

**Essays in Corporate Investment, Financing, and Product Market
Competition**

By

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Dedication

To my parents, for teaching me the value of knowledge.

To my husband, for his deepest and unconditional love.

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Chapter 1

Introduction

My dissertation examines issues related to corporate investment, financing frictions, and competitive environments in product markets.

Chapter 2 explores the empirical investment behavior of firms in the standard q model extended to include imperfect product market competition and financial constraints. In the model, product market is composed by a number of competitors supplying a homogenous good, and financial constraints are the outcome of costly external financing. Marginal q exceeds average Q (Tobin's q) whenever the marginal benefit from strategic investing outweighs the monopoly rents earned per unit of capital. Moreover, when competition rather than collusion is expected in the product market, the balance between the marginal effect of the inverse elasticity of demand and market share would induce an inverted U-shaped relationship between a firm's price-cost margin and the difference between marginal q and average Q . Consistent with the model's prediction, I find investment responds the most to Tobin's q for firms with medium market power or in moderately concentrated industries in the regression of investment on Tobin's q . After including cash flow in the regression, I find the sensitivity of investment to cash flow increases with market power. This is due to the failure of Tobin's q to take into account firms' strategic considerations and the measurement error in the realized

value of Tobin's q . After controlling for the measurement error, I find monopolistic firms have a lower sensitivity of investment to cash flow than firms with medium market power, because cash flow has to compensate for the increased side effect of monopoly rents in Tobin's q . I also find financial constraints can cause excess investment sensitivity to cash flow after accounting the effect of imperfect competition in product market and the measurement error in realized Tobin's q . My results reveal the importance of imperfect competition in product market and strategic interdependence between firms and help to address the debate on the relationship between financial constraints and investment sensitivity to cash flow.

Chapter 3 empirically studies the interplay between globalization, product market competition, and corporate investment. It has three main findings. First, imports and foreign direct investment (FDI) adversely affect domestic firms' market power, but the effect of imports is more pronounced. Second, firms with stronger market power cut more capital expenditures and increase less spending on R&D when they lose market power. Internal funds and market power show a complementary effect on corporate investment. Third, globalization appears linked to firms' abilities to get financing, as well as to their competitive product market positions and industry concentrations. Firms facing financial constraints appear to be more vulnerable to the entry of foreign rivals. Reductions in capital expenditures seem to be greater in firms that are more financially constrained. The negative impact of foreign competition on market power and capital expenditure appears to be more pronounced among industry laggards in more competitive industries.

Chapter 4 aims to explain recent time series evidence that the investment sensitivity to cash flow has declined over time (e.g., Brown and Peterson (2009); Chen and Chen (2012))

and addressed the unsettled interpretation of this sensitivity and its relation to financial constraints. In Chapter 3, we find that increased foreign competition reduces the market power of local U.S. manufacturing firms and investment by firms with greater market power tends to depend more on the availability of internal funds. Therefore, if one had predicted that, as globalization intensified, market power would decrease in many of the industries studied in this paper, one also would expect investment sensitivity to cash flow to gradually decline. This chapter provides supportive evidence for such a hypothetical prediction by comparing the time trend of investment sensitivities to cash flow between firms whose market power is the most and least adversely affected by globalization. Moreover, the response of investment to cash flow remains constant over time for firms in 15 manufacturing industries that are proxies of non-tradable industries. Beside through the channel of product market competition, the integration of global economy directly affects the investment sensitivity to cash flow. Compared to international trade, FDI is the channel of greater importance through which overseas rivals reduces the response of domestic firms' capital expenditures to cash flow. Lastly, globalization slowdowns are associated with the increase in the dependence of investment on cash flow.

Chapter 2

Investment with Imperfect Product

Market Competition and Financial

Constraints

2.1 Introduction

Numerous studies in macroeconomics and corporate finance have examined, based on the prediction of the q theory that a firm's investment rate is determined by the expected marginal contribution of its capital to market value, the effect of financial constraints on corporate investment. The investment literature contains two definitions of q : average Q and marginal q . Tobin (1969) is the first to introduce the concept of average Q , which is the ratio of market value to the replacement cost of a firm's capital stock, and to use it as an empirical measure of investment opportunities. Marginal q is defined as the ratio of the value of an additional unit of capital to its acquisition cost.¹ Average Q (also known as Tobin's q) is empirically observable, but not marginal q . Hayashi (1982) bridges the gap between marginal q and average

¹Mussa (1977) first is the first to link the convex costs of adjustment and the q theory of investment explicitly in a deterministic framework, and Abel (1983) makes the link clearly in a stochastic framework. Both papers focus on marginal q .

Q by assuming perfect competition and constant returns to scale. Based on assumptions in Hayashi (1982), most of the empirical work in this field, beginning with Fazzari et al. (1988), uses Tobin's q to control for investment opportunities and finds high investment-to-cash-flow sensitivity for financially constrained firms.

However, an assumption of perfect competition in product market is critical to the reliability of these results. When competition is not perfect, average Q exceeds marginal q because it contains information on monopoly rents besides investment opportunities. In the absence of capital market imperfections, if cash flow is correlated with marginal q but not monopoly profits, firms' investment may be sensitive to cash flow simply because cash flow reflects information about investment opportunities. Furthermore, strategic considerations can dictate deviation from the optimum level of investment in the classical q model. Firms form expectation on their rivals' actions and adjust capital expenditures correspondingly. For example, they may overinvest to keep out aspiring entrants, preempt rivals, or force out weak players.² The contribution of an additional unit of capital takes into account the benefit associated with fighting for market shares, but average Q does not. Therefore, this missing information in average Q could make room for cash flow to explain investment. Besides, recent research suggests that the interactions between firms and their competitors are important to understand

²This point has been demonstrated in the theoretical work by Spence (1977) and Dixit (1980). Bolton and Scharfstein (1990) also argue that rich rivals may pursue predatory actions to force out financially weak firms. Several empirical studies relate corporate investment to industry structure and competitive environments in the product market, for instant, Hay and Liu (1998), Akdogu and MacKay (2008).

the effect of corporate financial policies.³ Hence, ignoring the role of imperfect product market competition in investment and financing policies will bias the explanatory power of these empirical tests of the effect of external financing constraints.

The objective of this paper is to explore the empirical investment behavior of firms in the classical q model extended to include imperfect product market competition and financial constraints. In the model, the product market is composed of a number of competitors supplying a homogenous good, and financial constraints are the outcome of costly external financing. Allowing for oligopolistic interdependence between firms, I show that average Q deviates from marginal q and the divergence between them depends on the competitive structure in the product market, the elasticity of the aggregate demand curve, the proportion of total demand fulfilled by a firm's supply, and the expected value of its future profits. Marginal q exceeds average Q whenever the marginal benefit from strategic investing overrides the monopoly rents earned per unit of capital, or equivalently say, if the representative firm earns positive profits in future, has relatively small market share, and believes its rivals would adopt for fighting other than colluding. Furthermore, the inverse elasticity of demand widens the wedge between marginal q and average Q no matter which q is greater. Firms' market share appears to reduce marginal q relative to average Q when firms in the product market compete with others. Therefore, when competition rather than collusion is expected in the product market, the balance between the marginal effect of the inverse elasticity of demand and market share would induce

³See Maksimovic (1995). More recent studies include Faure-Grimaud (2000), Cestone and White (2003), Povel and Raith (2004), Campello and Fluck (2006) and Khanna and Schroder (2010).

a nonlinear relationship between a firm's market power and the difference between marginal q and average Q .

In the light of the model's prediction on the difference between marginal q and average Q , I develop two hypotheses for empirical tests, regarding the impact of market power (concentration) on investment sensitivity to Tobin's q and cash flow. First, without controlling for the divergence between two qs , an increase in market power (industry concentration) can initially lead to the overestimation of marginal q 's contribution to investment, resulting in high response of investment to Tobin's q for firms with medium market power or operating in moderately concentrated industries. After the negative effect of market share causes average Q to surpass marginal q , the estimate of the influence of Tobin's q would decline for high market power firms or firms in industries with high concentration. Second, cash flow plays a role in interpreting investment if Tobin's q is used as the control for investment opportunities because cash flow is persistent and correlated with expected future profits. Acting as a measure of expected profits, cash flow can either boost or discourage investment, depending on how far average Q deviates from marginal q due to imperfect competition. If firms expect competition from their rivals, the model suggests an inverted U-shaped relationship between market power and investment sensitivity to cash flow. Cash flow can also be the indicator of the availability of internal funds. In the presence of capital market imperfections, I show in the model financial constraints cause excess sensitivity of investment to internal funds after taking into account imperfect product market competition and develop the third hypothesis for the effect of financial constraints. All else things equal, firms exposed to more financing difficulty respond more strongly to cash flow than firms more immune to such difficulty.

The empirical part of this paper investigates how both market power (concentration) and financial constraints influence the investment-Tobin's q response as well as the investment-cash-flow sensitivity. Based on the investment equations derived from the model, I test those three hypotheses from the model using data collected from 5,495 firms in 104 well-defined manufacturing industries over four decades. My approach differs significantly from those of previous studies in two ways. First, investment is connected to the empirical observable variable-Tobin's q instead of the unobservable marginal q . Second, it allows for the marginal effect of Tobin's q and cash flow on investment to vary according to the level of firm market power (industry concentration). Focusing on the impact of imperfect competition and financial frictions, I report a new set of findings on the interplay between investment, Tobin's q and cash flow.

I first examine the difference in investment responses to Tobin's q across different regimes of market power (concentration), finding supportive evidence for the first hypothesis and strategic overinvesting. I find that the investment responds the most to Tobin's q for firms with moderate market power or in mid-concentration industries, without controlling for cash flow in the investment regression. I further address the interpretation of investment sensitivity to cash flow by running a regression of investment on Tobin's q , cash flow, and an interaction between cash flow and the measure of firms' market power (industry concentration). I find market power strengthens the dependence of investment on cash flow, inconsistent with the second hypothesis which states that a monopoly tends to have a lower sensitivity of investment to cash flow than firms with a moderate number of competitors. The conflict between the second hypothesis and the empirical finding is due to the difference between the expected

and realized value of average Q . This difference biases up the estimate of the marginal effect of cash flow more for firms with higher market power. To eliminate measurement errors in realized Tobin's q , I use the high-order moment method developed by Erickson and Whited (2000, 2012) to re-estimate the cash-flow-augmented investment regression. In line with the second hypothesis, firms with high and low market power invest less than those with moderate power according to the level of cash flow. To gauge the effect of financial constraints on investment sensitivity to cash flow, I include in the regression another cross term, cash flow with the measure of financial constraints. Conditional on market power and Tobin's q , the increase in cash flow for more financially constrained firms is associated with greater capital expansion. My results support the third hypothesis and suggest financial constraints contribute to excessive sensitivities of investment to cash flow.

Several theoretical papers have also demonstrated market power can induce the principle link between corporate investment and internal funds. By assuming perfect capital markets and monopolistic competition, Cooper and Ejarque (2001) show that a simple dynamic optimization framework can replicate the empirical results from regressing investment on Tobin's q and the profit rate in Gilchrist and Himmelberg (1995). Further, Cooper and Ejarque (2003) find that adding financial frictions does not improve the fit of the model relative to a model with market power alone. In their models, average Q outweighs marginal q by the ratio of monopoly rents to capital. They explain the inequality between two qs as the measurement

error that attributes to the dependence of investment on cash flow. However, cash flow is positively correlated with monopoly rents-the noise in average Q .⁴ In order to offset the side effect of monopoly rents on investment, a negative loading on cash flow should be expected in the investment regression. My model and empirical results suggest their findings are due to the difference between the expected and realized value of average Q and the correlation between cash flow and monopoly profits. The difference between marginal q and average Q cannot simply be treated as the measurement error to explain the effect of market power.

This paper complements existing studies on investment sensitivity to cash flow. Previous empirical work finds either positive or negative excess sensitivity of investment to cash flow for firms facing greater financial constraints, indicating cash flow contains information about either the availability of internal funds or investment opportunities or both. For example, Fazzari et al. (1988) identify firms with low dividends as the most constrained and find higher sensitivity of investment to cash flow for those firms. In contrast, Kaplan and Zingales (1997) identify financially constrained firms based on the qualitative and quantitative information contained in firms' various reports, and find "never constrained" firms have a higher sensitivity than "likely constrained" firms. To reconcile these conflicting empirical results, Moyen (2004) presents models of unconstrained and constrained firms and points out the role of debt financing in magnifying the sensitivity of unconstrained firms. Gomes (2001) adopts a decreasing return-to-scale production function and obtains significant cash flow effects in a standard neoclassical investment model that is extended to account for financial constraints.

⁴Hayashi and Inoue (1991) also note the correlation between cash flow and monopoly profits. They said "Cash flow can be significant because of its correlation with monopoly rent."

Alti (2003) shows in his the model that when financing is frictionless, the magnitude and pattern of investment-cash-flow sensitivity closely resemble those observed in the data, and this sensitivity is higher for firms with higher growth rates and lower dividend payout ratios. By assuming a concave profit function, Abel and Eberly (2011) present a model without convex capital adjustment costs and any financial frictions, in which investment is responsive to average Q and cash flow but not to marginal q . Empirical Work by Erickson and Whited (2000) shows that to a large extent the sensitivity of investment to cash flows is attributable to measurement error in marginal q . Hadlock and Piece (2010) collect detailed qualitative information from financial filings to categorize financial constraints for a random sample of firms from 1995 to 2004, and their findings about the investment-to-cash-flow sensitivity are consistent with Kaplan and Zingales (1997). Unlike them, my paper emphasizes the importance of product market competition for the sensitivity of investment to cash flow, indicating that cash flow reflects important information about future profits in addition to the availability of internal funds for the period 1970-2011.

This paper is related to the literature on the effect of financial frictions on corporate investment under alternative setups: Whited (1992), Bond and Meghir (1994), Hennessy and Whited (2007), Hennessy et al. (2007) and Erickson and Whited (2010). My work also relates to Bustamante (2010), who examines the impact of real and financing frictions on corporate decisions and finds financially constrained firms that are subject to fixed costs postpone investment to a higher value of marginal q . Her paper defines real frictions as the fixed costs of investment and adjustment costs, but does not include imperfect competition in product markets. In contrast, I focus on an imperfectly competitive product market and costly external

financing. In addition to financial frictions, imperfect competition plays a role in determining capital investment.

The remainder of the chapter is organized as follows. In Section 2.2, I study a simple dynamic model of investment to propose the relations between investment, Tobin's q , and cash flow. Section 2.3 describes the data collection process and measures of financial constraints and imperfect competition. Section 2.4 studies the effect of imperfect competition and financial constraints on the interplay between investment, Tobin's q , and cash flow. It contains the paper's central empirical findings. Section 2.5 presents concluding remarks.

2.2 The Model for Q -regressions

This section serves as the starting point to motivate my subsequent empirical analysis. It first presents a dynamic investment model with imperfect product market competition to provide a framework for estimating Q -regressions. The model is then extended to include capital market imperfections. I also develop three hypotheses for empirical tests from the model and discuss possible factors that induce the links between investment, qs , and internal funds.

2.2.1 Investment Model with Imperfect Competition

I start by specifying the supply side of the product market in which firms operate. Much of the literature is either silent on the market environments or assumes monopolistic competition with all firms facing the same elasticity of demand (e.g. Whited (1992), Gomes (2001), Cooper and Ejarque (2003)). But firms which aim at establishing dominant position in the relevant

industries might invest strategically. Because a firm's physical capacity will determine its market share in the long run, investment may be used as an instrument for market competition. Investment in physical capacity is a competitive game. To study the strategic role of investment and the interdependence between firms, I model the product market as a Cournot oligopoly with n competitors supplying a homogeneous good. This good's price P_t depends on the aggregate demand for n competitors' outputs, $Y_t = \sum_{j=1}^n Y_{j,t}$. To capture imperfect competition in the product market, I assume a downward sloping demand curve with constant elasticity $\varepsilon = -\frac{P_t}{Y_t} \frac{dY_t}{dP_t}$, $1 \leq \varepsilon < \infty$. Therefore, the elasticity of the inverse demand curve faced by firm j is its market share $s_j (= \frac{Y_{j,t}}{Y_t})$ divided by the elasticity of demand ε . $\frac{s_j}{\varepsilon}$ reflects firm j 's ability to raise the output price above its marginal cost by $\frac{P_t s_j}{\varepsilon}$ to earn $\frac{s_j}{\varepsilon} P_t Y_{i,t}$ more profits than perfectly competitive firms.

Consider the representative firm i which uses capital stock $K_{i,t}$ and the costlessly adjustable factors (like labor) $L_{i,t}$ to produce the homogenous good at the beginning of period t . Consistent with prior literature of investment, I assume it adopts the Cobb-Douglas production function, $Y(K_{i,t}, L_{i,t}) = K_{i,t}^\rho L_{i,t}^{1-\rho}$, $0 < \rho < 1$. Parameters ρ and $1 - \rho$, respectively, measure the elasticity of output with respect to physical capital and freely adjustable factors. The difference between firm i 's revenue $P(Y_t)Y(K_{i,t}, L_{i,t})$ and total costs on freely adjustable factors $w_{i,t}L_{i,t}$ yields its profits π_t^i in period t .

$$\pi_t^i(K_{i,t}, L_{i,t}, Z_{i,t}) = Z_{i,t} [P(Y_t)Y(K_{i,t}, L_{i,t}) - w_{i,t}L_{i,t}] \quad (2.1)$$

where $w_{i,t}$ is the unit price of adjustable factors. Random variable $Z_{i,t}$ measures exogenous shocks to profits and is observed by the firm but unobserved by the econometrician at time t . The profit function π_t^i is not time-invariant because it depends on the aggregate outputs of firm i 's competitors.

Capital stock K_t depreciates at an exogenous rate δ and the firm undertakes investment I_t to accumulate capital. The identity below governs the law of motion for capital stock.

$$K_{i,t+1} = I_{i,t} + (1 - \delta) K_{i,t} \quad (2.2)$$

The newly installed capital $K_{i,t+1}$ will become productive in period $t + 1$. The relative unit price of physical capital is normalized to be one. Besides purchasing costs to acquire new capital, due to real frictions, firm i incurs the adjustment costs associated with investing. Its investment adjustment cost function $G(I, K, v)$ is increasing in I , decreasing in K , convex and linearly homogeneous in both arguments. I adopt the commonly used quadratic function in standard q models to characterize the capital adjustment costs (e.g. Erickson and Whited (2000)),

$$G(I_{i,t}, K_{i,t}, v_{i,t}) = (\gamma_0 + \gamma_1 v_{i,t}) I_{i,t} + \frac{\gamma}{2} \left(\frac{I_{i,t}}{K_{i,t}} \right)^2 K_{i,t}, \quad \gamma > 0 \quad (2.3)$$

where γ is the parameter governing the curvature of this capital adjustment cost function. Random variable $v_{i,t}$ measures exogenous shocks at time t to adjustment costs and is observed by the firm but unobserved by the econometrician. The cost function allows linearities in the marginal costs of adjustment. The presence of convex capital adjustment costs induces firm to

smooth investment over time, so that anticipation of an unexpected need for capital tomorrow increases a firm's desire to invest today.

In the frictionless word, the representative firm maximizes the expected present value of the stream of its future profits subject to the law of capital stock accumulation (2.2). The time-varying value function of firm i at time t is defined as follows,

$$V_t^i(K_{i,t}, Z_{i,t}, v_{i,t}) = \max_{\{I_{i,t}, L_{i,t}\}} \left\{ \begin{array}{l} [\pi_t^i(K_{i,t}, L_{i,t}, Z_{i,t}) - I_{i,t} - G(I_{i,t}, K_{i,t}, v_{i,t})] \\ + \frac{1}{R} E_t [V_{t+1}^i(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})] \end{array} \right\} \quad (2.4)$$

where E_t is the expectation operator conditional on the firm's information set at time t . R is the firm's gross required rate of return for each period. Rearranging the Euler equation for capital yields the familiar regression equation:

$$\frac{I_{i,t}}{K_{i,t}} = \alpha + \beta E_t [q_{i,t+1}] + u_{i,t} \quad (2.5)$$

where $\alpha = -\frac{\gamma_0+1}{\gamma}$, $\beta = \frac{1}{R\gamma}$, and $u_{i,t} = -\frac{\gamma v_{i,t}}{\gamma}$. $q_{i,t+1} = \frac{dV_{t+1}^i(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})}{dK_{i,t+1}}$, is firm i 's marginal q for period $t+1$ in this model. It measures the marginal contribution of new capital stock $K_{i,t+1}$ to firm's market value $V_{t+1}^i(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})$ conditional on the exogenous shocks to profits $Z_{i,t+1}$ and to capital adjustment costs $v_{i,t+1}$.

2.2.2 Marginal q and Average Q

In period t , firm i forms value function V_t^i based on time paths that are set at the beginning of this period and specify optimal actions of other players for the entire game. Based

on this value function, its marginal q for period $t + 1$ evaluates how installing an extra unit of capital stock attributes to the variations in market value $V_t^i(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})$ but not $V_{t+1}^i(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})$. When n firms in the product market have commitment to the pre-terminated time paths, their value function will be time-consistent. That is, $V_t^i = V^i$, $i = 1, \dots, n$. This result corresponds to the open-loop equilibrium of the dynamic Cournot game (see in Dockner (1992)). In this case, marginal q is equal to average Q minus the present value of future monopoly rents.

$$q_{i,t} = Q_{i,t} - \frac{s_i}{\rho \varepsilon + (1 - \rho) s_i} E_t \left[\sum_{m=0}^{\infty} R^{-m} \frac{\pi_{i,t+m}}{K_{i,t+m}} \right] \quad (2.6)$$

where $\pi_{i,t}$ is the maximum value of firm i 's revenues minus the costs of freely adjustable factors in period t conditional on the shock to profits $Z_{i,t}$ and optimal time paths of other firms. It measures period t 's cash flow (internal funds) in the model.⁵ Average Q is defined as the ratio of the market value of capital to its replacement value, or formally, $Q_{i,t} \equiv \frac{V^i(K_{i,t}, Z_{i,t}, v_{i,t})}{K_{i,t}}$.

Equation (2.6) shows average Q equals marginal q when the product market is perfectly competitive or the representative firm's future cash flows are expected to zero. For imperfectly competitive firms earning positive profits, their average Q exceeds marginal q by the expected present value of future average monopoly rents. Moreover, firms with either larger market share or facing a steeper demand curve ($\varepsilon = \infty$) tend to have a smaller marginal q relative to average Q . This is the subject of Proposition 1.

⁵In my model, revenues minus the costs of inputs, $\pi_{i,t}$, is a measure of cash flow. I can also subtract adjustment costs. As noted by Cooper and Ejarque (2003), this difference is not important. For calculation simplicity, I do not subtract the adjustment costs.

Proposition 1 *Assume the present value of imperfectly competitive firms' future cash flows is positive. In the open-loop equilibrium, firms' marginal q is smaller than its average Q . All else equal, the magnitude of the difference between the two q s is an increasing function of the inverse elasticity of demand curve and the firm's market share.*

When n firms in the product market cannot commit themselves to the entire time paths of investment, they use closed-loop (subgame perfect) strategies to compete. Because firms take into account the rivals' actual reactions to their own actions, their optimal decision rules depend on current state variables of the game—firms' capital stocks in this model. This closed-loop equilibrium generates a time-inconsistent value function, and as a consequence, firm i 's evaluation of the marginal contribution of capital for period $t + 1$ will deviate from the actual marginal q .⁶ In this case, firm i forms expectation on the deviation of rivals' actions from their preannounced plans after its investment decision.

To characterize firms' conjectures about rivals' strategies and simplify econometric testing of the theory, I apply the concept of "conjectural variation" in the empirical industrial organization literature. Conjectural variation is a term referring to the beliefs that one firm has about the way its competitors may react if it varies its output (or price). Like Hay and Liu (1998), I assume firm i 's conjectures on others' actual responses are as follows

$$\frac{dK_{j,t}}{dK_{i,t}} = \eta \frac{K_{j,t}}{K_{i,t}} \quad (2.7)$$

⁶This is because $\frac{dV_i^i(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})}{dK_{i,t+1}} \neq \frac{dV_{t+1}^i(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})}{dK_{i,t+1}}$

where $\eta < 0$ corresponds to competitive outcomes, like Bertrand equilibrium.⁷ With negative conjectures, the firms act as if they believe the other firm adjusts its output so as to offset the changes caused by their actions on the total output (or market price).

I show in Appendix A.1 that an additional term-conjectural variations appears on the right side of equation 2.6 to evaluate the difference between marginal q and average Q ,

$$q_{i,t} = Q_{i,t} + \frac{-s_i + (-\eta)\rho(1-s_i)\sum_{j \neq i} s_j}{\rho\varepsilon + (1-\rho)s_i} E_t \left[\sum_{m=0}^{\infty} R^{-m} \frac{\pi_{i,t+m}}{K_{i,t+m}} \right] \quad (2.8)$$

where $q_{i,t} = \frac{dV_t^i(K_{i,t}, Z_{i,t}, v_{i,t})}{dK_{i,t}}$ and $Q_{i,t} \equiv \frac{V_{t-1}^i(K_{i,t}, Z_{i,t}, v_{i,t})}{K_{i,t}}$. Equation (2.8) shows average Q is an imperfect measure of investment opportunities-marginal q because it not only fails to capture the firm's conjectures of its rival's investment strategies but also contains the noisy information of monopoly rents. Substitute the relationship between firms' market shares, $\sum_{j \neq i} s_j = 1 - s_i$, into equation (2.8) yielding

$$q_{i,t} = Q_{i,t} + (1 - \eta\rho) \frac{\frac{(-\eta)\rho}{1-\eta\rho} - s_i}{\rho\varepsilon + (1-\rho)s_i} E_t \left[\sum_{m=0}^{\infty} R^{-m} \frac{\pi_{i,t+m}}{K_{i,t+m}} \right] \quad (2.9)$$

It shows the difference between marginal q and average Q depends on the nature of competition in the product market (η), the elasticity of demand curve (ε), a firm's market share (s), and the present value of its future cash flows.

Negative conjectural variations imply that the divergence between a firm's marginal q and average Q can be either positive or negative, depending on its market share. On one hand,

⁷Zero conjectural variations ($\eta = 0$) are the outcome of Nash non-cooperative equilibria. Positive conjectures ($0 < \eta \leq 1$) are the equivalent of collusive equilibria.

marginal q outweighs average Q when the firm's expected monopoly rent is dominated by the benefit from aggressive investment strategies in response to its rivals' actions, or equivalently say, when this firm's market share is relatively small, $s < \frac{(-\eta)\rho}{1-\eta\rho}$. On the other hand, a firm with an extremely large share of demand tends to have a smaller marginal q than average Q because its monopoly profits surpass the effect of strategic considerations. Furthermore, like the case of the open-loop equilibrium, an increase in the elasticity of demand reduces the distance between marginal q and average Q no matter which one is larger. In other words, the degree of imperfect competition determines how far the average Q to deviate from marginal q . Proposition 2 summarizes the analysis.

Proposition 2 *Assume the present value of imperfectly competitive firms' future cash flows is positive. With negative conjectural variations ($\eta < 0$), the difference between firm i 's marginal q and average Q is positive (negative) if and only if $s_i < \frac{(-\eta)\rho}{1-\eta\rho}$ ($s_i > \frac{(-\eta)\rho}{1-\eta\rho}$). If all else things equal, the magnitude of the difference between two qs is an increasing function of the inverse elasticity of demand curve ($\frac{1}{\epsilon}$).*

However, the measure of a firm's market power, price-cost margin ($\frac{s_i}{\epsilon}$), is determined both by its market share and the elasticity of the demand curve. Either a decrease in the firm's market share or an increase in the elasticity of demand will cause the price-cost margin (or market power) to decline. Although the inverse elasticity of demand curve can boost marginal q relative to average Q when a small proportion of total demand is satisfied by the firm's output, its market share tends to reduce marginal q compared to average Q . Therefore, the

balance between the marginal effect of the inverse elasticity of demand and market share induces a nonmonotonic association between a firm's market power and the difference between marginal q and average Q . More specifically, the positive effect of the inverse elasticity of demand dominates the negative effect of market share for firms with a small share of aggregate demand and facing a flat demand curve; while the negative effect takes over for firms with a large price-cost margin. Proposition 3 presents the formalized summary of the analysis.

Proposition 3 *Assume the present value of imperfectly competitive firms' future cash flows is positive and they have negative conjectures of rivals' strategies ($\eta < 0$). When the inverse elasticity of demand curve and firm i 's market share increase by the same amount, the difference between its marginal q and average Q goes up if $\frac{1-\eta\rho}{(-\eta)\rho} (s_i + \frac{1}{\varepsilon}) + \frac{1-\rho}{\rho} \frac{1}{\varepsilon^2} < 1$ and declines if $\frac{1-\eta\rho}{(-\eta)\rho} (s_i + \frac{1}{\varepsilon}) + \frac{1-\rho}{\rho} \frac{1}{\varepsilon^2} > 1$.⁸*

2.2.3 Hypotheses for Empirical Tests

In the frictionless world, the representative firm i makes decisions on investment to maximize equation (2.4) subject to the motion of capital accumulation (2.2). Given firms having the same value of average Q , Proposition 3 implicitly suggests those with medium market power or operating in moderately concentrated industries have the greatest marginal q , and as a result, they will invest a highest rate according to equation (2.5). Because empirically observable Tobin's q is used as the proxy for marginal q in the investment- Q regression, the estimate of investment response to Tobin's q would vary correspondingly to the degree of firm market

⁸Proof of Proposition 3 is Appendix A.2.

power. As firms' market power increases, the effect of marginal q would be first overstated and then undermined in the regression of investment on Tobin's q . Formally, I present Hypothesis 1.

Hypothesis 1 *Suppose firms face the same value of Tobin's q . Firms with either high or low market power (in most or least concentrated industries) invest less than those with medium market power (in moderately concentrated industries). As a result, in the investment- Q regression, the estimate of investment response to Tobin's q should be the greatest for firms with medium market power (in moderately concentrated industries).*

To simplify the econometric testing on the link between investment and cash flow, I assume the ratio of cash flow to capital follows $AR(1)$ process with autocorrelation coefficient μ . That is,

$$\frac{\pi_{i,t+1}}{K_{i,t+1}} = \mu \frac{\pi_{i,t}}{K_{i,t}} + c_{i,t} \quad (2.10)$$

where $c_{i,t}$ is the white noise. Substituting the expression for q derived in equation (2.9) and equation (2.10) to equation (2.5) yields a new regression for estimation.

$$\frac{I_{i,t}}{K_{i,t}} = \alpha + \beta E_t [Q_{i,t+1}] + \phi \left[\frac{\frac{(-\eta)\rho}{1-\eta\rho} - s_i}{\rho\varepsilon + (1-\rho)s_i} \right] \frac{\pi_{i,t}}{K_{i,t}} + u_{i,t} \quad (2.11)$$

where $\phi = \frac{\mu(1-\eta\rho)}{\gamma(R-\mu)} > 0$. Equation (2.11) connects firms' investment rate directly to the empirical observable average Q and the ratio of cash flow to capital. Based on Proposition 2

and 3, in the absence of financial constraints and in the presence of negative conjectural variations, Hypothesis 2 below reveals imperfect competition can induce an association between investment and cash flow and this association is a nonlinear function of market power.

Hypothesis 2 *The sensitivity to cash flow of investment by firms with either high or low market power (in most or least concentrated industries) is less compared to firms with medium market power (in moderately concentrated industries).*

In the case of negative conjectural variations, cash flow has two functions to affect firms' investment decisions in addition to Tobin's q . First, the strategic role of investment depends on the expected value of future profitability and firms may overinvest to guarantee their competitive position. Second, the difference between average Q and marginal q generates in the reduced-form investment regression an omitted variable-monopoly rent, which has a negative impact on firms' investment rate. Because cash flow reflects the information contained in monopoly rents, a firm with greater market power will cut capital expenditure more in response to cash flow. Therefore, after controlling for Tobin's q in the investment regression (2.11), more cash flow may lead firms to invest more if the strategic role of investment overtakes the negative effect of monopoly profits and might mean less investment than the prediction by Tobin's q when the monopoly rents' negative effect dominates. Parallel to the analysis of the contribution of Tobin's q , market power (concentration) reinforces the dependence of investment on cash flow for firms with relatively low market power but discourages the incentive to invest in response to cash flow for firms with relatively high market power.

2.2.4 Financial Constraints

In the presence of financial frictions, investment may be sensitive to the measure of the availability of internal funds-cash flow. To study this, I add capital market restrictions to this capital accumulation model. With financial imperfections, such as transaction costs, agency problems and market timing issues, external financing is not a perfect substitute for internal funds. Firms can borrow from outside capital market to finance their investment, but the access to external capital market is costly. Like Hennessy et al. (2007), I use a quadratic functional form to capture a variety of costs of going to financial markets to raise capital.

$$H(I_{i,t} - \pi_t^i, K_{i,t}) = \frac{h}{2} \frac{1}{K_{i,t}} [\max(I_{i,t} - \pi_t^i, 0)]^2 \quad (2.12)$$

These costs would include the variable costs of public stock offering, costs of monitoring the firm and the discounted present value of any premia associated with external debt and equity financing.

