FEDERAL INDIVIDUAL INCOME TAXES AND INVESTMENT: EXAMINING THE EMPIRICAL EVIDENCE

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Executive Summary

Investment is widely recognized as a key to long-term economic growth. Marginal individual income tax rate reductions clearly stimulate aggregate consumption and labor force participation, but their stimulative effects on aggregate investment have been disputed. Based on the empirical evidence available a decade and a half ago, marginal individual income tax reductions were thought to have slight and indirect effects on aggregate investment. Even marginal corporate income tax rate reductions were thought to boost aggregate investment only modestly. To stimulate aggregate investment, many economists recommended asset-specific tax relief such as accelerated depreciation, investment tax credits, and lower differential tax rates on the income from specific capital assets. But, empirical progress in aggregate investment modeling during the last decade and a half suggests that marginal income tax rate reductions is more effective than previously thought in stimulating aggregate investment.

In the three decades prior to 1988, aggregate investment models assumed that all firms operated in a close approximation of a perfect financial market. Beginning in 1988, empirical studies have found that some large businesses in new, rapidly changing industries, many medium-sized businesses, and virtually all small businesses and farms are financing constrained. When financing constrained firms cannot fund their investments through their cash flow or liquid asset stocks, such firms must pay substantial external finance premia over the opportunity costs of internal funds to contract debt or issue equity. As a result, financing constraints force some businesses and farms to forgo some profitable investments.

Incorporating financing constraints into aggregate investment models has profound implications for U.S. tax policy. Aggregate investment models that assume a perfect financial market favor asset-specific tax relief. In contrast, aggregate investment models that incorporate financing constraints favor marginal income tax rate reductions. Marginal income tax rate reductions would increase a business' or a farm's cash flow from its portfolio of existing assets and should stimulate investment. Since many financing constrained businesses and farms are proprietorships, partnerships, or Subchapter S corporations whose income and expenses flow-through to individual tax returns, marginal individual income tax rate reductions rather than asset-specific tax relief are critically important to stimulating investment among these "flow-through" businesses and farms.

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I. INTRODUCTION

Investment is widely recognized as a key to long-term economic growth. Advocates for marginal individual income tax rate reductions argue that such reductions can stimulate aggregate investment directly and substantially. Thus, such reductions sustain long-term U.S. economic growth. Opponents allege that marginal individual income tax rate reductions affect aggregate investment indirectly and slightly. Such reductions diminish future federal budget surpluses and drive real interest rates higher. Consequently, the resulting decrease in aggregate investment from higher real interest rates offsets any meager gains in aggregate investment from such reductions. This depresses long-term U.S. economic growth.

As a previous JEC study observed, empirical studies have been unable to find the frequently alleged statistically significant relationship between the federal budget balance and real interest rates. Apparently, the effects of any change in the federal budget balance on real interest rates are so small that they cannot be consistently measured.[1]

This JEC study answers another question – whether individual marginal income tax rate reductions can stimulate aggregate investment. If this study had been written a decade and a half ago, the answer would have been yes, but only marginally. Clearly, marginal individual income tax reductions stimulate aggregate consumption and labor force participation. However, based on the empirical evidence available a decade and half ago, marginal income tax rate reductions were thought to have indirect and slight effects on aggregate investment. Even marginal corporate income tax rate reductions were thought to boost aggregate investment modestly. To stimulate aggregate investment, many economists recommended asset-specific tax relief such as accelerated depreciation, investment tax credits, and lower differential tax rates on the income from specific capital assets.

But, empirical progress in aggregate investment modeling during the last decade and a half now suggests that marginal income tax rate reductions is more effective than previously thought in stimulating aggregate investment. Based on the findings of recent empirical studies, marginal individual income tax rate reductions appear especially important for stimulating investment among small businesses and farms whose income and expenses flow-through to individual tax returns. This JEC study chronicles this change in aggregate investment modeling and its profound implications for U.S. tax policy.

Although the modeling of aggregate investment began almost a century ago, economists have not yet agreed upon a consensus aggregate investment model. Early economists based their aggregate investment models on macroeconomic scale variables such as income, output, or sales. However, such flexible accelerator models were theoretically unsatisfactory because they used macroeconomic scale variables rather than microeconomic price variables such as input prices, output prices, capital asset prices, and interest rates that should determine investment.

In 1958, Nobel laureates Merton H. Miller and Franco Modigliani proved that a firm's financial structure and its dividend policy were irrelevant to its market value in a perfect financial market.[2] In a perfect financial market, (1) both the managers and the external investors and lenders of every firm have symmetric information about its prospects, and (2) every firm can contract debt or issue equity in whatever amount it needs to invest in any capital asset with a positive net present value at an interest rate

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[1] Robert P. O'Quinn, *Fiscal Policy Choice: Examining the Empirical Evidence*, prepared for the Joint Economic Committee, 107th Congress, 1st session, November 2001.

[2] Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review* 48 (June 1958): 261-297.

that is set competitively in centralized security markets and fully reflects the risk inherent in such assets.[3] This Miller-Modigliani theorem led to the development of two aggregate investment models that are derived from a microeconomic understanding of a firm's investment decision: the neoclassical model (also known as the user cost of capital model) and the *Q* model. While both the neoclassical model and the *Q* model were theoretically superior to flexible accelerator models, neither the neoclassical model nor the *Q* model was empirically better than flexible accelerator models in explaining aggregate investment.

In 1988, Steven M. Fazzari, future Chairman of the Council of Economic Advisers R. Glenn Hubbard, and Bruce C. Petersen demonstrated that (1) many firms confront financing constraints in an imperfect financial market and (2) financing constraints are an independent and statistically significant determinate of aggregate investment. When financing constrained firms cannot fund their investments in capital assets through their cash flow or liquid asset stocks, such firms must pay significant external finance premia over the opportunity costs of internal funds to contract debt or issue equity. As a result, financing constraints force some firms to forgo some profitable investments in capital assets. Fazzari, Hubbard, and Petersen found that the inclusion of a proxy variable for financing constraints such as cash flow in both the neoclassical model and the *Q* model significantly improved their explanatory power.[4] Various empirical studies have subsequently confirmed the findings of Fazzari, Hubbard, and Petersen.

Aggregate investment models that assume firms operate in close approximation of a perfect financial market favor asset-specific tax relief, which lowers a specific asset's effective tax rate, to stimulate aggregate investment. In a perfect financial market, a Miller-Modigliani firm will invest in any capital asset whenever its net present value is positive. A firm's cash flow from its portfolio of existing capital assets is irrelevant to its investment decision. Thus, a firm's marginal income tax rate influences a firm's investment decision only to the extent that such rate affects the cash flow from a newly acquired capital asset and thereby changes such asset's effective tax rate.[5]

In contrast, aggregate investment models that incorporate financing constraints favor marginal income tax rate reductions to stimulate aggregate investment. When financing constraints are binding, a firm's cash flow from its portfolio of existing capital assets determines its investment. Financing constraints may force some firms to forgo investing in some capital assets with a positive net present value. Even if asset-specific tax relief were to reduce a newly acquired capital asset's effective tax rate to zero, such relief would not increase a financing constrained firm's cash flow from its portfolio of existing capital assets and cannot, therefore, enable it to invest. By lowering the average income tax rate applied to a financing constrained firm's cash flow from its portfolio of existing capital assets, a marginal income tax rate reduction would increase a firm's cash flow from its portfolio of existing capital assets and should, therefore, stimulate investment.

