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Regional disparities and investment-cash flow sensitivity: Evidence from Chinese listed firms*

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Abstract

In China, regional disparities are important. We examine the difference in the sensitivity of investment to cash flow between firms in inland regions and those in coastal regions. By using the financial data of Chinese listed firms, we found that firms in inland regions rely more on their internal funds in terms of their investment activities than those in coastal regions and that the sensitivity gap between inland and coastal firms widened in the recent contractionary monetary policy period. This suggests that firms in inland regions are harder to obtain outside funds due to unfavorable social and economic environments for inland firms. Our findings suggest that capital markets in China respond rationally to the potential impact of regional disparities on a firm's performance.

JEL Classification O16; G14; G31

Key words: sensitivity of investment to cash flow; sensitivity gap; regional disparities; Chinese economy

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1. Introduction

Listed firms in China are embedded in conspicuous regional disparities.[1] In China, the regional disparities have an impact on the earnings of listed firms through the following three major channels. First, in the context of a political centralized system, firms in West and central regions (hereafter, inland regions) carry heavier social burdens than those in the East and coastal regions (hereafter, coastal regions).[2] Second, under the arrangement of fiscal decentralization, listed firms in inland regions bear directly or indirectly more extra charges than those in coastal regions.[3] Finally, high-quality labor continues to be absorbed by firms in coastal regions and has boosted these firms to grow more quickly, but the firms in inland regions have been thwarted by the low level of human capital. Consequently, the three foregoing differences might translate into performance gaps of a firm, and listed firms in coastal regions tend to perform better than their inland counterparts.

Based on the above, a reasonable deduction is presented as follows. After a capital market incorporates the information, firms in inland regions, which have larger uncertainty than those in

[1] A long-term unbalanced development strategy (i.e., giving priority to the development of the East and coastal regions) has resulted in conspicuous regional disparities, (i.e., rich East and coastal regions and poor West and central regions).

[2] For example, there are fewer job opportunities in inland regions, and the State considers employment and social stability to be important performance measures used by local officials. Therefore, due to the pressure from local officials who are appointed and dismissed by upper level governments, the listed firms in inland regions have to hire more redundant workers than those in coastal regions.

[3] The reason is that, in comparison to governments in coastal regions, it is difficult for inland governments to collect their own revenues and fulfill the same responsibilities or mandates.

coastal areas, tend to face tighter external financing constraints than those in coastal regions in terms of their investment decisions. In other words, firms in inland regions might rely more on their internal funds in their investment decisions than their coastal counterparts. "Unfortunately, the extant research lacks empirical analyses, which are necessary for addressing the deduction within the framework of conspicuous regional disparities. We attempt to do this by using the Chinese stock market and the financial data of listed firms.

A number of studies initialed by Fazzari et al. (1988) argue that firms that face tighter financing constraints have to rely more on internal funds for making investments.[4] However, Kaplan and Zingales (1997) and Cleary (1999) diverge from these studies by showing that investment is more sensitive to cash flow for the least financially constrained firms. Allayannis and Mozumdar (2004) report that Cleary's findings can be explained by negative cash flow observations, and Kaplan and Zingales' results are driven by a few outlying observations in a small sample. Erickson and Whited (2000) and Alti (2003) argue that the measurement error in Tobin's Q affects the estimated investment-cash flow sensitivity. The authors of other recent papers (Boyle and Guthrie (2003), Moyen (2004), Cleary et al. (2007), and Lyandres (2007)) develop a different theoretical model and offer some explanations for the previously different empirical findings. In addition, Ağca and Mozumdar (2008) find that there is a decline in investment-cash flow sensitivity through time and test whether investment-cash flow sensitivity should decrease with factors that reduce capital market imperfections.

The remainder of the paper is structured as follows. In the next section, we present data and empirical specifications. In Section 3, we provide the empirical results and discuss their robustness.

[4] See Hubbard (1999) for a detailed review of this literature.

The last section is the conclusion.