With the cost of capital market participation, the representative firm i 's dynamic optimization problem is relatively complicated. It includes decision about whether to incur the cost of external financing along with a decision on investment. The optimization problem is,

$$V_t^i(K_{i,t}, Z_{i,t}, v_{i,t}) = \max_{\{I_{i,t}, L_{i,t}\}} \left\{ \begin{array}{l} \pi_t^i(K_{i,t}, L_{i,t}, Z_{i,t}) - I_{i,t} - G(I_{i,t}, K_{i,t}, v_{i,t}) \\ -H(I_{i,t} - \pi_t^i(K_{i,t}, L_{i,t}, Z_{i,t}), K_{i,t}) \\ + \frac{1}{R} E_t [V_{t+1}^i(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})] \end{array} \right\} \quad (2.13)$$

subjected to the motion of capital accumulation (2.2). When firm i is financially constrained in period t but not in the future,⁹ the reduced-form investment regression (2.11) changes to

$$\frac{I_{i,t}}{K_{i,t}} = \alpha + \beta E_t [Q_{i,t+1}] + \phi \left[\frac{\frac{(-\eta)\rho}{1-\eta\rho} - s_i}{\rho\varepsilon + (1-\rho)s_i} \right] \frac{\pi_{i,t}}{K_{i,t}} + \lambda \frac{\pi_{i,t}}{K_{i,t}} + u_{i,t} \quad (2.14)$$

where $\alpha = -\frac{\gamma_0+1}{h+\gamma}$, $\beta = \frac{1}{R(h+\gamma)}$, $\phi = \frac{\mu(1-\eta\rho)}{(R-\mu)(h+\gamma)}$, $\lambda = \frac{h}{h+\gamma}$, and $u_{i,t} = -\frac{\gamma_1 v_{i,t}}{h+\gamma}$. It explicitly shows financially constrained firms' investment is sensitive to cash flow. An extra dollar of internal funds increases financially constrained firm's desire to invest λ dollar more. Lastly, I present Hypothesis 3 on the effect of financial constraints on the sensitivity of investment to cash flow.

Hypothesis 3 *All else equal, the investment by financially constrained firms is sensitive to cash flow.*

2.3 Measures and Sample

In this section, I start by describing the construction of measures of product market competition and financial constraints, the data sources, and sample selection. I also present summary statistics of the key variables used.

⁹Actually, this assumption is very restrictive. It requires $I_{i,t} > \pi_{i,t}$ and $I_{i,t+m} \leq \pi_{i,t+m}$, where $m \geq 1$. I made this assumption because the main emphasis of this paper is not the cross effect of future potential financial constraints and market power on investment sensitivity to cash flow. Equation (A.12) in Appendix A.1 shows there is an extra term on the right side of the reduced-form regression when firm i goes to external capital markets to raise capital at least one period after period t . This term represents the difference between marginal q and average Q caused by costly external finance.

2.3.1 Measuring Market Power and Concentration

I consider three different measures of market power and two different measures of market concentration for the analysis.

Pursuant to the empirical literature on industrial organization, I use price-cost margin (*PCM*)-the conventional measure as one proxy of a firm's market power. It is defined as the difference between one and the average variable cost divided by dollar sales (*sale*), where the average variable cost is the sum of the cost of goods sold (*cogs*) and selling, general, and administrative expenses (*sga*). Price-cost margin is also the empirical approximation of the Lerner index and a firm's markup, which captures differences in market power across firms. It is worth noting that price-cost margin could bias firm-level estimations because it accounts for inter-industry differences in product market competition. To alleviate this concern, I also use relative price-cost margin to measure a firm's market power. It is the difference in price-cost margin between a firm and its industry, reflecting one firm's ability, relative to its industry peers, to raise its prices above its marginal costs in an imperfectly competitive product market.

Two industry price-cost margins are used to calculate relative price-cost margins. The first one is the sales-weighted average of firms' price-cost margin within each three-digit Standard Industry Classification (SIC) industry in my firm-level sample. Using this measure to calculate relative price-cost margin excludes only within-sample across industry differences in product market competition. I call the first relative price-cost margin within-sample relative price-cost margin (*InRPCM*). Like Xu (2011), I calculate the second industry price-cost margin as the

ratio between Value Added minus Payroll and the sum of Value Added and Total Cost of Materials from the NBER-CES Manufacturing Industry Database. This provides an exogenous relative price-cost margin because the NBER-CES Manufacturing Industry Database covers almost the entire universe of manufacturing firms. I denote the second relative price-cost margin as outside-sample relative price-cost margin (*OutRPCM*).

The most commonly used measure of the degree of product market concentration is the Herfindahl-Hirschman Index (*HHI*). It is defined as the sum of the squares of the market shares of firms within the industry and ranges from zero to one. Increases in the *HHI* generally indicate decreases in competition and increases of market power. I measure market concentration for each three-digit SIC industry by using both within-sample *HHI* (*InHHI*) and the fitted *HHI* (*HP – HHI*) provided by Hoberg and Phillips (2010). I use Hoberg and Phillips (2010)'s measure for two reasons. Their measure is preferable to within-sample *HHI* for two reasons. First, their measure of industry concentration takes account for both public and privately held firms. Second, they combine Compustat data with not only Herfindahl data from the Commerce Department but also employee data from the Bureau of Labor Statistics (BLS). Their measure offers broader coverage availability and thus helps minimize selection bias and classification error.

2.3.2 Measuring Financial Constraints

To measure firm-level financial constraints, I adopt the commonly used synthetic Kaplan and Zingales (1997) index (*KZ*) and the synthetic Whited and Wu (2006) index (*WW*).¹⁰¹¹

According to Lamont et al. (2001), the *KZ* index is constructed by classifying firms into discrete categories of financial constraints (based on the annual reports of 49 firms in the Fazzari et al. (1988) sample of low-dividend manufacturing firms) and then using an ordered logit regression to relate their classifications to observable accounting variables. Specifically, this index is defined as $KZ = 0.283Q - 1.002CF + 3.139TDTK - 1.315CHK - 39.368DIV$, where *Q* is Tobin's *q*, *CF* is the ratio of cash flow to capital, *TDTK* is the ratio of total debt to capital, *CHK* is the ratio of the stock of cash to capital, and *DIV* is the ratio of total dividends to capital. Firms with a high *KZ* index have high debt burdens and Tobin's *q*, and low cash flows, cash inventories, and dividend payout ratios.

The *WW* index is derived from general method of moments (GMM) estimation of the shadow value of costly external funds in the Euler equation of an intertemporal investment model.¹² Formally, the *WW* index is $WW = 0.021TLTD - 0.091CFTA - 0.044LNNTA - 0.062DIVPOS - 0.035SG + 0.102ISG$, where *TLTD* is the ratio of long-term debt to total assets, *CFTA* is the ratio of cash flow to total assets, *LNNTA* is the natural log of total assets, *DIVPOS* is a dummy variable equal to one if the firm pays out dividends, *SG* is the sales

¹⁰There are also many other indicators of the severity of financial constraints, like the dividends payout ratio in Fazzari et al. (1988), bond rating from *Moody's* by Whited (1992), firm size or Standard & Poor bond rating in Erickson and Whited (2000), and firms' commercial paper ratings by Almeida et al. (2004).

¹¹Hadlock and Piece (2010) also develop a synthetic financial index based on firms' size and age. They argue this index is relatively exogenous compared to indexes using financial ratios. I do not use their index because a firm's size and age tends to be correlated with its market power. But using this financial index provides similar results as *KA* and *WW* financial indexes.

¹²Note that they use quarterly data for GMM estimation.

growth, and *ISG* is the three-digit industry sales growth. A small and slow-growing firm with a high debt burden and a low cash flow in a fast-growing industry will tend to have a high *WW* index. It also seldom pays dividends.

2.3.3 Sample and Summary Statistics

The firm-level panel data comes from the universe of all manufacturing firms (2000-3999 SIC range) on the fundamentals annual Compustat industrial files from 1970 to 2011. I follow the previous literature to define the rate of a firm's investment as its annual spending on capital expenditures (*capx*) divided by the beginning-of-year property, plant, and equipment (*ppent*). I use Tobin's *q* to measure average *Q*. As in Kaplan and Zingales (1997), Tobin's *q* is defined as the market value of assets divided by the book value of assets (*at*), where the market value of assets equals the book value of assets plus the market value of common equity ($csho \times prccf$) minus the sum of common equity (*ceq*), and balance sheet deferred taxes (*txdb*). The ratio of cash flow to capital is the sum of operating income (*ib*) and depreciation (*dp*), divided by beginning-of-year property, plant, and equipment.

For a firm-year to be included in the firm-level sample, it must have sufficient information to compute the Tobin's *q*, cash flow, physical investment, capital stock, price-cost margin, and *KZ* and *WW* financial indexes. Like Almeida et al. (2004), I exclude firm-year observations in which growth of assets or sales exceeds 100% in a single year to avoid business discontinuities associated with mergers and acquisitions. To eliminate outliers, I delete firm-year observations for which lagged capital stock, total assets, and sales are less than 5 million

real 2005 dollars. All variables are winsorized at the 1st and 99th percentiles and adjusted for the Consumer Price Index (measured in constant 2005 dollars). Lastly, I deleted firms in three-digit SIC codes ending with “0” or “9” because these industries are not economically meaningful markets. Firms in Compustat are typically assigned to SIC codes ending with “0” if they are too diversified or lack enough counterparts to make up a particular 3-digit SIC code. SIC codes ending with a “9” combine “miscellaneous” and “not elsewhere classified.”

The final sample consists of 62,177 firm-years including 5,495 manufacturing firms in 104 three-digit SIC industries from 1970 to 2011. The average cross-section is 1,480 observations, with a minimum of 1099 in 1970 and a maximum of 1,842 in 1997. Table 2.1 presents summary statistics of firm characteristics for the final sample. The mean values of variables in investment regressions and financial ratios are higher than their medians. While the measures of market power tend to have greater medians than average, the mean values of two *HHIs* are higher than their medians. For example, the average investment to capital ratio is 2.41%, and the median is slightly lower at 1.85%. The mean value of the cash flow to capital ratio is 3.02%, but it is 2.98% for the median firm. Average and median price-cost margin are 0.096 and 0.011, respectively.

2.4 Empirical Estimation and Results

This section intends to examine how imperfect product market competition and financial constraints affect the response of investment to Tobin’s q and to cash flow. It starts with Hypothesis 1 in Section 2.3 about how imperfect competition affects the dependence of investment

on average Q . Then, I test Hypothesis 2 by examining the difference in the sensitivity of investment to cash flow between firms with small, medium, and large market power and the difference across different regimes of industry concentration. Lastly, I study the impact of financial constraints on investment sensitivity to cash flow for Hypothesis 3 in Section 2.4.

2.4.1 Effect of Imperfect Competition on the Response of Investment to Tobin's q

In this section, I show an inverted U-shaped relationship between firm market power (industry concentration) and the response of investment to Tobin's q in my sample. This relationship suggests reductions in market power for firms with moderate (high) market power are associated with decreased (increased) capital expenditures corresponding to Tobin's q . This finding supports Hypothesis 1 in Section 2.2.3 and reveals firms use investment as an instrument for market competition.

To identify variations in the effect of Tobin's q across different regimes of market power (industry concentration), I regress firms' investment rate (I) on beginning of period Tobin's q (Q), dummy variables of high and low market power (industry concentration) ($High$ and Low), and the interactions between them ($Q \times High$ and $Q \times Low$):

$$\begin{aligned}
 I_{i,t} = & \alpha + \beta Q_{i,t-1} + \beta_l (Q_{i,t-1} \times Low_{i(j),t-1}) + \beta_h (Q_{i,t-1} \times High_{i(j),t-1}) \\
 & + \zeta_l Low_{i(j),t-1} + \zeta_h High_{i(j),t-1} + Firm_i + Year_t + u_{i,t}
 \end{aligned} \tag{2.15}$$

The subscripts i , t , and j , respectively, represent firm, year, and three-digit SIC industry. *High* is the indicator variable for the top one-third of observations of each year based on the measure of market power (industry concentration), and *Low* is the indicator for the bottom one-third of observations of each year. Three variables are used to measure firms' market power at the beginning of period t : price-cost margin (*PCM*), within-sample relative price-cost margins (*InRPCM*), and outside-sample relative price-cost margin (*OutRPCM*). Two variables are used to measure industry concentration: within-sample *HHI* (*InHHI*) and *HHI* by Hoberg and Phillips (2010) (*HP – HHI*). Thus, the coefficients β_l and β_h , respectively, in front of two cross terms reflect the premium of investment response to Tobin's q for firms with low and high market power or operating in less and more concentrated industries. $Firm_i$ is fixed firm effects to absorb unobservable firm-specific components in firms' (relative) price-cost margins.¹³ $Year_t$ is fixed time effect to capture the influence of time trends and cyclical factors. Lastly, I use the Huber-Whited heteroskedastic-consistent errors, allowing for within-firm error clustering.

Table 2.2 presents the estimates of regression (2.15) for each of the five measures of market power (industry concentration) in my sample. The significantly negative estimates of the coefficients of two cross terms- β_l and β_h suggest the greatest investment response to Tobin's q for firms with moderate market power and for firms operating in relatively-but not highly concentrated industries. In other words, at the margin, the increase in Tobin's q for firms with distinctively higher levels of market power is associated with aggressive investment due to

¹³We do not include industry fixed effects because firms in our sample seldom switch industry classifications. Including or excluding industry fixed effects will not alter the results because industry fixed effects are collinear with firm fixed effects.

the failure of average Q to capture the contribution of strategic considerations. However, the addition of more market power does not monotonically lead to capital expenditure expansion. Rather, investment reductions seem to be observed by firms in highly concentrated industries. This is because increased monopoly rents give rise to greater noisy information in Tobin's q . Agca and Mozumdar (2008) also find investment- Q response is highest in oligopolistic industries. But they attribute lower response of investment to Tobin's q in monopolistic industries to the reason that the value of investing strategically outweighs the value of waiting. My model suggests the noisy information contained in average Q could be the reason to explain why investment by firms in high-concentration industries is less dependent on Tobin's q .

The findings in Table 2.2 are consistent with the nonmonotonicity implications of the model-Hypothesis 1 and provide evidence for the strategic role of investment. On one hand, Proposition 2 in Section 2.2 shows marginal q can surpass average Q more for firms with small market share but facing a steeper demand curve if they believe their competitors choose aggressive strategies, which gives rise to the overestimation of the effect of marginal q on their investment. On the other hand, monopoly rents increase with firms' market power or industry concentration so that average Q deviates more from marginal q for firms with larger market share and facing a steeper demand curve. This fact results in the underestimation of the effect of marginal q on monopolistic firms' investment. At a minimum, the results presented here suggest that the data reject the notion that imperfect competitive environment in product market leads to one particular outcome: market power (concentration) can overstate or undermine the effect of marginal q on investment. The analysis, however, lacks a more complete characterization of the interplay between investment and competitive environments

in product market. The next subsection will shed more light on the influence of imperfect market competition on the investment to cash flow sensitivity.

2.4.2 Effect of Imperfect Competition on the Sensitivity of Investment to Cash Flow

Based on the equation (2.11), I continue to study the influence of firm market power (industry concentration) on the sensitivity of investment to cash flow. The pooled cross-sectional–time series regression model I first estimate has the following form:

$$I_{i,t} = \alpha + \beta Q_{i,t-1} + \psi (CF_{i,t} \times MP_{i(j),t-1}) + \theta CF_{i,t} + \zeta MP_{i(j),t-1} + Firm_i + Year_t + u_{i,t} \quad (2.16)$$

where $CF_{i,t}$ is the ratio of firm i 's cash flow to capital during period t and $MP_{i(j),t-1}$ represents the level of three measures of firm market power (PCM , $InRPCM$, $OutRPCM$) and two measures of industry concentration at beginning of period t ($InHHI$, $HP - HHI$). I also estimate an alternative specification by using the intersections between cash flow and indicators for high and low market power (industry concentration) instead of the cross term $CF \times MP$ in equation (2.16). Formally,

$$I_{i,t} = \alpha + \beta Q_{i,t-1} + \psi_h (CF_{i,t} \times High_{i(j),t-1}) + \psi_l (CF_{i,t} \times Low_{i(j),t-1}) + \theta CF_{i,t} + \zeta_h High_{i(j),t-1} + \zeta_l Low_{i(j),t-1} + Firm_i + Year_t + u_{i,t} \quad (2.17)$$

In the estimations performed, I correct the regression error structure for within-firm residual clustering and heteroskedasticity using Huber-White's covariance estimator.

Panel A and B in Table 2.3, respectively, reports the results from the estimation of regressions (2.16) and (2.17). A noteworthy feature in Panel A is that market power (industry concentration) appears to have a significantly positive impact on investment sensitivity to cash flow. For instant, if firms have an extra dollar of cash flow, those with 10% price-cost margin will increase investment by one cent more than those with zero mark-up. The estimate in Panel B of ψ_l in front of the interaction term, $CF * Low$, is significantly negative in all specifications using different measures of market power (industry concentration). These findings support only part of Hypothesis 2 in Section 2.2.3 in that low firm market power is associated with reduced capital expenditures corresponding to the level of cash flow.

However, the difference in the sensitivity to cash flow between firms with high and moderate market power tends to be indistinguishable from zero,¹⁴ as suggested by the insignificant estimates of the coefficient of the cross term $CF \times High$ in Panel B, not significantly negative as predicted. One possible explanation is the measurement error in the realized value of Tobin's q when it is used as the proxy for the expected value of firms' average $Q - E_t [Q_{i,t+1}]$ in the equation (2.11). Market power could bias up the estimate of investment sensitivity to cash flow for firms with high market power (or operating in highly concentrated industries) in the presence of this measurement error. The intuition is straightforward. First, measurement errors in realized average Q bias down the OLS estimate of the coefficient in front of average

¹⁴The estimate in three out of five cases is insignificantly negative, *PCM*, *InRPCM*, *InHHI*. For the other two cases, the estimate is positive and one of them is significant at 5% level (*HP - HHI*).

$Q-\beta$. Next, cash flow is positively correlated with monopoly rents. The positive correlation is stronger for firms with greater market power. Third, the OLS estimate of cash flow's effect equals its effect on investment minus the product of its effect on average Q and the OLS estimate of β . Therefore, underestimating β will result in overestimation of the marginal contribution of cash flow to investment. The overestimation problem is more severe for firms with greater market power.¹⁵

To eliminate the biases caused by measurement errors, I use the high-order moment method (HOM) developed by Erickson and Whited (2000, 2012) to re-estimate equation (2.17). They construct consistent estimators that use the information contained in the third- and high-order moments of the joint distribution of the observed regression variables. Their method first uses GMM to exploit the information afforded by an excess of moment equations over parameters each period. Then, estimates from different cross-sections in a panel are combined optimally via a minimum distance procedure to produce a single coefficient estimate for the entire panel. Because their method does not control for fixed firm effect, before estimation, I demean all variables in equation (2.17) to eliminate firm-specific components in firms' investment, Tobin's q and cash flow.

Table 2.4 reports the results by the high-order moment estimation of the regression (2.17). Consistent with Hypothesis 2, the estimated marginal effect of cash flow on investment for firms with either high or low market power is less than cash flow's marginal effect for firms with moderate market power in all cases and statistically significant in three out of five specifications. More importantly, this finding reflects the role played by the measurement error in

¹⁵Appendix A.3 provides a rigorous analysis of the statements in this paragraph.

overestimating the sensitivity of investment to cash flow for firms with high market power or in monopolistic industries.

As Hayashi (1982), Cooper and Ejarque (2001, 2003) incorporate monopolistic competition into the standard q model.¹⁶ They evaluate the dynamic investment model by the simulate moment of method and find their model can replicate the empirical estimation of the cash-flow-augmented reduce-form investment regressions in Gilchrist and Himmelberg (1995). Therefore, they conclude market power connects investment to cash flow. While my findings indicate market power cannot be the only force drives the positive response of investment to cash flow. Measurement errors in the realized average Q is the other key factor. In their model, the only uncertainty faced by firms is the exogenous shocks to their profitability and characterized by a stochastic process. Two parameters govern this process: one measures the serial correlation and the other denotes the standard deviation of the innovation. Their simulated method of moments (SMM) estimations show the serial correlation of profitability shocks is less than 0.1 and the standard deviation of the innovation exceeds 0.8 in all cases. High variations and low persistence in profits indicate great differences between the expected and realized average Q . Their results actually suggest it is both market power and measurement errors in the realized average Q that induce the principle link between investment and internal funds.

¹⁶They do not consider the exogenous shock to adjustment costs associated with investing. They make an assumption on the process of shock to profits but not the process of cash flows.

2.4.3 Effect of Financial Constraints

I now proceed to analyze the effect of financial constraints on the sensitivity of investment to cash flow after controlling for the effect of imperfect competition. According to Hypothesis 3 in Section 2.2.4, whenever firms has an extra dollar of internal funds, they will use it rather than borrowing from outside capital markets to finance investment, so firms that are more financially constrained will make more adjustments to their capital expenditures in response to internal funds. Therefore, if cash flow reflects information about the availability of internal funds, the sensitivity of investment to cash flow is an increasing function of financial constraints.

Based on each of the financial constraints indexes (WW and KZ) during the preceding year, I sort firms into terciles and denote the top tercile as most financially constrained and the bottom tercile as least financially constrained. In the estimations below, most financially constrained firm i in year t is assigned to the indicator variable $Most_{i,t}$ and least financially constrained firm i in year t is assigned to the indicator variable $Least_{i,t}$. These two indicators are then interacted with cash flow, yielding two intersection terms, $CF_{i,t} \times Most_{i,t-1}$ and $CF_{i,t} \times Least_{i,t-1}$. To examine whether financial constraints accelerate a rise in the sensitivity of investment to cash flow, I introduce those two indicators and two interactions into regressions (2.16) and (2.17). Then, I use the fixed-effect model to estimate the augmented version of regressions (2.16) and (2.17) and the high-order moment method to estimate the augmented version of regression (2.17).

Panels A, B, and C of Table 2.5, respectively, present results from the estimation similar to those in Table 2.3 and Table 2.4. The only difference is the inclusion of the interaction terms for cash flow and the indicators of most and least financial constraints. To save space, I only report the coefficients of the variables that interacted with cash flow. The results from the different ways of classifying a firm as most or least financially constrained and sorting a firm (an industry) into high or low market power (concentrated or competitive) groups are all very similar. As expected, the estimate in Table 2.5 of the coefficient is positive for the interaction $CF \times Most$ and negative for the cross term $CF \times Least$. It highlights the positive association between financial constraints and investment sensitivity to cash flow. This result also supports Hypothesis 3 and is consistent with the idea that cash flow reflects the availability of internal funds.

Three results emerge from the full inspection of Table 2.5. First, the results in Panel A and B show that the difference in the sensitivity of investment to cash flow appears to be more significant between moderately and least financially constrained firms classified by *KZ* index, but this difference tends to be more pronounced between most and moderately constrained firms based on *WW* index. The second feature of the results seen from the fixed-effect to HOM estimation using the *WW* index is the increased magnitude and improved significance of the estimates of the interactions between cash flow and indicators for most and least financial constraints. It suggests that the measurement error in Tobin's q seems to weaken rather than strengthen the positive relationship between financial constraints and the dependence of investment on cash flow. Third, the effect of market power (industry concentration) on investment sensitivity to cash flow is still pronounced after accounting for the impact of financial

constraints, as seen from the comparison of the results between Table 2.3 and Panel A and B in Table 2.5 and between Table 2.4 and Panel C in Table 2.5. I also test the null hypothesis that the sum of the coefficients of the cross terms $CF \times Most$ and $CF \times Low$ after HOM estimations and find the corresponding p -value is greater than 0.10 for nine out of ten cases. This test result suggests ignoring market power's impact on the sensitivity of investment to cash flow could underestimate the positive effect of financial constraints on the dependence of investment on cash flow because most financially constrained firms usually tend to be small and young and have low market power. Generally speaking, the dependence of investment on cash flow differs according to the intensity of imperfect competition as well as the degree financial constraints.

2.5 Concluding Remarks

Empirical regressions of investment on Tobin's q and cash flow often find an important role for cash flow in explaining investment. Moreover, there is hot debate in the literature on whether the excess investment-cash-flow sensitivity can be interpreted as evidence of the existence of financial constraints. I show that imperfect competition in product markets as well as financial constraints can account for these phenomena.

In my model, imperfect competition arises because firms face downward sloping demand curves and use investment as instrument for positions in the long-run competition. Firms become financially constrained because of the cost associated with external financing. Marginal q can be either greater or smaller than average Q when competitive outcome is expected in

the product market, dependent on how large the proportion of aggregate demand is satisfied by a firm's supply. Marginal q , defined as the marginal contribution of new installed capital to a firm's market value, subsumes all information about the investment opportunities, but it is empirically unobservable. Although average Q can be empirically observed based on a firm's market value, it not only fails to take into account the benefit from strategic investing but also contains noise-the monopoly rent per unit of capital. Cash flow reflects the variations in the difference between marginal q and average Q , so it plays a role in interpreting investment when marginal q exceeds average Q and compensates for the side effect of monopoly profits when average Q surpasses marginal q . Financial constraints can generate excess investment sensitivity to cash flow after controlling the effect of imperfect product market competition because cash flow is also informative about the availability of internal funds.

My empirical work is based on estimations of reduced form regressions of investment on Tobin's q , cash flow, and interaction terms of cash flow with indicator variables for imperfect competition and financial constraints. I find significant support for the nonlinear impact of market power (concentration) on the investment-Tobin's q response and the investment-cash-flow sensitivity. Firms in highly competitive or concentrated industries invest at a lower rate in response to cash flow (Tobin's q) than firms with medium market power. Investment by more financially constrained firms is more sensitive to cash flow. This is because cash flow reflects the availability of internal funds besides the variations in future profitability. My empirical findings also suggest the insensitivity of constrained firm documented in the literature (e.g. Kaplan and Zingales (1997); Hadlock and Pierce (2010)) could be driven by the investment behavior of firms facing a relatively flat demand curves. Intensive competition reduces the

marginal effect of cash flow and financially constrained firms tend to have smaller market power and assemble in relatively competitive industries.

Overall, the current paper improves our understanding of the effects of imperfect product market competition and financial constraints on the mechanism linking investment and cash flow. Future work could quantitate the model to compare the importance of imperfect product market competition, financial constraints, and the measurement error problem in affecting corporate investment.

Table 2.1: Descriptive Statistics

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
<i>Investment Regression</i>						
<i>I</i>	62177	0.241	0.185	0.205	0.014	1.206
<i>Q</i>	62177	1.533	1.208	1.003	0.549	6.416
<i>CF</i>	62177	0.302	0.298	0.713	-3.251	2.795
<i>Measure of Market Power</i>						
<i>PCM</i>	62177	0.096	0.111	0.174	-1.085	0.394
<i>InRPCM</i>	62177	-0.044	-0.016	0.180	-1.345	0.327
<i>OutRPCM</i>	55381	-0.230	-0.197	0.198	-1.471	0.086
<i>Measure of Market Concentration</i>						
<i>InHHI</i>	62177	0.198	0.155	0.152	0.035	1.000
<i>HP – HHI</i>	46776	0.126	0.096	0.110	0.000	1.000
<i>Other Financial Ratios</i>						
<i>CHK</i>	62177	0.949	0.221	2.251	0.000	15.607
<i>DIV</i>	62177	0.054	0.019	0.093	0.000	0.584
<i>TLTD</i>	62177	0.177	0.154	0.153	0.000	0.694
<i>SG</i>	62177	0.094	0.047	0.292	-0.468	1.626
<i>ISG</i>	62177	0.067	0.062	0.114	-0.468	1.626
<i>Size</i>	62177	5.882	5.588	1.806	2.812	10.83

This table displays summary statistics of the sample of U.S. manufacturing companies for the period 1970 to 2011. *I* is the ratio of investment (net capital expenditure, *capx*) to beginning-of-period capital stock (net property, plant and equipment, *ppent*). Tobin's *q*, *Q*, is defined as the market value of assets divided by the book value of assets (*at*), where the market value of assets equals the book value of assets plus the market value of common equity (*csho* \times *prccf*) minus the sum of common equity (*ceq*) and balance sheet deferred taxes (*txdb*). *CF* is the sum of income before extraordinary items (*ib*) and depreciation and amortization (*dp*) divided by capital stock. Price-cost margin, *PCM*, is defined as the difference between one and the average variable cost, where the average variable cost is the sum of cost of goods sold (*cogs*) and selling, general, and administrative expenses (*sga*) divided by sales. *RPCM* refers to relative price-cost margin—the difference between a firm's price-cost margin and its three-digit SIC industry price-cost margin. *InRPCM* uses within-sample sale-weighted average as industry price-cost margin. *OutRPCM* uses the ratio between Value Added minus Payroll and the sum of Value Added and Total Cost of Materials (from NBER-CES Manufacturing Industry Database) as industry price-cost margin. *InHHI* is within-sample Herfindahl-Hirschman Index (*HHI*) and *HP – HHI* is the *HHI* developed by Hoberg and Phillips (2010). Cash-to-capital ratio, *CHK*, is defined as cash plus marketable securities (*che*) to the beginning-of-period capital. Total-dividend-to-capital ratio, *DIV*, is the total annual dividend payments (*dvc* + *dvp*) normalized by the beginning-of-year capital. Long-term-debt-to-total-asset ratio, *TLTD*, is the sum of the long-term debt (*dltt*) divided by total assets (*at*). Sales growth, *SG*, is the firm's most recent annual percentage change in sales (*sale*). *ISG* is the three-digit industry sales growth. *Size* is the natural log of beginning-of-period book value of total assets. Variables in levels are adjusted by the Consumer Price Index, in millions of 1995 dollars.

Table 2.2: Effect of Market Power on Investment Response to Tobin's q

	Firm Market Power			Industry Concentration	
	(1)	(2)	(3)	(4)	(5)
	<i>PCM</i>	<i>InRPCM</i>	<i>OutRPCM</i>	<i>InHHI</i>	<i>HP – HHI</i>
Q	0.0826*** (23.18)	0.0817*** (23.76)	0.0742*** (21.18)	0.0858*** (24.98)	0.0922*** (23.41)
$Q \times Low$	-0.0170*** (-3.60)	-0.0153*** (-3.44)	-0.0094* (-2.40)	-0.0168*** (-4.06)	-0.0188*** (-3.98)
$Q \times High$	-0.0220*** (-5.70)	-0.0174*** (-4.73)	-0.0041 (-1.04)	-0.0151*** (-3.39)	-0.0105* (-2.02)
<i>Low</i>	-0.0365*** (-6.41)	-0.0344*** (-6.16)	-0.0387*** (-7.00)	0.0206*** (3.32)	0.0182* (2.48)
<i>High</i>	0.0572*** (10.28)	0.0393*** (7.40)	0.0356*** (6.20)	0.0119 (1.88)	0.0234** (3.08)
R-sqr	0.371	0.367	0.364	0.356	0.376
#Obs.	62177	62177	55381	62177	46776

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table displays fixed-effect regression coefficients and t -values (in parentheses) for panel data regressions examining the effect of market power (or industry concentration) on the response of investment to Tobin's q . All regressions include firm and year fixed effects. The regression error structure is corrected for within-firm residual clustering and heteroskedasticity using Huber-White's covariance estimator. The dependent variable is the investment-to-capital ratio. Independent variables include Tobin's q (Q), indicators for high and low market power (or industry concentration), and the interactions between them. Measures of firms' market power (columns (1)-(3)) and industry concentrations (columns (4) and (5)) are defined in Table 2.1. The dummy variable, *High* (*Low*), equals one for observations in the top (bottom) tercile in the observation year of the measure of market power (or industry concentration).

Table 2.3: Effect of Market Power on Investment to Cash Flow Sensitivity

	Firm Market Power			Industry Concentration	
	(1)	(2)	(3)	(4)	(5)
	<i>PCM</i>	<i>InRPCM</i>	<i>OutRPCM</i>	<i>InHHI</i>	<i>HP – HHI</i>
<i>Panel A: Cross Term CF × MP</i>					
<i>Q</i>	0.0529*** (25.16)	0.0541*** (26.08)	0.0521*** (24.00)	0.0629*** (30.41)	0.0676*** (27.37)
<i>CF × MP</i>	0.1182*** (14.05)	0.1181*** (14.72)	0.1462*** (16.40)	0.0841*** (3.64)	0.0538** (3.25)
<i>CF</i>	0.0486*** (18.45)	0.0688*** (24.17)	0.1163*** (25.83)	0.0498*** (11.45)	0.0395*** (4.01)
<i>MP</i>	0.2519*** (16.34)	0.2295*** (14.93)	0.2570*** (16.23)	-0.0205 (-1.28)	0.0073 (0.63)
R-sqr	0.392	0.391	0.400	0.380	0.401
#obs.	62177	62177	55381	62177	46776
<i>Panel B: Cross Terms CF × High and CF × Low</i>					
<i>Q</i>	0.0551*** (26.60)	0.0569*** (27.36)	0.0567*** (26.05)	0.0629*** (30.42)	0.0675*** (27.34)
<i>CF × High</i>	-0.0067 (-1.08)	-0.0040 (-0.63)	0.0126 (1.73)	-0.0028 (-0.47)	0.0168* (1.99)
<i>CF × Low</i>	-0.0467*** (-8.11)	-0.0465*** (-8.06)	-0.0385*** (-5.88)	-0.0289*** (-5.11)	-0.0154* (-2.26)
<i>CF</i>	0.0796*** (16.44)	0.0814*** (16.44)	0.0877*** (16.13)	0.0755*** (18.79)	0.0738*** (14.54)
<i>High</i>	0.0186*** (5.19)	0.0073* (2.21)	0.0137*** (3.44)	-0.0070* (-2.04)	0.0030 (0.69)
<i>Low</i>	-0.0363*** (-12.66)	-0.0324*** (-11.14)	-0.0294*** (-8.43)	0.0075* (1.97)	-0.0024 (-0.54)
R-sqr	0.390	0.388	0.391	0.380	0.401
#obs.	62177	62177	55381	62177	46776

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table displays fixed-effect regression coefficients and t -values (in parentheses) for panel data regressions examining the effect of market power (or industry concentration) on the sensitivity of investment to cash flow. All regressions include firm and year fixed effects. The regression error structure is corrected for within-firm residual clustering and heteroskedasticity using Huber-White's covariance estimator. The dependent variable is the investment-to-capital ratio. Independent variables in Panel A include Tobin's q (Q), the cash-flow-to-capital ratio (CF), the level of measures of market power (or industry concentration), and the interactions between cash flow and measures of market power (or industry concentration). Independent variables in Panel B include Tobin's q (Q), the cash-flow-to-capital ratio (CF), indicators for high and low market power (or industry concentration), and the interactions between cash flow and indicators. Measures of firms' market power (columns (1)-(3)) and industry concentrations (columns (4) and (5)) are defined in Table 2.1. MP is the level of measures of market power (or industry concentration). The dummy variable, *High* (*Low*), equals one for observations in the top (bottom) tercile in the observation year of the measure of market power (or industry concentration).