Some large firms in new, rapidly changing industries, many medium-sized firms, and virtually all small firms are financing constrained. Many financing constrained firms are proprietorships, partnerships, or Subchapter S corporations whose income and expenses flow-through to individual tax returns. Marginal individual income tax rate reductions rather than asset-specific tax relief are critically important to stimulating investment among these "flow-through" firms. Hence, the recent empirical progress in aggregate investment modeling demonstrates that marginal individual income tax rate reductions promote not only aggregate consumption and labor force participation but also aggregate investment.

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[3] The concept of "firm" includes both farms and non-agricultural businesses.

[4] Steven M. Fazzari, R. Glenn Hubbard, and Bruce C. Petersen, "Financing Constraints and Corporate Investment," in *Brooking Papers on Economic Activity 1*, ed. William C. Brainard and George L. Perry (Washington, D.C.: Brookings Institution, 1988): 141-204.

[5] "Marginal income tax rate reductions" encompass marginal rate reductions for both individual income tax filers and corporate income tax filers unless otherwise specified.

II. WHAT IS INVESTMENT?

"Investment" has many meanings. On one hand, investment may refer to assets. For individuals, investments may mean real estate assets or financial assets such as corporate stocks and bonds. For businesspeople, investments may mean long-term assets such as equipment, land, structures, and intellectual property rights that firms use to produce and distribute goods and services. On the other hand, investment may refer to the acquisition of assets.

To economists, **investment** is the change in capital during a period of time. **Capital** refers to long-term assets that firms use to produce and sell goods and services. Capital is a **stock** variable that is measured at a particular time. In contrast, investment is a **flow** variable that is measured as the change in a stock between two times. Investment and capital are related terms, but they are not synonymous.

The cost of a firm's investment in a capital asset normally exceeds its purchase price. For example, a firm must pay the cost of installing new equipment and training its employees to use it productively. Installation may disrupt existing production and temporarily lower output. Economists refer to these additional costs as **adjustment costs**. Generally, adjustment costs are convex; *i.e.*, they increase at an increasing rate as additional capital assets are added during any period. The sum of a capital asset's purchase price and its adjustment cost is its **replacement cost**.

Cash flow refers to the accounting concept of net cash flow from operating activities. A firm's net cash flow from operating activities equals its cash inflows from sales of goods and services, returns on interest-earning assets (interest received from others), and returns on equity investments (dividends from others) less its cash outflows from payments for inventory purchases, payments for operating expenses (salary, rent, insurance, *etc*.), payments for non-inventory supplies, payments to lenders (interest paid to others), and payments for taxes. In any accounting period, a firm's net change in its cash and cash-equilivent securities must equal the sum of its net cash flow from operating activities, its net cash flow from investing activities, and its net cash flow from financing activities.[6]

Financial economists use **net present value** to determine what expected future cash flows are worth at the present time. Net present value is the sum of discounted future cash flows where the discount rate reflects the time value of money, expected inflation, and the risk associated with such cash flows.[7] A firm's market value is the net present value of its expected future after-tax cash flows.

A firm seeks to maximize its market value through the production and sale of goods and services. A firm combines various inputs such as labor, raw materials, and the use of capital assets to produce an output of goods and services. A firm invests in capital assets during the current period in order to employ such capital assets in producing and selling goods and services during future periods. Interest rates and prices of inputs, outputs, and captial assets are market-determined. Based upon a firm's expectations for future prices, technological change, adjustment costs, and other factors, a firm makes production and

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[6] A firm's net cash flow from investing activities equals its cash inflows from sales of long-term assets (property, structures, and equipment), sales of the debt and equity securities of other entities (except trading securities), and returns from loans (principal) to other entities less its cash outflows from acquisitions of long-term assets, purchases of debt and equity securities of other entities (except trading securities), and loans (principal) to others. A firm's net cash flow from financing activities equals its cash inflows from proceeds from its borrowing and proceeds from issuing its equity securities less its cash outflows from repayments of its debt principal, repurchases of its equity securities, and payments of dividends to its shareholders.

[7] Specifically, net present value is:

$$NPV = \sum_{t=1}^{\infty} CF_t / (1 + d)^t, \text{ where}$$

NPV = net present value

CF_t = cash flow at time t

d = discount rate that reflects the time value of money, expected inflation, and risk

investment decisions in the current period. Economists refer to this description of a firm's operations as its **optimization problem**.

III. MODELING AGGREGATE INVESTMENT

In theory, aggregate investment models should be derived from a firm's optimization problem. The price variables that determine a firm's investment at the microeconomic level should be the same factors that determine aggregate investment at the macroeconomic level. In practice, modeling aggregate investment has proven difficult. After years of empirical research, economists have agreed upon the modified life cycle permanent income hypothesis as the consensus model for explaining aggregate consumption. However, economists have yet to achieve a consensus model for explaining aggregate investment.

A. FUNDAMENTAL CHARACTERISTICS OF INVESTMENT

Fundamental characteristics of investment – **duration; lumpiness; specificity, irreversibility, and sunk costs;** and **entry and exit of other firms** – have made aggregate investment far more challenging to model than aggregate consumption.

- **Duration**. Investment involves the acquisition of long-term assets. In contrast, most consumption expenditures are for nondurable goods and services. In 2000, nondurable goods and services constituted 87.8 percent of personal consumption expenditures in the United States, while durable goods accounted for only 12.2 percent.[8]
- **Lumpiness**. Investment is lumpy. Citing a U.S. Department of Commerce, Bureau of the Census study that documented annual equipment investment at 12,000 U.S. manufacturing plants over 17 years, Caballero (1999) noted that the largest equipment investment episode in a plant averaged 25 percent of its total equipment investment over the entire period and that more than half of the plants experienced equipment capital growth of nearly 50 percent in a single year. Moreover, the second largest increase in equipment capital occurred in the year before or after the largest increase suggesting that both represent a single plant expansion or overhaul. Citing the same study that included data on approximately 360,000 establishments for Census years 1977 and 1987, Caballero noted that the top 100 investment projects accounted for 18 percent of the aggregate investment.[9] In contrast, consumption is relatively smooth. The costs of most nondurable goods and services and even some durable goods are relatively small compared to an average consumer's income.
- **Specificity, irreversibility, and sunk costs**. Most capital assets are **specific** to a single industry or even a single firm. For example, integrated steelmakers need basic oxygen furnaces (BOFs), whose unit construction cost is approximately $1 billion, to make virgin steel, but BOFs are useless to firms in other industries.[10] Economists describe investments in specific assets as **irreversible**; *i.e.*, if a firm terminates a project using a specific asset, the firm can recover only a small fraction of its cost in the secondary market. If the demand for steel declines, an integrated steelmaker may attempt to sell a BOF. However, slack demand lessens the market value of a BOF to other integrated steelmakers. To firms in other industries, a BOF is worth no more than its scrap value. The costs of investing in capital assets that cannot be recovered when they are terminated are called **sunk costs**. If a bankrupt integrated steelmaker were forced to liquidate its BOF for $1 million, its sunk cost would be $999 million. In contrast, most consumer goods and services are not specific to a particular consumer.