2. Methodology

2.1 Empirical specifications

Following previous studies (Cleary et al. (2007), Lyandres (2007), and Ağca and Mozumdar (2008)), we use a classical cash flow model to explore the impacts of regional disparities on investment-cash flow sensitivity. To control for possible heteroskedasticity due to differences in firm size, we divide both the investment and the cash flow by the net fixed assets (NFA) of the previous time period. Specifically, the model is as follows.

$$I_{i,t} = \alpha_0 + \alpha_1 CF_{i,t} + \alpha_2 dummyCF_{i,t} + \alpha_3 Q_{i,t-1} + \lambda_i + \varepsilon_{i,t} \quad (1)$$

Here, $I_{i,t}$ is defined as the gross investment of firm i for the current year ($GI_{i,t}$) divided by the net fixed assets of the previous time period (=$GI_{i,t}$ / $NFA_{i,t-1}$). $CF_{i,t}$ is the ratio of firm i's depreciation plus profits after tax for the current year ($DPAT_{i,t}$) to the net fixed assets of the previous time period (=$DPAT_{i,t}$ / $NFA_{i,t-1}$). Dummy denotes the regional dummy variable, which equals 1 if listed firm i locates in coastal regions and 0 otherwise. Therefore, the coefficient of dummyCF (a cross term of CF and regional dummy) indicates the difference of investment-cash flow sensitivity between coastal and inland firms. Q_{t-1} is the lagged one time period Tobin's Q for firm i. Due to the measurement difficulty of the marginal Tobin's Q, empirical studies usually use the average Q. We follow Kaplan and Zingales (1997), Cleary (1999), and Cleary et al. (2008) and employ the market-to-book ratio as a proxy for the average Q. Specifically, we calculate the Chinese Tobin's Q as follows (Firth et al. (2008)).

Tobin's Q=(MVCS+BVPS+BVLTD+BVINV+BVCL-BVCA)/BVTA,

where MVCS is the market value of the firm's common stock, BVPS is the book value of the

firm's preferred stock, BVLTD is the book value of firm's long-term debt, BVINV is the book value of the firm's inventories, BVCL is the book value of the firm's current liabilities, BVCA is the book value of the firm's current assets, and BVTA is the book value of the firm's total assets. Listed firms in China do not issue preferred stocks. Because, until the recent share reform, listed firms issued both tradable and non-tradable shares, we adjust the measurement of Tobin's Q. Specifically, in order to obtain the value of equity in the above formula, we multiply the amount of tradable shares by the market price and the amount of non-tradable shares by 30% of the market price (Chen and Xiong (2002) and Firth et al. (2008)).

Based on the fact that ignoring the unobservable factors probably creates an endogenous problem and a bias in the estimation results, almost all the previous studies in this field (e.g., Fazzari et al. (1988), Kaplan and Zingales (1997), Allayannis and Mozumdar (2004), and Ağca and Mozumdar (2008)) use the firm fixed effects panel regression. We follow them and use the fixed-effect (demeaned estimation) panel regression. λ_i and $\varepsilon_{i,t}$ refer to an individual firm fixed effect and error term, respectively.

Previous studies (Allen et al. (2005) and Firth et al. (2008)) also suggest that stock returns in China are less informative of firm performance than those in developed economies because they tend to reflect market-level information rather than firm-specific information. Consequently, attention should be given to the potential question of measurement error in Tobin's Q. Following Cleary et al. (2008) and Firth et al. (2008), we employ sales growth ($SG_{i,t}$) as an alternative proxy of firm performance. Here, $SG_{i,t}$ is defined as the ratio of the difference between firm *i*'s net sales in the current year and that in the previous one year to the net sales in the previous one year to capture the growth opportunities of a listed firm. If we employ the SG_{t-1} rather than Tobin's Q_{t-1} as

the performance of measure, the model is as follows.

$$I_{i,t} = \beta_0 + \beta_1 CF_{i,t} + \beta_2 dummyCF_{i,t} + \beta_3 SG_{i,t-1} + \gamma_i + \mu_{i,t} \quad (2)$$

2.2 Data and sample description

We use the sample consisting of 1,412 firms that issue only A shares and are listed on the Shanghai Stock Exchange or the Shenzhen Stock Exchange in China.[5] Our data are from the China Stock Market and the Accounting Research Database (CSMAR). In China, relatively standardized and internationalized financial regulations were introduced and rigorously enforced in 1997. Therefore, we construct our data set over the 1998 to 2007 period. To make the sample more homogenous, the firms in financial industries are eliminated. Firm-year observations are deleted if the value for net fixed assets or sales is zero or if there are missing values for any of the five key variables. To avoid distortions arising from mergers and acquisitions, observations with sales growth exceeding 100% are eliminated (Cleary et al. (2008)). Extreme values of Tobin's Q exceeding 20 are also deleted. After that, 9,147 firm-year observations are left. We work with an unbalanced panel, and our data set covers firms of different sizes and ages from a variety of industries. A summary of the statistics of the key variables is presented in Table 1.