Table 2.4: Estimate Effect of Market Power by High-Order Moment

	Firm Market Power			Industry Concentration	
	(1)	(2)	(3)	(4)	(5)
	<i>PCM</i>	<i>InRPCM</i>	<i>OutRPCM</i>	<i>InHHI</i>	<i>HP – HHI</i>
<i>Q</i>	0.1880*** (40.19)	0.1827*** (42.05)	0.2032*** (33.48)	0.1821*** (39.25)	0.2178*** (30.71)
<i>CF</i> × <i>High</i>	-0.0494*** (-7.70)	-0.0424*** (-6.16)	-0.0322*** (-3.88)	-0.0072 (-1.14)	-0.0006 (-0.06)
<i>CF</i> × <i>Low</i>	-0.0149** (-2.69)	-0.0165** (-2.81)	-0.0181* (-2.47)	-0.0139* (-2.33)	-0.0103 (-1.30)
<i>CF</i>	0.0369*** (8.65)	0.0333*** (7.09)	0.0439*** (7.39)	0.0310*** (7.62)	0.0224*** (3.75)
<i>High</i>	-0.0081 (-1.83)	-0.0082* (-2.07)	-0.0102* (-2.16)	-0.0108* (-2.53)	-0.0047 (-0.88)
<i>Low</i>	-0.0097** (-2.97)	-0.0000 (-0.01)	0.0071 (1.58)	0.0201*** (4.21)	-0.0015 (-0.25)
#obs.	62177	62177	55381	62177	46776

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table displays high-order monment (HOM) estimates and t -values (in parentheses) for panel data regressions examining the effect of market power (or industry concentration) on the sensitivity of investment to cash flow. All regressions use demeaned variables to control for firm fixed effects. The dependent variable is the investment-to-capital ratio. Independent variables include Tobin's q (Q), the cash-flow-to-capital ratio (CF), indicators for high and low market power (or industry concentration), and the interactions between cash flow and indicators. Measures of firms' market power (columns (1)-(3)) and industry concentrations (columns (4) and (5)) are defined in Table 2.1. The dummy variable, *High* (*Low*), equals one for observations in the top (bottom) tercile in the observation year of the measure of market power (or industry concentration).

Table 2.5: Effect of Financial Constraints on Investment to Cash Flow Sensitivity

	KZ					WW				
	Firm Market Power			Industry Concentration		Firm Market Power			Industry Concentration	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	PCM	InRPCM	OutRPCM	InHHI	HP – HHI	PCM	InRPCM	OutRPCM	InHHI	HP – HHI
<i>Panel A: Fixed-Effect Estimation of Regression (2.16) with Cross Terms CF × Most and CF × Least</i>										
<i>CF × Most</i>	0.0074 (1.53)	0.0070 (1.44)	0.0042 (0.72)	0.0048 (0.97)	0.0002 (0.03)	0.0199*** (4.36)	0.0210*** (4.59)	0.0239*** (4.55)	0.0082 (1.77)	0.0076 (1.38)
<i>CF × Least</i>	-0.0232*** (-5.12)	-0.0227*** (-5.01)	-0.0199*** (-3.66)	-0.0195*** (-4.18)	-0.0173** (-3.02)	-0.0160* (-2.54)	-0.0142* (-2.26)	-0.0129 (-1.74)	-0.0068 (-1.10)	-0.0111 (-1.44)
<i>CF × MP</i>	0.1005*** (12.75)	0.0997*** (13.34)	0.1288*** (15.07)	0.0573** (2.66)	0.0373* (2.39)	0.1313*** (15.23)	0.1303*** (15.81)	0.1574*** (17.24)	0.0867*** (3.72)	0.0573*** (3.47)
<i>Panel B: Fixed-Effect Estimation of Regression (2.17) with Cross Terms CF × Most and CF × Least</i>										
<i>CF × Most</i>	0.0132** (2.70)	0.0120* (2.44)	0.0079 (1.34)	0.0050 (1.00)	0.0004 (0.07)	0.0183*** (3.91)	0.0194*** (4.07)	0.0197*** (3.62)	0.0089 (1.91)	0.0082 (1.49)
<i>CF × Least</i>	-0.0240*** (-5.22)	-0.0240*** (-5.20)	-0.0228*** (-4.05)	-0.0205*** (-4.42)	-0.0172** (-3.02)	-0.0135* (-2.15)	-0.0156* (-2.46)	-0.0113 (-1.50)	-0.0066 (-1.10)	-0.0116 (-1.51)
<i>CF × High</i>	0.0006 (0.09)	0.0021 (0.33)	0.0172* (2.45)	-0.0084 (-1.46)	0.0099 (1.25)	-0.0028 (-0.45)	-0.0010 (-0.16)	0.0158* (2.17)	-0.0020 (-0.33)	0.0183* (2.16)
<i>CF × Low</i>	-0.0472*** (-8.49)	-0.0464*** (-8.44)	-0.0383*** (-6.09)	-0.0259*** (-4.90)	-0.0141* (-2.18)	-0.0530*** (-8.96)	-0.0546*** (-9.05)	-0.0440*** (-6.68)	-0.0297*** (-5.26)	-0.0164* (-2.43)
<i>Panel C: HOM Estimation of Regression (2.17) with Cross Terms CF × Most and CF × Least</i>										
<i>CF × Most</i>	0.0089 (1.51)	0.0110 (1.89)	0.0183* (2.48)	0.0142* (2.40)	0.0151* (2.06)	0.0249*** (4.69)	0.0256*** (4.81)	0.0301*** (4.67)	0.0290*** (5.39)	0.0300*** (4.58)
<i>CF × Least</i>	-0.0103* (-2.09)	-0.0117* (-2.41)	-0.0170** (-2.66)	-0.0154** (-3.06)	-0.0185** (-2.76)	-0.0162* (-2.29)	-0.0222** (-3.14)	-0.0321*** (-3.71)	-0.0233** (-3.27)	-0.0387*** (-4.28)
<i>CF × High</i>	-0.0436*** (-6.96)	-0.0365*** (-5.46)	-0.0211** (-2.59)	-0.0103 (-1.68)	-0.0026 (-0.29)	-0.0450*** (-6.94)	-0.0390*** (-5.70)	-0.0238** (-2.90)	-0.0027 (-0.42)	0.0075 (0.84)
<i>CF × Low</i>	-0.0159** (-2.99)	-0.0194*** (-3.50)	-0.0191** (-2.80)	-0.0140* (-2.49)	-0.0107 (-1.41)	-0.0230*** (-3.98)	-0.0277*** (-4.54)	-0.0227** (-3.14)	-0.0158** (-2.66)	-0.0131 (-1.69)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Panel A and B display fixed-effect estimates and t -values (in parentheses) and Panel C presents high-order moment (HOM) estimates and t -values (in parentheses) for panel data regressions examining the effect of market power (or industry concentration) on the sensitivity of investment to cash flow. All fixed-effect regressions include firm and year fixed effects and correct for within-firm residual clustering and heteroskedasticity using Huber-White's covariance estimator. All HOM regressions use demeaned variables to control for firm fixed effects. The dependent variable is the investment-to-capital ratio. Independent variables in Panel A include Tobin's q (Q), the cash-flow-to-capital ratio (CF), the level of measures of market power (or industry concentration), the interactions between cash flow and measures of market power (or industry concentration), the indicators for most and least financial constraints, and the cross terms of cash flow and indicators for financial constraints. Independent variables in Panel B and C include Tobin's q (Q), the cash-flow-to-capital ratio (CF), the indicators for high and low market power (or industry concentration), the interactions between cash flow and indicators, the indicators for most and least financial constraints, and the cross terms of cash flow and indicators for financial constraints. Measures of firms' market power (columns (1)-(3)) and industry concentrations (columns (4) and (5)) are defined in Table 2.1. KZ is the synthetic financial constraints index by Kaplan and Zingales (1997) and WW is the synthetic financial constraints index by Whited and Wu (2006). MP is the level of measures of market power (or industry concentration). The dummy variable, *High* (*Low*), equals one for observations in the top (bottom) tercile in the observation year of the measure of market power (or industry concentration). The dummy variable, *Most* (*Least*), equals one for observations in the top (bottom) tercile in the observation year of the measure of financial constraints.

Chapter 3

Globalization, Product Market

Competition, and Corporate Investment

(with Antonio Mello)

3.1 Introduction

The past 25 years have witnessed rapid globalization of the product and financial markets. This globalization of economic activity is associated with a number of phenomena: increases in the flow of trade and foreign direct investment (FDI), reduction of barriers, lower transportation costs, rapid information diffusion, greater transfers in technology and processes, cross-border labor migration, and geographical convergence of prices. These factors contribute to increased competitive pressures on firms and labor in domestic markets. Theory and empirical evidence show that corporate investment decisions are influenced by these competitive pressures, because rivalry, as distinct from the business cycle, affects the amount and stability of firms' cash flows. Integration of the global economy increases firms' exposure to business risks through

the impact of this integration on the competitive environment and in turn causes firms to adjust their investment decisions. This intuitive linkage between globalization, product market competition, and corporate investment is relevant to a better understanding of a number of important corporate policies. Although recent work shows that international trade promotes gains in productivity and helps foster economic development, so far little attention has been devoted to the relation between globalization and firm-level product market choices. This paper helps bridge this gap by empirically investigating how trade openness and foreign investment affect the intensity of product market rivalry and the investment strategies that firms design to cope with the threat of a rapidly changing landscape.

Competitive environments in U.S. domestic product markets can be influenced by foreign rivals through two ways: Import and FDI. To characterize the penetration of foreign products and direct investment in U.S. markets, we construct three variables — import penetration, FDI, and total effect — using international data on imports and sales by foreign multinationals operating in the U.S. These variables are used as proxies for the competitive pressure exerted by imports, by the sales of foreign multinationals in the domestic market, and by a combination of both. Table 1 shows that foreign competitors' share of local markets has quadrupled from 1977 to 2005, suggesting the intensification of threats to U.S. firms. Using these proxy measurements, we first establish an empirical association between advances in globalization and domestic firms' market power. Using data between 1978 and 2006 collected from 4,978 U.S. manufacturing firms in 118 three-digit SIC industries, we find that the penetration of foreign rivals lowers U.S. firms' expected profits and market power. The results clearly show that FDI, despite less of an immediate impact than international trade, is an important channel

for the influence of overseas players on the competitive environment within the U.S. Because FDI requires much higher entry costs, foreign firms behave less aggressively and follow local firms in host countries if they choose FDI other than export. As a result, international trade has a stronger negative impact on domestic firms' market power than FDI.

We use reduced-form investment regressions to further investigate how the degree of product market rivalry changes U.S. firms' investment decisions. Classical q theory predicts a linear relationship between the optimal rate of a firm's investment and the contribution of an additional unit of capital to the firm's market value (marginal q). More recently, Hayashi (1982) has shown that the empirically observable Tobin's q is not a sufficient statistic when firms operate in imperfectly competitive product markets.¹ In addition, firms with market power may invest strategically to deter entry, preempt, and accelerate the exit of rivals. In light of these considerations, a firm's decision to install and replace its capital stock depends on its relative market power. In a world in which external financing is more costly than internal funds, the role of market power in interpreting a firm's investment decisions varies with the level of the firm's internal funds. Market power can strengthen a product market advantage if firms benefit from having greater cash reserves. Accordingly, to gauge the effect of increased competition on corporate investment, it is important to include in a second regression, in addition to Tobin's q , the predicted values obtained from the first regression of market power on foreign competition. This variable is then interacted with the firm's cash flow, yielding an augmented investment regression. Using this predicted value is preferable to using a direct measure of market power for two reasons. First, it signals the amount of lost profit attributable

¹Tobin's q is defined as the ratio between the market value and replacement value of capital stock.

to foreign rivals' gains in market share. Second, it mitigates concerns about the endogenous nature of the relation between corporate investment and competitive performance and helps to establish a causal link between market power and choices in investment strategies.

In the second-step estimation, we find that firms that gain market power expand their capital expenditures. Unsurprisingly, capital expenditures by these firms vary across the board and tend to reflect a firm's market power, with firms with the least market power tending also to spend the least. Capital expenditures are also positively related to the amount of firms' internal funds. More important, the estimates from the two-stage empirical investigation reveal that the effect of globalization on corporate investment is economically significant. In aggregate, increases in average import penetration and in FDI cause an average firm's profit margins to decline by 4.58% and lower its rate of investment by 2.79% (from 1978 to 2006). The drop in investment represents approximately 12% of the average investment rate in the sample. Moreover, a one standard deviation increase in cash flow enhances by 0.151% the marginal effect of predicted market power on investment. The results of the paper suggest that on average, domestic firms lose market power in the wake of globalization and react to the increased competition and lower profits by following a conservative investment strategy.

We find that the reaction to advances in globalization in domestic firms' spending on R&D differs from the reaction on physical investment across industries. Firms that lose market power reduce capex but increase R&D expenditures. The response of R&D spending to cash flows is insignificant in the case of firms in high-tech and non-durables sectors. Moreover, we find that globalization is linked to firms' positions in the product market as well as industry

concentration. Our evidence points out noticeable asymmetries in globalization-induced outcomes between market leaders and followers across different competitive settings. The negative impact of foreign competition on market power appears to be more pronounced among industry laggards in more competitive industries. On the other hand, for firms in industries with the highest degree of concentration, the level and adjustment of investment respond the most to predicted market power. The dependence on cash balances of the marginal effect of predicted market power on investment is strongest for firms in industries with moderate concentration. This finding is consistent with the result in Chapter 2 that, as the degree of market concentration goes up, firms first increase and then reduce capital expenditure according to cash flow. We also find that the effect of foreign competition is related to firms' financing prospects. Financially constrained firms are especially vulnerable to foreign rivals and reduce their capital expenditures more.

We believe that this work makes several contributions to the literature. First, it establishes that globalization, product market competition, and corporate investment are related in a direct and clear fashion. Second, it identifies imports and FDI as two channels through which the entry of foreign rivals into the domestic market alters the competitive environment and affects domestic firms' behavior. Third, the paper not only supplements the literature on the interactions between corporate policies and product markets, but also bridges the gap between studies in corporate finance and international trade and finance.

This work also complements other recent work that uses international trade data to study the interactions between product market competition and corporate policies. For instance, Fressard (2010) uses shifts in import tariffs to identify an exogenous intensification of competition

and a difference-in-differences method to analyze the causal impact of cash holdings on product market performance. In the same vein, Fresard and Valta (2012) examine the impact of increased product market competition on corporate investment and financing policies before and after a reduction in tariffs. Booth and Zhou (2009) use import penetrations to measure market power and show that market power affects dividend policy through what the authors claim to be its effect on business risk. Cunat and Guadalupe (2009) use import penetration to measure foreign competition and show that it positively affects the structure of compensation and incentives of U.S. executives. Xu (2011) uses import penetration as instrument for future expected profitability and provides consistent evidence of the predictions made by traditional trade-off models of capital structure. Cai et al. (2011) provide robust empirical evidence that both outward and inward tariffs are significantly and positively related to firm leverage, suggesting that firms tend to use more equity and less debt as foreign trade increases. Valta (2011) uses import tariff to capture exogenous changes in a firm's competitive environment and finds that competition increases the cost of bank debt. None of these researchers, however, studied the importance of FDI, which we introduce as an addition to imports as a way to assess the effect of globalization on investment and the sensitivity of investment to cash flow. Our findings reveal the importance of FDI, in addition to imports, in studying the interdependence of product market competition and corporate policies.

The remainder of this chapter is organized as follows. In Section 3.2, we review the relevant literature on the relations between globalization, competition, and investment. Section 3.3 describes firm- and industry-level data used for the empirical analysis and summarizes the relevant descriptive statistics. In Section 3.4 we use a two-stage regression procedure to

explore the interplay between globalization, product market competition, and corporate investment. We compare the difference in responses to intensified foreign competition between firms expenditures on capital and R&D. Section 3.5 examines if (and how) our results change when the analysis allows for differences between financially constrained and unconstrained firms, between market leaders and followers, and across concentrated and competitive industries. Section 3.6 presents the main conclusions.

3.2 The Link between Globalization, Competition and Corporate Investment

Globalization, product market competition, and investment can be related in many different ways. This paper, at the risk of being incomplete, centers the analysis on product markets. The simple representation of a firm having to set prices to maximize a stream of profit when its product faces a downward sloping demand curve will help to frame the problem. In static monopoly models the ratio of the output price to marginal cost monotonically decreases as the elasticity of the demand curve increases, or equivalently, the price mark-up over cost is negatively related to the elasticity of demand. New international trade theory models with imperfect competition have used a variety of modeling techniques to generate this kind of elasticity effect. For example, when trade liberalization reduces the market share of domestic firms (Helpman and Krugman (1985)) or increases the variety of available products (Krugman

(1979)), domestic players perceive their demand elasticity as going up. Therefore, when foreign firms increase their sales — either through imports or FDI — domestic firms gradually lose market share and their profit margins decline.

A handful of empirical studies have linked mark-ups to import penetration with industry- and firm-level panel data while controlling for cross-industry differences in technology and firm market shares. These studies have typically found that mark-ups fall with import competition. For example, Levinsohn (1993) uses Turkish data and finds that imports from foreign countries gradually swallow up domestic producers' market share and force domestic firms to behave more competitively. Using industry tariffs and transportation cost data to study changes in productivity, Bernard et al. (2006) find that variable costs and domestic firms' market shares decrease over time. In a comprehensive survey, Tybout (2003) presents evidence at the plant and firm level of the effects on mark-ups on trade openness. In addition, to discuss the effects caused by import penetration, we analyze how FDI changes the competitive environment and firms' market power.

It is commonly accepted in corporate finance that firms' investment and financing decisions are tied to the competitive structure of the product market and to the strategic interactions among market participants. All else being equal, investment opportunities for firms in a perfectly competitive market differ from those of firms with a monopoly because the actions of rivals usually determine the amount of future expected cash flow as well as the discount factor that management uses to calculate firm value. As predicted by q theory, firms adopt investment decisions to cope with investment opportunities under different product market settings. Also, strategic considerations can dictate deviations from the optimum level of investment in the

classical q model. For example, the strategic role of investment to keep out aspiring entrants, preempt rivals, or force out weak players has been modeled in works such as those by Spence (1977) and Dixit (1980); similarly, accommodation of entry by investing sparingly has also been demonstrated (Fudenberg and Tirole (1984)). All these papers discuss overinvestment or underinvestment relative to the partial equilibrium optimal level of investment. Furthermore, Bolton and Scharfstein (1990) argue that rich rivals might pursue predatory actions to force out financially weak firms. Grenadier (2002) shows that in a monopolistic environment the option to postpone either costly capacity adjustments or irreversible investment quickly erodes when the investment option is contestable. Akdogu and MacKay (2008) find evidence to support Grenadier (2002)'s conclusion that firms in competitive industries invest sooner than firms in concentrated industries, especially in the case of large investments. In many instances, investments by firms in highly concentrated industries are less sensitive to Tobin's q . It appears, then, that the actions of rivals have a direct effect on a firm's future prospects, thereby affecting investment choices.

Intensive competition not only reduces market power and drives down expected profit, but also increases the risk to firms' expected cash flows. Gaspar and Massa (2006) find that firms have lower idiosyncratic volatility when they enjoy strong market power or operate in concentrated industries. In this sense market power works as a natural hedge and smooths out cash flow fluctuations that result from idiosyncratic cost shocks and lessen investors' uncertainty about the firm's performance. Irvine and Pontiff (2009) find that in recent decades the idiosyncratic volatility of both stock returns and operating cash flows dramatically increased. They attribute the changes to increased competition. Bates et al. (2009) document that from

1980 to 2006 cash holdings more than doubled and cash ratios increased by almost 300% for firms in industries that experienced the greatest increase in risk. To interpret their findings on cash holdings, Morellec and Nikolov (2009) develop a real option model in which cash flow may be used to cover unexpected operating losses and avoid inefficient closure. They find that cash holdings are associated with the intensity of product market competition, and this association is more important in riskier industries and for firms that face greater financing constraints. Therefore, it is possible that increased competition and heightened uncertainty about future cash flows cause risk-averse managers and investors to adopt conservative investment strategies.

3.3 Data and Sample

This section describes the data sources, the construction of the variables, and the sampling method. We also summarize the statistics of the key variables used.

3.3.1 Measures of Competitive Pressure from Globalization

Our first task is to identify proxies that capture variations in competition along with the integration of global economic activity. We use industry-level data on trade flows and sales by U.S.-based foreign multinationals to construct measurements of the share of domestic demand that foreign competitors satisfy. Because these measures are industry specific, they vary across industries and with time.

Import penetration has often been used in empirical research in international trade to measure the competitive pressures that foreign rivals exert on domestic firms. Many of these U.S. firms may themselves be multinationals; however, except for a few players, we believe that product markets are not fully integrated and that borders still matter, especially in large markets such as the U.S.A. We define import penetration as the proportion of production that imports satisfy. According to Bertrand (2004), the import penetration ($Import_{j,t}$) for industry j in year t is:

$$Import_{j,t} = \frac{\text{imports}_{j,t}}{\text{shipments}_{j,t} - \text{exports}_{j,t} + \text{imports}_{j,t}} \quad (3.1)$$

The denominator equals the sum of the gross domestic production and imports, reflecting the domestic absorption of the goods from industry j in year t . In addition to exports, foreign competitors could modify the competitive environment in the domestic market by directly investing in their U.S. affiliates or by green field investments.² To identify the competitive pressure from FDI, we use the proportion of the production in U.S markets that is fulfilled by foreign multinationals' sales. Similar to import penetration, we calculate the measure of FDI effect ($FDI_{j,t}$) for industry j in year t as below:

$$FDI_{j,t} = \frac{\text{SalesbyAffiliates}_{j,t}}{\text{shipments}_{j,t} - \text{exports}_{j,t} + \text{imports}_{j,t}} \quad (3.2)$$

where the numerator on the right side is sales by U.S. affiliates of foreign multinationals. These sales also appear in the denominator, where they are included in shipments and in exports. The

²Greenfield investments mean the expansion of existing facilities or a direct investment in new facilities (in an area where no previous facilities exist).

sum of imports and sales from FDI is a proxy measure of the aggregate market share of foreign competitors. We call this sum the total effect (*Total*).

The import and export data used to compute import penetration comes from two datasets.³ Both datasets contain information on multilateral imports and exports data at the four-digit Standard Industrial Classification (SIC) industry-level. The first dataset, compiled by Feenstra (1996), spans the period 1972-1994 and includes 419 four-digit SIC industries, and the second dataset, compiled by Feenstra et al. (2002) and Schott (2010), covers the period 1989-2005, and includes 390 four-digit SIC industries. Sales by foreign multinationals based in the U.S. come from the Bureau of Economic Analysis (BEA) Survey of FDI in the U.S.⁴ Under the International Investment and Trade in Services Survey Act, FDI in the U.S. is defined as the direct or indirect ownership or control by a single foreign legal entity of at least 10% of the voting securities of an incorporated U.S. business enterprise, or the equivalent interest in an unincorporated U.S. business enterprise. The BEA reports sales of U.S. affiliates with foreign parents by a three-digit or two-digit SIC code⁵ on an annual basis that covers 1977 to 2009. To keep the industry classification consistent, we calculate import penetration, FDI sales, and total effect at the same digit SIC level for 64 industries from 1977 to 2005, using the values of shipments for the period 1958-2005 from the NBER-CES Manufacturing Industry Database.

³Both datasets are available on Peter Schott's website at Yale:

http://www.som.yale.edu/faculty/pks4/sub_international.htm

⁴See "A Guide to BEA Statistics on Foreign Direct Investment in the United States" by Alicia M. Quijano for detailed information on these data.

⁵For 7 out of 20 two-digit SIC manufacturing industries, multinational firms' sales are available only at two-digit SIC level. For example, 21-tobacco products, 22-Textile mill products. For the other 13 industries, the BEA reports multinationals' sales by three-digit SIC codes, but it combines information on two or three or more industries together. Hence, we only have 64 industries as classified by mixed digit SIC codes.

3.3.2 Firm-Level Variables

We use the Compustat annual database of firms operating in manufacturing industries (2000-3999 SIC range) during 1963-2006 as the base sample in which to study the interplay between globalization, product market competition, and corporate investment. To be consistent with previous studies, we measure investment as net capital expenditure (*capx*), capital stock as net property, plant and equipment (*ppent*), and cash flow as the sum of income before extraordinary items (*ib*) and depreciation and amortization (*dp*). Both investment and cash flow are deflated by the beginning-of-the-period capital stock. As in Kaplan and Zingales (1997), Tobin's *q* is defined as the market value of assets divided by the book value of assets (*at*), where the market value of assets equals the book value of assets plus the market value of common equity ($cs_{ho} \times prcc_f$) minus the sum of common equity (*ceq*), and balance sheet deferred taxes (*txdb*). Pursuant to the empirical literature on industrial organization, we use the conventional measure of profit margin as our main proxy of a firm's market power. It is defined as the difference between one and the average variable cost divided by dollar sales (*sale*), where the average variable cost is the sum of the cost of goods sold (*cogs*) and selling, general, and administrative expenses (*sga*). Profit margin is also the empirical approximation of the Lerner index, which captures differences in market power across firms.

It is worth noting that profit margins also account for inter-industry differences in product market competition, which could bias subsequent firm-level estimations. This concern can be alleviated by using relative profit margin measures of a firm's market power: the difference in profit margin between a firm and its industry. This difference reflects one firm's ability, relative

to its industry peers, to raise its prices above its marginal costs in an imperfectly competitive product market. Like Xu (2011), we calculate industry profit margin as the ratio between Value Added minus Payroll and the sum of Value Added and Total Cost of Materials from the NBER-CES Manufacturing Industry Database. This provides an exogenous and reasonable measure of the domestic industry-level profit margin. It is preferable for two reasons to use of a measure of the sales (or equally) weighted average of firm-level profit margin within an industry. First, Compustat datasets do not contain information on the entire universe of firms. Second, the NBER-CES Manufacturing Industry Database contains the broadest coverage available and thus helps minimize selection bias and classification errors.

For a firm-year to be included in the firm-level sample, it must have sufficient information to compute the Tobin's q , cash flow, profit margins, physical investment, and capital stock. Like Chen and Chen (2012), we exclude firm-year observations for which we cannot compute the lagged cash flow to capital ratio to mitigate the problem of Compustat's backfilling bias. To avoid business discontinuities associated with mergers and acquisitions, we follow the example of Almeida et al. (2004) and exclude firm-year observations in which growth of assets or sales exceeds 100% in a single year. To eliminate outliers, we delete firm-year observations for which lagged capital stock, total assets, and sales are less than \$1 million. All variables are winsorized at the 1st and 99th percentiles and adjusted for the Consumer Price Index (measured in constant 2005 dollars). Because the product market under study in this paper is the U.S. domestic product market, U.S. multinational firms are excluded to eliminate

the possibility that their overseas investments and production decisions drive the results.⁶ This selection procedure leaves us with an unbalanced panel of 6,332 firms from 1963 to 2006 and consisting of 67,878 observations.

3.3.3 Descriptive Statistics

We merge industry-level data with a cleaned firm-level sample by assigning three measures of competitive pressure to each firm according to its SIC code. Our final sample contains 42,935 firm-year observations for 1978 to 2006 from 4,978 firms in 118 three-digit SIC manufacturing industries.⁷ As a preliminary look at the evolution of trade and FDI, we first report the basic statistical information on the measures of globalization: import penetration, the effect of FDI, and the total effect. Next, we display summary statistics of the key variables at the firm level.

Figure 3.1 plots the yearly average of import penetration, FDI effect, and total effect for 64 SIC industries from 1977 to 2005. Unsurprisingly, three measures have risen steadily over time, suggesting a significant increase in the competitive challenge foreign rivals pose to the U.S. manufacturing industry. Note that in most years the average import penetration across industries slightly exceeds the average effect of FDI. In our sample U.S. manufacturing firms apparently are more exposed to import competition than to sales by foreign multinationals located in the U.S. Table 3.1 reports the annual mean and median of the measures of competitive pressure and the number of industries and presents quantitative evidence consistent with the

⁶The number of multinational firms accounts for less than 6% of the cleaned firm-level sample. Results in the following sections change little if we include multinational firms. We also find that for these multinational firms, investment sensitivity to cash flow has declined over time.

⁷We also require firms to have information on last year market share, capital-labor intensity, long-term debt and cash holdings for the empirical analysis in following sections.

visual findings in Figure 3.1. In each year, the mean of the variables is larger than the median, indicating a positive skewness across industries. Some industries are heavily exposed to foreign competition. More important, both the annual mean and median of the three variables have quadrupled over the sample period. For example, the yearly average of import penetration increased from 5.59% in 1977 to 23.04% in 2005, and the median firm's FDI effect increased from 2.90% to 13.93%.

Descriptive statistics for the main variables used in regressions are given in Table 3.2. The mean values for the investment to capital ratio, Tobin's q , capital-labor intensity, and domestic firms' market shares are all higher than their corresponding median values. For example, the average investment to capital ratio is 24.1%, and the median is 18.3%. On the other hand, the mean values of the cash flow to capital ratio, profit margin, and relative profit margin are all less than their corresponding median values. The mean and median cash flow to capital ratios are 0.239 and 0.295, respectively. The mean and median firm's profit margins are 0.047 and 0.100, respectively.

3.4 Two-Stage Regressions

We start this section by presenting the results from a two-stage regression procedure that first examines the influence of globalization on firms' market power and then investigates how changes in product market competition affect corporate investment and the sensitivity of investment to cash flow. Then, we investigate how foreign competition leads firms' decisions on R&D expenditures to differ from physical investment.

3.4.1 Empirical Method

It is natural to think that more globalization increases the degree of rivalry in domestic markets. Similarly, firms' investment and financing policies depend on the structure of competition and the actions of rivals. To test this hypothesis, we proceed in two steps. First, we establish whether globalization and domestic firms' market power are linked. Then, we examine how firms invest according to their market power.

The initial stage consists of a fixed effect regression that is meant to estimate firms' market power. Specifically, we estimate the following specification:⁸

$$\begin{aligned}
 \pi_{i,t} = & \alpha + \delta Global_{j,t-1} + \delta_1 MktShr_{i,j,t-1} + \delta_2 CapSale_{i,t-1} + \delta_3 CapLabor_{i,t-1} \\
 & + \delta_4 GTFP_{j,t-1} + \delta_5 \Delta \ln Demand_{j,t-1} + \delta_6 \Delta \ln GDP_{t-1} \\
 & + \delta_7 NetLeverage_{i,t-1} + Firm_i + \varepsilon_{i,t}
 \end{aligned} \tag{3.3}$$

The subscripts i , t , and j , respectively, represent firm, year, and three-digit SIC industry. The dependent variable, $\pi_{i,t}$, is the proxy for firm i 's market power in year t : either its profit margin or the relative profit margin. $Global_{j,t-1}$ denotes the measure of competitive pressure from

⁸Here, we adopt the static econometric model to characterize the relation between independent and depend variables. It is possible that independent variables have feedback effect on dependent variables. We add one period lagged dependent variable as an independent variable to equation (3.3) and use general moment of method (GMM) to estimate. The sign and significance of estimates by GMM are similar to our static specification. But the GMM estimations cannot pass the over-identification test.

foreign rivals in industry j in which firm i operates at year $t - 1$ and is measured by import penetration (*Import*), and the FDI effect (*FDI*), and the total effect (*Total*).⁹ $Firm_i$ is fixed firm effect to absorb unobservable firm-specific components in firms' (relative) profit margins.¹⁰ Before estimating equation (3.3), we remove the effect of time trends and cyclical factors by adjusting all observations of the dependent and independent variables (except $\Delta \ln GDP$ and fixed firm effects) by their cross-sectional average each year.¹¹ We use the heteroskedasticity and autocorrelation consistent errors,¹² allowing for cross-sectional and temporal dependence as the time dimension becomes large.

Consistent with prior literature, we include a set of control variables that could affect firms' market power. A firm's profit margin is related to its market share. More efficient firms might be larger and have higher profits. Therefore, a firm whose sales account for a larger proportion of the total gross sales in the industry is expected to earn more profit regardless of its market power. To control for efficiency-related variation in profit margins, we use the proportion of

⁹One potential concern with the measure *Global* is endogeneity because it is possible that domestic producers of a given product have incentives to lobby government to impose either an import tariff schedule or foreign investment restrictions that protect them. First, because this measure is calculated at the industry level, it is less subject to this endogeneity problem at the product level. Second, we use a one-year lag of independent variables to estimate regression (3.3) to control for endogeneity. It is also possible that the government is more willing to negotiate tariff cuts in those industries with badly-performed firms. In this sense, low profit margin may induce low import penetration and FDI effect. Without controlling for this endogeneity problem would result in the weakened negative effect of globalization on domestic firms' profit margin. In other words, if we had control this endogeneity problem, much stronger results should be observed.

¹⁰We do not include industry fixed effects because firms in our sample seldom switch industry classifications. Including or excluding industry fixed effects will not alter the results because industry fixed effects are collinear with firm fixed effects.

¹¹We do not use fixed year effects to control for time trends in the dependent and independent variables across all firms because the variable $\Delta \ln GDP$ is a linear combination of year dummies and the constant term in panel data. Thus, $\Delta \ln GDP$ becomes collinear with year dummies in the fixed year effects specification.

¹²We use the heteroskedasticity and autocorrelation consistent covariance matrix estimation developed by ?.

a firm's sales to the total sales in its industry (domestic market) as the measure of its market share (*MktShr*).¹³

In addition, a firm's profit margin may be related to barriers to entry into the industry. Profit margin equals current economic profits over revenues plus the competitive return on capital over revenues. In industries in which free entry drives economic profits to zero, the intensity of foreign competition should not contribute to an explanation of profits after controlling for the competitive return on capital. In keeping with the literature that links mark-ups to import competition (see the survey by Tybout (2003)), we include the ratio of capital stock to sales (*CapSale*) as an independent variable in regression (3.3).