[8] Derived from Table B-1 in Executive Office of the President, Council of Economic Advisors, *Economic Report of the President* (Washington, D.C.: U.S. Government Printing Office, 2002): 320.
[9] Ricardo J. Caballero, "Aggregate Investment," in *Handbook of Macroeconomics, Volume 1,* ed. John B. Taylor and Michael Woodford (Amsterdam: Elsevier Science B.V., 1999): 823-824.
[10] The BOF cost estimate is based upon the author's conversations with steel industry experts and would fund a BOF of sufficient size to enjoy economies of scale given current technology.

While many nondurable goods and services are irreversible (*e.g.*, a restaurant meal cannot be resold to another consumer), the cost of an individual unit of most nondurable goods and services is so small relative to a consumer's income that termination does not involve a substantial sunk cost (*e.g.*, a consumer that dislikes a particular brand of cereal loses only a couple of dollars by terminating his or her consumption of such cereal). Terminating the consumption of durable goods often may entail large sunk costs relative to a consumer's income.

- **Entry and exit of other firms**. Capital assets are determined by not only the investment decisions of incumbent firms in any particular industry but also by the entry decisions of new firms or firms in other industries and the exit decision of incumbent firms. An individual firm's investment decisions may affect the number of firms in its industry as well as industry output and prices. In contrast, the number of consumers changes slowly and predictably due to demographic factors of birth, death, and migration. Consumers are so numerous that an individual consumer's consumption decisions are unlikely to affect sales volume and prices of consumer goods and services significantly.

B. ACCELERATOR, FLEXIBLE ACCELERATOR, NEOCLASSICAL, AND *Q* MODELS

1. Accelerator Model

During the first quarter of the last century, John Maurice Clark offered an *ad hoc* model to explain aggregate investment. Disregarding any relationship to a firm's optimization problem, Clark (1917) proposed the **accelerator model**, in which aggregate investment has a simple proportional relationship with output or gross domestic product (GDP).[11]

2. Flexible Accelerator Model

Economic data rejected a simple proportional relationship between aggregate investment and GDP. Consequently, Hollis B. Chenery (1952) proposed the **flexible accelerator model**. Assuming that the desired capital has a proportional relationship to GDP, the flexible accelerator model describes aggregate investment as a function of macroeconomic scale variables that transforms current capital into desired capital over time.[12] However, the flexible accelerator model remained theoretically unsatisfactory because it is not tethered to a firm's optimization problem and excludes microeconomic price variables that should *a priori* affect aggregate investment.

3. Miller-Modigliani Revolution

Early econometric studies suggested that financing constraints among firms were important determinates of aggregate investment. For example, Nobel laureate Jan Tinbergen (1939) found "that fluctuations in investment activity are in the main determined by the fluctuations in the profits earned in industry as a whole some months earlier."[13] While the investment decision is subject to a multiplicity of influences, Meyer and Kuh (1957) observed, "By far the most outstanding aspect of the direct [empirical] inquiries is their virtual unanimity in finding that internal liquidity considerations and a strong preference for internal finance are prime factors in determining the volume of investment."[14]

With the publication of "The Cost of Capital, Corporation Finance, and the Theory of Investment," Nobel laureates Merton H. Miller and Franco Modigliani (1958) revolutionized financial economics and swept away any consideration of financing constraints in the modeling of aggregate investment for three decades. Miller and Modigliani proved that a firm's financial structure – its liquidity

[11] John Maurice Clark, "Business Acceleration and the Law of Demand," *Journal of Political Economy* 25 (March 1917): 217-235.
[12] Hollis B. Chenery, "Overcapacity and the Acceleration Principle," *Econometrica* 20 (January 1952): 1-20.
[13] Jan Tinbergen, "A Method and Its Application to Investment Activities," in *Statistical Testing of Business Cycle Theories*, vol. 1. (Geneva: League of Nations, 1939): 49.
[14] John R. Meyer and Edwin Kuh, *The Investment Decision: A Empirical Study* (Cambridge, Massachusetts: Harvard University Press, 1957): 17.

and its leverage – and its dividend policy are irrelevant to its optimization problem and its market value in a perfect capital market. Subsequently, this became known as the **Miller-Modigliani theorem**.[15]

a) Neoclassical Model (User Cost of Capital Model)

The Miller-Modigliani theorem led to the development of two aggregate investment models, the **neoclassical model** and the ***Q* model**, based upon a firm's optimization problem.[16] Jorgenson (1963 and 1971), Hall and Jorgenson (1967), and Jorgenson and Siebert (1968) derived the neoclassical model (also known as the user cost of capital model) from a firm's optimization problem.[17] Holding that investment is the adjustment between current capital and desired capital, the neoclassical model represents aggregate investment as the sum of capital depreciation and a function of the **user cost of capital** and output variables.[18] The user cost of capital is a summary variable for the implicit price that a firm pays to use capital assets to produce goods and services during one time period. The user cost of capital variable includes asset price, captial asset depreciation, interest rate, and tax components, the interest rate component of which is set in centralized, competitive financial markets. The user cost of capital concept differs from the traditional cost of funds concept because the user cost of capital incorporates capital asset depreciation and thus represents a firm's total cost of using capital assets to produce goods and services.[19]

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[15] Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review* 48 (June 1958): 261-297.

[16] Both the neoclassical model and later the *Q* model assume that a firm can borrow whatever funds they need to finance their investments at interest rates determined in centralized securities markets. External investors and lenders are assumed to have essentially the same information on a firm's prospects as its managers. Such a firm is not financing constrained and is referred to as a Miller-Modigliani firm.

[17] Dale W. Jorgenson, "Capital Theory and Investment Behavior," *American Economic Review* 53 (May 1963): 247-259; Robert E. Hall and Dale W. Jorgenson, "Tax Policy and Investment Behavior," *American Economic Review* 57 (June 1967): 391-414; Dale W. Jorgenson and Calvin D. Siebert, "A Comparison of Alternative Theories of Corporate Investment Behavior," *American Economic Review* 58 (September 1968): 681-712; and Dale W. Jorgenson, "Econometric Studies of Investment Behavior: A Survey," *Journal of Economic Literature* 9 (December 1971): 1111-1147.