Insert Table 1 here.

As is evident from Table 1, the mean investment scaled by the net fixed assets of the overall sample, the coastal region sub-sample, and the inland region sub-sample are 0.425, 0.447, and

[5] A small proportion of the shares of Chinese listed firms are traded at the same time in mainland China, Hong Kong, and the U.S., and a firm has different stock prices simultaneously inside and outside the mainland because of capital regulation policies in China. To avoid the measurement question of Tobin's Q, we exclude these firms. In addition, because Hainan province and the Guangxi autonomous region have been lagging far behind other coastal provinces in terms of economic development, they are classified as inland regions.

0.399, respectively, which indicates that there is a high investment ratio for Chinese listed firms and the mean of the investment ratio of firms in coastal regions is slightly higher than that in inland regions. The sample average cash flow divided by net fixed assets of firms in coastal regions and in inland regions is 0.621 and 0.245, respectively, which demonstrates that the mean of the cash flow ratio in coastal firms is much higher than that in inland regions. Based on the definition of cash flow, this shows that the performance of coastal firms is probably higher than that of firms in inland regions. From the mean and median of the sales growth rate, firms in both coastal and inland regions indicated relatively strong growth opportunities during our sample period.

3. Empirical results

3.1 Tests of regional disparities and investment-cash flow sensitivity

The results of our empirical models based on fixed effects are presented in Table 2. As is evident form Equation (1) of Table 1, the coefficient on the cash flow is positive and statistically significant at the 1% level after controlling for investment opportunities. The table shows that inland firm investment is significantly correlated with proxies for changes in internal funds. The coefficient of interest is related to the *dummyCF* (the cross term of regional dummy and cash flow variables), which allows us to explore whether the regional disparities affect the investment-cash flow sensitivity of a firm. The coefficient on dummyCF is -0.572 and is statistically significant at the 1% level, which shows that ①, the coefficient on the cash flow of coastal firms is 0.085, and their investment is also significantly correlated with cash flow, and ②, there is a significant sensitivity gap between the inland and the coastal firms. The proxy Tobin's Q for investment opportunities is positive but insignificant. The results of Equation (2) are the same as those of

Equation (1). However, the coefficient on Sales Growth SG, another proxy for investment opportunities, is negative and insignificant, which indicates, over our sample period, that Tobin's Q is probably a better proxy than Sales Growth. The above findings show that the inland firms rely more on internal funds than those in coastal regions and that inland firms face tighter external financing constraints than their counterparts in coastal regions.

Insert Table 2 here.

3.2 Time series pattern of the sensitivity of investment to cash flow

Next, we investigate the time series pattern of the sensitivity of investment to cash flow by running rolling regressions of Equations (1) and (2) for overlapping periods of five years during our sample period. Our first regression is for the period 1998-2002, the second one, for the period 1999-2003, and so on. We report the results based on the fixed effects model in Table 3. To clearly view the time series pattern of the sensitivities, we plot the sensitivity of inland firms, the sensitivity of coastal firms, and the sensitivity gap between the two types of firms. Figure 1 presents the changes of the sensitivities over time.

As is evident in Table 3, for six rolling equations of the Q performance, all the coefficients on CF in six regressions are positive and statistically strongly significant at the 1% level. The results show that, after controlling for investment opportunities, the internal funds of a Chinese firm in inland regions play an important role in investment decisions. The solid curve in Fig. 1-A depicts the six coefficients' time series pattern. The curve indicates that inland firm sensitivity of investment to cash flow falls slowly for a long time before ascending steeply.