Because globalization may be associated with an industry's technological advances, and given that firms' profitability depends on productivity, it is also necessary to control in the model for technological changes that affect the impact of globalization on market power. Moreover, lagging in technology could be the potential reason other than heightened competition that leads firms to perform poorly and cut investment. To account for these, we use the growth rate of total factor productivity (*GTFP*) to control for industry-level productivity. As in Xu (2011), we also include the capital-labor ratio (*CapLabor*), measured by the total invested capital (*icapt*) over the total number of employees (*emp*), to control for the level of capital intensity and firm-level technology.

¹³Some of the three-digit SIC codes employed by Compustat are not useful in identifying economically meaningful markets. Firms are typically assigned to SIC codes ending with "0" if they are too diversified or lack enough counterparts to make up a particular three-digit SIC code. SIC codes ending with a "9" combine "miscellaneous" and "not elsewhere classified." Thus, for firms in three-digit SIC industry codes ending with "0" or "9," we use the two-digit SIC industries in which they operate to calculate their market share. As a robustness check, we also deleted three-digit SIC industry codes ending with "0" or "9," and find qualitatively similar and quantitatively stronger results.

The fact that there is more supply coming from foreign firms and the fact that these foreign firms seem to have a larger market share over time do not necessarily imply that competition in domestic markets has increased. It could be possible that the product market demand and the size of market industry have also increased. To account for this, we use the change in the natural logarithm of the real total domestic demand ($DlnDemand$) to control for the growth of product demand and market size for an industry.

The business cycle may also plausibly account for changes in the degree of product market competition, or at a higher level, globalization may be correlated with the state of the macroeconomy. Therefore, we follow Campello (2003) and use changes in the natural logarithm of the real GDP ($\Delta lnGDP$) to control for changes in macroeconomic trends. Decreases in this measure represent economic slowdowns.

Lastly, we include a measure of the net leverage ($NetLeverage$) as the ratio of the difference between long-term debt ($dltt$) and cash holding (che) to the beginning-of-period total assets.¹⁴ The purpose of this inclusion is to capture the effect of firms' financial constraints on investment that Hennessy (2004) models.

From the first step, we obtain variations in the measure of market power that are predicted by the competitive pressure exerted by foreign as well as domestic competitors and advances

¹⁴Results are similar by using total debt (short-term plus long-term debt) to calculate $NetLeverage$ instead.

in technology and fluctuations in macroeconomics.¹⁵

$$\begin{aligned}\hat{\pi}_{i,t} = & \hat{\delta}Global_{j,t-1} + \hat{\delta}_1MktShr_{i,j,t-1} + \hat{\delta}_2CapSale_{i,t-1} + \hat{\delta}_3CapLabor_{i,t-1} \\ & + \hat{\delta}_4\Delta lnDemand_{j,t-1} + \hat{\delta}_5GTFP_{j,t-1} + \hat{\delta}_6\Delta lnGDP_{t-1}\end{aligned}\quad (3.4)$$

$\hat{\pi}$ is the predicted value of the profit margin (or relative profit margin), reflecting how globalization triggers competition that changes a domestic firm's expected future profitability. After running equation (3.3), the predicted value of the measure of market power is collected and assigned to each firm every year.

In the second stage, we first study the effect of intensified competition on corporate investment; this assessment is based on the linear relationship between the investment rate and the marginal contribution of one additional unit of capital on firms' market values as predicted by q theory. More precisely, we regress firm i 's investment rate in year t ($I_{i,t}$) on Tobin's q ($Q_{i,t-1}$) as well as the first-stage estimations of market power ($\hat{\pi}_{i,t}$), plus a constant, firm, and time fixed effects.

$$\begin{aligned}I_{i,t} = & \alpha_1 + \beta_1 Q_{i,t-1} + \zeta_1 \hat{\pi}_{i,t} + \theta_1 CF_{i,t} + \gamma_1 NetLeverage_{i,t-1} \\ & + \eta_1 \sigma_{j,t-1} + Firm_i + Year_t + \varepsilon_{i,t}\end{aligned}\quad (3.5)$$

Hayashi (1982) shows that Tobin's q is incomplete as a characteristic of the investment behavior of firms operating in imperfectly competitive markets. Because market power contributes,

¹⁵We exclude variable *NetLeverage* to isolate from corporate financing the effect of intensified competition on corporate investment.

on average, to higher future profitability, it should play an important role in interpreting corporate investment in imperfectly competitive markets. Moreover, in light of the theory of strategic investment, firms with market power might overinvest to deter entry, preempt rivals, or induce exit. Accordingly, firms' investment decisions should change with variations in their market power other than Tobin's q . Therefore, we expect a positive coefficient for predicted market power, or say, $\zeta_1 > 0$. Taking the parameter estimates of regressions (3.3) and (3.5) together, the product of the estimated coefficients, $\hat{\delta}\hat{\zeta}_1$, indicates how globalization induces firms to alter their investments.

Besides market power, a firm's financial status is very important to its investment decisions under imperfect capital markets. Financial frictions limit, for example, the access of firms to external finance, thereby restricting and delaying profitable investment opportunities. To see whether the effect on corporate investment of foreign competition is dominated by that of financial status, we use two variables in the investment regression (3.5) as controls for financial positions: cash flow (CF) and net leverage ($NetLeverage$). Cash flow measures the availability of internal funds and is common in the investment finance literature. We include net leverage—the difference between financial leverage and cash holdings because Almeida et al. (2004) and Whited (2006) show that a firm's stock of liquid assets and debt financing can influence its investment.

Bates et al. (2009) show that cash ratios increase and associate the increase with riskier cash flow. Some papers (e.g. Irvine and Pontiff (2009), Gaspar and Massa (2006), Morellec and Nikolov (2009)) attribute the increased idiosyncratic risk in cash flows to heightened competition in the product markets. To examine whether idiosyncratic cash flow risk also

plays a role in explaining corporate investment, we include the measure of cash flow risk- σ (“*Industry Sigma*” in Bates et al. (2009)) in the equation (3.5).¹⁶

We also use the following model to examine the effect of estimated market power on changes in the investment rate (ΔI):

$$\begin{aligned} \Delta I_{i,t} = & \alpha_2 + \beta_2 \Delta Q_{i,t-1} + \zeta_2 \hat{\pi}_{i,t} + \theta_2 CF_{i,t} + \gamma_2 NetLeverage_{i,t-1} \\ & + \eta_2 \sigma_{j,t-1} + Firm_i + Year_t + \varepsilon_{i,t} \end{aligned} \quad (3.6)$$

where $\Delta Q_{i,t-1}$ is the change in firm i 's Tobin's q at year $t - 1$. The coefficient of interest in equation (3.6) is ζ_2 , reflecting the impact of the predicted market power on changes in the investment rate.

Firms compete in both product and financial markets. In gauging the extent to which a firm's financial status and market power jointly affect investment rate, we add to the investment regression (3.5) the interaction between cash flow and predicted market power- $\hat{\pi}$.

$$\begin{aligned} I_{i,t} = & \alpha_3 + \beta_3 Q_{i,t-1} + \zeta_3 \hat{\pi}_{i,t} + \theta_3 CF_{i,t} + \phi CF_{i,t} \times \hat{\pi}_{i,t} \\ & + \gamma_3 NetLeverage_{i,t-1} + \eta_3 \sigma_{j,t-1} + Firm_i + Year_t + \varepsilon_{i,t} \end{aligned} \quad (3.7)$$

Firms with more cash flow require fewer external funds to finance investment and consequently, are less likely to be constrained. As a result, they will discount expected future profitability less than firms with the same market power but with less cash flow on hand. That

¹⁶We measure σ at three-digit SIC industry level, while Bates et al. (2009) uses two-digit SIC industry level σ .

is, the response of investment to market power (predicted profitability) positively depends on the level of cash flow, or formally, $\phi > 0$. In this sense, cash flow performs as the equivalent of the discount factor, and together with market power, it should have a complementary effect on the investment rate. Lastly, for all second-stage regressions described above, we use the bootstrapped standard errors, allowing for within-firm error clustering.

3.4.2 Main Results

The results for the first-stage regression (3.3) are presented in Table 3.3 using a sample of 4,978 firms in 118 three-digit SIC manufacturing industries over the period 1978 to 2006. Columns (1) to (4) report the results of estimating regression (3.3) using as the dependent variable the firms' profit margins, and columns (5) to (8) report the results using the relative profit margins. We find evidence that increased competition from foreign rivals reduces the domestic firms' market power and drives down their expected profits. Note that the impact of globalization on firms' market power is negative in all regressions, when using different sets of measures of competitive pressure and proxies of market power.

The estimated coefficients of import penetration, -0.194 in column (1) and -0.229 in column (5), are comparable in magnitude with those reported in prior studies.¹⁷ This finding confirms once more the negative association between import competition and profit margins (e.g., Katics and Peterson (1994); Xu (2011)). In columns (2) and (6), the estimated coefficients on the effect of FDI are -0.063 and -0.033, highlighting the importance of FDI, in

¹⁷Xu (2011) reports a coefficient for imports of -0.172 at the firm level. Pagoulatos and Sorensen (1976) report coefficients from -0.222 to -0.255. Katics and Peterson (1994) report a coefficient of -0.175 for the sample period 1964-1986.

addition to imports, in intensifying the competition in domestic markets. We also use the total effect in columns (3) and (7), the sum of import penetration and FDI, to measure the competitive pressure from foreign competitors (imports and foreign multinationals producing in the U.S.). In terms of magnitude, all else being equal, an increase of one standard deviation (about 20 percentage points) in domestic demand that is met by imports and sales by foreign multinationals leads to a loss of 2.38 percentage points (0.1191×0.20) in the profit margins of domestic firms. Generally speaking, the negative coefficients (all statistically significant) of the measures of competitive pressure from globalization (*Import*, *FDI*, or *Total*) support the idea that foreign suppliers shrink the profit margins of U.S. firms.

To disentangle the effect of imports from FDI on firms' market power, we estimate equation (3.3) using import penetration and the FDI effect as the right side control variables for foreign competition.¹⁸ Columns (4) and (8) present the results. Because average import penetration increases by about 17.45% (Table 3.1) in our sample, the estimate in column (4) implies that firms' profit margins decline by about 3.62% (0.2074×17.45) in total. In contrast, the effect of FDI, on average, increases by about 11.89%, implying a drop in firms' profit margins of 0.96% (0.0803×11.89) in total. In combination, the entry of foreign imports and U.S.-based foreign firms push down the profit margins of domestic firms by an aggregate of 4.58%. Four fifths of the decline in profit margins is attributable to increased import penetration. The Wald test of the equality between two coefficients of import penetration and the FDI effect suggests a significant difference between them ($p < 0.02$). Simple calculations show that the difference between the estimated coefficients accounts for more than half of the difference in

¹⁸The correlation coefficient between import penetration and the FDI effect is 0.1341 in the sample.

their contribution to this profit margin decline; the original difference in the growth between import penetration and FDI accounts for the other half. These facts show imports exert more competitive pressure than foreign multinationals on the market power of domestic firms. In addition, a positive coefficient on firms' market shares observed across all regressions suggests that gains in market share by domestic firms result in increases in their profit margins. The positive coefficients for the growth of Total Factor Productivity (TFP) and as well for capital-labor intensity suggest that improvements in industry and firm technologies lead to higher profit margins for firms.

Table 3.4 reports the second step of the estimation procedure, (3.5)-(3.6), following the estimation of equation (3.3) in Table 3.3. Panel A displays results from the reduced-form investment model, (A.2), which includes as an independent variable the (relative) profit margin that is predicted in the first-step regression (3.3). The impact of the predicted market power is positive and statistically significant at the 5% level or higher across different specifications. More important, the estimates in column (4) of Table 3.3 and 3.4 together reveal that the ratio of domestic manufacturing firms' investment to capital stock has decreased by approximately 2.79% (0.6081×4.58) from 1978 to 2006, a period in which globalization increased. This effect is not economically trivial. This decline represents about 12% of the average investment rate for the sample (which is about 0.241). This observed decline in the investment rate supports the idea that firms cut their capital expenditures in the face of competitive pressures from globalization. Panel B presents results from the regression (3.6) when the dependent variables are changes in the investment rate. This regression shows a significant negative effect of intensified competition on variations in the investment rate. The estimated coefficients,

ζ_2 , are statistically positive in all specifications. This suggests that market power accelerates the speed at which firms adjust their investments.

In addition, a negative coefficient on firms' net leverage observed in Panel A and B of Table 3.4 suggests that firms' investment rate decreasingly declines with their financial leverage. Panel A reveals a positive relation between cash flow and investment; this positive link is more pronounced for firms with greater available internal funds, as shown by the positive coefficient on cash flow in Panel B. The negative coefficients for σ on investment rate and positive coefficients on changes in investment rate suggest greater increases in idiosyncratic cash flow risk result in fewer decreases in firms' investment rate.

The coefficient of interest in the regression (3.7) is the interaction term between cash flow (CF) and predicted market power ($\hat{\pi}$). It reflects dependence on the availability of internal funds in the response of investment to market power. In Panel C, the estimated coefficient of the cross term ranges from 0.141 to 0.158, and is positive and statistically significant in all cases. The observed positive coefficients reveal a complementary effect of funding availability and market power on the rate of investment. All else being equal, financially strong firms have higher valuations of investment opportunities than financially weak ones. Hence, firms that have stronger internal resources invest at a higher rate. Focusing on the estimate in column (4), one standard deviation increase in cash balances (0.984) translates into a 0.151 (0.984×0.1534) increase in the marginal effect of market power on investment. Similarly, these observed positive coefficients, $\hat{\phi}$, reveal that a loss in firms' market power is accompanied by a notable reduction in the sensitivity of investment to cash flow. Overall, the evidence

indicates that the positive association between market power and investment depends on the availability of internal funds.¹⁹

Tables 3.3-3.4 suggest that the intensification of competition triggered by the increase in import and FDI drives firms to alter their investment decisions. This is confirmed by Akdogu and MacKay (2008) who document that competition slows the speed of investment. Fresard and Valta (2012) also find that firms react to heightened competition by hoarding more cash and cutting capital expenditures, thus suggesting that firms tend to become more conservative. We see a significant slowing in the rate of corporate investment after increases in competitive pressures from globalization. Also, we find that competition strengthens the dependence of corporate investment on the interaction between market power and financial constraints. Firms with fewer internal funds choose to follow more conservative investment strategies.

3.4.3 Capital versus R&D Expenditures

The previous subsection finds evidence that globalization alters the competitive landscape in ways that affect firms' capital expenditures. But, how do advances in globalization impact firms' spending on R&D? It is possible that firms substitute physical capital (equipment) for R&D expenditures to improve their competitive positions in the wake of stronger foreign

¹⁹We also include the intersection between cash flow and measure of cash flow risk to see whether the idiosyncratic risk influences investment sensitivity to cash flow. A significant and negative impact is observed. It seems that other factors than product market competition affect the risk to cash flow and cause firms to build cash balances. However, we find the bulk of the decline in the sensitivity of investment to cash flow does not occur in industries that experience the largest increases in cash flow volatility. We first sort firms into terciles each year based on the annual breakpoints of the measure of cash flow risk; then we use the combined cross section and time series regressions in Section ?? of Chapter 3 to study the time trend of the investment sensitivity to cash flow for each group. The results show that investment sensitivity to cash flow declines most in firms in industries that experience the least increase in cash flow volatility. Therefore, the decline in investment sensitivity to cash flow cannot be attributed to an increase in idiosyncratic cash flow risk.

competition. On the other hand, it is possible that intensified foreign competition leads firms to invest more conservatively in both capital and R&D. This subsection exploits the difference between firms' decisions on capital expenditures and R&D spending as globalization increases product market competition.

As Chen and Chen (2012), we first divide the manufacturing sector into three industry groups: high-tech, durable goods and non-durables industries. Three-digit SIC industry with codes, 283, 357, 366, 367, 382, or 384, are classified as high-tech industries.²⁰ An industry belongs to the durable goods industries if it is not a high-tech industry and the first two-digit of its SIC code are 24, 25, or between 32 and 38, inclusive. An industry belongs to the non-durables industries if it is not a high-tech industry and the first two-digit of its SIC code are between 20 and 23, or between 26 and 31, inclusive. We do not include in any of the three industry groups the industries with two-digit SIC code 39 ("Miscellaneous"). Within each industry group, we replicate the two-stage estimation in Section 3.4.1 but now use either the investment rate of capital or R&D as the dependent variable in the second stage regressions. We scale R&D expenditures (*xrd*) by the difference between total assets and net property, plant, and equipment because R&D is not included in physical capital, but may contribute to alter the value of the firms' assets. For consistency, we also scale cash flow by the difference between total assets and capital to study firms' decisions on R&D.²¹ In the second stage, we use the seemingly unrelated regressions to test the difference in effects of predicted market power from the first-stage regression on the rate of investment on physical capital and on

²⁰This list of manufacturing sector by two-digit and three-digit codes is presented in Table B.2.

²¹Like Brown and Peterson (2009), cash flow in this subsection is previous subsection measure plus R&D expenditures because R&D is deducted in accounting to calculate free cash flows.

R&D, changes in physical capital and R&D investment rates, and the sensitivities of physical capital and R&D investment to cash flow.

Panels A, B, and C in Table 3.5, respectively, presents results from the second-stage estimation of equation (3.5), (3.6), and (3.7), using the subsample that includes 27,868 observations with non-missing R&D expenditures. The independent variable of interest - predicted profit margin ($\hat{\pi}$) - is, respectively, estimated for the three industry groups by the first stage regression (3.3) that uses both import penetration and the FDI as measures of competitive pressure from globalization.²² Table 3.5 also reports the p -value from tests by the seemingly unrelated system of the difference in effects of predicted market power on investment rate, changes in investment rate, and investment sensitivity to cash flow between capital and R&D expenditures.

From Panel A, we find that in all three industry groups, firms that lose market power cut their capital expenditures but increase their spending in R&D. Specifically, one percent increase in predicted profit margin leads to a 31 basis point decline in the rate of physical investment for high-tech firms, and almost one percent for firms in either the durable or the non-durable goods industries. At the same time, firms in all three industry groups increase their investment rate of R&D by about 10 basis points. These findings imply that as the entry of foreign rival intensifies, U.S. manufacturing firms reduce their total rate of investment (physical capital plus R&D), and more so if they operate in the durable and the non-durable

²²We use the subsample with valid R&D expenditures to estimate the first stage regression (3.3). The results are comparable to those using the whole sample for high-tech and durable goods industries but not for non-durable goods industries. However, the second-stage results are similar by using the predicted profit margin from either the subsample or whole sample estimation. In this and following subsections, we present results that use profit margin as dependent variables in the first-stage regression. Using relative profit margins to measure market power produces similar results, which are available upon request.

sectors. Our results are different from the findings in Fresard and Valta (2012) that the ratio of R&D expenditures to total assets fall for firms experiencing a tariff rate reduction.

The estimates in Panel B reveal a positive relation between predicted market power and changes in the physical investment rate in the three industry sectors; in the case of R&D, the relation is negative, suggesting that the intensified product market competition boost the increment of the spending on R&D. Turning to the results in Panel C, the estimation of regression (3.7) reveals that decreases in market power are accompanied by a declining sensitivity of physical investment to cash flow for firms in the high-tech and durable goods sectors, and a decreasing response of R&D expenditures to cash flow in the case of the durable goods sector.

3.5 Heterogeneous Effect of Globalization

The previous section finds evidence that globalization alters the competitive landscape in ways that affect firms' capital investment choices. However, an immediate question is to what extent heterogeneity determines the reactions of firms to advances in globalization. This heterogeneity could be, on one hand, firm-related, such as the ability to access external funds or a reflection of a position in an industry; on the other hand, it could be industry-related, such as the degree of market concentration. This section exploits the cross-sectional dimension of the sample to further characterize the nature of the results.

3.5.1 Market Leadership and Concentration

Section 3.4 reports evidence that the relation between globalization and corporate investment is derived from imperfect market dynamics. However, competitive position in an industry and the intensity with which a firm interacts with rivals also affect this relation. Obviously, some firms are better equipped to deal with increased foreign competition than others. Market leaders are not threatened by foreign competition to the same extent as industry followers. To examine this claim, we first introduce the intersection between the indicator variable of market leader (*Leader*) and measures of competitive pressure from globalization (*Global*) to the first-stage regression (3.3). The dummy variable-*Leader*, takes the value of one if firms are market leaders in their respective industry in the prior year. Like Haskel and Scaramozzino (1997), we denote as market leaders those firms whose sales account for a sizable percentage (more than 15%) of the total gross sales in their industries. This indicator is then interacted with the predicted value for profit margin ($\hat{\pi}$), cash flow (*CF*), and the interaction between them ($CF \times \hat{\pi}$), yielding an augmented version of the second-stage baseline specifications (3.5) - (3.7).

We also wish to investigate whether the degree of industry concentrations changes the effect of globalization. To illustrate the impact of market concentration, we redo the analysis with subsamples of less and more concentrated (manufacturing) industries. We measure market concentration by using the fitted Herfindahl-Hirschman Index (HHI) provided by Hoberg and Phillips (2010), and classify industries into terciles based on the beginning-of-period HHI.

Those industry-years in the top tercile are denoted as “concentrated,” those in the middle are as “moderately concentrated (or competitive),” and the bottom third is “competitive.”

Panels A and B of Table 3.6, respectively, present results for 103 three-digit SIC industries with valid HHI from the estimation similar to those in columns (3) and (4) in Table 3.3 and in Table 3.4. The only difference is the inclusion in Panel A of the interaction terms for the indicator of market leader and measures of globalization, and inclusion in Panel B of the cross terms of this variable with the predicted value of profit margin or cash flow (or both). To save space, we only report the coefficients of the variables that interact with this indicator variable *Leader* and the coefficients of all cross terms. The estimates in columns (1) of Panel A reveal evidence of the asymmetric reaction of market leaders and followers to competitive pressures from globalization, as seen from the significant positive estimates for the coefficients associated with the intersection terms, $Total \times Leader$, $Import \times Leader$, and $FDI \times Leader$. We also note in column (5) that the market leaders’ power is virtually unaffected by an increase in sales by foreign multinationals. In fact, for ordinary firms, a one percent increase in the effect of FDI is associated with diminished profit margins of 9 basis points, but market leaders lose nothing as the impact of FDI increases. Also, a one percent increase in import penetration leads to a decline of 23 basis points in the profit margins of ordinary firms and a decrease of 16 $((-0.2332 + 0.0769) \times 0.01)$ basis points for market leaders.

The results from regression (A.2) in Panel B indicate that there is no significant difference in investment strategies between market leaders and followers with the same predicted market power. Taken together with the evidence found in column (5) of Panel A, a one percentage point increase in import penetration leads to a decline of 13 $(16 \times (0.5863 + 0.0370))$ basis

points in the market leader's investment, 3 ($23 \times 0.5863 = 13$) basis points more for market followers. Industry followers will reduce investment by 5 (9×0.5863) basis points if the effect of FDI increases by 1 percent, but there is no adjustment in a market leader's investment. From the estimation of regression (3.6), we note that leadership enhances the response of changes in investment to the predicted profit margin. However, the complementarity effect of financial availability and market power on investment is independent of the firms' competitive position in the product market, as suggested by the insignificant estimates of the coefficient of the cross term $CF \times \hat{\pi} \times FC$ from regression (3.7). To summarize, all else being equal, industry leaders register lower reductions in market power and in investment associated with an increase in import competition and show little variation to the growth in market share of foreign multinationals located in the U.S.

Columns (2)-(4) and (6)-(8) in Table 3.6 allow for comparisons across concentrated, moderately concentrated and competitive industries. As the degree of market concentration increases, we see a clearly diminished influence of foreign competition on domestic firms' market power (see the first row of columns (2)-(4) in Panel A). The same pattern occurs with the effect of FDI as seen in columns (6)-(8). However, we find that the ratio of imports to domestic sales tends to be more negatively correlated with the profitability of domestic sellers in more concentrated industries. The standard interpretation of this is that prices in concentrated industries are more responsive to heightened import competition because firms operating in these industries enjoy greater market power. The estimates in columns (6)-(8) also make a strong case for firm leadership as a key element in fighting foreign multinationals. However, when it

comes to competition from imports, market leaders in moderately concentrated industries are best equipped to resist increased competitive pressure from foreign producers.

Turning to the results in Panel B, the estimation of regression (3.5) reveals that for an average firm, increases in market concentration are accompanied by an increasing response of investment to predicted market power. The strategic role of investment suggests that a firm with exclusive power over the market will use its physical capacity as instrument for the long-run competition. Because more concentrated markets are composed by a smaller number of firms with larger market shares, firms are more responsive to their market power in making investment decisions. Furthermore, market leaders in more competitive industries care more about maintaining their status as leaders and decide to optimally overinvest more to keep aspiring entrants out, as seen from the positive estimates of the coefficient of the cross term $\hat{\pi} \times Leader$ in columns (2) and (6). Fresard and Valta (2012) find virtually no changes in capital expenditures when tariff rates are reduced in concentrated industries, but these reductions are not trivial in competitive industries. Nevertheless, our evidence in columns (2) and (4) suggests that after the total effect has gone up by 29% from 1977 to 2005, overinvestment by firms in competitive industries decreased by 2.2% ($-0.1947 \times 0.3952 \times 0.29$) and that of firms in concentrated industries by 2.5% ($-0.0647 \times 1.3128 \times 0.29$) in total.

Furthermore, the results from regression (3.6) indicate that the impact of market concentration on the response of investment adjustment to predicted profit margin resembles that of the response of investment in regression (3.5). Another feature of the results seen in Panel B is the nonlinear complementarity effect on investment of cash flow and predicted profit margin

across competitive and concentrated, as seen from the first magnified and then minified estimates of the coefficients of the intersection term $-CF \times \hat{\pi}$ in regression (3.7). The availability of internal funds and market power together appear to have the strongest impact on investment choices for firms in moderately concentrated industries. In more competitive industries, relatively low future profitability discourages firms from investing even when they have abundant funds on hand. In contrast, in more concentrated industries, better future prospects loosen the dependence of investment on the availability of internal funds.

3.5.2 Financial Constraints

We start by examining whether the reported findings of the effects of globalization on investment differ if firms are more or less financially constrained. As a matter of fact, a firm's difficulty in obtaining external funding might exacerbate or attenuate the negative impact of globalization on capital expenditures. On one hand, in line with the deep pockets theory of predation, financial fragility hinders a firm's ability to fight foreign competition, resulting in diminished profits and loss of market share. As suggested by Chevalier and Scharfstein (1996), financially constrained firms are less inclined to invest in expanding their market share when the probability of liquidation increases. On the other hand, because financial frictions increase the cost to invest and diminish the benefit of an additional unit of capital (e.g. Erickson and Whited (2002), Hennessy et al. (2007)), firms exposed to more financing risk respond more weakly to investment opportunities than firms more immune to such risk. Therefore, the same

reduction in market power will lead financially less constrained firms to cut capital expenditure more. All in all, the effect of financial constraints on the interaction between globalization and corporate investment depends on the balance between these two opposing forces.

Like Fazzari et al. (1988), we first classify as financially constrained those firms that did not pay dividends in prior years. This is obviously a crude categorization, because some financially strong firms do not pay dividends because of their investment opportunities, tax situations, ownership structure, and so on. Also, large and mature firms often enjoy privileged access to external financing. As Hadlock and Pierce (2010) did earlier, we construct an index of financial constraints using size and age (SA). In addition, we use the Whited and Wu (2006) financial constraints index (WW). Firms with a high WW index are small and highly leveraged, seldom pay dividends, exhibit low growth rates but face high industry growth rates, and have low cash flows. Based on each of the proxies during the preceding year, we sort firms into terciles and denote the top tercile as financially constrained. A financially constrained firm i in year t is then assigned to the indicator variable $FC_{i,t}$.

To examine whether financial constraints accelerate a decline in profit margins, we replicate the estimation in Section 4.4 analysis for market leader but now use the dummy variable- FC . The results in Table 3.7 from the different ways of classifying a firm as financially constrained are all very similar. The estimates in Panel A reveal a negative relation between foreign competition and market power for ordinary firms; in the case of more financially constrained firms, these estimates highlight a strong and adverse effect on profit margins from the pressure foreign rivals exert. In two out of three cases, we see an almost doubled total effect

on those firms whose condition is worst. This result is consistent with the idea that financial fragility hampers a firm's competitiveness.

A noteworthy feature in Panel A of the results that use both import penetration and the FDI effect is that the FDI effect appears to have a statistically significant impact on market power for those firms that are more financially constrained but its impact is insignificant for less financially constrained firms. However, the effect of import penetration tends to affect equally the profit margins of both more and less financially constrained firms (Dividends) or have a stronger negative effect for firms expose to greater financial risks (WW and SA). For instance, one standard deviation increase in the FDI effect (0.123) leads to a decline in a firm's profit margin of 52 (0.0424×0.123) basis points and by 152 ($((0.0424 + 0.0813) \times 0.123)$) basis points if the firm does not pay dividends. On the other hand, one standard deviation increase in import penetration (0.138) leads a firm's profit margin to decline by 2.43 (0.1764×0.138) percentage points. To sum up, profit margins of a financially constrained firm are expected to fall by 3.95% ($1.52 + 2.43$), but financially stronger firms fall by just 2.95% ($0.52 + 2.43$).

Four results emerge from the second-stage estimation. First, compared with firms facing low financing risk, investment by financially constrained firms responds less to variations in their market power from globalization,²³ suggesting that capital market imperfections constrain firms' ability to generate cash flows in the future, and increase the riskiness of firms' cash flows. Second, it appears that financially constrained firms face greater reductions in investment. This is because financial frictions strengthen the negative impact of

²³The negative coefficient of the cross term from the regression (3.5), $\hat{\pi} \times FC$, is significant when FC is constructed based on the SA and WW index in three out of six cases.

foreign competition on profit margins more than they weaken the positive association between the predicted market power and investment. Specifically, when both import penetration and the FDI effect rise by one standard deviation, a firm reduces its rate of investment by 2.38% $((0.6210 - 0.0180) \times 3.95)$ if it has never paid out dividends, a reduction that is 0.55% $(0.6210 \times (3.95 - 2.95) - 0.0180 \times 3.95)$ more than other firms. This alone is not particularly relevant. However, and third, compared with ordinary firms with the same predicted profit margin, more market power leads to less adjustment of investment for more financially constrained firms, as seen from the negative estimates for the coefficient of the cross term $\hat{\pi} \times FC$ in regression (3.6). Lastly, insignificant coefficients on the product of cash flow, predicted profit margin, and indicator FC all imply that financial constraints have no impact on the complementary effect of funds availability and market power. Fresard and Valta (2012) financially constrained firms reduce investment more is because greater import competition significantly exacerbates financial frictions and constrains firms' access to external funds. However, we find evidence that financial constraints hamper a firm's ability to resist foreign competition, especially in the case of FDI. Large losses in market share induce domestic firms to reduce investment, and this in turn results in a diminished sensitivity of investment to cash flow.

3.6 Concluding Remarks

This paper investigates the importance of the interaction between globalization, product market competition, and corporate investment. We provide conclusive evidence that firms substantially adjust their investment policies in response to foreign competition that decreases

their market power and in response to the availability of internal funds. Using a panel of three decades of data from U.S. firms in over a hundred manufacturing industries, we find that the market power of domestic firms declines with an increase in the fraction of market demand satisfied by imports and sales by foreign firms located in the U.S. Based on q theory, we then relate a firm's investment decision to its market power and find that firms reduce their capital but increase R&D expenditures after foreign competition intensifies. Increased import competition drives expected profitability down and this leads to a decline in the marginal effect of cash flow on investment. We further investigate whether the influence of globalization varies with a firm's ability to access external finance, whether or not a firm is a market leader, and with the degree of industry concentration. We observe that the larger reductions in investment are associated with firms that are more exposed to financing risk, with nonmarket leaders, and with firms in competitive industries.

Previous work on corporate investment focuses on using firm-level characteristics and product market performance to explain firms' investment decisions. We emphasize the roles of trade openness and FDI as a product of the integration of the global economy. Our paper helps to bridge the gap between empirical corporate finance and international economics. Intuitively, the connections between globalization, corporate investing, and financing choices can occur through a host of different channels. The findings in this paper are meant to invite further research on the multiple facets of these connections. Other than exploring the importance of foreign rivals' access to the domestic market, future researchers should consider the reaction of firms to the openness of foreign markets. It would also be interesting to examine

how firms adjust different types of investments (PPE, R&D expenditure, branding) to cope with the globalization of their product markets.