[18] Specifically, the neoclassical model is:

$$I_t = (\delta * K_{t-1}) + \sum_{j=0}^{j=J} [\alpha * B_j * \Delta(Y_{t-j} * C_{t-j}^{-\sigma})] + u_t, \text{ where}$$

I_t = investment during time t-1 to time t
δ = depreciation of capital at a geometric rate
K_{t-1} = capital at time t – 1
J = number of lags
α = distribution parameter and is normally assumed to be 1
B_j = delivery distribution lag at time j
Y_{t-j} = output at time t – j
C_{t-j} = user cost of capital at time t – j
σ = elasticity of the user cost of capital with respect to investment
u_t = stochastic error term at time t

[19] Specifically, the user cost of capital variable is:

$$C_t = p_t * (r_t + \delta) * (1 + m_t + z_t) / (1 - t_t), \text{ where}$$

C_t = user cost of capital at time t
p_t = purchase price of new capital relative to output at time t
r_t = real interest rate at time t, which is composed of a nominal interest rate less the inflation rate
δ = depreciation of capital at a geometric rate
m_t = investment tax credit rate at time t
z_t = present value of depreciation tax allowances at time t
t_t = marginal business income tax rate at time t

b) "*q*" Model and *Q* Model

William C. Brainard and Nobel laureate James Tobin (1968) and Tobin (1969) developed the *q* model for aggregate investment based upon a firm's optimization problem. Under the *q* model, a Miller-Modigliani firm invests so long as the ratio of the marginal expected value of an additional unit of capital to its replacement cost, known as **marginal *q***, exceeds 1. While marginal *q* is theoretically attractive as an explanatory variable for investment, it depends upon future expectations and therefore cannot be directly observed.[20]

Hayashi (1982) reconciled the neoclassical model with the *q* model theoretically and demonstrated how the *q* model could be used empirically. First, Hayashi demonstrated that the neoclassical model and the *q* model are theoretically equivalent under the assumption of convex adjustment costs. Second, Hayashi proved that **average *q*** – the ratio of a firm's market value to the replacement costs of its existing capital stock – equals marginal *q* under certain conditions.[21] Since average *q* is observable, substituting average *q* for marginal *q* makes the *q* model empirically testable.[22]

Future Secretary of the Treasury Lawrence H. Summers (1981) believed that a *q* should reflect tax factors such as the corporate income tax rate, investment tax credits, the value of depreciation allowances, the effective tax rate on corporate dividends, and the effective tax rate on capital gains that are relevant to a firm's investment decision.[23] As a result, Summers developed a **tax-adjusted average *q***, which he named ***Q***.[24] Summers compared various specifications of *q* models and *Q* models using aggregate U.S. time-series data.[25] Summers found, "*Q* has more explanatory power gauged in terms of its own statistical significance or regression standard errors than does *q*."[26]

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[20] William C. Brainard and James Tobin, "Pitfalls in Financial Model Building," *American Economic Review* 58 (May 1968): 99-12; and James Tobin, "A General Approach to Monetary Theory," *Journal of Money, Credit, and Banking* 1 (February 1969): 15-29.

[21] Hayashi's conditions are: (1) competitive input and output markets; (2) adjustment and production costs are linearly homogeneous; (3) capital is homogeneous; and (4) investment decisions are largely separate from other real and financial decisions.

[22] Fumio Hayashi, "Tobin's Marginal *q* and Average *q*: A Neoclassical Interpretation," *Econometrica* 50 (January 1982): 214-224.

[23] Lawrence H. Summers, "Taxation and Corporate Investment: A *q* Theory Approach," in *Brookings Papers on Economic Activity 1*, ed. by William C. Brainard and George L. Perry (Washington D.C.: Brookings Institution, 1981): 67-127.

[24] Specifically, *Q* is:

$Q = <\{[(V - D_p) * (1 - c)] / [p * K * (1 - \theta)]\} - 1 + \beta + I + D_f> / (1 - \tau)$, where

V = stock market value of all non-financial corporations at the beginning of the year
D_p = present value of depreciation tax allowances for existing capital
c = estimated effective marginal tax rate on capital gains
p = price level
K = capital stock at the beginning of the year, which is assumed to be the sum of equipment, structures, and inventories, all valued at replacement costs
θ = estimated marginal tax rate on dividends, which is a weighted average of individual marginal rates with weights equal to the share of dividends to taxpayers in each weight class
β = ratio of the market value of outstanding corporate debt, less financial assets, to the capital stock, K
I = investment tax credit rate adjusted to reflect eligibility rules
D_f = present value of depreciation tax allowances for future investments in new capital
τ = marginal corporate income tax rate

In this study, small letter *q* refers exclusively to Tobin's *q* and capital letter *Q* refers exclusively to Summers' tax adjusted *q* or *Q*. A *q* model uses the *q* variable. A *Q* model uses the *Q* variable.

[25] Specifically, the *Q* model is:

$I_t/K_t = [(1 / \alpha) * Q_t] + u_t$, where

4. Other Explicit and Implicit Models

While the neoclassical model and the *Q* model have important similarities, Chirinko (1993) recognized that they treat dynamic factors such as expectations and adjustment costs differently.[27] The *Q* model explicitly introduces expectations and adjustment costs into the model and allows economists to estimate coefficients linked to these factors. Therefore, the *Q* model is an **explicit model**. Other explicit models include the Euler investment equations model[28] and the direct forecasting model.[29] In contrast, the neoclassical model maintains a specific assumption about adjustment costs and introduces unobservable expectations through distributed lags on observable variables.[30] Therefore, the neoclassical model is an **implicit model**. Other implicit models include the vector autoregressive model,[31] the effective tax rate model,[32] and the return-over-cost model.[33]

I_t = investment during time t-1 to time t
K_t = capital at time t
α = adjustment cost variable
Q_t = the tax adjusted value of *q* at time t
u_t = stochastic error term at time t

[26] Summers (1981): 94.

[27] Robert S. Chirinko, "Business Fixed Investment Spending: Modeling Strategies, Empirical Results, and Policy Implications," *Journal of Economic Literature* 31 (December 1993): 1875-1911.

[28] The Euler investment equations model differs from the *Q* model in how unobservable expectations are treated. In the *Q* model, unobservable expectations are represented the shadow price of a unit of capital. This is defined as the net present value of expected future cash flows (also known as future marginal revenue products) from a unit of capital whose discount rate reflects the risk associated with these cash flows over the expected life of the unit of capital. Using the Euler investment equations allows the infinite number of expected future marginal revenue products from a unit of capital to be reduced to a single marginal revenue product from a unit of capital. Thus,

$I_t/K_t = (\rho * I_{t+1} / K_{t+1}) - \{(1 / \alpha) * [p_t - (\rho * p_{t+1})]\} + [(1 / \alpha) * \lambda_t] + u_t$, where

I_t = investment during time t-1 to time t
K_t = capital at time t
I_{t+1} = investment during time t to time t+1
K_{t+1} = capital at time t+1
α = adjustment cost variable
p_t = price of unit of capital at time t
p_{t+1} = price of unit of capital at time t+1
λ_t = marginal revenue product of a unit of capital at time t
u_t = stochastic error term at time t

[29] The direct forecasting model forecasts the net present value of expected future cash flows (or future marginal revenue products) from a unit of capital.

[30] A lagged variable incorporates not only the value of a variable during the current time but also its value during a certain number of past periods of time.

[31] Because autonomous shocks in the neoclassical model may be correlated with output and user cost of capital variables, the resulting bias could result in finding significant output effects and insignificant user cost of capital effects even though the user cost of capital should have a substantial negative effect on investment. To overcome this problem, Sims (1980) applied a vector autoregressive model that treats each variable as endogenous and regresses current values on their lags and those of other variables. Christopher A. Sims, "Macroeconomics and Reality," *Econometrica* 48 (January 1980): 1-48.