All six coefficients on the dummyCF are negative, which is consistent with our expectations. These results indicate that, in comparison to inland firms, coastal firms faced weaker external

financing constraints over the sample period. The first three coefficients are insignificant, but the last three are significant at the 1% level. The six coefficients on dummyCF, which capture the sensitivity gap between the inland and coastal firms, are plotted in Fig. 1-B. The solid curve of the sensitivity gap has two components. The first is nearly a horizontal segment up to the last rolling period. In this range, the two types of firms maintain a steady sensitivity gap. The second is steeply downright-sloping, which indicates that, in comparison to coastal firms, firms in inland regions are forced to rely heavily on internal funds during the last rolling period. The solid curve of Fig. 1-C tells us that the sensitivity of investment to cash flow in coastal firms depicts the same time pattern as that in the inland regions in Fig. 1-A. The last sensitivity estimates of inland firms and coastal firms are 0.993 and 0.280, respectively, which results in a wider difference between them, reflected by the sharp drop in the gap curve in the figure.

Insert Table 3 here.

Insert Fig. 1 here.

We will now examine the reasons for the results above. Although capital markets in China are still nascent, they have been growing quickly. During this process of growth, more financial instruments continued to be introduced, and the informational imperfections in the capital markets continued being reduced." This has lowered the external financing constraints and mitigated the reliance of firms on internal funds. Therefore, the sensitivities of investment to cash flow in both inland and coastal firms tended to fall gradually, as described by the slowly downright-sloping segment of the sensitivity curves in Fig. 1-A and C. The result is consistent with that in Ağca and Mozumdar (2008), who argue, using the data of U.S. manufacturing firms, that investment-cash

flow sensitivity decreases with five factors that reduce capital-market imperfections.[6]

The reasons that the sensitivity curves in Fig. 1-A and C rise steeply during the last rolling period are as follows. To suppress speculative activities in the real estate market since 2004, China's central bank (PBOC) raised the required reserve deposit ratio 14 times from 7% in April 2004 to 14.5% in December 2007.[7] The banking sector, which has undergone management reforms pursuing a value-maximizing target, has to make it difficult for both inland and coastal firms to obtain external loans.[8] In addition, the Chinese financial system has been dominated by a large state-own banking sector (Allen et al. (2008)), and there is significant reliance on bank loan finance by Chinese listed firms (Firth et al. (2008)). Hence, we observe a recent steeply rising segment in the sensitivity curves in Fig. 1-A and C.

Figure 1-B captures the sensitivity gap between both coastal and inland firms. After capital markets acquire the information that the performance of firms in coastal regions is probably better than that of those in inland regions, they prefer to offer help to coastal firms that are short of funds rather than to those in inland regions. The disparity of external financial costs begins to widen. As compared to firms in coastal regions, firms in inland regions have to rely more on their internal funds regarding their investment decisions, and, therefore, their sensitivity of investment to cash

[6] These five factors are increasing fund flows, institutional ownership, analyst following, antitakeover amendments, and the existence of bond rating.

[7] Specifically, these increases were from 7.0% to 7.5% in April 2004, 7.5% to 9.0% (0.5% every time) in 2006, and 9.0% to 14.5% (0.5% every time) in 2007.

[8] After China's entry into the WTO in December 2001, the banking sector continued to face increasing pressure from the competition of foreign financial institutions and to experience many important reforms. In 2005 and 2006, three of the Big Four banks (BOC, PCBC, and ICBC) successfully partially privatized, accepted investment from foreign financial organizations, which were subject to the 25% restriction of foreign ownership, and issued IPOs outside mainland China. The fourth (ABC) will be partially privatized in the near future.

flow is higher than it is for firms in coastal regions. Interestingly, the sensitivity gap remains nearly constant until the last rolling sample period. During the last rolling sample of continuously and strictly contractionary monetary policy, banks experiencing continuous management reforms have to give priority to allocating scarce credit funds to firms in coastal regions. Although both types of firms face more external financial constraints over the last rolling period, the investment-cash flow sensitivity of firms in inland regions rises more quickly than it does for the coastal firms.