Table 3.1: Annual Mean and Median of Import Penetration, FDI Effect, and Total Effect

Year	# of Industries	Mean			Median		
		Import	FDI	Total	Import	FDI	Total
1977	56	5.59%	4.47%	10.05%	4.21%	2.90%	8.72%
1978	56	6.59%	5.02%	11.61%	4.76%	3.47%	10.18%
1979	56	6.57%	5.56%	12.13%	4.92%	3.54%	11.28%
1980	56	6.94%	6.50%	13.44%	5.25%	3.77%	11.57%
1981	55	6.27%	7.62%	13.89%	5.28%	4.24%	12.01%
1982	55	6.38%	7.89%	14.27%	5.64%	4.74%	11.65%
1983	56	7.22%	8.04%	15.27%	6.04%	4.76%	12.72%
1984	56	8.36%	8.12%	16.48%	6.88%	4.92%	12.99%
1985	56	8.86%	8.75%	17.61%	7.48%	5.71%	15.30%
1986	56	9.87%	8.25%	18.12%	8.28%	4.37%	13.46%
1987	56	10.06%	8.95%	19.01%	8.54%	6.37%	18.13%
1988	57	11.41%	10.68%	22.09%	8.79%	7.28%	20.57%
1989	64	12.60%	11.47%	24.07%	8.73%	6.90%	19.25%
1990	64	12.73%	12.29%	25.02%	8.59%	8.21%	23.32%
1991	64	12.89%	12.96%	25.86%	8.71%	9.41%	25.62%
1992	64	13.22%	13.42%	26.65%	9.09%	9.97%	23.79%
1993	64	13.56%	13.72%	27.28%	9.13%	10.96%	25.85%
1994	64	14.27%	14.05%	28.33%	9.39%	9.78%	25.68%
1995	64	14.78%	14.05%	28.83%	9.59%	10.58%	26.67%
1996	64	14.98%	14.15%	29.12%	10.28%	10.91%	25.80%
1997	61	16.11%	14.46%	30.57%	14.03%	11.28%	29.49%
1998	61	16.66%	15.93%	32.59%	14.46%	12.14%	31.65%
1999	61	17.45%	16.71%	34.17%	15.34%	13.12%	33.31%
2000	61	18.70%	17.20%	35.90%	15.59%	12.89%	34.46%
2001	61	19.11%	17.45%	36.56%	15.13%	12.68%	34.48%
2002	61	19.94%	17.60%	37.54%	15.89%	13.89%	33.29%
2003	61	20.83%	16.65%	37.48%	15.18%	13.28%	37.21%
2004	61	22.51%	16.29%	38.80%	17.50%	13.53%	38.02%
2005	61	23.04%	16.36%	39.40%	17.13%	13.93%	38.03%

Import penetration and FDI effect are defined by equations (3.1) and (3.2), respectively. Total effect is the sum of the FDI effect and import penetration. Three variables are measured at the three-digit SIC industry level. Mean (median) is annual mean (median) of three variables across 64 manufacturing industries for the period 1977-2005 in our sample for analysis.

Table 3.2: Summary Statistics of Key Variables in Final Sample

Variable	Obs	Mean	Median	Std	Min	Max
Investment Regression						
<i>I</i>	42935	0.241	0.183	0.214	0.010	1.342
<i>Q</i>	42935	1.557	1.222	1.052	0.539	7.195
<i>CF</i>	42935	0.239	0.295	0.983	-5.626	3.205
Market Power						
<i>PM</i>	42935	0.047	0.100	0.354	-3.064	0.375
<i>RPM</i>	41561	-0.289	-0.222	0.364	-3.353	0.075
Competitive Pressure Proxies						
<i>Import</i>	42935	0.171	0.138	0.138	0.000	0.894
<i>FDI</i>	42935	0.139	0.104	0.123	0.000	0.735
<i>Total</i>	42935	0.310	0.275	0.196	0.000	0.894
Other Control Variables						
<i>CapLabor</i>	42935	150.5	97.80	162.7	-8.271	1007.9
<i>MktShr</i>	42935	0.055	0.008	0.128	0.000	1.000
<i>CapSale</i>	42935	0.288	0.210	0.284	0.028	2.091
<i>NetLeverage</i>	42935	0.048	0.069	0.263	-0.780	0.757
<i>GTFP</i>	42935	0.003	0.002	0.045	-0.474	0.247
<i>ΔlnDemand</i>	42935	0.016	0.022	0.089	-0.696	0.829
<i>σ</i>	42935	0.062	0.058	0.025	0.005	0.186

I is the ratio of investment (net capital expenditure, *capx*) to capital stock (net property, plant and equipment, *ppent*). Tobin's *q*, *Q*, is defined as the market value of assets divided by the book value of assets (*at*), where the market value of assets equals the book value of assets plus the market value of common equity (*csho* × *prccf*) minus the sum of common equity (*ceq*) and balance sheet deferred taxes (*txdb*). *CF* is the sum of income before extraordinary items (*ib*) and depreciation and amortization (*dp*) divided by capital stock. Profit margin, *PM*, is defined as the difference between one and the average variable cost, where the average variable cost is the sum of cost of goods sold (*cogs*) and selling, general, and administrative expenses (*sga*) divided by sales. *RPM* is relative profit margin, the difference between a firm's profit margin and its three-digit SIC industry profit margin. *Import* is import penetration defined by equation (3.1) and *FDI* is the FDI effect as defined by equation (3.2). *Total* is the sum of *Import* and *FDI*. Three proxies of competitive pressure are measured at the three-digit SIC industry level. *CapLabor* is a firm's capital-labor intensity, total invested capital (*icapt*) over total number of employees (*emp*). *MktShr* is the proportion of a firm's sales to the total sales in its three-digit SIC industry. *CapSale* is the ratio of capital to sales. *NetLeverage* is the ratio of the difference between long-term debt and cash holdings to the beginning-of-period total assets. *GTFP* is the median of all four-digit SIC industry growth of TFP within a three-digit industry. *ΔlnDemand* is the change in the natural logarithm of the real total domestic demand within a three-digit industry. *σ* is the mean of the standard deviations of the ratio of cash flow to total assets over 10 years for firms in the same three-digit SIC industry.

Table 3.3: First Stage Regressions

	Profit Margin				Relative Profit Margin			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Import</i>	-0.1936*** (-5.25)			-0.2074*** (-6.25)	-0.2285*** (-7.41)			-0.2370*** (-8.33)
<i>FDI</i>		-0.0629* (-2.09)		-0.0803** (-2.60)		-0.0333 (-1.06)		-0.0513 (-1.57)
<i>Total</i>			-0.1191*** (-6.63)				-0.1056*** (-6.34)	
<i>MktShr</i>	0.0197 (1.19)	0.0271 (1.59)	0.0228 (1.38)	0.0193 (1.18)	0.0449 (1.95)	0.0532* (2.29)	0.0494* (2.13)	0.0446 (1.94)
<i>CapSale</i>	-0.3608*** (-10.46)	-0.3590*** (-10.29)	-0.3597*** (-10.38)	-0.3606*** (-10.50)	-0.3449*** (-10.84)	-0.3426*** (-10.64)	-0.3434*** (-10.73)	-0.3448*** (-10.87)
<i>CapLabor</i>	0.0001 (1.74)	0.0001 (1.60)	0.0001 (1.71)	0.0001 (1.77)	0.0000 (1.37)	0.0000 (1.20)	0.0000 (1.29)	0.0000 (1.39)
<i>NetLeverage</i>	0.0768*** (7.90)	0.0797*** (8.31)	0.0777*** (8.20)	0.0764*** (7.99)	0.0801*** (8.09)	0.0834*** (8.26)	0.0817*** (8.30)	0.0798*** (8.16)
<i>GTFP</i>	0.0925** (2.88)	0.1013*** (3.80)	0.0933*** (3.33)	0.0895** (2.89)	-0.0010 (-0.04)	0.0150 (0.64)	0.0056 (0.25)	-0.0029 (-0.12)
$\Delta \ln Demand$	0.0081 (0.51)	0.0049 (0.33)	0.0005 (0.04)	0.0026 (0.18)	-0.0128 (-0.90)	-0.0150 (-1.14)	-0.0199 (-1.53)	-0.0163 (-1.22)
$\Delta \ln GDP$	0.0374 (0.22)	0.0385 (0.21)	0.0339 (0.19)	0.0338 (0.20)	0.0294 (0.15)	0.0326 (0.16)	0.0275 (0.14)	0.0271 (0.14)
R^2	0.790	0.790	0.790	0.790	0.817	0.817	0.817	0.817
<i>Observations</i>	42935	42935	42935	42935	41561	41561	41561	41561

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table presents results of the first-stage regression (3.3) coefficients and standard errors (in parentheses) using the sample that contains 4,978 firms in 118 three-digit SIC industries over the period 1978 to 2006. The regression error structure is corrected for heteroskedasticity and autocorrelation. The dependent variable of regression is firms' profit margins (or relative profit margins) in columns (1)-(4) (in columns (5)-(8)), given by π on the left side of equation (3.3). *Import* is import penetration defined by equation (3.1). *FDI* is defined by equation (3.2) to measure the effect of FDI. *Total* is the sum of *Import* and *FDI*. All of them are measured by three-digit SIC codes. *MktShr* is a firm's market share in the industry it operates. *CapLabor* is a firm's capital-labor intensity. *CapSale* is the ratio of capital to sales. *NetLeverage* is the ratio of the difference between long-term debt and cash holdings to the beginning-of-period total assets. *GTFP* is the median of all four-digit SIC industry growth of TFP within a three-digit industry. $\Delta \ln Demand$ is the change in the natural logarithm of the real total domestic demand within a three-digit industry. $\Delta \ln GDP$ is the change in the natural logarithm of the real GDP.

Table 3.4: Second Stage Regressions

	Profit Margin				Relative Profit Margin			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Panel A: Regression (3.5) - Investment Rate as Dependent Variable</i>								
Q	0.0489*** (0.0023)	0.0490*** (0.0024)	0.0491*** (0.0028)	0.0490*** (0.0022)	0.0492*** (0.0022)	0.0492*** (0.0026)	0.0493*** (0.0023)	0.0492*** (0.0022)
$\hat{\pi}$	0.6143*** (0.0404)	0.6242*** (0.0404)	0.6117*** (0.0426)	0.6081*** (0.0368)	0.6220*** (0.0436)	0.6436*** (0.0449)	0.6300*** (0.0356)	0.6191*** (0.0442)
CF	0.0374*** (0.0025)	0.0374*** (0.0027)	0.0374*** (0.0024)	0.0374*** (0.0030)	0.0376*** (0.0026)	0.0376*** (0.0026)	0.0376*** (0.0024)	0.0376*** (0.0028)
$NetLeverage$	-0.1584*** (0.0090)	-0.1570*** (0.0105)	-0.1583*** (0.0106)	-0.1588*** (0.0068)	-0.1600*** (0.0089)	-0.1579*** (0.0084)	-0.1592*** (0.0094)	-0.1602*** (0.0088)
σ	-0.9105*** (0.1059)	-1.0114*** (0.1350)	-0.9789*** (0.1548)	-0.9304*** (0.1344)	-0.9170*** (0.1189)	-1.0256*** (0.1459)	-1.0027*** (0.1536)	-0.9300*** (0.1313)
R^2	0.442	0.442	0.442	0.441	0.441	0.441	0.441	0.441
<i>Panel B: Regression (3.6) - Changes in Investment Rate as Dependent Variable</i>								
ΔQ	0.0499*** (0.0033)	0.0497*** (0.0033)	0.0499*** (0.0029)	0.0499*** (0.0033)	0.0501*** (0.0029)	0.0498*** (0.0033)	0.0500*** (0.0024)	0.0501*** (0.0030)
$\hat{\pi}$	0.7356*** (0.0497)	0.7485*** (0.0410)	0.7300*** (0.0412)	0.7256*** (0.0444)	0.7653*** (0.0509)	0.7942*** (0.0536)	0.7732*** (0.0523)	0.7599*** (0.0553)
CF	0.0318*** (0.0026)	0.0319*** (0.0024)	0.0319*** (0.0035)	0.0318*** (0.0027)	0.0320*** (0.0035)	0.0320*** (0.0025)	0.0320*** (0.0023)	0.0320*** (0.0030)
$NetLeverage$	-0.1590*** (0.0089)	-0.1573*** (0.0100)	-0.1590*** (0.0120)	-0.1597*** (0.0100)	-0.1602*** (0.0097)	-0.1575*** (0.0103)	-0.1592*** (0.0107)	-0.1605*** (0.0086)
σ	0.2807* (0.1174)	0.1598 (0.1191)	0.1987 (0.1152)	0.2566 (0.1426)	0.2742* (0.1094)	0.1406 (0.1080)	0.1688 (0.0965)	0.2581* (0.1037)
R^2	0.178	0.178	0.178	0.177	0.178	0.178	0.178	0.177
<i>Panel C: Regression (3.7) - Cross Effect of Predict Market Power and Cash Flow on Investment Rate</i>								
Q	0.0483*** (0.0022)	0.0485*** (0.0024)	0.0485*** (0.0023)	0.0483*** (0.0024)	0.0485*** (0.0020)	0.0487*** (0.0027)	0.0487*** (0.0024)	0.0486*** (0.0027)
$\hat{\pi}$	0.6895*** (0.0523)	0.7018*** (0.0457)	0.6921*** (0.0438)	0.6851*** (0.0489)	0.6960*** (0.0451)	0.7230*** (0.0501)	0.7133*** (0.0516)	0.6948*** (0.0439)
CF	0.0504*** (0.0043)	0.0439*** (0.0033)	0.0509*** (0.0032)	0.0535*** (0.0038)	0.0528*** (0.0038)	0.0439*** (0.0034)	0.0510*** (0.0033)	0.0549*** (0.0045)
$CF \times \hat{\pi}$	0.1487*** (0.0244)	0.1411*** (0.0243)	0.1535*** (0.0209)	0.1534*** (0.0244)	0.1511*** (0.0220)	0.1441*** (0.0274)	0.1582*** (0.0262)	0.1549*** (0.0255)
$NetLeverage$	-0.1530*** (0.0095)	-0.1512*** (0.0097)	-0.1520*** (0.0085)	-0.1530*** (0.0095)	-0.1549*** (0.0092)	-0.1524*** (0.0088)	-0.1530*** (0.0077)	-0.1548*** (0.0091)
σ	-0.9067*** (0.1455)	-1.0213*** (0.1639)	-0.9828*** (0.1376)	-0.9276*** (0.1324)	-0.9147*** (0.1430)	-1.0384*** (0.1252)	-1.0112*** (0.1385)	-0.9283*** (0.1140)
R^2	0.444	0.444	0.444	0.444	0.443	0.443	0.443	0.443
<i>Observations</i>	42935	42935	42935	42935	42935	42935	42935	42935

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table presents results of the second-stage regressions (A.2) and (3.7) coefficients and standard errors (in parentheses) using the sample that contains 4,978 firms in 118 three-digit SIC industries over the period 1978 to 2006. We use the bootstrapped standard errors, allowing for within-firm error clustering. Panel A displays results from the reduced-form investment model (A.2) in which the dependent variable is investment rate- I . Panel B represents results from the regression (3.6) in which the dependent variable is the change in investment rate- ΔI . $\hat{\pi}$ in columns (1)-(4) (in columns (5)-(8)) is the predicted value of firms' profit margin (relative profit margin) according to the estimation (3.4). Panel C reports results from the regression (3.7) which adds the cross term $CF \times \hat{\pi}$ in regression (A.2). Q is Tobin's q. ΔQ is the change in Tobin's q. CF is the ratio of cash flow to capital. $NetLeverage$ is the ratio of the difference between long-term debt and cash holdings to the beginning-of-period total assets. σ is the mean of the standard deviations of the ratio of cash flow to total assets over 10 years for firms in the same three-digit SIC industry.

Table 3.5: Second Stage Regressions in High Technology, Durable Goods, and Non-durable Goods Industries

	High Tech		Durable		Non-durable	
	Capital (1)	R&D (2)	Capital (3)	R&D (4)	Capital (5)	R&D (6)
<i>Panel A: Regression (3.5) - Investment Rate as Dependent Variable</i>						
Q	0.0402*** (0.0032)	0.0107*** (0.0014)	0.0404*** (0.0056)	0.0006 (0.0014)	0.0345*** (0.0073)	0.0011 (0.0020)
$\hat{\pi}$	0.3101*** (0.0305)	-0.0933*** (0.0157)	0.9879*** (0.1204)	-0.0849*** (0.0241)	0.9138*** (0.1299)	-0.1160 (0.0610)
CF	0.0490*** (0.0035)	0.0745*** (0.0076)	0.0730*** (0.0058)	0.0631*** (0.0062)	0.0622*** (0.0159)	0.0405*** (0.0088)
$NetLeverage$	-0.1796*** (0.0166)	0.0297*** (0.0066)	-0.1444*** (0.0163)	0.0008 (0.0044)	-0.1607*** (0.0240)	-0.0008 (0.0070)
σ	-0.6986 (0.5292)	-0.0508 (0.2134)	-0.8632*** (0.2297)	-0.1101 (0.0605)	-0.6985** (0.2566)	0.1179* (0.0574)
<i>Observations</i>	12659	12659	10329	10329	4880	4880
	$H_0: [Capital]\hat{\pi}=[R\&D]\hat{\pi}$					
<i>p - value</i>	0.0000		0.0000		0.0000	
<i>Panel B: Regression (3.6) - Changes in Investment Rate as Dependent Variable</i>						
ΔQ	0.0422*** (0.0043)	0.0047*** (0.0009)	0.0500*** (0.0075)	0.0034*** (0.0010)	0.0399*** (0.0113)	0.0032 (0.0022)
$\hat{\pi}$	0.4153*** (0.0450)	-0.0310** (0.0102)	1.1411*** (0.1724)	-0.0557* (0.0257)	0.8139*** (0.1485)	-0.0253 (0.0190)
CF	0.0446*** (0.0036)	0.0283*** (0.0050)	0.0636*** (0.0060)	0.0231*** (0.0036)	0.0655*** (0.0165)	0.0037 (0.0058)
$NetLeverage$	-0.1091*** (0.0201)	0.0199*** (0.0045)	-0.1381*** (0.0185)	0.0002 (0.0027)	-0.1863*** (0.0267)	-0.0077* (0.0038)
σ	0.5990 (0.5083)	-0.1063 (0.1072)	0.0743 (0.2007)	-0.0613* (0.0258)	0.1354 (0.2868)	0.0811 (0.0464)
<i>Observations</i>	12659	12592	10329	10172	4880	4770
	$H_0: [Capital]\hat{\pi}=[R\&D]\hat{\pi}$					
<i>p - value</i>	0.0000		0.0000		0.0000	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	High Tech		Durable		Non-durable	
	Capital (1)	R&D (2)	Capital (3)	R&D (4)	Capital (5)	R&D (6)
<i>Panel C: Regression (3.7) - Cross Effect of Cash Flow and Predicted Market Power</i>						
Q	0.0394*** (0.0032)	0.0106*** (0.0014)	0.0408*** (0.0055)	0.0003 (0.0014)	0.0345*** (0.0073)	0.0010 (0.0019)
$\hat{\pi}$	0.3298*** (0.0310)	-0.0928*** (0.0157)	1.0488*** (0.1120)	-0.0860*** (0.0222)	0.9107*** (0.1277)	-0.1177 (0.0693)
CF	0.0692*** (0.0047)	0.0882*** (0.0096)	0.0940*** (0.0096)	0.0811*** (0.0092)	0.0676*** (0.0175)	0.0417*** (0.0124)
$CF \times \hat{\pi}$	0.1509*** (0.0203)	0.0500 (0.0328)	0.4351** (0.1548)	0.1543** (0.0514)	0.0902 (0.1214)	0.0121 (0.1219)
$NetLeverage$	-0.1728*** (0.0165)	0.0305*** (0.0066)	-0.1391*** (0.0160)	0.0021 (0.0044)	-0.1600*** (0.0241)	-0.0007 (0.0070)
σ	-0.7716 (0.5324)	-0.0646 (0.2145)	-0.8624*** (0.2328)	-0.1096 (0.0602)	-0.6949** (0.2567)	0.1180* (0.0575)
<i>Observations</i>	12659	12659	10329	10329	4880	4880
	$H_0: [Capital]CF \times \hat{\pi} = [R\&D]CF \times \hat{\pi}$					
<i>p-value</i>	0.0127		0.0204		0.6774	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table presents results of regressions (A.2) and (3.7) coefficients and standard errors (in parentheses) in high technology, durable goods, and non-durable goods industries over the period 1978 to 2006. Panel A displays results from the reduced-form investment model (A.2). Dependent variable in columns (1), (3), and (5) is the investment rate and in columns (2), (4), and (6) is the ratio of R&D expenditures to the difference between total assets and capital stock. Panel B represents results from the regression (3.6). Dependent variable in columns (1), (3), and (5) is the change in investment rate and in columns (2), (4), and (6) is the change in the ratio of R&D expenditures to the difference between total assets and capital stock. Panel C represents results from the regression (3.7). Dependent variable in columns (1), (3), and (5) is the investment rate and in columns (2), (4), and (6) is the ratio of R&D expenditures to the difference between total assets and capital stock. $\hat{\pi}$ is the predicted value of firms' profit margin according to the estimation of first-stage regression (3.3) in high technology, durable goods, and non-durable goods industries. Q is Tobin's q. ΔQ is the change in Tobin's q. CF is the ratio of cash flow to capital. $NetLeverage$ is the ratio of the difference between long-term debt and cash holdings to the beginning-of-period total assets. σ is the mean of the standard deviations of the ratio of cash flow to total assets over 10 years for firms in the same three-digit SIC industry.

Table 3.6: Effect of Market Leaders and Market Concentration

	All Industries	Competitive	Moderately	Concentrated		All Industries	Competitive	Moderately	Concentrated
	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
<i>Panel A: First Stage Regression (3.3)</i>									
<i>Total</i>	-0.1356*** (0.0186)	-0.1947*** (0.0443)	-0.0815* (0.0318)	-0.0647** (0.0208)	<i>Import</i>	-0.2332*** (0.0346)	-0.1962*** (0.0539)	-0.0970 (0.0525)	-0.4069*** (0.0719)
<i>Total</i> × <i>Leader</i>	0.1001*** (0.0187)	0.1102*** (0.0254)	0.0938*** (0.0202)	0.1002*** (0.0182)	<i>Import</i> × <i>Leader</i>	0.0769*** (0.0162)	-0.0656 (0.0405)	0.0791*** (0.0214)	0.1884*** (0.0312)
					<i>FDI</i>	-0.0948** (0.0328)	-0.1964*** (0.0482)	-0.0673 (0.0454)	0.0523* (0.0240)
					<i>FDI</i> × <i>Leader</i>	0.1097** (0.0363)	0.3122*** (0.0502)	0.1043** (0.0375)	0.0306 (0.0241)
<i>Panel B: Second Stage Regressions</i>									
<i>Regression (3.5)</i>									
$\hat{\pi}$	0.5886*** (0.0514)	0.3953*** (0.0408)	0.8707*** (0.1147)	1.3128*** (0.2091)		0.5863*** (0.0514)	0.3955*** (0.0408)	0.8704*** (0.1148)	0.9784*** (0.1579)
$\hat{\pi}$ × <i>Leader</i>	0.0409 (0.0298)	0.2113* (0.0866)	-0.0386 (0.0752)	0.1732 (0.1163)		0.0370 (0.0283)	0.2236** (0.0836)	-0.0353 (0.0761)	0.0267 (0.0995)
<i>Regression (3.6)</i>									
$\hat{\pi}$	0.7019*** (0.0542)	0.5375*** (0.0543)	1.0634*** (0.1606)	1.5618*** (0.2466)		0.6969*** (0.0544)	0.5374*** (0.0541)	1.0576*** (0.1605)	1.2124*** (0.1900)
$\hat{\pi}$ × <i>Leader</i>	0.0623* (0.0283)	0.1953* (0.0894)	-0.0208 (0.0690)	0.2268 (0.1720)		0.0619* (0.0280)	0.2037* (0.0933)	-0.0159 (0.0702)	0.0598 (0.1357)
<i>Regression (3.7)</i>									
<i>CF</i> × $\hat{\pi}$	0.1513*** (0.0206)	0.1121*** (0.0165)	0.3264*** (0.0960)	0.2335 (0.2966)		0.1525*** (0.0207)	0.1121*** (0.0165)	0.3320*** (0.0957)	0.1086 (0.1038)
<i>CF</i> × $\hat{\pi}$ × <i>Leader</i>	0.0956 (0.2420)	0.5243 (0.2803)	-0.7564 (0.4476)	1.7340 (1.3784)		-0.0282 (0.3071)	0.5127 (0.3097)	-0.6923 (0.4762)	-0.9293 (0.5108)
$\hat{\pi}$	0.6714*** (0.0547)	0.5110*** (0.0423)	0.9490*** (0.1097)	1.2879*** (0.2033)		0.6663*** (0.0544)	0.5108*** (0.0424)	0.9487*** (0.1095)	0.9637*** (0.1581)
$\hat{\pi}$ × <i>Leader</i>	0.0193 (0.0334)	0.1546* (0.0691)	-0.0068 (0.0786)	-0.0631 (0.1795)		0.0268 (0.0351)	0.1792* (0.0826)	-0.0107 (0.0774)	0.0451 (0.0853)
<i>CF</i>	0.0516*** (0.0036)	0.0467*** (0.0070)	0.0665*** (0.0103)	0.0594*** (0.0144)		0.0547*** (0.0039)	0.0468*** (0.0070)	0.0682*** (0.0106)	0.0605*** (0.0131)
<i>CF</i> × <i>Leader</i>	0.0006 (0.0251)	0.0599 (0.0400)	-0.0811* (0.0405)	0.0201 (0.0449)		-0.0081 (0.0341)	0.0703 (0.0463)	-0.0783 (0.0444)	-0.0914* (0.0404)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table presents results of the two-stage regressions (3.3) and (A.2)-(3.7) that are augmented to include cross terms between an indicator variable for market leaders, *Leader*, and variables of interests. *Leader* takes the value of one if firms' sales account for more than 15% of the total gross sales in their industries as defined by three-digit SIC codes. *Import* is import penetration defined by equation (3.1). *FDI* is defined by equation (3.2) to measure the effect of FDI. *Total* is the sum of *Import* and *FDI*. *Q* is Tobin's q. *CF* is the ratio of cash flow to capital. $\hat{\pi}$ is the predicted value of firms' profit margins (or relative profit margins) π by globalization based on the estimation of equation (3.3). Industries are classified into terciles based on the beginning-of-period HHI proposed by Hoberg and Phillips (2010). Those industry-years in the top tercile are denoted as "concentrated," those in the middle as "median concentrated (or competitive)," and those in the bottom as "competitive." Panel A displays estimates from the first-stage regression (3.3) of coefficients for measures of globalization, *Import*, *FDI*, and *Total*, as well as estimates of coefficients for intersection terms between the indicator variable *Leader* and any one of them. Panel B presents estimates from the second-stage regression (A.2)-(3.7) of coefficients for variables that interacted with indicator *Leader* and estimates of coefficients for all intersections.

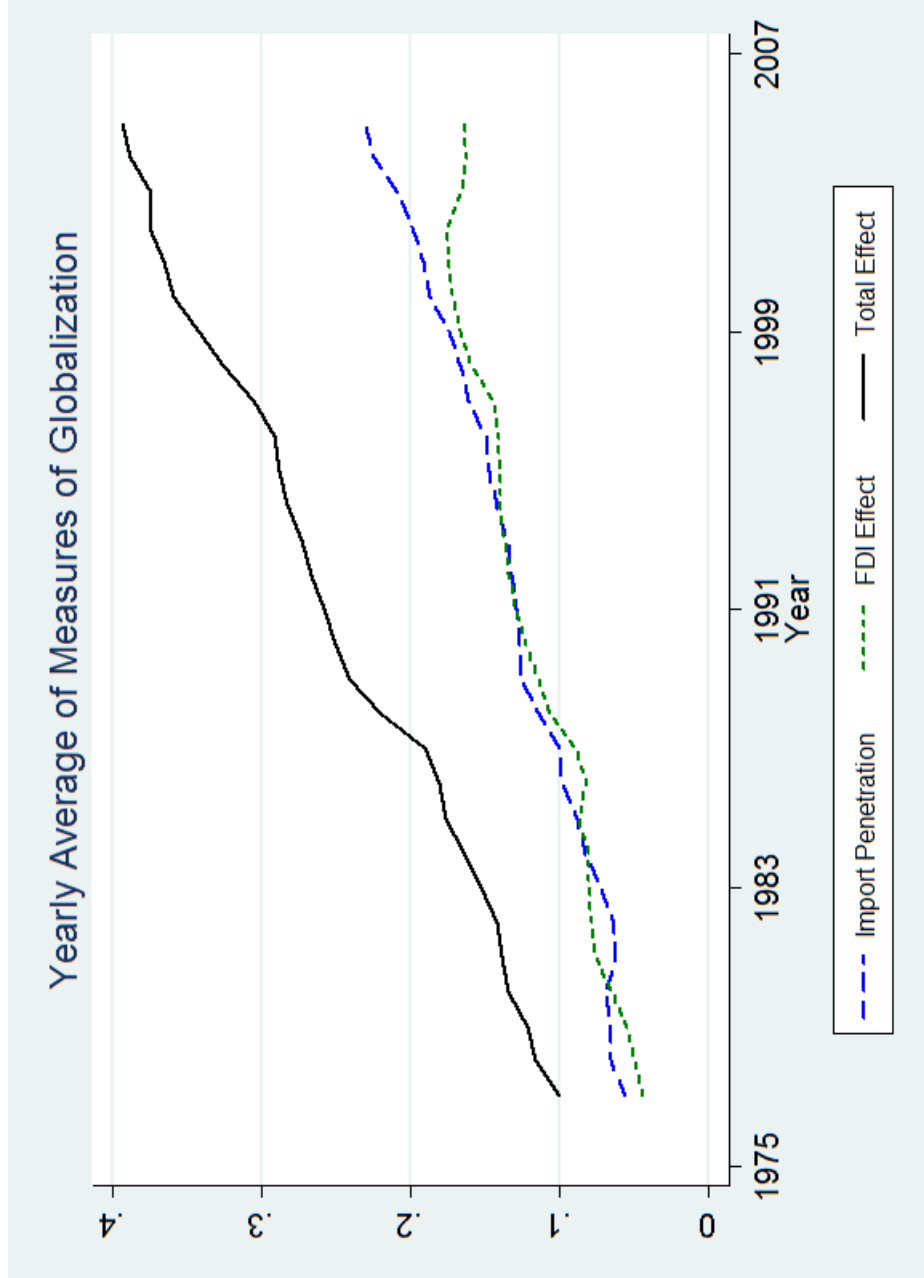
Table 3.7: Effect of Financial Constraints

	Dividends	SA	WW		Dividends	SA	WW
	(1)	(2)	(3)		(4)	(5)	(6)
<i>Panel A: First Stage Regression (3.3)</i>							
<i>Total</i>	-0.0837*** (0.0189)	-0.0765*** (0.0162)	-0.0697*** (0.0145)	<i>Import</i>	-0.1764*** (0.0312)	-0.1758*** (0.0307)	-0.1728*** (0.0292)
<i>Total</i> × <i>FC</i>	-0.0653** (0.0232)	-0.1682*** (0.0204)	-0.1340*** (0.0240)	<i>Import</i> × <i>FC</i>	-0.0359 (0.0229)	-0.1396*** (0.0325)	-0.0579** (0.0181)
				<i>FDI</i>	-0.0424 (0.0263)	-0.0240 (0.0210)	-0.0050 (0.0226)
				<i>FDI</i> × <i>FC</i>	-0.0813* (0.0340)	-0.2016*** (0.0493)	-0.2196*** (0.0410)
<i>Panel B: Second Stage Regressions</i>							
<i>Regression (3.5)</i>							
$\hat{\pi}$	0.6258*** (0.0482)	0.6447*** (0.0518)	0.6324*** (0.0587)		0.6210*** (0.0475)	0.6412*** (0.0503)	0.6319*** (0.0577)
$\hat{\pi}$ × <i>FC</i>	-0.0202 (0.0288)	-0.1100** (0.0370)	-0.0720 (0.0392)		-0.0180 (0.0269)	-0.1089** (0.0351)	-0.0745* (0.0369)
<i>Regression (3.6)</i>							
$\hat{\pi}$	0.8264*** (0.0506)	0.7799*** (0.0648)	0.8715*** (0.0579)		0.8184*** (0.0496)	0.7789*** (0.0638)	0.8771*** (0.0573)
$\hat{\pi}$ × <i>FC</i>	-0.1531*** (0.0379)	-0.1889*** (0.0510)	-0.3647*** (0.0507)		-0.1465*** (0.0356)	-0.1913*** (0.0477)	-0.3671*** (0.0483)
<i>Regression (3.7)</i>							
<i>CF</i> × $\hat{\pi}$	0.1318** (0.0450)	0.2195*** (0.0663)	0.1495* (0.0731)		0.1319** (0.0454)	0.2120*** (0.0610)	0.1430* (0.0704)
<i>CF</i> × $\hat{\pi}$ × <i>FC</i>	0.0195 (0.0442)	-0.0824 (0.0593)	0.0104 (0.0752)		0.0190 (0.0443)	-0.0757 (0.0538)	0.0152 (0.0723)
$\hat{\pi}$	0.6837*** (0.0523)	0.7061*** (0.0568)	0.6861*** (0.0601)		0.6788*** (0.0518)	0.6981*** (0.0544)	0.6840*** (0.0594)
$\hat{\pi}$ × <i>FC</i>	0.0057 (0.0282)	-0.0845* (0.0387)	-0.0372 (0.0375)		0.0045 (0.0265)	-0.0837* (0.0359)	-0.0425 (0.0355)
<i>CF</i>	0.0577*** (0.0061)	0.0530*** (0.0058)	0.0523*** (0.0056)		0.0599*** (0.0068)	0.0568*** (0.0064)	0.0547*** (0.0066)
<i>CF</i> × <i>FC</i>	-0.0082 (0.0071)	0.0007 (0.0056)	0.0029 (0.0077)		-0.0081 (0.0077)	-0.0011 (0.0060)	0.0023 (0.0085)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table presents results of the two-stage regressions (3.3) and (A.2)-(3.7) that are augmented to include cross terms between an indicator variable for financial constraints, *FC*, and variables of interests. SA is the size and age financial constraints index defined by Hadlock and Piece (2010). WW is the Whited and Wu (2006) financial constraints index. *FC* takes the value of one if firms paid out dividends in the preceding year, or belong to the top tercile as classified by either the SA or WW index in the prior year. *Import* is import penetration defined by equation (3.1). *FDI* is defined by equation (3.2) to measure the effect of FDI. *Total* is the sum of *Import* and *FDI*. *Q* is Tobin's q. *CF* is the ratio of cash flow to capital. $\hat{\pi}$ is the predicted value of firms' profit margins (or relative profit margins) π by globalization based on the estimation of equation (3.3). Panel A displays estimates from the first-stage regression (3.3) of coefficients for measures of globalization, *Import*, *FDI*, and *Total*, as well as the estimates of coefficients for intersection terms between the indicator variable *FC* and any one of them. Panel B presents estimates from the second-stage regression (A.2)-(3.7) of coefficients for variables that interacted with indicator *FC* and presents estimates of coefficients for all intersections.