[32] Specifically,

$I_t/Y_t = \gamma_0 + \gamma_1 RN_{t-1} + \gamma_2 UCAP_{t-1} + u_t$, where

I_t = investment during time t-1 to time t
Y_t = gross national product (GNP) during time t-1 to time t
RN_{t-1} = the real net return to capital at time t-1, which is equal to the average yield to bondholders and equity investors net of depreciation and effective taxes at time t-1
$UCAP_{t-1}$ = capacity utilization index at time t-1

C. EMPIRICAL STUDIES WITHOUT FINANCING CONSTRAINTS

1. Neoclassical Models and Q Models

Prior to Fazzari, Hubbard, and Petersen (1988), empirical studies tested either the neoclassical model or the *Q* model using aggregate or firm-level data without reference to any financial factors. Aggregate investment models that are derived from a firm's optimization problem, use microeconomic price variables, and assume firms operate in a close approximation of a perfect financial market should be significantly better than *ad hoc* aggregate investment models that are based upon macroeconomic scale variables in predicting actual investment. However, empirical studies using either the neoclassical model or the *Q* model have not, in fact, yielded more accurate forecasts.[34]

Applying a sales and profits accelerator model to data from 800 U.S. firms in the McGraw-Hill capital expenditure surveys during 1955-1962, Eisner (1967) found that a firm's investment is highly responsive to sales growth in firms in other industries, but less so to its sales growth or sales growth in other firms in its industry. Eisner interpreted these findings as a "permanent income theory of investment" in which firms invest when their managers believe sales growth is permanent (as represented by cross-industry sales growth) rather than transitory (as represented by their or own-industry sales growth).[35]

Using Jorgenson's quarterly U.S. data during 1947-1960, Eisner and Nadiri (1968) found "scant empirical support for usefulness of the neoclassical model." Jorgenson's findings arose from his assumption that the elasticity of the desired capital stock is 1 with respect to both output and relative prices. Instead, Eisner and Nadiri found the elasticity of the desired capital stock with respect to relative prices was approximately 0.05, while the elasticity of the desired capital stock with respect to output was reasonably high. Their findings are consistent with the flexible accelerator model, but inconsistent with the neoclassical model.[36]

As for the *Q* model, both Summers (1981) and Hayashi (1982) applied *Q* models to aggregate U.S. data with each using a slightly different definition of *Q*.[37] However, Summers and Hayashi found a weak fit of their models to their data. Summers and Hayashi also found unreasonably large adjustment costs, implying that investment responds over an implausibly long time to exogenous changes in the economic environment.[38] The adjustment cost parameter – α – affects the speed at which investment

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There are two major differences between the neoclassical model and the effective tax rate model. First, the price variable in the neoclassical model, the user cost of capital, is a marginal concept, but the price variable in the effective tax rate model is based upon averages. Second, the effective tax rate model relates net investment directly to quantity and price variables, treating "the combined behavior of firms and households as a 'black box' that links net investment to the net-of-tax profitability of investment." Martin Feldstein, "Inflation, Tax Rules, and Investment: Some Econometric Evidence," *Econometrica* 50 (July 1982): 825-862.

[33] Feldstein's return-over-cost model substitutes $MPNR_{t-1} - COF_{t-1}$ for RN_{t-1} in the effective tax rate model where $MPNR_{t-1}$ = the maximum potential net return at time t - 1 and COF_{t-1} = cost of funds at time t - 1. Feldstein (1982).

[34] For a review of empirical studies, see: Jorgenson (1971) and Chirinko (1993).

[35] Robert Eisner, "A Permanent Income Theory for Investment: Some Empirical Explorations," *American Economic Review* 57 (June 1967): 363-390.

[36] Robert Eisner and M. I. Nadiri, "Investment Behavior and Neo-Classical Theory," *Review of Economics and Statistics* 50 (August 1968): 369-382.

[37] Summers (1981): 92-93 and Hayashi (1982): 223.

[38] Chirinko (1993): 1892.

If $(I_t/K_t) - \alpha \geq 0$, then $A = (\alpha/2) * [(I_t/K_t) - \alpha]^2 * K$, and if $(I_t/K_t) - \alpha < 0$, then $A = 0$, where

A = adjustment cost
α = adjustment cost factor
I_t = investment during time t-1 to time t
K_t = capital stock at time t

responds to exogenous changes. As α becomes larger, the adjustment cost function becomes steeper and investment responds more slowly. Summers (1981) found α of 32.3, meaning that the capital stock would have moved only 59 percent of the way to its ultimate steady-state level 20 years after an exogenous change to the economic environment.[39] Similarly, Hayashi found α of 23.6.[40]

2. Tax Reforms as Natural Experiments

To demonstrate a relationship between microeconomic price variables and aggregate investment, economists employed firm-level data and "natural experiments" such as major tax reforms. Generally, non-fundamental factors may cause short-term "noise" in the stock market; *i.e*., fluctuations of a firm's stock market value around its fundamental value. Such noise obscures any change in a firm's fundamental *Q* and biases a *Q* model's estimate of the *Q* variable toward zero. Immediately after a tax reform is implemented, a large share of the change in the *Q* variable would represent fundamental change rather than noise. Therefore, an estimate of the *Q* variable should be more accurate immediately after a tax reform is implemented.

Using U.S. Department of Commerce, Bureau of Economic Analysis annual data on investment for 36 asset classes and 7 industrial groups during 1947-1985, Auerbach and Hassett (1991) constructed an investment model with a user cost of capital variable to forecast 1987 and 1987-1989 outcomes for equipment and structure investment and compared forecasted outcomes to actual results. For equipment and structures, Auerbach and Hassett found that actual investment was lower than predicted investment for either 1987 or 1987-1989. Regressing the equipment forecast errors for 1987, the user cost of capital variable coefficient was -0.99 and statistically significant. Regressing the structure forecast errors for 1987, however, the user cost of capital coefficient was only -0.07 and statistically insignificant.[41] Auerbach and Hassett concluded:

> *The results … suggest that the* Tax Reform Act of 1986 *may have exerted a considerable impact on equipment investment after its passage. … [T]he pattern of overprediction corresponds well to the pattern of changes in marginal effective tax rates facing new equipment investment.*[42]

Using annual data on U.S. manufacturing firms in the Compustat industrial database during 1970-1985, Cummins and Hassett (1992) constructed another model to forecast outcomes for equipment and structure investment for 1987 and compare the forecasted outcomes to actual results. For both equipment and structure investment, actual results were below forecast results. Regressing the forecast errors, Cummins and Hassett found that the user cost of capital variable coefficient ranged from -1.06 to -1.25 for equipment and from -0.575 to -0.712 for structures. These estimates implied an elasticity of the user cost of capital with respect to investment of approximately -1.1 for equipment and -1.2 for structures. Cummins and Hassett also estimated α to be 4.6 for equipment and 14 for structures. Adjustment costs were substantially lower than in Summers (1981) or Hayashi (1982). In other words, a dollar investment in equipment would cause 28 cents in adjustment costs; a dollar in structures, 35 cents.[43]