3.3 Robustness tests

Because of the potential question of a measurement error in Tobin's Q, we substitute another financial variable (sales growth) for Tobin's Q as a proxy for investment opportunities. The results of sales growth measurement are consistent with those of Tobin's Q measurement. In addition, our previous results were based on a rolling regression for an overlapping period of five years. Moreover, when we change the overlapping period (6 years, 7 years and 8 years),[9] the previous results remain unchanged.[10] This indicates that our results are robust.

In order to test our findings of robustness further, we choose a typical industry, such as manufacturing, and use that data from our sample. The empirical results and the time series pattern of sensitivities are provided in Tables 4 and 5 and Fig. 2.

Insert Table 4 here.

Insert Table 5 here.

[9] The definition of sales growth SG_{t-1} and Equation (2) decide our whole adjusted sample of 8 years, i.e., 2000 to 2007.

[10] For space reasons, we do not report the tables for other overlapping periods. These tables are available on request.

Insert Fig. 2 here.

As is evident from Table 4, the investment of both firms in inland and coastal areas is significantly correlated with their cash flow at the 1% level, and there is still a significant sensitivity gap at the 1% level. In addition, although the coefficients of Tobin's Q and sales growth SG are positive, the former is significant at the 1% level, but the latter is insignificant, which indicates, for the manufacturing industry, that Tobin's Q is probably a better proxy for investment opportunities than sales growth. Figures 2-A and C show the same time series pattern of sensitivity as that in Fig. 1-A and C. The patterns of the sensitivity gap in Fig. 2-B are not fully consistent, as a sharp increase of the gap is not found when SG is used. However, as the other results remain qualitatively unchanged, our findings are robust with regard to the manufacturing industry.

4. Conclusions

To our knowledge, there is no extant research on the impact of conspicuous regional disparities on investment-cash flow sensitivity. The main goal of our paper is to try to help fill the gap in the literature by addressing the issue of investment-cash flow sensitivity using Chinese financial data of listed firms. Our empirical results suggest that firms in inland regions rely more on their internal funds in their investment activities than those in coastal regions and that the sensitivity gap between inland firms and coastal firms becomes wider under contractionary monetary policy. This suggests that regional disparities have a statistically significant impact on investment-cash flow sensitivity and that it is more difficult for firms in inland regions to obtain outside funds, such as those from capital markets. Our findings indicate that capital markets in China rationally reflect regional disparities.

References

Ağca, Ş., Mozumdar, A., 2008. The impact of capital market imperfections on investment-cash flow sensitivity. Journal of Banking and Finance 32, 207-216.

Aivazian, V., Ge, Y., Qiu, J., 2005. The impact of leverage on firm investment: Canadian evidence. Journal of Corporate Finance 11, 277-291.

Allayannis, G., Mozumdar, A., 2004. The impact of negative cash flow and influential observations on investment‐cash flow sensitivity estimates. Journal of Banking and Finance 28, 901-930.

Allen, F., Qian, J., Qian, M., 2005. Law, finance, and economic growth in China. Journal of Financial Economics 77, 57-116.

Allen, F., Qian, J., Qian, M., Zhao, M., 2008. A review of China's financial system and initiatives for the future. Working paper, the Wharton School, University of Pennsylvania.

Alti, A., 2003. How sensitive is investment to cash flow when financing is frictionless? Journal of Finance 58, 707-722.

Boyle, G., Guthrie, G., 2003. Investment, uncertainty, and liquidity. Journal of Finance 58, 2143-2166.

Chen, Z., Xiong, P., 2002. The illiquidity discount in China. Working paper, International Center for Financial Research, Yale University.

Cleary, S., 1999. The relationship between firm investment and financial status. Journal of Finance 54, 673-692.

Cleary, S., Povel, P., Raith, M., 2007. The U-shaped investment curve: Theory and evidence. Journal of Financial and Quantitative Analysis 42, 1-39.

Erickson, T., Whited, T., 2000. Measurement Error and the Relationship between Investment and q. Journal of Political Economy 108, 1027-1057.

Fazzari, S., Hubbard, R., Petersen, B., 1988. Financing constraints and corporate investment. Brookings Papers Economic Activity 1, 141-195.

Firth, M., Chen, L., Wong, S., 2008. Leverage and investment under a state-owned bank lending environment: Evidence from China. Journal of Corporate Finance, in press.