Figure 3.1: Yearly Average of Import Penetration, FDI Effect and Total Effect



Chapter 4

Globalization and Investment-Cash Flow

Sensitivity (with Antonio Mello)

4.1 Introduction

The study of the investment-cash flow sensitivity constitutes one of the largest empirical literatures in corporate finance. Despite the disagreement on the interpretation of the findings in this line of research, cash flow augmented reduced-form investment regressions continue to be used extensively as a tool to study a variety of issues in corporate finance. The increasingly global economy alters the environment in which firms operate as well as the business opportunities and risks they face. In order to cope with the rapidly changing landscape, firms design strategies on capital investment and financing policies, which give rise to variations in the dependence of their investment on the availability of internal funds. The goal of this paper is to explore the contribution of globalization to investment-cash flow sensitivity.

The first part of the paper is an attempt to interpret the time series evidence on the sensitivity of investment to cash flow. Recently a few interesting papers have documented that this sensitivity has declined over time. But none of them has satisfactorily explained the reason

for this declining pattern.¹ To examine the cause of the observed reduction in the response of investment to cash flow, we use data from the period 1972 to 2005 from 1,869 manufacturing firms in 114 four-digit SIC industries. We start by sorting firms into terciles based on both the estimates of the effect of import competition on each individual firm's market power and the predicted value for market power. For each of these three groups, we then estimate a cross-sectional regression of investment on cash flow in each year. Next, we study the time trend of these sensitivities via a time-series regression developed by Prais-Winsten and compare the time trend across the three groups. Lastly, we test the significance of the difference in the time trends of the investment to cash flow sensitivity between the bottom and top terciles by using a seemingly unrelated regression system.

Results from cross-sectional and time-series regressions show that investment sensitivity to cash flow declines faster in firms from groups whose market power has been affected most by import competition. These findings suggest that, if one had predicted that market power would decrease as globalization intensified in many of the industries studied in this paper; one also would expect investment sensitivity to cash flow to gradually decline. They are consistent with the results in the previous two chapters that market power strengthens the response of capital expenditure to the availability of internal funds. We then apply the analysis to a subsample composed of 15 manufacturing industries that are proxies for nontradable industries. We find that the response of investment to cash flow for firms in these pseudo nontradable industries remains constant over time. A plausible explanation for this result is that foreign

¹These papers are Allayannis and Mozumdar (2004), Agca and Mozumdar (2008), Brown and Peterson (2009), and Chen and Chen (2012).

rivals pose no direct competitive threat to firms in nontradable industries; therefore, their market power is unaffected by advances in globalization, which could be a reason why we observe their investment sensitivity to cash flow fluctuates around a constant level.

We further investigate the contribution of globalization to the dependence of investment on cash flow. Our event study provides the first direct evidence that firms cut capital expenditure following unexpected reductions in import tariff rates in U.S. international trade history. To characterize globalization, we use import penetration, the foreign direct investment (FDI) effect, and total effect as the proxies for the competitive pressure exerted by imports, by the sales of foreign multinationals in the domestic market, and by a combination of both. These measures are then interacted with cash flow, yielding an augmented version of reduced-form investment regression. We find both imports and FDI weaken the response of investment to cash flow, and the negative impact of FDI is more pronounced. After taking into account variations in firms' market power, the negative impact of globalization on investment sensitivity to cash flow, despite drops, is still prominent. This suggests that the growth of international trade and FDI activities and firms' investment and financing policies can be related in many different ways other than intensified competition. For instance, the increased competitive pressures from globalization stimulate U.S. local firms to innovate and substitute R&D for capital expenditure, which could give rise to the decline of investment-cash flow sensitivity. Lastly, we study how the dependence of investment on cash flow varies according to globalization slowdowns and find supportive evidence that temporal globalization reversals are associated with increases in this dependence.

This study contributes to the literature in four dimensions. First, it helps to settle the debate on the relation between financial constraints and the sensitivity of investment to cash flow. Second, it also reveals the importance of trade openness and FDI for firms' investment strategies and financing policies. Third, our findings suggest that the intensification of foreign competition accounts for declines in the response of investment to cash flow. Fourth, the evidence provided in this chapter, especially in the first part, lends a support to the predictions and arguments in Chapter 2 and 3.

The remainder of this chapter is organized as follows. Section 4.2 presents the related literature. In Section 4.3, we focus on exploring the reason for the declining pattern of investment sensitivity to cash flow. Section 4.4 connects this sensitivity to the growing and temporal reversals of integrated global economy. Concluding remarks are presented in Section 4.5.

4.2 Related Literature

Research work on the sensitivity of corporate investment to cash flow started with the work of Fazzari et al. (1988) who attributed this sensitivity to the existence of financial constraints. This explanation has been challenged in subsequent papers. For instance, Kaplan and Zingales (1997) and Cleary (1999) find that firms with no financial constraints have higher investment-cash flow sensitivities than firms that face financial constraints. Also, Altı (2003) and Moyen (2004) show that investment-cash flow sensitivity can be generated even if firms do not face financial frictions by using simulated data from models of firms use debt as an imperfect

substitute for internal funds. But many studies use investment sensitivity to cash flow as an indication of financial constraints despite controversy regarding its interpretation. For example, see Hoshi et al. (1991) and Almeida and Campello (2007).

This debate is far from settled, but four recent papers present new and interesting time series evidence that investment-cash flow sensitivities have declined substantially over the past decades. Allayannis and Mozumdar (2004) note that investment sensitivity to cash flow was lower 1987-1996 than in 1977-1986, but offer no explanation for the difference. Agca and Mozumdar (2008) find a steady decline in the estimated sensitivity of investment to cash flow over time by using 10-year rolling windows for the period 1970-2001; they attribute this decline to a reduction in capital market imperfections, but they do not provide a direct time series analysis of the relation between these imperfections and the sensitivity of investment to cash flow.

Brown and Peterson (2009) show that investment sensitivity to cash flow for physical capital decreases across three sample subperiods, 1970-1981, 1982-1993, and 1994-2006, but remains largely unchanged for R&D investments. They explain these findings as the result of changes in the composition of investments as well as the increased availability of public equity markets as a source of funds. Interestingly, equity markets continue to be a very small source of funds for firms, and it is unclear whether net issuance has increased over time, given the decisions to take many companies private. Chen and Chen (2012) provide evidence of the disappearance of investment-cash flow sensitivities during the recent credit crunch (2007-2009)

for both physical and R&D investment and explore several explanations: Sample composition, corporate governance, market power,² decreases in the measurement error of Tobin's q , and changes in the information intensity of firms' cash flows. Although they consider the measurement error hypothesis and the decrease in information intensity in the cash flow of investment opportunities as the best candidates, they nevertheless lack a complete explanation for the pattern of decline.

From the findings in the previous two chapters, we conjecture that the decline of investment sensitivity to cash flow is related to an intensification of the competition among firms, and globalization is an important ingredient in this intensified competition. In this chapter, we argue that globalization, in addition to product market competition, is important for understanding the sensitivity of investment to cash flow. More specifically, the investment-cash flow sensitivity declines in normal periods. In stressful periods, whether the result of perturbations in integrated financial markets or of stronger international frictions in trade relations, this sensitivity stops declining and may even reverse its course.

4.3 Investment-Cash Flow Sensitivity over Time

This section examines the time series properties of investment sensitivity to cash flow and tries to identify the contributions of global economic integration to the trend observed over time. In turn, we discuss data and sample selections, describe our empirical methodology, and presents findings.

²Their discussion of market power is based on Cooper and Ejarque (2003)'s partial equilibrium model that does not take into account interaction between participants in the product market and shocks from globalization.

4.3.1 Data and Sample

Like the study in Chapter 3, we use import penetration (3.1) to measure competitive pressure from international trade, but this proxy is recorded at four-digit SIC level. The import and export data of 419 four-digit SIC manufacturing industries over the period 1972-1994 is compiled by Feenstra (1996), while Feenstra et al. (2002) and Schott (2010) provide information on import and export for 390 four-digit SIC manufacturing industries from 1989 to 2007.³ Along with the values of shipments from the NBER-CES Manufacturing Industry Database for the period 1958-2005, we can calculate import penetration from 1972 to 2005 for 350 four-digit SIC industries after compile two datasets. Lastly, we drop “not elsewhere classified” industries, i.e. four-digit SIC industries ending with nine following Bertrand (2004). The selection procedure leaves us with a sample of 342 four-digit SIC industries for the period 1972-2005.

The firm-level data comes from Compustat annual fundamental database. The sample is limited to firms operating in manufacturing industries (2000-3999 SIC range) during the period 1972-2005, because of the availability of industry-level import, export, and value of shipments data. We require a firm-year to have valid information to compute the rate of investment to capital, Tobin’s q , cash flow to capital ratio, and profit margin. To mitigate the problem of Compustat’s backfilling bias, we follow Chen and Chen (2012) to delete firm-year observations without the lagged cash flow to capital ratio. Like Almeida et al. (2004), we exclude firm-year observations in which growth of assets or sales exceeds 100% in a single

³Both datasets are available on Peter Schott’s website at Yale:
http://www.som.yale.edu/faculty/pks4/sub_international.htm

year to avoid business discontinuities associated with mergers and acquisitions. We exclude firm-year observations for which lagged capital stock, total assets, and sales are less than \$1 million, and then winsorize all variables at the 1st and 99th percentiles to eliminate outliers.

Then, we assign import penetration to firms by their four-digit SIC codes in each year. Because this paper focuses on domestic product markets, we delete multinational firms to eliminate the possibility that the results are driven by their investment and production behaviors in foreigner countries.⁴ Lastly, the sample is restricted to include firms with a minimum data of five consecutive years because we need an individual firm's time series data to track the effect of import competition on its market power. After the selection, we are left with a sample with 24,387 firm-year observations of 1,869 manufacturing firms in 114 four-digit SIC industries from 1972 to 2005. The sample size is comparable with studies of the relation between product market competition and corporate policies that use the same international trade dataset. For example, the number of observations in Fresard (2010) is 20,514 (Table 4) and 19,605 (Table 5B) for the period 1972-2001 in Booth and Zhou (2009).

Table 4.1 reports the annual mean and median of the number of four-digit SIC manufacturing industries and their corresponding import penetration for the period 1972 - 2005 across 342 industries before merging with the firm-level data and across 114 industries after merging. The annual average and median import penetrations are slightly greater after merging with the firm-level data, indicating that the measure of foreign competition in our sample is representative for the manufacturing sector. Import penetration has, on average, more than tripled during

⁴The number of multinational firms accounts for less than 10% of the merged sample. The results change little without excluding multinational firms.

the sample period, from 7.14% (8.02%) in 1972 to 29.98% (32.34%) in 2005. It suggests that there is a significant increase in competitive pressure from foreign rivals who export to the U.S. manufacturing industry as the result of globalization. Summary statistics are presented in Table 4.2.

4.3.2 Empirical Research Design

We examine time variation in investment sensitivity to cash flow with a two-step procedure that combines cross-sectional and time series regressions. The initial stage consists of a purely cross-sectional reduced-form investment regression meant to generate a time-specific estimate of investment sensitivity to cash flow. Formally,

$$I_{i,t} = \alpha_t + \beta_t Q_{i,t-1} + \theta_t CF_{i,t} + Ind_j + \varepsilon_{i,t} \quad (4.1)$$

where i indexes firms, t indexes the year, and j indexes the industry by four-digit SIC code. Variables, $I_{i,t}$, $Q_{i,t}$, and $CF_{i,t}$, respectively, represent firm i 's investment rate, Tobin's q , and cash flow to capital ratio in year t . Ind_j controls for fixed industry effects that capture unobservable industry-related characteristics in the rate of investment. To purge idiosyncratic effects from the estimates at a low cost, we adjust the variables before the estimations by removing their mean firm effects each year. After each run of the equation (4.1), the estimated cash flow coefficient is collected and "stacked" in a time series vector, Θ .

The second step uses the Prais-Winsten time series method to examine the time trend of the first-stage estimated sensitivities, θ_t . Specifically, we regress θ_t on the year variable t , and

on proxies for the business cycle, plus a constant.

$$\theta_t = a + bt + c_1\Delta\ln GDP_t + c_2\Delta\ln GDP_{t-1} + \varepsilon_t \quad (4.2)$$

We use the change in the natural logarithm of the current and lagged values of real GDP, $\Delta\ln GDP$ and $\Delta\ln GDP_{-1}$, to control for macroeconomic movements. We include the Durbin-Watson test for serial correlation in the time-series regression. The relevant coefficient, b , measures the annual growth of investment sensitivity to cash flow. This two-step procedure is very similar to that in Campello (2003). As pointed out by Campello, although this approach produces less efficient estimates than the alternative one-step regression (substitute (4.2) into (4.1)), it reduces the likelihood of Type I inference errors⁵ and relaxes the restriction of an homogenous error structure across time.

Next, we compare the estimates of the time trends of the domestic firms' investment with the cash flow sensitivities of different groups of firms: those whose market power is most affected by foreign competition and those that appear more immune to foreign rivals. Because the extent to which a firm invests in response to cash flow should relate to its market power, time variations in investment sensitivity to cash flow should differ across firms and depend on how foreign competition affects their expected profitability. Accordingly, we develop two indexes to classify firms and facilitate comparisons of investment to cash flow sensitivities. More specifically, we use the Prais-Winsten method to first regress for each firm the measure of market power (π) on import penetration (*Import*), technological improvement (*GTFP*),

⁵That is, in this paper, the odds of concluding that cash flow matters to investment when it does not.

and the state of the economy ($D\ln GDP$).⁶ We then denote as an “effect” index the estimated coefficient of *Import* from these individual time series regressions and as a “predicted market power” index the product of the “effect” index and the *Import* variable. The effect index captures differences in the “effect” on market power caused by globalization, and the predicted market power index accounts for increases in such competitive pressure. Each year, we rank firms based on both of these indexes. For the “effect” index, we denote the bottom, middle, and top terciles as “very negative,” “negative,” and “none.” In the “predicted market power” index these terciles are labeled, in the same sequence, as “most,” “medium,” and “least” diminished in terms of market power. Descriptive statistics for different groups are also reported in Table 4.3

We estimate equation (4.1) separately for each of the three groups, and save the estimated investment sensitivity to cash flow from each of these cross-sectional regressions in three individual time series vectors. The series are used as dependent variables in within-group estimations of equation (4.2) by Prais-Winsten, and the results from the estimations are then compared. One concern associated with separate estimations of equation (4.2) is that it cannot indicate the significance of differences in the estimates of the time trends (b) across groups. To facilitate the comparison of time trends of investment-cash flow sensitivity, we then follow the

⁶We use either profit margin (PM) or relative profit margin (RPM) to measure a firm’s market power. PM is defined as the difference between one and the average variable cost, where the average variable cost is the sum of cost of goods sold (cogs) and selling, general and administrative expenses (sga) divided by sales. RPM is the difference between a firm’s profit margin and its four-digit SIC industry profit margin. Industry profit margin is the ratio between Value Added minus Payroll and the sum of Value Added and Total Cost of Materials from the NBER-CES Manufacturing Industry Database, which provides an exogenous and more reasonable measure than the within-sample sales-weighted average.

example of Campello (2003) and use the seemingly unrelated regression (SUR) method to re-estimate equation (4.2) for “very negative” (“most”) and “none” (“least”) effect (diminished market power) groups, and test the difference in the coefficients between the two groups.

4.3.3 Revisiting Prior Findings

Before conducting comparisons across groups, it is important to look at the time series properties of the investment sensitivity to cash flow in the new sample. We use our two-step estimation procedure to replicate the results of other studies. Panel (a) in Figure 4.1 illustrates the cross-sectional estimates of investment sensitivity to cash flow from 1972 to 2005. This sensitivity has declined steadily. In contrast, the response of investment to Tobin’s q fluctuates around its mean -0.053 , as seen from the plot in Panel (b) of Table 4.1, suggesting no time variation in the marginal effect of Tobin’s q on investment over the period in question. The time series estimate of the coefficient on year (b) is 52 basis points for investment sensitivity to cash flow and indifferent from zero for an investment-Tobin’s q response, confirming the findings in Figure 4.1. This means that our sample can replicate the findings in other studies.

4.3.4 New Findings

Results in Figure 4.1 show that if one assumes that the marginal effect of cash flow on investment varies over time, then a declining trend is obtained for the sensitivity of investment to cash flow. Our research design differs significantly from previous studies in that it allows the marginal effect of cash flow on investment to vary according to changes in firms’ market

power. In the analysis below, we examine how the evolution of investment sensitivity to cash flows in one effect (or predicted market power) group differs from the other.

To create three “effect” groups and three “predicted market power” groups, we first use profit margins as the dependent variable in each individual firm’s time series regression. The cross-sectional estimates of investment sensitivity to cash flow and fitted lines are plotted in Panel (a) of Figure 4.2 for “very negative” and “negative” effect groups (left axis), and for “most” and “least” diminished market power groups (right axis). Panel A in Table 4.5 reports the results from a time series regression (4.2) using the Prais-Winsten method for three groups that are classified by either the “effect” index (columns (1)-(3)) or the “predicted market power” index (columns (4)-(6)). In parallel, Panel A of Table 4.6 contrasts the trends for investment sensitivity to cash flow by using the seemingly unrelated regression between “very negative” and “negative” effect groups (columns (1)-(2)) and between “most” and “least” diminished market power groups (columns (3)-(4)). We then use the relative profit margin as the measure of market power; the corresponding results are shown in Panel (b) of Figure 4.2, and in Panel B of Table 4.5 and Table 4.6.

Inspection of Figure 4.2 shows a very consistent and remarkably distinct dynamic of investment sensitivity to cash flow for “very negative” (“most”) and “negative” (“least”) effect (diminished market power) groups. The response of investment to cash flow appears to fall much faster for firms more vulnerable to import competition (red line) than for firms immune to such competition (blue line). Firms with big losses in market power anticipate diminished profits and are thereafter reluctant to invest and adopt conservative investment strategies, which then give rise to a greater decline of investment sensitivity to cash flow. Table

4.5 provides evidence confirming the visual findings in Figure 4.2. The *DW* statistics in all regressions are around 2, indicating that the Prais-Winsten method removes the autocorrelation. As expected, we observe that the trend of investment sensitivity to cash flow increases monotonically from “very negative” (“most” diminished in market power) group to “none” (“least” diminished in the market power) group.

Columns (4) to (6) of Panel A show that the average annual rate at which the sensitivity of investment to cash flow declines is 80 basis points for firms with the largest losses in profit margin from import competition. In contrast, for firms little affected by the entry of foreign rivals, the estimated time trend of their investment sensitivity to cash flow is -22 basis points, insignificantly different from zero. Based on estimates from the seemingly unrelated regression shown in Table 4.6, we test the null hypothesis that differences in the trends of investment sensitivity to cash flow are zero between the “very negative” and “none” effect groups and between the “most” and “least” diminished market power groups.

The last two rows of each panel in Table 4.6 report the differences in trends and p-values. The differences are negative and statistically significant at the 2% level or higher in all cases. This result suggests once again that domestic firms adjust their investments in less response to cash flows because they lose market power in the face of foreign rivals. Also, the fact that the results based on the “effect” index resemble those based on the “predicted market power” index reveals the importance of import competition on firms’ market power in explaining the declining pattern of investment sensitivity to cash flow.⁷

⁷Actually, we have also used both import penetration (four-digit) and the FDI effect (defined in Chapter 3) as control variables to estimate the effect of globalization on individual firms’ market power and to sort firms based on these estimates. The results for import penetration closely resemble what we have presented in subsequent sections. But the results on the FDI effect are insignificant.

4.3.5 Pseudo Nontradable

We take the results in Figure 4.2 and in Tables 4.5 and 4.6 as evidence of the contribution of globalization to explaining the gradual reduction of the marginal effect of cash flow on investment. From these results we conjecture that in general, the investment sensitivity to cash flow of firms in the nontradable industries has not declined over time. Although this conjecture is difficult to test because import and export data are not available for all industries, we try to overcome this difficulty by constructing a pseudo nontradable industrial sector with our sample. An industry is classified as a pseudo nontradable industry if it satisfies two requirements: (1) the average of its import penetration over the lifetime of the study is less than 0.1; and (2) the average growth rate of its import penetration is less than 5%. The second condition is imposed to reduce the possibility that fast-growing imports could engender greater competitive pressure on domestic firms and drive down their profits, despite foreign rivals capturing only a small proportion of the whole market. Fifteen industries (10% of the total) meet the two selection criteria, and detailed information on them is provided in Table 4.4.

Panel (a) in Figure 4.3 displays the average growth rate of import penetration versus the average import penetration for all the 114 manufacturing industries. It appears that import penetration grows relatively slowly if an industry is, on average, relatively large, but increases rapidly if the industry is relatively small. Unsurprisingly, the 15 pseudo nontradable industries are located in the southwest corner of the panel, as seen from the black triangle markers in Panel (a). Panel (b) in Figure 4.3 plots the evolution of the cross-sectional estimates of investment sensitivity to cash flow (dash) and a corresponding fitted line (solid) of the plot of

these estimates for the pseudo nontradable industries. As expected, the estimated marginal effect of cash flow on investment fluctuates around its fitted line and to a large extent parallels the x-axis. Moreover, the time series estimation indicates that the time trend of investment sensitivity to cash flow of the pseudo nontradable industries is just -6 basis points and not significant.⁸ These findings support the conjecture that industries immune to foreign competition have not seen a significant decline in investment sensitivity to cash flow.

4.4 Effects of Globalization on Sensitivity

In Chapter 3 we found that increased foreign competition reduces the market power of local U.S. manufacturing firms and discourages them from investing. We also found in Section last section that the sensitivity of investment to cash flow declined more as foreign rivals exert greater pressure on domestic firms. Our findings suggest the contribution of globalization to variations in the investment to cash flow sensitivity occurs through its impact on the degree of competitive pressure in the domestic product market. In this section, we examine how globalization and its reversals directly impact firms' investment sensitivities to cash flows.

⁸To see whether the time pattern of the dependence of investment to cash flow for firms in pseudo nontradable industries changes according to their financial status, we use the ratio of the difference between long-term debt (*dltt*) and cash holding (*che*) to the beginning-of-period total assets (*NetLeverage*) to sort firms into three groups and find no significant differences. Our results could be very sensitive to sample sizes because we only have 1,862 observations for pseudo nontradable industries.

4.4.1 Event Study

This subsection uses important events in U.S. international trade history, like unexpected reductions in import tariff rates, as natural experiments to examine the relationship between globalization and corporate investment sensitivity to cash flow. To do so, we look at how firms alter investment in response to cash flow around each event by estimating the following cash flow-augmented investment regression:

$$I_{i,t} = \alpha + \beta Q_{i,t-1} + \theta CF_{i,t} + \eta CF_{i,t} \times Event_t + \kappa Event_t + \varepsilon_{i,t} \quad (4.3)$$

where i indexes firms and t indexes the year. The variable, $Event_t$, is a dummy variable that equals one after an event. To purge idiosyncratic effects from our estimates at a low cost before the estimations, we adjust the investment to capital ratio (I), Tobin's q (Q), and cash flow to capital ratio (CF). This adjustment involves removing their mean firm effects in each year and their mean time effects for each firm. The estimation uses the Huber-White estimator to correct the error structure for heteroskedasticity and within-period error clustering.

The identification of events suitable for natural experiments draws on Fresard and Valta (2012). They identify three waves of large reductions in tariff rates between 1972 and 1999. The first wave corresponded to the implementation of a U.S. trade program, "Generalized System of Preference (GSP)" in 1976. This program was designed to promote economic growth in the developing world by providing preferential duty-free entry for up to 4,800 products from 129 countries and territories. The second wave followed the ratification of the General Agreement on Tariffs and Trade (GATT) Tokyo round and the enactment of the U.S. Trade

Agreement Act (TAA) in 1979. In the early 1980s (1980-1982), tariff rates on a large variety of products decreased, on average, from 6.1% ad valorem to 4.2%.⁹ The third wave of tariff cuts in the early 1990s (1990-1995) coincided with Uruguay Round held by GATT (1986-1994). During this period, the U.S. and Canadian governments signed the Free Trade Agreement (FTA) in 1989, followed by the North American Free Trade Agreement (NAFTA) in 1994 between the United States, Canada, and Mexico. These two agreements reduced existing tariffs within the three countries, and the second one immediately eliminated tariffs on more than one-half of U.S. imports from Mexico. Also, the GATT was replaced by the World Trade Organization (WTO) in 1995.

In addition to these three waves of tariff cuts, we consider two other important events: the GATT Kennedy round and China's entry into the WTO. During the GATT Kennedy round from 1964 to 1967, duties (weighted by 1964 trade) were reduced by approximately 35%.¹⁰ China was granted official WTO membership December 11, 2001. That year was also the official beginning of the WTO Doha round. These five events meet the necessary conditions for our analyses for the following reasons. First, cuts in tariffs and duties and China's entry into the WTO all generate an exogenous and real-side shock to domestic firms, each of which is difficult to fully endogenize in all of its consequence in investment decisions. Second, these events affect a large cross-section of industries at the same time.¹¹

⁹See the 1979 annual report of the Office of the United State Trade Representative.

¹⁰This evidence comes from Norwood (1969).

¹¹One may argue that managers of individual firms may anticipate these events and change their investment and financing choices. However, Fresard and Valta (2012) find that firms' decisions have no statistical power to predict the dynamics of import tariffs and that tariff reductions do not concentrate in declining industries that politicians have essentially written off. Their findings dispel potential concerns about the endogeneity of tariff rate reductions.

The coefficient of interest in equation (4.3) is the interaction between cash flow and event dummy, η . It measures the difference in the sensitivity of investment to cash flow between the pre- and postevent periods. After a reduction in tariffs (or China's access to the WTO), domestic firms must alter their investment and financing decisions to compete in an exogenously modified product market environment. If trade liberalization really intensifies domestic market competition, because increased competitive pressure drives down expected profit and exaggerates uncertainty about future cash flows, risk-averse managers would delay investment projects and adopt more conservative investment strategies. Hence, one should see the responses of investment to cash flow drop in the aftermath of every event. That is, we are expecting $\eta < 0$. We first estimate equations (4.3) for five different events, respectively, by using three-year windows before and after each event period.¹² One concern with the interpretation of estimates of η for five separate events is the possibility that unobserved factors other than globalization (or factors not modeled) may jointly influence both the investment behavior of firms and the competitive market environment. To mitigate this concern, we re-estimate equation (4.3) using five time dummies that take the value of one after the end year of every event period.

Panel A of Table 4.7 reports the estimates of the cash flow augmented investment regression (4.3) for five different events by using three-year windows for the pre- and post-event periods. We use an unbalanced panel of 6,332 manufacturing firms from 1963 to 2006 for the study, which consists of 67,878 observations and is constructed following the procedure

¹²For the three waves of tariff cuts, we use the periods of 1974-76, 1980-82, and 1990-95. For the Kennedy round, we use 1965-67. For China's entry into the WTO, we use 1999-2001.

described in Section 3.3.2 of Chapter 3. The estimated coefficient- η in Panel A is uniformly negative across the five major trade events and largely significant at the 5% level in the last three cases. More precisely, the sensitivity of investment to cash flow declines by at least 1.51% and by at most 5.93% in response to exogenous shocks from the intergration of global economy to the competitive environment. Panel B uses the entire sample period and five time dummies to display the estimates of η , which are consistent with the estimates in Panel A. This result is important, because it alleviates any potential concern that the firms' investment behavior reflects latent trends other than globalization, such as, for example, technological advancements and different phases of the product cycle. In line with the concept that globalization changes the competitive structure of the U.S. domestic market, we find that major shocks to the competitive environment amplify the negative impact of globalization on corporate investment and on investment sensitivity to cash flow.

4.4.2 Empirical Methodology and Results

To connect globalization directly to investment-cash flow sensitivity, we add as independent variable the intersection between cash flow and measures of competitive pressure from globalization, $CF \times Global$, to the cash flow augmented reduced-form investment regression:

$$I_{i,t} = \alpha_4 + \beta_4 Q_{i,t-1} + \theta_4 CF_{i,t} + \varphi CF_{i,t} \times Global_{j,t} + \kappa Global_{j,t} + Firm_i + Year_t + \varepsilon_{i,t} \quad (4.4)$$

where i indexes firms, t indexes the year, and j indexes the industry by three-digit SIC code. $Global_{j,t}$ represents import penetration (*Import*), the FDI effect (*FDI*), or the total effect

(*Total*) for industry j in which firm i operates at year $t - 1$. *FDI* is defined as the proportion of the production in U.S markets that is fulfilled by foreign multinationals' sales. *Total* measures the aggregate market share of foreign competitors, the sum of *Import* and *FDI*. $Firm_i$ and $Year_t$ denote firm and time fixed effects. We use heteroskedasticity and autocorrelation consistent errors, allowing for cross-sectional and temporal dependence as the time dimension becomes larger.

The results for the regression (4.4) are presented in columns (1)-(4) of Table 4.8 using the sample constructed in Chapter 3. It is composed by 4,978 firms in 118 three-digit SIC manufacturing industries over the period 1978 to 2006. We find a significantly negative correlation between globalization and investment sensitivity to cash flow no matter which set of measures of competitive pressure from foreign competitors are included as controls: Import penetration, or the FDI effect, or the total effect, or import penetration and the FDI effect. In terms of magnitude, all else being equal, a one percent increase in domestic demand that is met by imports and foreign multinationals' sales leads to a decline of 0.09 percentage points (column (3)) in the marginal effect of cash flow on investment. The estimated coefficients of intersections- $CF \times Import$ and $CF \times FDI$ in column (4) are -0.081 and -0.114. The Wald test of the equality between these two coefficients ($p < 0.10$) suggests the difference in effects on the sensitivity of investment to cash flow between import and FDI. Unlike the fact in Table 3.4 that imports exerts more competitive pressure than foreign multinationals on the market power of domestic firms, this finding implies FDI rather than imports has a greater impact on the response of investment to cash flow.

To disentangle the direct and indirect effects of globalization on the association between investment and cash flow, we add as independent variables the predicted profit margin from the first-stage regression (3.1) and equation (3.4) in Chapter 3 and its interaction with cash flow. For this estimation, we use the bootstrapped standard errors, allowing for within-firm error clustering. Results are summarized in columns (5)-(8) of Table 4.8. The predicted profit margin, $\hat{\pi}$ in columns (5)-(8), respectively, corresponds to the estimation of the first-stage regression (3.3) in columns (1)-(4) of Table 3.3.¹³ Consistent with the findings in Panel C of Table 3.4, increases in foreign competition generate reductions in profit margin and the response of investment to cash flow, suggesting the entry of foreign rivals indirectly affects the marginal effect of cash flow through its impact on competitive environments in U.S. local markets. More importantly, we also observe a significant and negative impact of globalization on the sensitivity of investment. But the negative effect of imports falls to about half of what it was before controlling for the predicted market power and the negative impact of FDI drops by less than one fourth, as seen from the comparison between the estimated coefficient of the interactions, $CF \times Import$ and $CF \times FDI$, in column (8) and (4).

4.4.3 Globalization Slowdown

Results in the previous section show that advances in globalization help explain the decline in the investment sensitivity to cash flow of U.S. manufacturers. However, it is possible that

¹³Results are comparable if we use the predicted relative profit margin from the estimation the first-stage regression (3.3) in columns (5)-(8) of Table 3.3 as well as if we include controls for financial status-*NetLeverage* and cash flow risk- σ ("*Industry Sigma*" in Bates et al. (2009) at three-digit SIC level).

during stressful periods perturbations in the integration of financial markets and greater frictions in international trade can bring a halt to this decline in sensitivity or even increase it. For example, protectionist actions at times may intensify trade barriers (tariffs, quotas) and ease the competitive pressure from foreign rivals. As a result, domestic firms' investment might be more responsive to cash flow. Further, disturbances in worldwide financial markets may hinder firms' access to international financial markets and hence modify the relative importance of using internal funds to finance investment. To give additional support for the consequences of the effects of globalization on investment sensitivity to cash flow, we examine how firm adjust the dependence of capital expenditures on cash flow in response to unexpected temporary slowdowns.

We characterize a slowdown in globalization in terms of reduced intensity in product market rivalry. Because physical flows do not suffer from irreversibility and uncertainty to the extent that financial flows do, we use sizable variations in the FDI effect to identify temporary reversals of globalization at the three-digit industry level. Accordingly, a globalization slowdown occurs in a specific industry-year when a negative change in the FDI effect is 1.5 times larger than its annual standard deviation.¹⁴ Because the FDI effect increases on average, it is hard to tell if a short-term decline in the FDI effect corresponds to a subsequent adjustment to rapid increases in previous years. Therefore, to alleviate this concern, we exclude reductions in the FDI effect less than the sum of the pre- and postyearly changes. Another concern with using decreases in the FDI effect to characterize globalization slowdowns is the difficulty of

¹⁴As a robustness check, we also consider a negative change in the FDI effect is one time larger than its annual standard deviation. This requirement provides similar results as the following analysis in this section.

finding a good explanation as to why the FDI effect stops growing or even declines. A drop in the FDI effect may be caused by a decline in economic activity, by the U.S. government's restrictive policies on foreign investors, and so on. One way to mitigate this concern is to look at large reductions after events that obstruct the progress of global economic integration.

Figure 4.4 displays for each year the number of industries in which foreign multinational corporations lost a large share of the domestic market. Interestingly, the decline of the FDI effect in two periods, 1990-1992 and 2002-2005, respectively, corresponds to two important events in U.S. history. The decrease of FDI effect during 1990-1992 follows the enactment 1988 of a law called the Exon-Florio Amendment that called for a review of foreign investment within U.S. The Exon-Florio Amendment grants the president of the United States broad discretionary power to suspend or prohibit proposed or pending foreign acquisitions, mergers, or takeovers that threaten to impair national security. After the terrorist attacks on September 11, 2001, Congress passed the Patriot Act of 2001 and provided special support for industries critical to maintaining national defense, continuity of government, economic prosperity, and quality of life in the U.S. The implementation of this act as well as the Homeland Security Act of 2002 spurred subsequent reductions in the FDI effect in a large number of products during the period 2002-2005.