Applying both the *Q* model and the neoclassical model to annual data on U.S. manufacturing firms in the Compustat industrial database during 1963-1988, Cummins, Hassett, and Hubbard (1994) found that the *Q* variable has a positive and significant effect on investment in a year following a tax reform and has no significant effect in other years. When using a neoclassical model, Cummins, Hassett,

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[39] Summers (1981): 101.
[40] Hayashi (1982): 223.
[41] Alan J. Auerbach and Kevin A. Hassett, "Recent U.S. Investment Behavior and the Tax Reform Act of 1986: A Disaggregate View," *Carnegie-Rochester Conference Series on Public Policy* 35 (1991): 185-216.
[42] *Ibid*. 212.
[43] Jason G. Cummins and Kevin A. Hassett, "The Effects of Taxation on Investment: New Evidence from Firm Level Panel Data," *National Tax Journal* 45 (September 1992): 243-251.

and Hubbard found the user cost of capital variable was a significant determinate of investment in the year following a tax reform and insignificant in other years. Furthermore, Cummins, Hassett, and Hubbard calculated an elasticity of investment with respect to the user cost of capital of approximately -0.66.[44]

Applying the *Q* model to annual data from over 3,000 firms in 14 countries, Cummins, Hassett, and Hubbard (1996) compared the results of a time-series approach to a year after a major tax reform approach. The time-series approach yielded *Q* variable coefficients that are statistically significant and quantitatively similar across the 14 countries, but implied large adjustment costs. The year after a major tax reform yielded similar *Q* variable coefficients for 12 of the 14 countries. Additionally, the adjustment costs were more reasonable – between 5 percent and 10 percent of the unit cost of an investment – and implied that investment is highly responsive to changes affecting the marginal cost of investment.[45]

D. FINANCING CONSTRAINTS

Girded by the Miller-Modigliani theorem, both the neoclassic model and the *Q* model assume that financial markets will provide firms with whatever funds are necessary to invest in any capital assets with positive present values at an interest rate that is set competitively in centralized security markets and fully reflects the risk inherent in such assets. Financing constraints are absent from firms' optimization problem. In contradiction of the assumptions embedded in both the neoclassical model and the *Q* model, recent empirical studies have found that many firms confront significant financing constraints.

1. "Black Box" and the Credit Channel of Monetary Policy Transmission

To understand the significance of this departure, it is necessary to examine how monetary policy changes are transmitted to the economy. Nobel laureate Milton Friedman and Anna Schwartz (1963) posited that monetary policy actions affect real output during a long and variable interval of up to 2 years before their price effects are fully realized.[46] This transmission mechanism from monetary policy actions to changes in real output and prices is often referred to as the "**black box**." In neoclassical textbooks, the monetary authority takes policy actions to influence short-term interest rates. These policy actions change the user cost of capital and thus affect spending on fixed assets, housing, and durable goods. However, empirical studies have generally not found the user cost of capital to be a powerful explanatory variable for aggregate investment. Moreover, Bernanke and Gertler (1995) found that monetary policy-induced fluctuations in short-term interest rates produce real effects whose magnitude, timing, and composition are unexpected; *e.g.*, small policy-induced short-term interest rate changes often produce large swings in real income; policy-induced short-term interest rate changes typically dissipate after 8 months, but their effects on business investment in fixed assets occur 6 to 24 months later; and policy-induced short-term interest rate changes usually have their largest effects on the purchase of long-term assets that should be sensitive to long-term rather than short-term interest rates.[47]

Bernanke and Gertler explain these "black box" discrepancies through the **credit channel of monetary policy transmission**. The credit channel approach is based upon extensive theoretical and

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[44] Jason G. Cummins, Kevin A. Hassett, and R. Glenn Hubbard, "A Reconsideration of Investment Behavior Using Tax Reforms as Natural Experiments," in *Brookings Papers on Economic Activity 2*, ed. William C. Brainard and George L. Perry (Washington, D.C.: Brookings Institution, 1994): 1-73.

[45] Jason G. Cummins, Kevin A. Hassett, and R. Glenn Hubbard, "Tax Reforms and Investment: A Cross-Country Comparison," *Journal of Public Economics* 62 (1996): 237-273.

[46] Generally see: Milton Friedman and Anna J. Schwartz, *A Monetary History of the United States, 1867-1960* (Princeton, N.J.: Princeton University Press, 1963).

[47] Ben Bernanke and Mark Gertler, "Inside the Black Box: The Credit Channel of Monetary Transmission," *Journal of Economic Perspectives* 9 (Autumn 1995): 27-48.

empirical research into asymmetric information and principal-agent conflicts conducted during the last three decades of last century.[48]

2. Asymmetric Information and "Lemons" Premia

Debt and equity markets function differently when information is relatively costless than when lenders (principals) must incur significant costs to acquire information about the opportunities, characteristics, or actions of borrowers (agents). Nobel laureate George A. Akerlof (1970) established that buyers, lenders, or investors demand risk premia, known as **"lemons" premia**, when buyers, lenders, or investors face uncertainty about the quality of a class of products, individuals, or firms. The lemons premia (1) lower the market price for all products in the suspect class, (2) increase the market interest rate on loans to all borrowers in the suspect class, and (3) increase the threshold rate of return on equity expected by investors from firms in the suspect class.[49]

As long as a firm can fund its investments internally through its cash flow or liquid asset stock, its cost of funds is a market-determined opportunity cost; *i.e.*, the interest that it would have earned on its liquid assets used to fund its investments net of any tax effects. Now suppose that a firm has attractive investment prospects that exceed what it may fund internally. For large firms particularly in mature industries, managers do not generally have better information than external investors about a firm's prospects. Such firms can usually issue new stock to external investors to fund any attractive investments. For small- and medium-sized firms, however, managers often possess better information than external investors. When external investors cannot make quality distinctions, Myers and Majluf (1984) found that external investors demand "lemons" premia on the shares of high-quality firms to offset losses from on the shares of low-quality firms.[50]

3. Agency Problems and Monitoring Costs

Debt financing also creates **agency problems**. Asymmetric information encourages borrowers to engage in opportunistic behavior that may disadvantage lenders. To protect themselves, lenders develop contractual arrangements such as lending covenants and monitor their compliance. For small- to medium-sized firms without ready access to the commercial paper and bond markets, monitoring costs are significant. Jaffee and Russell (1976) found that asymmetric information increases borrowing costs and may result in credit rationing.[51] Bernanke and Gertler (1989) demonstrated that the agency costs of a financing constrained firm increase when an economic downturn reduces its net worth.[52] Because of asymmetric information and agency costs, Calomiris and Hubbard (1990) found that, holding investment

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[48] For reviews of the related empirical literature, see: Mark Gertler, "Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms," *Quarterly Journal of Economics* 109 (May 1994): 309-340

[49] George A. Akerlof, "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics* 84 (August 1970): 488-500.