Kaplan, S., Zingales, L., 1997. Do investment－cash flow sensitivities provide useful measures of financing constraints? Quarterly Journal of Economics 112, 169-215.

Lyandres, E., 2007. Costly external financing, investment timing, and investment-cash flow sensitivity. Journal of Corporate Finance 13, 959-980.

Moyen, N., 2004. Investment-cash Flow Sensitivities: Constrained versus Unconstrained Firms. Journal of Finance 59, 2061-2092.

Table 1

Summary statistics

	Panel A Whole observations					Panel B Observations of the Costal Regions					Panel C Observations of the Inland Regions				
	Mean	Median	Min	Max	Standard deviation	Mean	Median	Min	Max	Standard deviation	Mean	Median	Min	Max	Standard deviation
Investment I	0.425	0.174	0.000	222.295	3.104	0.447	0.181	0.000	222.295	3.853	0.399	0.162	0.000	91.358	1.934
Cash Flow CF	0.444	0.205	-102.314	341.74	5.312	0.621	0.232	-102.314	341.740	7.120	0.245	0.181	-13.542	51.350	1.646
Tobin's Q	1.300	1.008	0.004	13.505	1.032	1.268	0.982	0.021	13.500	1.009	1.335	1.043	0.004	13.505	1.057
Sales Growth SG	0.265	0.151	-1.071	31.619	1.055	0.275	0.153	-1.071	29.858	1.053	0.253	0.150	-1.000	31.619	1.058

The table provides the summary statistics. Investment and cash flow are normalized by the net fixed assets of a previous time period.

Table 2

Empirical results for Equations (1) and (2) over the whole sample period

	Constant	CF	dummyCF	Q	SG	# of Obs.	# of Firms	Adjusted R^2
Equation (1)	0.297 (4.277)***	0.657 (17.070)***	-0.572 (-14.621)***	0.022 (0.398)		7256	1240	0.279
Equation (2)	0.301 (8.821)***	0.652 (15.733)***	-0.543 (-12.237)***		-0.028 (-0.850)	5813	1148	0.432

The values reported herein are the estimates obtained from the firm fixed effect models of (1) and (2) over the whole sample period. Investment normalized by the net fixed assets of a previous time period is the dependent variable. The explanatory variables are the cash flow normalized by the net fixed assets of a previous time period, dummyCF, and either Tobin's Q (in Equation (1)) or Sales growth SG (in Equation (2)).

t-statistics in brackets. ***, **, and *: significance levels at 1%, 5%, and 10%, respectively.

Table 4

Empirical results for Equations (1) and (2) for the manufacturing industry during the whole sample period

	Constant	CF	dummyCF	Q	SG	# of Obs.	# of Firms	Adjusted R^2
Equation (1)	0.220 (14.551)***	0.220 (15.288)***	-0.205 (-13.547)***	0.083 (6.551)***		4523	734	0.251
Equation (2)	0.285 (39.877)***	0.094 (5.997)***	-0.083 (-5.102)***		0.008 (1.013)	3679	717	0.182

The values reported herein are the estimates obtained from the firm fixed effect models of (1) and (2) for the manufacturing industry during the whole sample period. Investment normalized by the net fixed assets of a previous time period is the dependent variable. The explanatory variables are the cash flow normalized by the net fixed assets of a previous time period, dummyCF, and either Tobin's Q (in Equation (1)) or Sales growth SG (in Equation (2)).

t-statistics in brackets. ***, **, and *: significance levels at 1%, 5%, and 10%, respectively.

