.036)	(0.036)	(0.036)
Q	0.069**	0.070**	0.052**	0.454**	0.411**	0.372**
	(0.028)	(0.028)	(0.023)	(0.129)	(0.123)	(0.129)
C/K	0.128**	0.119**	0.076	0.087	0.163	0.139
	(0.056)	(0.055)	(0.047)	(0.080)	(0.135)	(0.111)
CF/K		-0.028			0.128	
		(0.042)			(0.099)	
S/K			0.081**			0.027
			(0.017)			(0.022)
N	967	967	967	843	843	843
Hansen test	0.113	0.124	0.405	0.951	0.948	0.923
AR(2) test	0.359	0.342	0.239	0.451	0.441	0.425

[a] See notes for Table 1.

earlier regression results in Table 3 to eliminating the chaebol-affiliated firms. Interestingly, the results that we report in Table 9 remain quite similar to those reported in Table 3.[16]

[16] We repeated the regressions in Table 9 for small and large firms as well, and found that eliminating the chaebol-affiliated firms gave qualitatively similarly results to those presented in Table 5. We can therefore be reasonably certain that chaebol effects are not dominating our findings for old and large firms.

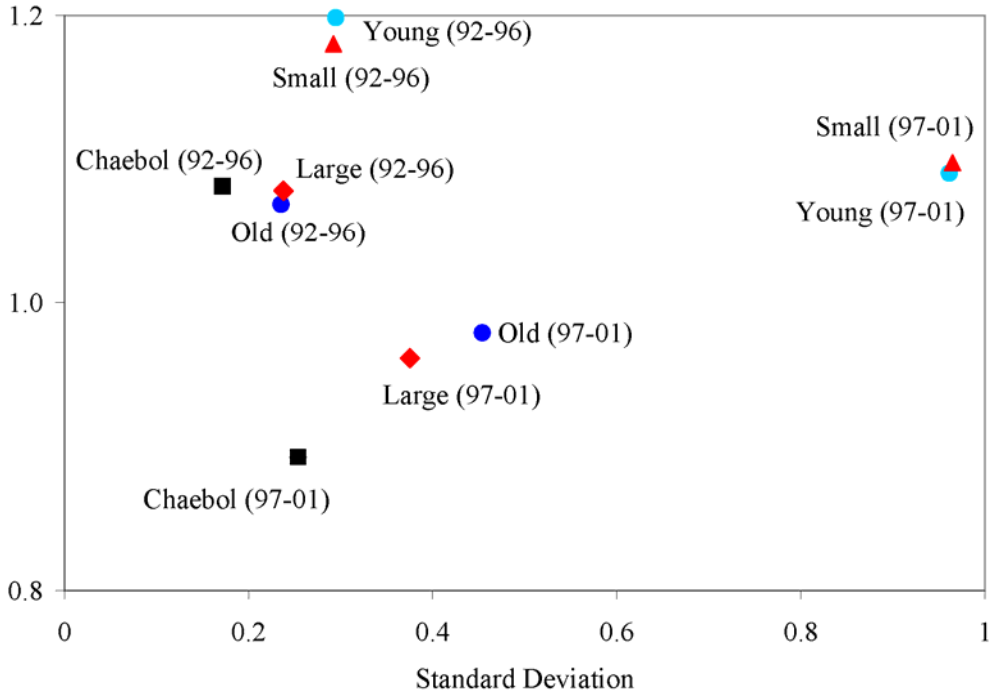
5. Risk, return, and a "flight-to-Q"

The main findings from estimation of the investment equations in Section 4 is that Tobin's Q is a significant determinant of investment in the post-crisis period for all categories of firms in our sample, whereas it was not for younger, smaller, and non-chaebol firms before the crisis. One possible explanation is that firms placed more weight after the crisis on potential profitability when considering new investments rather than simply responding to indicators of past performance such as sales. The lending sector may also have considered future profitability more carefully in making resource allocations after the crisis, rather than relying on traditional measures of repayment ability such as reputation, size or chaebol affiliation. Indeed, lenders may have found the risk and return characteristics of older, larger, and chaebol firms to be less desirable after the crisis than before, and found the tradeoff for younger and smaller firms comparatively more attractive.