[50] Stewart C. Myers and Nicholas S. Majluf, "Corporate Financing and Investment Decisions when Firms Have Information That Investors Do Not Have," *Journal of Financial Economics* 13 (June 1984): 187-221. Also see: Bruce C. Greenwald, Joseph E. Stiglitz, and Andrew Weiss, "Information Imperfections in the Capital Market and Macroeconomic Fluctuation," *American Economic Review* 74 (May 1984): 194-200 and Fazzari, Hubbard, and Petersen (1988): 150-151. A firm will make a new investment if its true average q (q^*) is at least equal to the average q (q_m) assigned to all firms by the market. With symmetric information, $q^*/ q_m = 1$. When good firms cannot initially be distinguished from bad firms, $(q^*/ q_m) + \Omega = 1$, where Ω is the lemons premium.

[51] Dwight M. Jaffee and Thomas Russell, "Imperfect Information, Uncertainty, and Credit Rationing," *Quarterly Journal of Economics* 90 (November 1976): 651-666. Also see: Joseph E. Stiglitz and Andrew Weiss, "Credit Rationing and Markets with Imperfect Information," *American Economic Review* 71 (June 1981): 393-411; and Stephen D. Williamson, "Costly Monitoring, Loan Contracting, and Equilibrium Credit Rationing," *Quarterly Journal of Economics* 102 (February 1987): 135-146.

[52] Ben Bernanke and Mark Gertler, "Agency Cost, Net Worth, and Business Fluctuations," *American Economic Review* 79 (March 1989): 14-31.

opportunities constant, firms with stronger balance sheets and higher net worth can secure greater credit and make larger investment than other similar size firms.[53]

4. "Pecking Order of Finance" and External Finance Premia

Because of asymmetric information, agency problems, and monitoring costs, firms face what Myers (1984) described as "**pecking order of finance**." Firms prefer funding their investments internally. Firms set their dividend payout so that cash flow and liquid asset stocks can fund most of a firm's expected level of investment. Firms may incur some debt, but restrain their debt to "safe" levels to minimize their premium over the default-free interest rate and to have "reserve borrowing power" available to take advantage of any unusual investment opportunities. When investment opportunities exceed what firms may generate internally or through "safe" debt, firms prefer to issue less risky securities such as convertible debt or preferred stock before issuing common stock.[54]

The difference between the opportunity costs of internally generated funds and the costs of incurring new debt or issuing new equity is referred to as the **external finance premium**. Existing in a close approximation of a perfect financial market, large firms in mature industries have insignificant or very small external finance premia. Such firms are **Miller-Modigliani firms**. However, some large firms in very rapidly growing industries, most medium-sized firms, and virtually all small firms confront significant external finance premia. Such firms are **financing constrained firms**.

5. Sub-Channels of the Credit Channel of Monetary Policy Transmission

The credit channel of monetary policy transmission operates through two sub-channels: the **balance sheet sub-channel** and the **bank-lending sub-channel**. Monetary policy actions directly affect a firm's balance sheet in two ways. First, monetary expansion (contraction) increases (decreases) the cash flow from firms with floating interest rate or short-term fixed interest rate loans. Second, nominal interest rates affect asset prices and therefore the value of a firm's collateral for loans. Monetary policy actions may also affect a firm's balance sheet indirectly. If a monetary expansion (contraction) increases (reduces) downstream demand, a firm may confront an imbalance between growing (declining) revenues and fixed- or quasi-fixed costs that buttresses (erodes) a firm's balance sheet.[55]

In addition to this balance sheet sub-channel, monetary policy actions may also affect the supply of loans from banks. This is known as the bank-lending sub-channel.[56] According to Kashyap and Stein (1994), monetary expansion (contraction) augments (shrinks) the lower cost core deposit base of banks and therefore allows (forces) banks to rely less (more) on higher cost funding sources such as jumbo CDs. In response to lower (higher) funding costs, banks seek to expand (contract) their loan portfolio, lowering (raising) the external finance premia. During a severe monetary contraction, banks may deny some bank-dependent firms credit altogether.[57]

6. Theoretical Implications for Investment

The credit channel of monetary transmission amplifies the initial effect of a monetary policy action or an external shock on aggregate investment. By reducing (increasing) the cash flow and liquid asset stocks of financing constrained firms, a monetary contraction (expansion) or a negative (positive) external shock effectively increases (decreases) their external finance premia. While investment among Miller-Modigliani firms will decline (expand) proportionately to a negative (positive) policy change or shock, higher external finance premia will cause investment among financing constrained firms to decline

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[53] Charles W. Calomiris and R. Glenn Hubbard, "Firm Heterogeneity, Internal Finance, and 'Credit Rationing'," *Economic Journal* 100 (March 1990): 94-104.
[54] Stewart C. Myers, "The Capital Structure Puzzle," *Journal of Finance* 39 (July 1984): 575-592.
[55] Bernanke and Gertler (1995): 35-40.
[56] *Ibid*. 40-43.
[57] Anil Kashyap and Jeremy Stein, "Monetary Policy and Bank Lending," in *Monetary Policy*, ed. N. Gregory Mankiw (Chicago: University of Chicago Press, 1994): 221-256.

(expand) more than proportionately to the change or shock. This pro-cyclical amplification of the initial effects of a monetary policy action or external shock is known as the **financial accelerator**.

Because of the financial accelerator, small changes in the external finance premia should produce large changes in aggregate investment. If financing constraints are significant, then neither a *Q* variable nor a user cost of capital variable can fully explain aggregate investment. Some financing constrained firms must forego investing in some capital assets in which Miller-Modigliani firms can invest because the external finance premia facing financing constrained firms spike their user cost of capital well above the market-determined user cost of capital in the neoclassical model. Equivalently, some financing constrained firms must forego investing in some capital assets whose marginal *q* exceeds 1 that Miller-Modigliani firms can make. Therefore, financing constraints should be an independent and significant determinate of aggregate investment, and aggregate investment models should include a proxy variable for financing constraints such as cash flow.

E. EMPIRICAL STUDIES INCORPORATING FINANCING CONSTRAINTS

1. Fazzari, Hubbard, and Petersen

Departing from the Miller-Modigliani theorem, Fazzari, Hubbard, and Petersen (1988) incorporated proxy variables for financing constraints into aggregate investments models.[58] Fazzari, Hubbard, and Petersen applied the statistical techniques that Hayashi (1985)[59] and Zeldes (1989)[60] developed to test whether liquidity constraints affect aggregate consumption.[61] Employing Value Line data for U.S. manufacturing firms with positive real sales growth between 1969 and 1984, Fazzari, Hubbard, and Petersen selected dividend policy as the *a priori* criterion for identifying firms likely to confront financing constraints and divided these firms into three groups: class 1 firms had dividend payout ratios of less 0.1 for at least 10 years, class 2 firms had ratios of greater than 0.1 but less than 0.2 for at least 10 years, and class 3 firms had ratios of greater than 0.2.[62]