Table 3

Empirical results for Equations (1) and (2) over the five-year rolling sample period

	1998-2002		1999-2003		2000-2004		2001-2005		2002-2006		2003-2007	
CF	0.167	0.037	0.118	0.044	0.098	0.046	0.040	0.044	0.080	0.005	0.993	1.046
	(3.838)***	(1.624)*	(3.965)***	(2.701)***	(3.548)***	(3.495)***	(2.536)***	(2.775)***	(2.872)***	(0.177)	(15.051)***	(16.136)***
dummyCF	-0.062	0.008	-0.030	-0.020	-0.014	-0.017	-0.041	-0.044	-0.100	-0.046	-0.713	-0.821
	(-1.410)	(0.250)	(-0.990)	(-1.174)	(-0.519)	(-1.223)	(-2.561)***	(-2.638)***	(-3.413)***	(-1.444)	(-9.975)***	(-11505)***
Q	0.068		0.078		0.092		0.126		-0.030		-0.251	
	(1.365)		(2.036)**		(2.511)***		(6.518)***		(-0.725)		(-1.842)*	
SG		-0.002		0.005		0.006		0.001		-0.006		-0.060
		(-0.141)		(0.376)		(0.646)		(0.071)		(-0.315)		(-1.104)
constant	0.270	0.356	0.262	0.347	0.252	0.332	0.223	0.326	0.386	0.333	0.455	0.240
	(3.481)***	(24.530)***	(4.542)***	(29.175)***	(4.872)***	(33.178)***	(8.992)***	(30.079)***	(9.147)***	(19.482)***	(3.488)***	(4.855)***
# of Obs.	2600	1702	3414	2384	3728	3153	4059	3456	4337	3815	4656	4111
# of Firms	882	744	970	821	1034	920	1100	970	1124	1047	1192	1091
Adjusted R^2	0.390	0.475	0.297	0.318	0.257	0.234	0.279	0.127	0.169	0.102	0.251	0.415

The values reported herein are the estimates obtained from the firm fixed effect models of (1) and (2) over the five-year rolling sample period. Investment normalized by the net fixed assets of a previous time period is the dependent variable. The explanatory variables are the cash flow normalized by the net fixed assets of a previous time period, dummyCF, and either Tobin's Q (in Equation (1)) or Sales growth SG (in Equation (2)).

t-statistics in brackets. ***, **, and *: significance levels at 1%, 5%, and 10%, respectively.

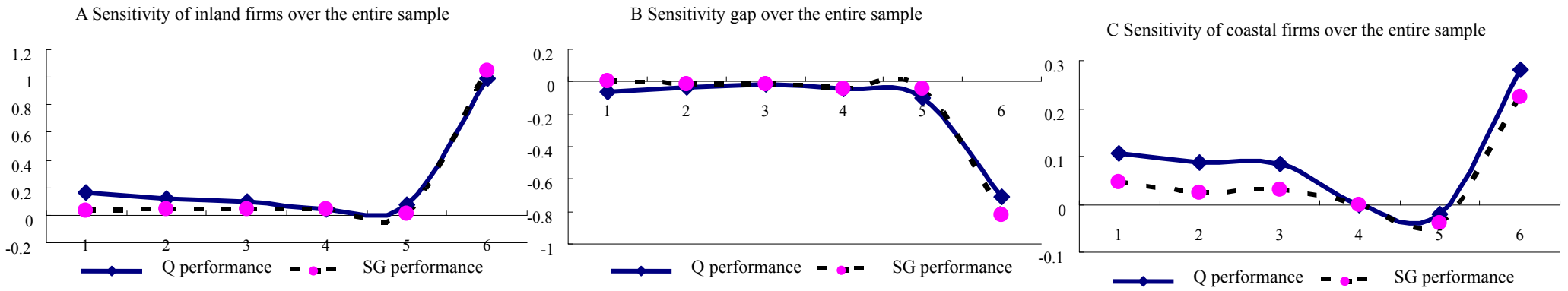

Fig. 1 Time series pattern of the sensitivity of investment-cash flow for the entire sample

Investment is regressed on cash flow CF, dummyCF, and Tobin's Q or sales growth SG over five-year periods from 1998 to 2007, i.e., 1998-2002, 1999-2003, and so on. The sensitivity value (A and C) or gap value (B) is on the vertical axis, and the numeral on the horizontal axis indicates the rolling sample periods, for example, the period 1998-2002 is shown as 1, 1999-2003 as 2, and so forth.