To study the effect of globalization slowdowns on the sensitivity of investment to cash flow, we estimate the following difference-in-difference regression:

$$I_{i,t} = \alpha + \beta Q_{i,t-1} + \theta CF_{i,t} + \psi CF_{i,t} \times GS_{j,t} + \omega GS_{j,t} + Firm_i + Year_t + \varepsilon_{i,t} \quad (4.5)$$

where the variable $GS_{j,t}$ is a dummy variable that equals one if industry j experiences a globalization slowdown in year t . We estimate equation (4.5) for two subperiods to eliminate the influence of the average of the increasing trend of the FDI effect. One corresponds to the enactment of the Exon-Florio Amendment, 1988-1992, and the other follows the September 11 event, 2001-2005.

Because reductions from the FDI effect occur in different industries at different periods, equation (4.5) effectively takes as a control group all firms in industries that experience a globalization reversal in year t , even if they have already experienced a reversal or will experience one later. As a result, the coefficient ψ measures the difference in investment-cash flow sensitivity between industries that have suffered from greater perturbations in integrated financial markets and industries that have suffered less or have not suffered at all. If less foreign competition modified the product market environment or if internal funds really provided an advantage over increased financial frictions, one should observe a magnified effect of cash flow on investment if reductions in the FDI effect were observed ($\psi > 0$). Columns (1) and (2) in Table 4.9 report the estimates of the difference-in-difference regressions for the two periods. As expected, the estimates of ψ are positive and significant at the 5% level for the period 1988-1992.

It is also plausible that reductions in the FDI effect are associated with or accompany changes in other industry specific characteristics, such as technology or the degree of trade liberation, that promote globalization and weaken the marginal effect of cash flow on investment. To further dissect the nature of the above results after accounting for these factors, we construct a matching sample of industries similar to those industries that experienced a

globalization slowdown. Specifically, for year t , we run a logit regression to measure the probability (propensity score) that globalization reverses in industry j , using as control variables the FDI effect, import penetration, industry profit margin, and the growth of TFP in year $t - 1$. Then, for each treated industry, we choose its nearest-neighbor from the group of untreated industries (with replacement) based on yearly estimated propensity scores. Lastly, we use the sample composed of treated and matched industries to re-estimate equation (4.5) for two different subperiods. The results are shown in columns (3) and (4) in Table 4.9. Notably, compared with column (2), the estimate of ψ for the period 2001-2005 in column (4) increases and becomes significant at the 10% level. In line with the idea that globalization is a key ingredient in explaining the decline of investment sensitivity to cash flow, the marginal effect of cash flow on investment becomes amplified when integrated financial markets are greatly disturbed and foreign competition is less intensive.

4.5 Concluding Remarks

We begin the study with an attempt to explain the pattern of decline in investment sensitivity to cash flow that recent studies have documented. We find that greater exposure to competition by foreign rivals lessens the dependence of investment on cash flow. This is because market power and the availability of funds appear to have a complementary effect on corporate investment; that is: Increased import competition drives expected profitability down and this leads to a decline in the marginal effect of cash flow on investment. Next, we focus on the linkage between globalization and the dependence of investment on cash flow. We find that trade

openness and increased FDI activities lead firms to reduce capital expenditure in response to decreases in cash flow even if they were not losing profit margin as globalization intensifies. Temporal globalization slowdowns are associated with increases in the marginal effect of cash flow on investment.

Our paper helps to bridge the gap between empirical corporate finance and international economics. The findings in this paper also suggests that the connections between globalization, corporate investing, and financing choices can occur through a host of different channels, which invites further research on the multiple facets of these connections.

Table 4.1: Time Series of Import Penetration by Four-Digit SIC Code before and after Merging with Firm Level Sample

Year	Panel A: Before Merging			Panel B: After Merging		
	#	Mean	Median	#	Mean	Median
1972	200	7.14%	3.55%	62	8.02%	3.88%
1973	200	7.64%	3.72%	62	8.61%	4.45%
1974	200	7.84%	3.76%	62	8.63%	4.52%
1975	200	7.44%	3.89%	63	8.67%	5.54%
1976	200	8.10%	4.38%	62	8.70%	4.53%
1977	200	8.40%	4.76%	62	9.02%	5.10%
1978	200	9.47%	5.07%	63	10.65%	5.39%
1979	200	9.76%	5.27%	62	10.41%	6.28%
1980	200	10.12%	5.69%	63	11.02%	6.38%
1981	200	10.69%	6.13%	62	11.02%	7.22%
1982	200	10.89%	6.27%	61	10.91%	6.25%
1983	200	11.63%	6.89%	65	11.73%	7.33%
1984	200	13.34%	8.04%	66	14.25%	9.74%
1985	200	14.52%	9.16%	65	14.75%	10.96%
1986	200	15.95%	10.06%	65	16.29%	13.06%
1987	200	16.44%	10.28%	64	16.99%	12.71%
1988	200	17.24%	11.10%	64	18.83%	13.40%
1989	338	14.79%	9.10%	111	17.09%	10.74%
1990	339	15.27%	9.56%	109	17.25%	11.14%
1991	339	15.49%	9.60%	109	17.51%	11.45%
1992	336	16.15%	10.11%	109	17.88%	11.25%
1993	337	16.80%	10.97%	111	18.00%	11.12%
1994	334	18.25%	11.76%	110	18.00%	12.05%
1995	334	18.86%	12.24%	111	19.83%	14.08%
1996	333	19.43%	12.70%	111	20.65%	15.05%
1997	326	20.24%	14.48%	106	22.49%	18.63%
1998	325	21.05%	15.28%	104	23.47%	20.14%
1999	326	22.13%	16.30%	104	24.97%	20.66%
2000	326	23.61%	17.21%	101	26.76%	23.08%
2001	326	24.22%	18.10%	101	27.36%	21.83%
2002	325	25.75%	19.02%	101	28.87%	23.50%
2003	327	27.05%	19.49%	101	29.71%	24.98%
2004	327	29.26%	21.69%	101	31.40%	25.74%
2005	326	29.98%	22.45%	100	32.34%	27.95%

Mean and median are annual mean and median of import penetration for the period 1972 - 2005 across 342 four-digit SIC manufacturing industries before merging with the firm level sample in Panel A and across 114 four-digit SIC manufacturing industries after merging. Import penetration is defined by equation (3.1).

Table 4.2: Summary Statistics for Study in Section 6

Variable	Obs	Mean	Median	Std	Min	Max
Investment Regression						
<i>I</i>	24387	0.253	0.189	0.226	0.010	1.337
<i>Q</i>	24387	1.639	1.233	1.192	0.537	7.188
<i>CF</i>	24387	0.281	0.303	0.941	-5.357	3.136
Market Power						
<i>PM</i>	24387	0.061	0.105	0.319	-2.847	0.372
<i>RPM</i>	24387	-0.314	-0.231	0.440	-4.976	0.087
Import Penetration						
<i>Import</i>	24387	0.183	0.137	0.171	0.000	0.964

I is the ratio of investment (net capital expenditure, *capx*) to capital stock (net property, plant and equipment, *ppent*). Tobin's *q*, *Q*, is defined as the market value of assets divided by the book value of assets (*at*), where the market value of assets equals the book value of assets plus the market value of common equity ($cs_{ho} \times prcc_f$) minus the sum of common equity (*ceq*) and balance sheet deferred taxes (*txdb*). *CF* is the sum of income before extraordinary items (*ib*) and depreciation and amortization (*dp*) divided by capital stock. Profit margin, *PM*, is defined as the difference between one and the average variable cost, where the average variable cost is the sum of cost of goods sold (*cogs*) and selling, general and administrative expenses (*sga*) divided by sales. *RPM* is relative profit margin, the difference between a firm's profit margin and its four-digit SIC industry profit margin. Industry profit margin as the ratio between Value Added minus Payroll and the sum of Value Added and Total Cost of Materials from the NBER-CES Manufacturing Industry Database. *Import* is import penetration as defined by equation (3.1) at the four-digit SIC industry level. *CapLabor* is a firm's capital-labor intensity.

Table 4.3: Summary Statistics in Three Effect Groups and Three Predicted Market Power Groups

	Mean						Median					
	Effect of <i>Import</i>			Predicted Market Power			Effect of <i>Import</i>			Predicted Market Power		
	Very Negt (1)	Negt (2)	None (3)	Most (4)	Less (5)	Least (6)	Very Negt (7)	Negt (8)	None (9)	Most (10)	Less (11)	Least (12)
<i>Panel A: Profit Margin to Measure Market Power</i>												
<i>I</i>	0.255	0.244	0.259	0.266	0.227	0.265	0.186	0.192	0.188	0.191	0.184	0.194
<i>Q</i>	1.638	1.463	1.817	1.633	1.501	1.784	1.217	1.191	1.307	1.210	1.212	1.287
<i>CF</i>	0.222	0.394	0.226	0.225	0.387	0.229	0.274	0.342	0.284	0.276	0.337	0.284
<i>PM</i>	0.030	0.114	0.039	0.029	0.117	0.036	0.098	0.110	0.106	0.097	0.113	0.104
<i>RPM</i>	-0.353	-0.221	-0.367	-0.344	-0.244	-0.353	-0.242	-0.202	-0.264	-0.232	-0.219	-0.246
<i>IP</i>	0.171	0.226	0.151	0.216	0.130	0.201	0.119	0.190	0.101	0.179	0.080	0.157
<i>Predicted PM</i>	-1.933	0.000	0.761	-1.939	-0.001	0.767	-0.114	0.000	0.093	-0.118	0.000	0.098
<i>Panel B: Relative Profit Margin to Measure Market Power</i>												
<i>I</i>	0.248	0.247	0.263	0.261	0.230	0.268	0.180	0.196	0.190	0.180	0.196	0.190
<i>Q</i>	1.614	1.512	1.791	1.597	1.539	1.782	1.215	1.219	1.272	1.215	1.219	1.272
<i>CF</i>	0.216	0.407	0.219	0.220	0.396	0.225	0.265	0.355	0.285	0.265	0.355	0.285
<i>PM</i>	0.036	0.111	0.036	0.033	0.115	0.035	0.102	0.112	0.100	0.102	0.112	0.100
<i>RPM</i>	-0.350	-0.234	-0.357	-0.340	-0.247	-0.353	-0.245	-0.210	-0.247	-0.245	-0.210	-0.247
<i>IP</i>	0.154	0.217	0.177	0.225	0.128	0.195	0.108	0.179	0.119	0.108	0.179	0.119
<i>Predicted RPM</i>	-1.964	-0.041	0.756	-1.985	-0.022	0.757	-0.155	-0.022	0.080	-0.155	-0.022	0.080

The definition of all variables and the sample used for study are the same as those presented in Table 4.2. “Very Negt,” “Negt,” and “None” effect groups are classified based on effect index. “Most,” “Less,” and “Least” diminished market power groups are classified based on a predicted market power index. Panel A uses profit margin as the measure of market power to construct an effect index and a predicted market power index, and Panel B uses relative profit margin. *Predicted PM* is the predicted market power index when profit margin is used as the measure of market power, and *Predicted RPM* is this index when relative profit margin is used. Columns (1)-(6) display the mean of all variables and columns (7)-(12) show the median of all variables.

Table 4.4: Pseudo Nontradable Industries

SIC	Name	# of Firms	<i>Import</i>	Growth of <i>Import</i>
2011	Meat Packing Plants	6	0.0673	0.0248
2033	Canned fruits and vegetables	8	0.0685	0.0339
2273	Carpets and rugs	15	0.0630	0.0486
2711	Newspapers	20	0.0021	-0.0099
2721	Periodicals	10	0.0063	0.0342
2731	Book publishing	24	0.0522	0.0139
2741	Miscellaneous publishing	4	0.0058	-0.0706
2842	Polishes and sanitation goods	9	0.0165	0.0340
2891	Adhesives and sealants	4	0.0231	0.0441
2911	Petroleum refining	26	0.0907	0.0276
3211	Flat glass	2	0.0746	0.0319
3231	Products of purchased glass	3	0.0929	0.0397
3341	Secondary nonferrous metals	2	0.0459	0.0221
3575	Computer terminals	4	0.0718	0.0172
3821	Laboratory apparatus and furniture	4	0.0434	-0.1900

This table lists 15 four-digit SIC manufacturing industries that are used as the proxies for nontradable industries, including their SIC codes, industry names, number of firms that operate in the industry, average import penetration, and average annual growth rate of import penetration. *Import* is import penetration defined by equation (3.1).

Table 4.5: Time Series Regression of Estimated Investment-Cash Flow Sensitivity in Three Effect Groups and Three Predicted Market Power Groups

	Effect of <i>Import</i>			Predicted Market Power		
	Very Negt (1)	Negt (2)	None (3)	Most (4)	Less (5)	Least (6)
<i>Panel A: Profit Margin to Measure Market Power</i>						
<i>t</i>	-0.0079*** (0.0009)	-0.0065*** (0.0012)	-0.0022 (0.0013)	-0.0080*** (0.0009)	-0.0075*** (0.0018)	-0.0022 (0.0015)
$\Delta \ln GDP$	0.6432 (0.6829)	0.0917 (0.6518)	-0.4344 (0.9601)	0.9978 (0.5544)	-1.0476 (1.0027)	0.2313 (0.8599)
$\Delta \ln GDP_{-1}$	-0.1418 (0.6872)	0.4998 (0.4737)	-0.7015 (0.5240)	-0.0151 (0.6455)	-0.0618 (0.7182)	-0.3910 (0.5751)
R^2	0.745	0.517	0.170	0.778	0.460	0.104
<i>DW</i>	1.887	1.846	1.993	1.710	1.795	1.842
<i>Observations</i>	34	34	34	34	34	34
<i>Panel B: Relative Profit Margin to Measure Market Power</i>						
<i>t</i>	-0.0081*** (0.0013)	-0.0072*** (0.0009)	-0.0040** (0.0014)	-0.0079*** (0.0010)	-0.0062*** (0.0014)	-0.0037** (0.0011)
$\Delta \ln GDP$	0.8827 (1.0291)	-0.1131 (0.6075)	-0.1241 (0.6239)	1.6425* (0.7485)	-1.2995* (0.6115)	-0.1811 (0.5582)
$\Delta \ln GDP_{-1}$	-0.4704 (0.9908)	0.5014 (0.5352)	-0.6625 (0.6443)	-0.6907 (0.8616)	0.7341 (0.5635)	-0.5464 (0.6316)
R^2	0.643	0.708	0.285	0.740	0.488	0.292
<i>DW</i>	1.882	1.876	1.835	1.736	1.899	1.884
<i>Observations</i>	34	34	34	34	34	34

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table reports the results from time series regression (4.2) the Prais-Winsten model for three groups that are classified by either the effect index (columns (1)-(3)) or predicted market power index (columns (4)-(6)). Panel A uses profit margin as the measure of market power to construct the effect index and the predicted market power index; Panel B uses relative profit margin. t is year. $\Delta \ln GDP$ and $\Delta \ln GDP_{-1}$ are the changes in the natural logarithm of real GDP in the current and previous year. DW is the Durbin-Watson test for serial correlation. The sample used to estimate investment-cash flow sensitivity contains 24,387 firm-year observations of 1,869 manufacturing firms in 114 four-digit SIC industries from 1972 to 2005.

Table 4.6: SUR for “Very Negative” and “None” Effect Groups and for “Most” and “Least” Diminished Market Power Groups

	Effect of <i>Import</i>		Predicted Market Power	
	Very Negt (1)	None (2)	Most (3)	Least (4)
<i>Panel A: Profit Margin to Measure Market Power</i>				
<i>t</i>	-0.0079*** 0.0000	-0.0022* (0.0239)	-0.0078*** 0.0000	-0.0022* (0.0247)
$\Delta \ln GDP$	0.1236 (0.8360)	-0.4260 (0.3919)	0.4773 (0.4080)	0.0748 (0.8819)
$\Delta \ln GDP_{-1}$	0.1460 (0.8068)	-0.7942 (0.1104)	0.2955 (0.6085)	-0.6071 (0.2280)
R^2	0.575	0.206	0.589	0.159
<i>Observations</i>	34	34	34	34
<i>Diff</i>	-0.0057***		-0.0056***	
<i>p – value</i>	(0.0000)		(0.0002)	
<i>Panel B: Relative Profit Margin to Measure Market Power</i>				
<i>t</i>	-0.0081*** 0.0000	-0.0038*** (0.0001)	-0.0077*** 0.0000	-0.0037*** 0.0000
$\Delta \ln GDP$	0.4061 (0.5699)	-0.3091 (0.5213)	1.0467 (0.1229)	-0.3617 (0.4121)
$\Delta \ln GDP_{-1}$	-0.1843 (0.7965)	-0.7147 (0.1381)	-0.3066 (0.6513)	-0.5973 (0.1756)
R^2	0.497	0.361	0.514	0.384
<i>Observations</i>	34	34	34	34
<i>Diff</i>	-0.0043*		-0.0040*	
<i>p – value</i>	(0.0179)		(0.0250)	
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$				

This table reports the results from time series regression (4.2) by SUR for “very negative” and “negative” effect groups (columns (1)-(3)) and for “most” and “least” diminished market power groups (columns (4)-(6)). Panel A uses profit margin as the measure of market power to construct the effect index and the predicted market power index; Panel B uses relative profit margin. t is year. $\Delta \ln GDP$ and $\Delta \ln GDP_{-1}$ are the changes in the natural logarithm of real GDP in the current and previous years. DW is the Durbin-Watson test for serial correlation. $Diff$ is the difference in the estimated coefficient b in regression (4.2). $p - value$ is the p value for the test of the null hypothesis that $Diff$ equals zero. The sample used to estimate investment-cash flow sensitivity contains 24,387 firm-year observations of 1,869 manufacturing firms in 114 four-digit SIC industries from 1972 to 2005.

Table 4.7: Event Study

<i>Panel A: Investment regressions surrounding events</i>					
	Kennedy Round	GPS	Tokyo Round	Uruguay Round	China to WTO
	1965-1967	1974-1976	1980-1982	1990-1995	1999-2001
Q	0.0373*** (0.0042)	0.0481*** (0.0058)	0.0697*** (0.0055)	0.0659*** (0.0046)	0.0641*** (0.0040)
CF	0.2539*** (0.0078)	0.1555*** (0.0171)	0.1375*** (0.0165)	0.0733*** (0.0045)	0.0402** (0.0068)
$CF \times Event$	-0.0529 (0.0252)	-0.0151 (0.0242)	-0.0593* (0.0210)	-0.0333* (0.0083)	-0.0264* (0.0081)
$Event$	-0.0164** (0.0020)	-0.0062** (0.0014)	-0.0051* (0.0016)	-0.0138*** (0.0012)	-0.0044* (0.0013)
R^2	0.153	0.118	0.110	0.103	0.093
<i>Observations</i>	3085	9514	10257	11651	11986

<i>Panel B: Investment regression with a series of event dummies</i>					
	($Y > 1967$)	($Y > 1976$)	($Y > 1982$)	($Y > 1995$)	($Y > 2001$)
($Y > .$)	-0.0289*** (0.0025)	-0.0046 (0.0023)	-0.0053*** (0.0010)	-0.0095*** (0.0011)	-0.0068*** (0.0014)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Panel A presents results of five cash flow augmented reduced-form investment regression (4.3) that examine changes in the investment rate and changes in investment sensitivity to cash flow in three-year windows before and after five important events in U.S. international trade history. All regressions use an unbalanced panel of 6,332 manufacturing firms from 1963 to 2006 and consisting of 67,878 observations. The dependent variable in two regressions is the investment to capital ratio, I . Independent variables are Tobin's q , Q , a year dummy variable that takes the value of one after event, $Event$, the ratio of cash flow to capital, CF , and the cross term of CF and $Event$. Panel B presents the estimates of the changes in investment sensitivity to cash flow sensitivity after five important events; estimates are derived from cash flow augmented reduced-form investment regression (4.3) with five-year dummies that take the value of one after each event: ($Y > 1967$), ($Y > 1976$), ($Y > 1982$), ($Y > 1995$), and ($Y > 2001$). Variables I , Q , and CF are demeaned at cross-sectional and time dimensions to control for fixed firm and year effects. Standard errors are adjusted for the correlation within a firm and for the correlation within a year.

Table 4.8: Globalization and Investment-Cash Flow Sensitivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Q</i>	0.0573*** (0.0028)	0.0577*** (0.0029)	0.0571*** (0.0027)	0.0572*** (0.0027)	0.0523*** (0.0025)	0.0527*** (0.0025)	0.0523*** (0.0025)	0.0524*** (0.0026)
<i>CF</i>	0.0654*** (0.0155)	0.0628*** (0.0107)	0.0861*** (0.0171)	0.0862*** (0.0171)	0.0642*** (0.0066)	0.0610*** (0.0042)	0.0820*** (0.0069)	0.0816*** (0.0066)
<i>Import</i>	0.0608 (0.0348)			0.0684* (0.0346)	0.1678*** (0.0347)			0.1843*** (0.0380)
<i>CF</i> × <i>Import</i>	-0.0755* (0.0353)			-0.0811** (0.0313)	-0.0347* (0.0159)			-0.0394** (0.0146)
<i>FDI</i>		0.0120 (0.0243)		0.0184 (0.0232)		0.0687*** (0.0206)		0.0834*** (0.0184)
<i>CF</i> × <i>FDI</i>		-0.1081*** (0.0292)		-0.1142*** (0.0249)		-0.0869*** (0.0210)		-0.0881*** (0.0183)
<i>Total</i>			0.0327 (0.0199)				0.1139*** (0.0133)	
<i>CF</i> × <i>Total</i>			-0.0933*** (0.0274)				-0.0636*** (0.0138)	
$\hat{\pi}$					0.7853*** (0.0537)	0.7866*** (0.0500)	0.7802*** (0.0434)	0.7786*** (0.0508)
<i>CF</i> × $\hat{\pi}$					0.1692*** (0.0258)	0.1441*** (0.0219)	0.1586*** (0.0215)	0.1527*** (0.0243)
R^2	0.409	0.410	0.411	0.411	0.427	0.427	0.428	0.428
<i>Observations</i>	42935	42935	42935	42935	42935	42935	42935	42935

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This table presents results of the regression (4.4) coefficients and standard errors (in parentheses) using the sample that contains 4,978 firms in 118 three-digit SIC industries over the period 1978 to 2006. The regression error structure in columns (1)-(4) is corrected for heteroskedasticity and autocorrelation. We use the bootstrapped standard errors in columns (5)-(8), allowing for within-firm error clustering. The predicted profit margins, $\hat{\pi}$ in columns (5)-(8), respectively, correspond to the estimation of the first-stage regression (3.3) in columns (1)-(4) of Table 3.3. *Import* is import penetration defined by equation (3.1). *FDI* is defined by equation (3.2) to measure the effect of FDI. *Total* is the sum of *Import* and *FDI*. All of them are measured by three-digit SIC codes. *Q* is Tobin's q. *CF* is the ratio of cash flow to capital. *NetLeverage* is the ratio of the difference between long-term debt and cash holdings to the beginning-of-period total assets. σ is the mean of the standard deviations of the ratio of cash flow to total assets over 10 years for firms in the same two- or three-digit SIC industry.

Table 4.9: Investment to Cash Flow Sensitivity: Difference-in-Difference Estimations

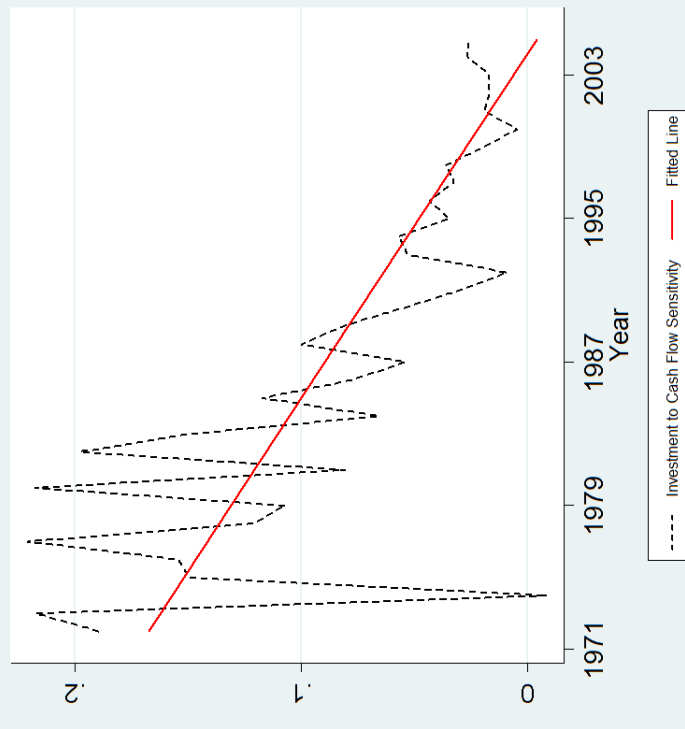
	Whole Sample		Treated and Matched	
	1988-1992	2001-2005	1988-1992	2001-2005
	(1)	(2)	(3)	(4)
Q	0.0622*** (0.0046)	0.0629*** (0.0053)	0.0601*** (0.0061)	0.0579*** (0.0056)
CF	0.0328*** (0.0043)	0.0050 (0.0043)	0.0328*** (0.0065)	-0.0055 (0.0060)
$CF \times GS$	0.0371** (0.0126)	0.0072 (0.0058)	0.0374** (0.0133)	0.0129* (0.0061)
GS	-0.0143 (0.0137)	-0.0151 (0.0137)	-0.0142 (0.0144)	-0.0150 (0.0171)
R^2	0.565	0.584	0.594	0.574
<i>Observations</i>	8679	9225	4269	4936

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table reports the results from the difference-in-difference regression (4.5) for two subsample periods: 1988-1992 and 2001-2005. The first two columns present results that use as the control group all firms in industries that do not experience globalization slowdowns and the last two columns use the matching sample based on a propensity score. Q is Tobin's q . CF is the ratio of cash flow to capital. GS is an indicator variable for treated industry-years.

Figure 4.1: Cross-Sectional Estimates of Investment to Cash Flow and Tobin's q

(a) Investment to Cash Flow Sensitivity



(b) Investment to Tobin's q Response

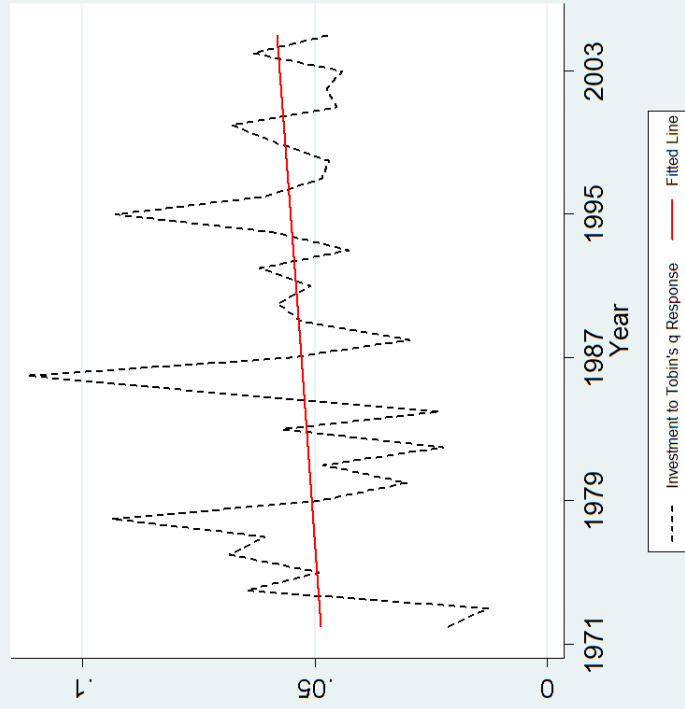
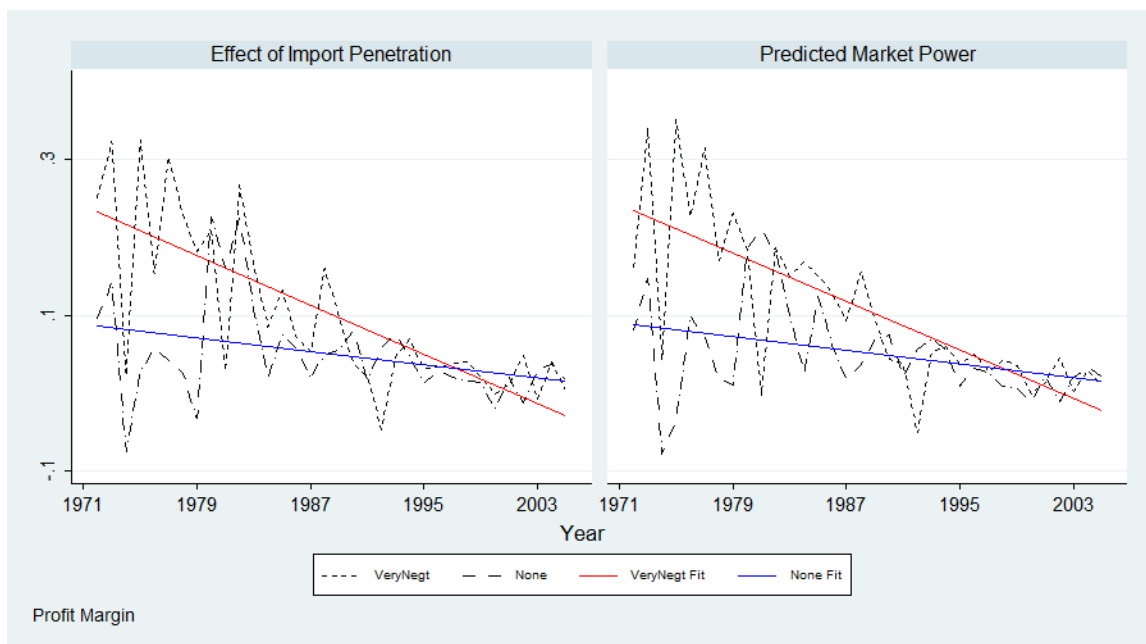


Figure 4.2: Cross-Sectional Estimates of Investment-Cash Flow Sensitivity in Groups

(a) Profit Margin as Dependent Variable



(b) Relative Profit Margin as Dependent Variable

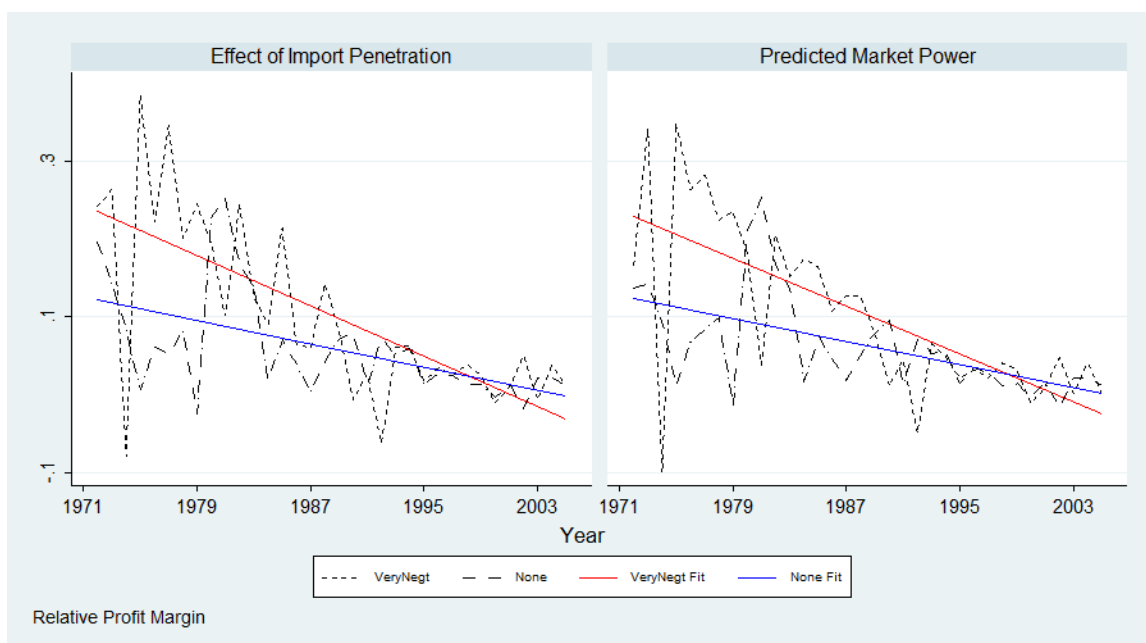
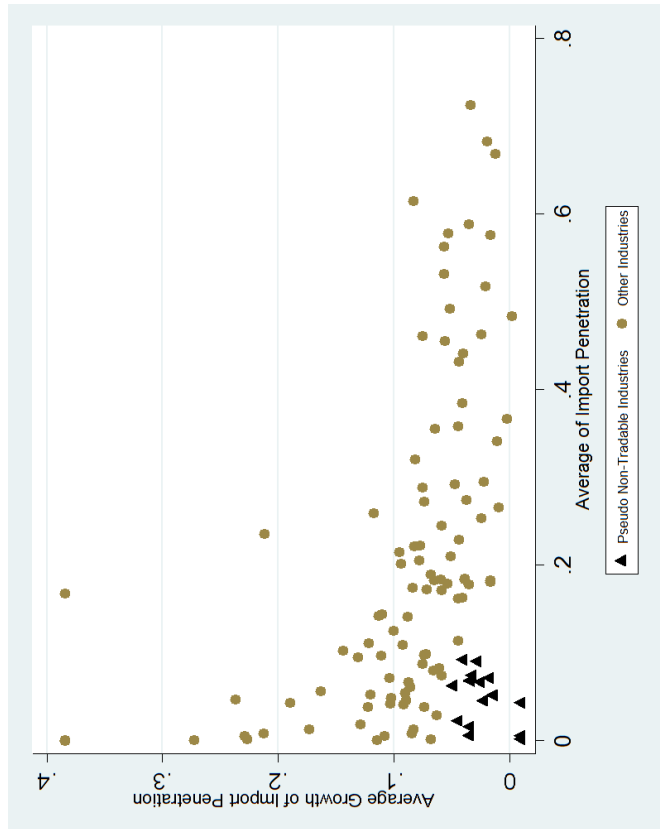