To examine the plausibility of this view, we consider the nature of the risk-return tradeoff before and after the crisis more directly. To do this, we start by dividing the sample into five categories: chaebol-affiliates, the younger and smaller 50 percent of non-chaebol firms, and the older and larger 50 percent of non-chaebols. Fig. 3 positions these groups according to Tobin's Q in mean and standard deviation space. All five groups show a decline in their average Q after the crisis, but the decline for chaebols is sharpest and involves only a small increase in variability. The mean Q of older (and also larger) firms fell less than that of chaebol affiliates, but the variability of Q, as measured by the standard deviation for these groups, almost doubled. The mean Q of younger (and also smaller) firms fell the least of all, remaining above unity after the crisis, but the variability of Q for both of these groups increased more than three-fold!

The differences across groups Fig. 3, along with our earlier investment equations, are

Fig. 3. Average Q before and after the crisis by firm classification



consistent with the view that the profitability outlook for chaebol-affiliated firms became less favorable after the crisis, leading investors to require higher returns to hold equities with a given level of risk. Our investment regressions suggest that, among chaebol firms, those with excess cash balances were also best equipped to sustain regular investments in the midst of the changing business climate. The post-crisis environment also seems to have been one in which the potential for returns figured more importantly in the resource allocation decisions of lenders for non-chaebol firms in general and for younger and smaller firms in particular. This suggests that there were still strong investment opportunities for smaller and less-established firms after the financial crisis, and indeed some very strong ones, but that potential investors would have needed to evaluate such firms carefully to avoid less sound projects. The financial market's assessment of future profitability, as reflected in the Tobin's Q, probably played a strong role in the allocation of funds to these firms, and in their decision to seek funding as well.

To identify determinants of changing risk-return relationship in Fig. 3, we turn next to a regression approach. To implement it, we computed the ratio of the sample mean and standard deviation of Q in the pre- and post-crisis periods for each firm in our sample, creating two observations per firm. We next estimated a cross-section OLS regression of these ratios on the corresponding means of the debt-to-equity ratio (i.e., D/E), C/K, and S/K, along with a dummy variable for the post-crisis period and its interactions with D/E, C/K, and S/K. Finally, we repeated the regression for each of our firm classifications.

Table 10 displays the results. Note that large values of the dependent variable, $\overline{Q}/\sigma_Q$, reflect a high market value per unit of risk, while smaller values reflect a deteriorating tradeoff between risk and expected return. The coefficient on the simple dummy variable for the post-crisis period is negative for all groups except the one containing chaebol affiliates, for which it is positive and statistically significant, and is significant for all groups except that containing the younger firms. This is consistent with the positioning of these groups in Fig. 3. After controlling for general "crisis" effects, we note that a high debt-to-equity ratio seems to enhance firm value prior to the crisis, and significantly so for young firms, chaebol firms, and all firms combined. After the crisis, however, the negative coefficients on the "Post-D/E" interaction term suggest that these positive effects of debt were apparently reversed, with high D/E ratios now associated with lower market values per unit of risk. This seems plausible in that the government's post-crisis regulatory ceiling on D/E ratios may have altered market perceptions of the relative costs of high leverage to more closely reflect the increased equity risk predicted by standard corporate finance theory.

The effects of cash on $\overline{Q}/\sigma_Q$ variable are negative across all firm classifications before the crisis, which is consistent with investors interpreting excess cash balances as wasteful at a

Table 10
OLS estimation of $\overline{Q}/\sigma_Q$, all firm classifications, 1992-2001[a]

	All	Young	Old	Small	Large	Chaebol	Non-chaebol
D/E	0.768**	2.060**	0.414	0.678	0.772	4.869**	0.486*
	(0.354)	(0.882)	(0.307)	(0.476)	(0.515)	(1.097)	(0.266)
C/K	-2.859**	-1.306*	-4.192**	-2.529**	-2.669	-14.513**	-2.333**
	(0.833)	(0.753)	(1.793)	(0.907)	(1.667)	(4.699)	(0.705)
S/K	0.107	0.092	0.235	0.228	0.058	-0.045	0.196
	(0.131)	(0.189)	(0.184)	(0.221)	(0.174)	(0.629)	(0.128)
Post × D/E	-0.773**	-2.055**	-0.422	-0.690	-0.780	-4.814**	-0.490*
	(0.354)	(0.882)	(0.308)	(0.476)	(0.515)	(1.098)	(0.266)
Post × C/K	2.009*	-1.011	5.251**	2.068*	-2.193	10.014	1.512
	(1.086)	(1.189)	(2.104)	(1.150)	(2.239)	(8.914)	(0.960)
Post × S/K	-0.183	-0.056	-0.523**	-0.258	-0.225	-1.312	-0.237
	(0.151)	(0.202)	(0.241)	(0.236)	(0.216)	(1.027)	(0.147)
Post	-3.531**	-0.028	-4.907**	-3.208**	-2.753*	8.636*	-3.457**
	(1.067)	(1.646)	(1.374)	(1.448)	(1.634)	(4.449)	(0.913)
Constant	10.030**	6.086**	12.001**	8.682**	10.987**	2.514	9.505**
	(1.029)	(1.600)	(1.307)	(1.425)	(1.529)	(3.630)	(0.879)
N	817	399	418	404	413	127	690
R^2	0.207	0.281	0.201	0.235	0.187	0.521	0.192