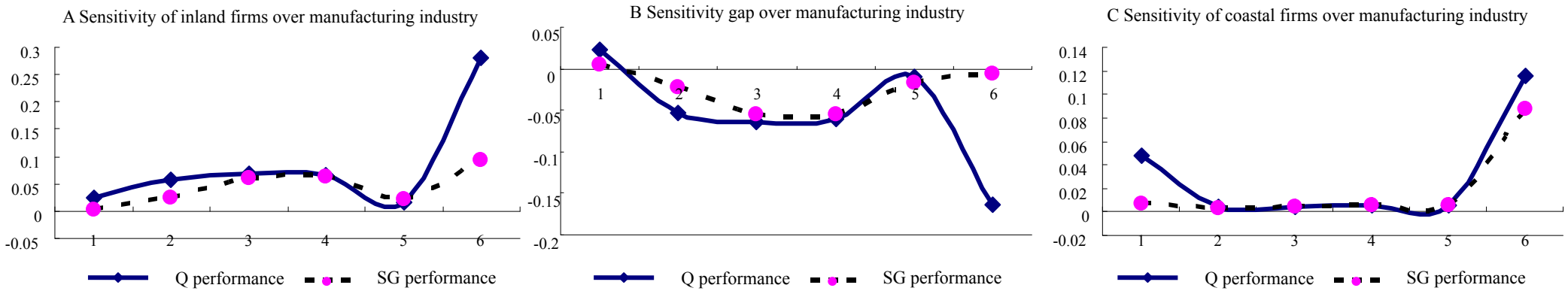

Fig. 2 Time series pattern of the sensitivity of investment-cash flow for the manufacturing industry

Investment is regressed on cash flow CF, dummyCF, and Tobin's Q or sales growth SG over five-year periods from 1998 to 2007, i.e., 1998-2002, 1999-2003, and so on. The sensitivity value (A and C) or gap value (B) is on the vertical axis, and the numeral on the horizontal axis indicates the rolling sample periods, for example, the period 1998-2002 is shown as 1, 1999-2003 as 2, and so forth.

Table 5

Empirical results for Equations (1) and (2) for the manufacturing industry during the five-year rolling sample period

	1998-2002		1999-2003		2000-2004		2001-2005		2002-2006		2003-2007	
CF	0.024	0.001	0.057	0.026	0.068	0.060	0.066	0.062	0.016	0.023	0.279	0.093
	(0.885)	(0.043)	(2.355)**	(1.045)	(2.981)***	(2.732)***	(2.933)***	(2.977)***	(0.745)	(1.126)	(16.060)***	(5.078)***
dummyCF	0.024	0.005	-0.052	-0.023	-0.064	-0.056	-0.060	-0.056	-0.011	-0.017	-0.164	-0.006
	(0.641)	(0.144)	(-2.129)**	(-0.924)	(-2.708)***	(-2.497)**	(-2.600)***	(-2.621)***	(-0.462)	(-0.816)	(-7.282)***	(-0.284)
Q	0.064		0.080		0.097		0.126		0.135		-0.027	
	(2.293)**		(3.616)***		(4.864)***		(6.926)***		(6.258)***		(-1.483)	
SG		0.004		0.011		0.011		-0.002		0.004		0.004
		(0.238)		(0.674)		(0.772)		(-0.189)		(0.404)		(0.513)
constant	0.286	0.359	0.267	0.346	0.249	0.331	0.215	0.315	0.194	0.284	0.289	0.253
	(6.808)***	(24.489)***	(8.355)***	(27.244)***	(9.232)***	(30.660)***	(9.583)***	(32.956)***	(9.158)***	(35.256)***	(16.813)***	(40.009)***
# of Obs.	1569	1035	2076	1466	2315	1953	2564	2178	2772	2440	2954	2644
# of Firms	527	448	581	495	629	558	686	601	713	667	719	696
Adjusted R^2	0.359	0.474	0.289	0.327	0.280	0.250	0.260	0.204	0.289	0.196	0.429	0.350

The values reported herein are the estimates obtained from the firm fixed effect models of (1) and (2) for the manufacturing industry during the five-year rolling sample period. Investment normalized by the net fixed assets of a previous time period is the dependent variable. The explanatory variables are the cash flow normalized by the net fixed assets of a previous time period, dummyCF, and either Tobin's Q (in Equation (1)) or Sales growth SG (in Equation (2)).

t-statistics in brackets. ***, **, and *: significance levels at 1%, 5%, and 10%, respectively.