Figure 4.3: Pseudo Non-Tradable Industries

(a) Import Penetration Average v.s. Average Growth



(b) Investment to Cash Flow Sensitivity

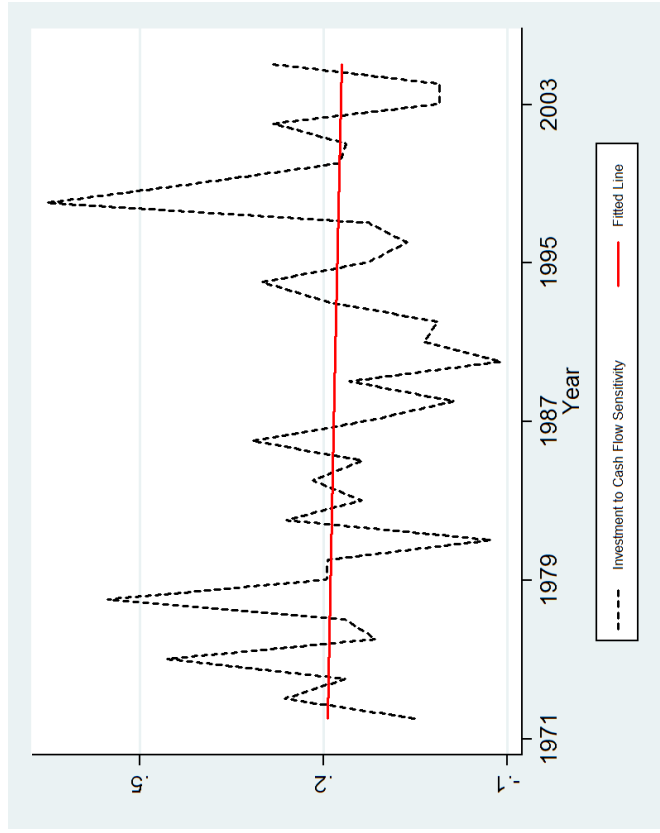
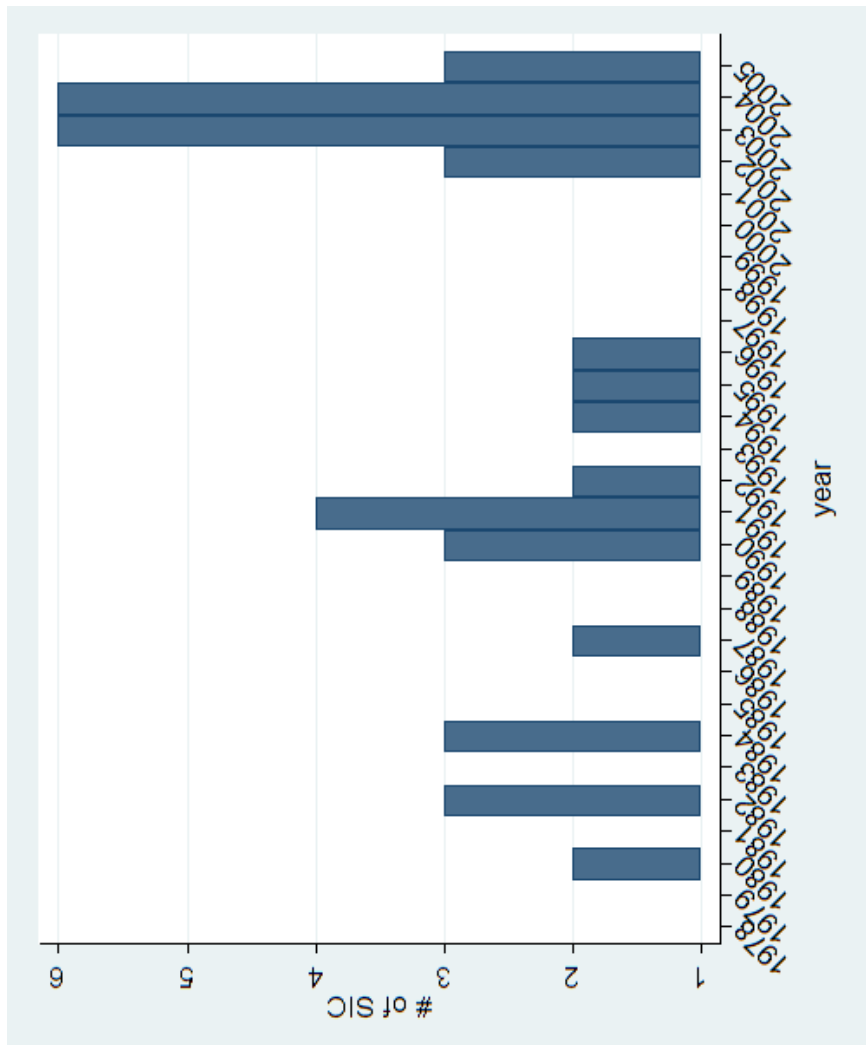


Figure 4.4: Number of SIC Industries that Experience Globalization Slowdown in Each Year



Appendix A

Appendix to Chapter 2

A.1 Optimization Problem

The representative firm i faces the optimal dynamic maximization problem as follows:

$$V(K_{i,t}, Z_{i,t}, v_{i,t}) = \max_{\{I_{i,t}, L_{i,t}\}} \left\{ \begin{array}{l} \pi(K_{i,t}, L_{i,t}, Z_{i,t}) - I_{i,t} \\ -G(I_{i,t}, K_{i,t}, v_{i,t}) - H(F_{i,t}, K_{i,t}) \\ + \frac{1}{R} E_t [V(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})] \end{array} \right\} \quad (\text{A.1})$$

subject to the accumulation law of capital governed by equation (2.2). $I_{i,t}$ is the firm i 's investment during period t . $K_{i,t}$ denotes the firm i 's capital stock at the beginning of period t . $L_{i,t}$ represents the costlessly adjustable factors (like labor) of production during period t . $F_{i,t} = I_{i,t} - \pi(K_{i,t}, L_{i,t}, Z_{i,t})$ is the amount of external funds firm i borrows from outside capital markets during period t . $Z_{i,t}$ and $v_{i,t}$, respectively, measure exogenous shocks to profits and adjustment costs; both are observed by the firm but unobserved by the econometrician at time t . H is the external finance cost function defined by equation (2.12), π is the profit function defined by equation (2.1), and G is the capital adjustment cost function defined by equation (2.3).

To simplify the exposition of optimal policies, I assume that V is concave and once differentiable. These assumption are not necessary for the the existence of the solution to this dynamic optimal maximization problem or of an optimal policy function. Hence, I also assume there exists a solution to this problem. The first order conditions with respect to investment I and freely adjustable factor L is given by,

$$1 + H_F(F_{i,t}, K_{i,t}) + G_I(I_{i,t}, K_{i,t}, v_{i,t}) = \frac{1}{R} E_t [V_K(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})] \quad (\text{A.2})$$

$$[1 + H_F(F_{i,t}, K_{i,t})] \pi_L(K_{i,t}, L_{i,t}, Z_{i,t}) = 0 \quad (\text{A.3})$$

Envelope theorem implies

$$\begin{aligned} V_K(K_{i,t}, Z_{i,t}, v_{i,t}) = & [1 + H_F(F_{i,t}, K_{i,t})] \pi_K(K_{i,t}, L_{i,t}, Z_{i,t}) - G_K(I_{i,t}, K_{i,t}, v_{i,t}) \\ & - H_K(F_{i,t}, K_{i,t}) + \frac{1}{R} E_t [(1 - \delta) V_K(K_{i,t+1}, Z_{i,t+1}, v_{i,t+1})] \end{aligned} \quad (\text{A.4})$$

Time capital $K_{i,t}$ to both sides of equation (A.4), investment $I_{i,t}$ to both sides of equation (A.2), and costlessly adjustable factors $L_{i,t}$ to both side of equation (A.3). Then, combine the three resulting equations and use the homogeneity of the capital adjustment and external finance cost functions yielding,

$$\begin{aligned} V_{K_{i,t}} K_{i,t} = & \pi_{K_{i,t}} K_{i,t} + \pi_{L_{i,t}} L_{i,t} - I_{i,t} - G_{i,t} + \frac{1}{R} E_t [V_{K_{i,t+1}} K_{i,t+1}] \\ & + (\pi_{K_{i,t}} K_{i,t} + \pi_{L_{i,t}} L_{i,t} - \pi_{i,t}) H_{\pi_{i,t}} - H_{i,t} \end{aligned} \quad (\text{A.5})$$

where $V_{K_{i,t}}$, $H_{F_{i,t}}$, $H_{i,t}$, $\pi_{L_{i,t}}$, $\pi_{K_{i,t}}$, $\pi_{i,t}$, and $G_{i,t}$ stand for $V_K(K_{i,t}, Z_{i,t}, v_{i,t})$, $H_F(F_{i,t}, K_{i,t})$, $H(F_{i,t}, K_{i,t})$, $\pi_L(K_{i,t}, L_{i,t}, Z_{i,t})$, $\pi_K(K_{i,t}, L_{i,t}, Z_{i,t})$, $\pi(K_{i,t}, L_{i,t}, Z_{i,t})$, and $G(I_{i,t}, K_{i,t}, v_{i,t})$. I evaluate the marginal effects of capital and freely adjustable factor and use equation (2.7) on the assumption of conjectural variations $\frac{dK_{i,t}}{dK_{i,t}}$ to show the relationship between the marginal effects and profit function as follows:

$$\pi_{K_{i,t}} K_{i,t} + \pi_{L_{i,t}} L_{i,t} = \pi_{i,t} + \frac{1}{\varepsilon} [(-\eta)\rho - (1 - \eta\rho) s_i] Z_t P_t Y(K_{i,t}, L_{i,t}) \quad (\text{A.6})$$

where P_t is the market price of firm i 's products in period t , s_i is firm i 's market share, and ε is the elasticity of demand curve. $Y(K_{i,t}, L_{i,t})$ is the Cobb-Douglas production function with the elasticity of output with respect to physical capital, ρ . Substituting equation (A.6) and the marginal effect of external finance to its costs H_F into (A.5) implies,

$$\begin{aligned} V_{K_{i,t}} K_{i,t} = & [\pi_{i,t} - I_{i,t} - G_{i,t}] + \frac{1}{R} E_t [V_{K_{i,t+1}} K_{i,t+1}] \\ & + [(-\eta)\rho - (1 - \eta\rho) s_i] \frac{1}{\varepsilon} Z_{i,t} P_t Y_{i,t} \left[1 + h \frac{(F_{i,t})_+}{K_{i,t}} \right] \end{aligned} \quad (\text{A.7})$$

where $(F)_+$ stands for $\max(F, 0)$. Solving the equation (A.7) forward by repeated substitution yielding

$$V_{K_{i,t}} K_{i,t} - V_{i,t} = \frac{(-\eta)\rho - (1 - \eta\rho) s_i}{\varepsilon} E_t \left\{ \sum_{m=0}^{\infty} [R^{-m} Z_{i,t+m} P_{t+m} Y_{i,t+m}] \left[1 + h \frac{(F_{i,t+m})_+}{K_{i,t+m}} \right] \right\} \quad (\text{A.8})$$

The first order conditions with respect to freely adjustable factor L implies a relationship between $\pi_{i,t}$ and $Z_{i,t}P_tY_{i,t}$ for $t \geq 0$.

$$Z_{i,t}P_tY_{i,t} = \frac{\pi_{i,t}\varepsilon}{\rho\varepsilon + (1-\rho)s_i} \quad (\text{A.9})$$

Divide $K_{i,t}$ in both sides of equation (A.8) and substitute equation (A.9) for $Z_{i,m}P_{i,m}Y_{i,m}$, $m \geq t$, resulting in the link between marginal q and average Q in the presence of costly external financing.

$$q_{i,t} = Q_{i,t} + \frac{(-\eta)\rho - (1-\eta\rho)s_i}{\rho\varepsilon + (1-\rho)s_i} E_t \left\{ \sum_{m=0}^{\infty} R^{-m} \frac{\pi_{i,t+m}}{K_{i,t+m}} \left[1 + h \frac{(I_{i,t+m} - \pi_{i,t+m})_+}{K_{i,t+m}} \right] \right\} \quad (\text{A.10})$$

In the frictionless world, there are no costs associated with external financing. Therefore, $h = 0$, implying equation (2.9) on the difference between marginal q and average Q in Section 2.2. When firm i is financially constrained in period t , $I_{i,t} > \pi_{i,t}$, equation (A.2) implies the familiar regression equation.

$$\frac{I_{i,t}}{K_{i,t}} = \alpha + \beta E_t [q_{i,t+1}] + \lambda \frac{\pi_{i,t}}{K_{i,t}} + u_{i,t} \quad (\text{A.11})$$

where $\alpha = -\frac{\gamma_0+1}{h+\gamma}$, $\beta = \frac{1}{R(h+\gamma)}$, $\lambda = \frac{h}{h+\gamma}$, and $u_{i,t} = -\frac{\gamma_1 v_{i,t}}{h+\gamma}$. When $h = 0$, the regression formula reduces to equation (2.5). Substituting the expression for q derived in equation (A.10) and the

assumption on the stream of cash flows (2.10) yields,

$$\begin{aligned} \frac{I_{i,t}}{K_{i,t}} = & \alpha + \beta E_t [Q_{i,t+1}] + \phi \left[\frac{\frac{(-\eta)\rho}{1-\eta\rho} - s_i}{\rho\varepsilon + (1-\rho)s_i} \right] \frac{\pi_{i,t}}{K_{i,t}} + \lambda \frac{\pi_{i,t}}{K_{i,t}} + u_{i,t} \\ & + h\phi \left[\frac{\frac{(-\eta)\rho}{1-\eta\rho} - s_i}{\rho\varepsilon + (1-\rho)s_i} \right] E_t \left\{ \sum_{m=1}^{\infty} \left[R^{-m} \frac{\pi_{i,t+m}}{K_{i,t+m}} \frac{(I_{i,t+m} - \pi_{i,t+m})_+}{K_{i,t+m}} \right] \right\} \end{aligned} \quad (\text{A.12})$$

where $\phi = \frac{\mu(1-\eta\rho)}{(R-\mu)(h+\gamma)}$. The term in the second line of equation (A.12) reflects the cross effect of future financial constraints and imperfect competition on the difference between marginal q and average Q . Future constraints on investment widen the distance between two qs no matter which one is larger.

A.2 Proof of Proposition 3

Define a new function as follows.

$$f(s_i, \varepsilon) = \frac{\frac{(-\eta)\rho}{1-\eta\rho} - s_i}{\rho\varepsilon + (1-\rho)s_i} \quad (\text{A.13})$$

To see the effect of market power on the difference between marginal q and average Q , I first evaluate the marginal effect of firm i 's market share s_i and the inverse elasticity of demand $\frac{1}{\varepsilon}$

to the function f .

$$\frac{\partial f(s_i, \varepsilon)}{\partial s_i} = - \frac{\rho \varepsilon + \frac{-\eta \rho (1-\rho)}{1-\eta \rho}}{[\rho \varepsilon + (1-\rho) s_i]^2} \quad (\text{A.14})$$

$$\frac{\partial f(s_i, \varepsilon)}{\partial \left(\frac{1}{\varepsilon}\right)} = - \varepsilon^2 \frac{\partial f(s_i, \varepsilon)}{\partial \varepsilon} = \frac{\rho \varepsilon^2 \left[\frac{(-\eta) \rho}{1-\eta \rho} - s_i \right]}{[\rho \varepsilon + (1-\rho) s_i]^2} \quad (\text{A.15})$$

If both firm i 's market share s_i and the inverse elasticity of demand $\frac{1}{\varepsilon}$ increase by $\Delta > 0$, f will increase by,

$$\left[\frac{\partial f(s_i, \varepsilon)}{\partial s_i} + \frac{\partial f(s_i, \varepsilon)}{\partial \left(\frac{1}{\varepsilon}\right)} \right] \Delta = \frac{\frac{(-\eta) \rho^2 \varepsilon^2}{1-\eta \rho} \left[1 - \frac{1-\eta \rho}{(-\eta) \rho} \left(s_i + \frac{1}{\varepsilon} \right) - \frac{1-\rho}{\rho} \frac{1}{\varepsilon^2} \right] \Delta}{[\rho \varepsilon + (1-\rho) s_i]^2} \quad (\text{A.16})$$

Under the assumptions in Proposition 3: imperfect product market competition, $\varepsilon < \infty$, positive present value of firm i 's future cash flows, $E_t \left[\sum_{m=0}^{\infty} R^{-m} \frac{\pi_{i,t+m}}{K_{i,t+m}} \right] > 0$, and negative conjectural variations, $\eta < 0$, equations (A.16) and (2.9) imply the difference between marginal q and average Q will change by

$$\frac{(-\eta) \rho^2 \varepsilon^2 \left[1 - \frac{1-\eta \rho}{(-\eta) \rho} \left(s_i + \frac{1}{\varepsilon} \right) - \frac{1-\rho}{\rho} \frac{1}{\varepsilon^2} \right] \Delta}{[\rho \varepsilon + (1-\rho) s_i]^2} E_t \left[\sum_{m=0}^{\infty} R^{-m} \frac{\pi_{i,t+m}}{K_{i,t+m}} \right]$$

This change is positive if $\frac{1-\eta \rho}{(-\eta) \rho} \left(s_i + \frac{1}{\varepsilon} \right) + \frac{1-\rho}{\rho} \frac{1}{\varepsilon^2} < 1$ and negative if $\frac{1-\eta \rho}{(-\eta) \rho} \left(s_i + \frac{1}{\varepsilon} \right) + \frac{1-\rho}{\rho} \frac{1}{\varepsilon^2} >$

1.

A.3 Measurement Error

For discussion convenience, I re-write equation (2.11) and drop the subscript,

$$y = \alpha + \beta \kappa + \phi f(s, \varepsilon) x + u \quad (\text{A.17})$$

where $y = \frac{I}{K}$, $x = \frac{\pi}{K}$, $f(s, \varepsilon)$ is defined in equation (A.13), and $\kappa_t = E_t [Q_{t+1}]$. Q_t is the realized value of expected average Q , $E_t(Q_{t+1})$. Thus, $Q = \kappa + e$, where e is the measurement error and independent of x and u . To see how market power attribute to the relationship between investment and cash flow, I first “partial out” the ratio of cash flow to capital x in y , κ and Q .

$$y - \mu_y x = \beta (\kappa - \mu_\kappa x) + u \quad (\text{A.18})$$

and

$$Q - \mu_Q x = (\kappa - \mu_\kappa x) + e \quad (\text{A.19})$$

where $(\mu_y, \mu_Q, \mu_\kappa) = [E(x^2)]^{-1} E[x(y, Q, \kappa)]$. Substituting equation (A.19) into (A.18) and taking expectation of the result yield the estimate of β ,

$$\beta = E[(y - \mu_y x)(Q - \mu_Q x)] \left\{ E[(Q - \mu_Q x)^2 - e^2] \right\}^{-1} \quad (\text{A.20})$$

Regardless of errors in average Q , the OLS estimation of regression (A.17) with Q as the control for investment opportunities implies

$$\beta_{OLS} = E [(y - \mu_{yx})(Q - \mu_Q x)] \left\{ E [(Q - \mu_Q x)^2] \right\}^{-1} \quad (\text{A.21})$$

which is smaller than true value β . Next, I show the correlation between cash flow x and the realized value of average Q is greater for firms with higher market power. Equation (2.9) on the relation between marginal q and average Q implies

$$\begin{aligned} Cov(Q, x) &= Cov[q - (1 - \eta\rho) f(s, \varepsilon)x, x] \\ &= Cov(q, x) - (1 - \eta\rho) f(s, \varepsilon) Var(x) \end{aligned} \quad (\text{A.22})$$

According to Proposition 2-3 in Section 2.2, $f(s, \varepsilon)$ is negative for firms with high market power and decreases as their market power increases. Equation (A.22) shows even cash flow is uncorrelated with marginal q , the correlation between cash flow and average Q would increase with firms' market power. Thus, μ_Q would increase with market power. Because the estimate of the coefficient for cash flow equals $\mu_y - \mu_Q \beta_{OLS}$, the underestimation of β could lead to the greater overestimation of cash flow's effect on investment for firms with higher market power.

Appendix B

Appendix to Chapter 3

B.1 Import Penetration

Two trade datasets, compiled by Feenstra (1996) and by Feenstra et al. (2002) and Schott (2010), generate different values of import penetration for a given industry during the overlapping period 1989-1994. This is because the second dataset uses a revised version of the HS-SIC concordance, which provides a more complete match of the imports and exports for the relevant domestic industries. Because of the comparability problem associated with the two datasets, we cannot directly use import penetration after we merge them. Our preference is to use the updated data as much as possible, so we kept intact the 1989-2005 import penetration computed from the second dataset. Then, we decide whether to extend the time series back to 1972 by using the first dataset based on the difference ratio of import penetration in 1989 proposed by Booth and Zhou (2009). The difference ratio for industry j is defined as the absolute value of $[(IP_{j,1989} \text{ from 1989-2005 dataset} / IP_{j,1989} \text{ from 1972-1994 dataset}) - 1]$. If it is less than 25%, 1972-1988 values of import penetration will be included in the study.

Raw data on import, export, and industry shipments are recorded by the four-digit SIC codes. To measure import penetration and the effect of FDI at the same industry level, we first

calculate aggregate imports, exports, and shipments at a relatively rough industry level, based on the industry classification that is used by the BEA to record the sales of multinational affiliates with foreign parents. Then, we compute import penetration according to equation (3.1) and apply the selection procedure described above for the empirical analysis in this paper. Descriptive statistics are provided in Table 3.1 and Figure 3.1.

B.2 FDI Effect

Records by the Bureau of Economic Analysis (BEA) financial and operating dataset for U.S. multinational companies use two different industry classification systems before and after 1997. The BEA has reported sales by multinational affiliates by the four-digit North American Industry Classification System (NAICS) since 1997, when the U.S. government changed the industry classification system from SIC to NAICS. Despite a vast literature, there is no indication as to the best way to reconcile the two systems. We propose a method to deal with this problem as follows.

1. Convert the three-digit NAICS sales to two-digit SIC codes by using a transform matrix.
2. Compute the average sales shares of each three-digit SIC industry in its two-digit SIC industry over the period 1977 to 1996.
3. Compute three-digit SIC sales for the period 1997 to 2005 based on the matrix from Step 1 and the shares from Step 2.

Because the BEA also reported sales data by two-digit SIC codes in 1997, we can construct a matrix that transfers three-digit NAICS multinational affiliates' sales to two-digit SIC codes according to two concordance documents provided by the BEA: "Comparison of 1997 NAICS-based ISI Codes with 1987 SIC-based ISI Codes" and "Comparison of 1987 SIC-based ISI Codes with 1997 NAICS-based ISI Codes."¹ Then, we calculate the mean of each three-digit SIC foreign multinationals' sales share in its two-digit SIC industry over the period 1977 to 1996. Using the matrix created in Step 1 and shares from Step 2, we can generate three-digit SIC foreign multinationals' sales based on a three-digit NAICS FDI for the period 1997 to 2005.²

Our method can give rise to concerns that the transform between the two systems may be dynamic and not static. To lessen these concerns, we test three null hypotheses, and the p value for each test in different industries is presented in Table B.1. Panel A tests the null hypothesis: The change in foreign multinationals' sales share of a two-digit SIC industry throughout the manufacturing sector is zero. All the p values are larger than 0.10, suggesting that we cannot reject the null hypothesis. Panel B tests the null hypothesis: The change in foreign multinationals' sales share of a three-digit SIC industry within its two-digit industry is zero. All but three industries have p values larger than 0.20. Panel A and B use data recorded by the SIC system from 1977 to 1996. Panel C tests the null hypothesis: The change in foreign multinationals sales' share of a three-digit NAICS industry in the whole manufacturing sector is zero. All but two industries have p values larger than 0.10. Panel C uses data recoded by the

¹These two documents can be found on webpage: <http://www.bea.gov/surveys/iftcmat.htm>

²We do not use four-digit NAICS sales because most of them became unavailable after 2002 and to construct a transform matrix requires better information on sales by SIC code in 1997.

NAICS system from 1997 to 2005. This evidence helps to mitigate concerns and suggests that the composition of multinational affiliates' sales in the manufacturing industry is relatively stable over time.

Table B.1: Tests of Changes in Shares

Panel A: Two-Digit SIC								
SIC2	# of Obs.	<i>p</i> – value	SIC2	# of Obs.	<i>p</i> – value	SIC2	# of Obs.	<i>p</i> – value
20	19	0.4292	27	19	0.6411	35	19	0.4885
21	3	0.4519	28	19	0.7667	36	19	0.4168
22	19	0.7074	29	19	0.1140	37	19	0.0630
23	19	0.7690	30	19	0.2216	38	19	0.5166
24	19	0.7633	32	19	0.7216	39	14	0.6237
25	19	0.6484	33	19	0.4063	21/31	11	0.2860
26	19	0.9605	34	19	0.5320			

Panel B: Three-Digit SIC								
SIC3	# of Obs.	<i>p</i> – value	SIC3	# of Obs.	<i>p</i> – value	SIC3	# of Obs.	<i>p</i> – value
201	13	0.9305	289/285	19	0.3024	354	19	0.6623
202	16	0.8438	291/292	10	0.9863	355	19	0.4446
203	7	0.3772	299	14	0.2311	356	19	0.6684
204	7	0.3380	301/305/306	19	0.8748	357	19	0.6053
205	10	0.4501	308	19	0.8749	358	19	0.2115
208	19	0.7265	321/322/323	14	0.9558	359	12	0.7419
209	19	0.9458	324/325/326/327/328/329	14	0.9553	363	4	0.5206
261/262/263	19	0.2148	331/332/332	19	0.0769	365/366	19	0.7012
265/267	19	0.2142	333/336/339	19	0.0768	367	19	0.9422
271	9	0.2790	341/346	19	0.4870	361/362/364/369	14	0.8707
272/273/274	9	0.0879	342/345	19	0.5454	371	19	0.4014
275/279	9	0.1298	343/344	19	0.8499	379	19	0.4014
281/286/282	19	0.3237	348-349	19	0.7007	381/382	19	0.7615
283	19	0.0644	351	15	0.7851	384/385	19	0.2587
284	19	0.6144	352	17	0.6273	386	17	0.2891
287	19	0.6907	353	19	0.9457			

Panel C: Three-Digit NAICS								
NAICS3	# of Obs.	<i>p</i> – value	NAICS3	# of Obs.	<i>p</i> – value	NAICS3	# of Obs.	<i>p</i> – value
313/314/315/316	7	0.1702	322	8	0.4397	333	8	0.8008
313	5	0.0461	323	4	0.1154	334	8	0.1299
314	4	0.0222	324	8	0.5119	335	8	0.5779
315	5	0.5739	325	8	0.6508	336	8	0.3970
316	4	0.7173	326	8	0.9630	337	8	0.4006
311	8	0.8111	327	8	0.2889	339	6	0.5345
312	5	0.6655	331	8	0.9214			
321	8	0.7613	332	8	0.2070			

SIC2 is a two-digit SIC code. SIC3 is a three-digit SIC code. NAICS is a three-digit NAICS code. # of Obs. is the number of observations used for a test. The null hypothesis for Panel A is that change in the foreign multinationals' sales share of a two-digit SIC industry throughout the manufacturing sector is zero. The null hypothesis for Panel B is that change in the foreign multinationals' sales share of a three-digit SIC industry within its two-digit industry is zero. The null hypothesis for Panel C is the change in the foreign multinationals' sales share of a three-digit NAICS industry throughout the manufacturing sector is zero. *p* – value is the corresponding p value.

Table B.2: Manufacturing Sector by Two-Digit and Three-Digit Codes

SIC	Name	SIC	Name	SIC	Name	SIC	Name
20	Food and Kindred Products	25	Furniture and Fixtures	31	Leather and Leather Products	35	Industrial Machinery and Equipment
201	Meat Products	251	Household Furniture	311	Leather Tanning and Finishing	351	Engines and Turbines
202	Dairy Products	252	Office Furniture	313	Footwear Cut Stock	352	Farm and Garden Machinery
203	Preserved Fruits and Vegetables	253	Public Building & Related Furniture	314	Footwear, Exc Rubber	353	Construction and Related Machinery
204	Grain Mill Products	254	Partitions and Fixtures	315	Leather Gloves and Mittens	354	Metalworking Machinery
205	Bakery Products	255	Misc. Furniture and Fixtures	316	Luggage	355	Special Industry Machinery
206	Sugar and Confectionery Products	26	Paper and Allied Products	317	Handbags and Personal Leather Goods	356	General Industrial Machinery
207	Fats and Oils	261	Pulp Mills	319	Leather Goods, Nec	357	Computer and Office Equipment
208	Beverages	262	Mills, Exc Building Paper	32	Stone, Clay, and Glass Products	358	Refrigeration and Service Machinery
209	Misc. Foods and Kindred Products	263	Paperboard Mills	321	Flat Glass	359	Industrial Machinery, Nec
21	Tobacco Products	265	Paperboard Containers and Boxes	322	Glass and Glassware, Pressed or Blown	36	Electronic and Other Electric Equipment
211	Cigarettes	267	Misc. Converted Paper Products	323	Products of Purchased Glass	361	Electric Distribution Equipment
212	Cigars	27	Printing and Publishing	324	Cement, Hydraulic	362	Electrical Industrial Apparatus
213	Chewing and Smoking Tobacco	271	Newspapers	325	Structural Clay Products	363	Household Appliances
214	Tobacco Stemming and Redrying	272	Periodicals	326	Pottery and Related Products	364	Electric Lighting and Wiring Equipment
22	Textile Mill Products	273	Books	327	Concrete, Gypsum and Plaster Products	365	Household Audio & Video Equipment
221	Broadwoven Fabric Mills, Cotton	274	Miscellaneous Publishing	328	Cut Stone and Stone Products	366	Communications Equipment
222	Broadwoven Fabric Mills, Manmade	275	Commercial Printing	329	Misc. Nonmetallic Mineral Products	367	Electronic Components and Accessories
223	Broadwoven Fabric Mills, Wool	276	Manifold Business Forms	33	Primary Metal Industries	369	Misc. Electrical Equipment & Supplies
224	Narrow Fabric Mills	277	Greeting Cards	331	Blast Furnace and Basic Steel Products	37	Transportation Equipment
225	Knitting Mills	278	Blankbooks and Bookbinding	332	Iron and Steel Foundries	371	Motor Vehicles and Equipment
226	Textile Finishing, Exc Wool	279	Printing Trade Services	333	Primary Nonferrous Metals	372	Aircraft and Parts
227	Carpets and Rugs	28	Chemicals and Allied Products	334	Secondary Nonferrous Metals	373	Ship and Boat Building and Repairing
228	Yarn and Thread Mills	281	Industrial Inorganic Chemicals	335	Nonferrous Rolling and Drawings	374	Railroad Equipment
229	Misc. Textile Goods	282	Plastics Materials and Synthetic	336	Nonferrous Foundries (Castings)	375	Motorcycles, Bicycles and Parts
23	Apparel and Other Textile Products	283	Drugs	339	Misc. Primary Metal Products	376	Guided Missiles, Space Vehicles, Parts
231	Men's and Boys' Suits and Coats	284	Soaps, Cleaners and Toilet Goods	34	Fabricated Metal Products	379	Misc. Transportation Equipment
232	Men's and Boys' Furnishings	285	Paints and Allied Products	341	Metal Cans and Shipping Containers	38	Instrument and Related Products
233	Women's, Misses', and Juniors' Outerwear	286	Industrial Organic Chemicals	342	Cutlery, Hand Tools and Hardware	381	Search and Navigation Equipment
234	Women's and Children's Undergarments	287	Agricultural Chemicals	343	Plumbing and Heating, Exc Electric	382	Measuring and Controlling Devices
235	Hats, Caps and Millinery	289	Misc. Chemical Products	344	Fabricated Structural Metal Products	384	Medical Instruments & Supplies
236	Girl's and Children's Outerwear	29	Petroleum and Coal Products	345	Screw Machine Products, Bolts, etc.	385	Ophthalmic Goods
238	Misc. Apparel and Accessories	291	Petroleum Refining	346	Metal Forgings and Stampings	386	Photographic Equipment and Supplies
239	Misc. Fabricated Textile Products	295	Asphalt Paving and Roofing Materials	347	Metal Services, Nec	387	Watches, Clocks, Watchcases & Parts
24	Lumber and Wood Products	299	Misc. Petroleum and Coal Products	348	Ordnance and Accessories, Nec	39	Misc. Manufacturing Industries
241	Logging	30	Rubber and Misc. Plastics Products	349	Misc. Fabricated Metal Products	391	Jewelry, Silverware and Plated Ware
242	Sawmills and Planing Mills	301	Tires and Inner Tubes			393	Musical Instruments
243	Millwork, Plywood and Structural Members	302	Rubber and Plastic Footwear			394	Toys and Sporting Goods
244	Wooden Containers	305	Hose & Belting & Gaskets & Packing			395	Pens, Pencils, Office, & Art Supplies
245	Wood Buildings and Mobile Homes	306	Fabricated Rubber Products, Nec			396	Costume Jewelry and Notions
249	Misc. Wood Products	308	Misc. Plastics Products, Nec			399	Misc. Manufacturing

This table lists manufacturing industries by two-digit and three-digit codes for the analysis in this dissertation.

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