[a] The table reports OLS estimates where the dependent variable is the ratio of average Q to its standard deviation in the pre- and post-crisis periods for each firm in our sample. *T*-statistics based on robust standard errors appear in parentheses beneath the coefficient estimates. * and ** denote statistical significance at the 10 and 5 percent levels respectively.

time of relatively easy credit. As credit markets tightened after the crisis, however, firms with more cash were perhaps better positioned to exploit new investment opportunities with high net present values, thereby raising Q, while at the same time avoiding gains in leverage that would increase equity risk. This seems especially true for the small, old, large, and chaebol-affiliated firms. Interestingly, the level of sales had little effect in either period on the nature of the risk-return tradeoff at the firm level.

6. Conclusion

In this study we examine the role of Tobin's Q, cash balances and sales on the investment

decisions of Korean manufacturing firms in the five years before and after the East Asian financial crisis of late 1997. To investigate the issue of heterogeneity embedded in a financing hierarchy or "pecking order" theory of investment, we defined three different classifications, by age, size, and affiliation to a chaebol. To address econometric issues such as endogeneity and the serial correlation of errors in our dynamic panel models, we used GMM estimation.

We find that the standard Q-theory of investment explains firm-level decisions well when we pool data for all firms listed on the Korean Stock Exchange, and that this result for the most survives when we consider the pre- and post-crisis periods separately. When we allow for firm heterogeneity before and after the financial crisis, however, we find that the investment of younger firms did not depend on Q before the crisis but that Q became an important determinant afterwards. The opposite occurred among chaebol-affiliated firms. In addition, the level of internal cash balances became much more important for the investment of chaebol firms after the crisis, suggesting that chaebols lost some of their earlier preferential access to credit.

Our inferences regarding the effect of financing constraints on investment are not without caveats. Gomes (2002) and Kaplan and Zingales (1997), for example, argue that variation in cash-related variables may not reflect financing constraints at all, with the former study arriving at this conclusion through structural modeling and the latter through a careful evaluation of financing patterns among the firms that comprised the FHP sample. Indeed, Gomes (2002) argues that financial constraints should be reflected in a firm's market value and thus captured by a good measure of Q. Our finding of a strong role for Q in the investment decisions of Korean firms is consistent with this as well as earlier findings for the OECD countries by Kadapakkam, Kumar, and Riddick (1998), yet there still seems to be some evidence that financing constraints also mattered, especially for chaebol affiliates after the financial crisis.

Overall, we interpret our results as indicative of a "flight-to-Q" among Korean and international lenders. By this we mean that resource allocation decisions became more market-oriented after the financial crisis and less dependent on imperfections in the capital markets. This is not to say that such imperfections are now unimportant, but rather that the financial crisis was a defining event in Korea's postwar history – a time when its capital markets matured significantly and prices therein became more informative about the underlying quality of business plans. With one step back and two steps forward, the Korean economy now seems better poised for the challenges that lie ahead.

Appendix

Table A.1
Cross tabulation of firms by the three classification schemes[a]

	Small	Large	Young	Old	Chaebol	Non-chaebol
Small	N.A.					
Large						
Young Firms	139	70	N.A.			
Old Firms	70	139				
Chaebol	7	56.5	19	44.5	N.A.	
Non-chaebol	202	152.5	190	164.5		
Number of Firms	*209*	*209*	*209*	*209*	*63.5*	*354.5*

[a] "N.A." in a diagonal element of the table indicates non-applicable self-pointing cases for the cross tabulation. The chaebol classification can change over time, meaning that a chaebol-affiliated firm before the crisis may not be classified as a chaebol-affiliate in the post-crisis period. This could occur if the chaebol itself was removed from the official FTC list or if the firm had ended its affiliation with the chaebol.

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