Fazzari, Hubbard, and Petersen hypothesized that class 1 firms would likely confront financing constraints. Applying a modified *Q* model with a cash flow variable, Fazzari, Hubbard, and Petersen found, "In class 1, 46 percent to 55 percent of the variance in I/K is explained, depending on the time period analyzed, primarily due to the variation in cash flow alone."[63] Moreover, the addition of a cash flow variable significantly improved the fit of the *Q* model to data.[64] Fazzari, Hubbard, and Petersen concluded:

> *Internal funds help explain investment in all class, even for firms that have much more cash flow than investment. … These results are consistent with the cost*

[58] Fazzari, Hubbard, and Petersen (1988): 141-195.
[59] Fumio Hayashi, "The Effects of Liquidity Constraints on Consumption: A Cross-Sectional Analysis," *Quarterly Journal of Economics* 100 (February 1985): 183-206.
[60] Stephen P. Zeldes, "Consumption and Liquidity Constraints: An Empirical Investigation," *Journal of Political Economy* 97 (April 1989): 305-346.
[61] For an overview of the modeling of aggregate consumption, see: Robert P. O'Quinn, *The Effects of Duration of Federal Tax Reductions: Examining the Empirical Evidence*, Prepared for the Joint Economic Committee, 107th Congress, 2nd session, February 2002: 2-7.
[62] Fazzari, Hubbard, and Petersen (1988): 157-163.
[63] Fazzari, Hubbard, and Petersen observed that the structure of the Value Line data contributed to this outcome. Value Line does not add a firm to its database until it is "of interest to subscribers and the financial community, but when a firm is added, Value Line records a firm's income and balance sheet data for at least 10 years prior to the date of its inclusion. Therefore, the rapid growth period for a young firm is more likely to occur during the early years of this sample. Therefore, "[m]ost class 1 firms began paying dividends in the last two years of the sample (1983-1984) and were no longer exhausting their internal funds. … [A]s firms mature and more observations of projected realizations and balance sheets are collected, asymmetric information problems should become less severe."
[64] *Ibid*. 165-173.

> *differential between internal and external finance … The economic importance of these findings is magnified by the fact that cash flow is highly variable for the rapidly growing firms in the first class, while mature firms in the third class experience much less variation in cash flow*.[65]

Applying two modified sales accelerator models, one with a lagged sales variable and a cash flow variable and the other with a lagged sales variable, a cash flow variable, and a *Q* variable, Fazzari, Hubbard, and Petersen sought to determine whether the cash flow variable should be interpreted as a signal of expected investment profitability not captured in the lagged sales variable or whether the cash flow variable should be interpreted as a signal of the importance of low cost internal funds among financing constrained firms that must pay external finance premia. In the first model, the coefficients on the cash flow variable were 0.277 for class 1 firms and 0.120 for class 3 firms, both of which were statistically significant. Since *Q* is based on asset prices in forward-looking markets, the inclusion of *Q* should capture expected future investment profitability and reduce the importance of the cash flow variable if the cash flow variable is merely reflecting expected future investment profitability not captured in the lagged sales variable. After the inclusion of *Q* in the second model, Fazzari, Hubbard, and Petersen found that the coefficients on the cash flow variable were 0.286 for class 1 firms and 0.086 for class 3 firms, both of which were again statistically significant.[66] "To the extent that *Q* captures the effect of the future profitability on the demand for investment, this result supports the financing constraint interpretation."[67]

Applying two modified neoclassical models, one with a cash flow variable and the other with both a cash flow variable and a *Q* variable, Fazzari, Hubbard, and Petersen found once again that cash flow variable was statistically significant in the first neoclassical model. The addition of *Q* to the second neoclassical model made little difference. Regardless of the model applied, Fazzari, Hubbard, and Petersen found that cash flow was statistically significant in explaining aggregate investment, but its importance fell as the dividend payout ratio rose.[68]

Firms that face external finance premia may accumulate liquid assets as buffer stocks against cash flow fluctuations. Such buffer stocks should reduce the sensitivity of investment to cash flow fluctuations and therefore have a positive relationship with investment in financing constrained firms. Applying three modified *Q* models with a cash-and-marketable securities variable, a working capital variable, and lagged cash and sales variables, Fazzari, Hubbard, and Petersen tested this hypothesis. Fazzari, Hubbard, and Petersen found that these stock liquidity variables were significant for class 1 firms, but were insignificant for class 3 firms in each of the three modified *Q* models. Moreover, while including lagged cash and sales variables caused the cash flow coefficient to decline across all classes, the inclusion did not have any significant effect on the stock liquidity variables. Since stock liquidity variables, unlike cash flow, are unlikely to have predictive power about future investment profitability, these findings provide strong support for importance of financing constraints in determining aggregate investment.[69]

2. Subsequent Empirical Studies

Fazzari, Hubbard, and Petersen sparked other economists to commence empirical research on whether financing constraints affect aggregate investment. These empirical studies have applied different statistical techniques to a wide variety of data sets. Virtually all of these empirical studies confirmed the findings of Fazzari, Hubbard, and Petersen that (1) many firms confront financing constraints in an imperfect financial market and (2) financing constraints are an independent and statistically significant

[65] *Ibid*. 172-173.
[66] *Ibid*. 173-175.
[67] *Ibid*. 174.
[68] *Ibid*. 175-178.
[69] *Ibid*. 178-182.

determinate of aggregate investment. These nearly unanimous findings provide strong support for including a proxy variable for financing constraints in all aggregate investment models.

These empirical studies are summarized in the Appendix. Readers who accept their findings regarding the prevalence of financing constraints may skip the Appendix and go directly to Section IV. Others are encouraged to review the rich and varied empirical literature on financing constraints in the Appendix before going to Section IV.

IV. IMPLICATIONS FOR TAX POLICY

A. GENERAL TAX POLICY IMPLICATIONS

Although economists have made progress toward achieving a consensus aggregate investment model during the last decade and a half, a number of issues have yet to be fully resolved. The freedom of market entry and the cost of scrapping existing assets may affect aggregate investment, especially when investments are irreversible and sunk costs are high. Caballero and Pindyck (1996) found:

> *If demand increases, existing firms will expand or new firms will enter until the market clears. From the point of view of an individual firm, this limits the amount that price can rise under good industry outcomes. But if investment is irreversible, there is no similar mechanism to prevent price from falling under bad outcomes. Each firm takes price as given, but knows that the distribution of future prices is affected by the irreversibility of investment industry-wide, which leads it to raise the trigger point at which it willing to invest. Idiosyncratic shocks, which affect only an individual firm, do not induce entry and thus should have less impact on the firm's willingness to invest.*[70]

Moreover, asymmetric information about an industry's prospects may cause "investment bunching" as new or peripheral firms in an industry defer from investing until the industry's leading firm makes its investment decisions.[71] Likewise, specificity makes some assets worth more within a business relationship than outside of it. Because of specificity, the value of some long-term assets may be dependent upon cooperation from other firms. Without contracts to protect firms from opportunism, specificity may deter firms from making certain cooperation-dependent investments. Thus, the ease of contracting and contract enforceability may also affect aggregate investment.[72] Further empirical research is needed to resolve the significance of these issues fully.[73]

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[70] Ricardo J. Caballero and Robert S. Pindyck, "Uncertainty, Investment, and Industry Evolution," *International Economic Review* 37 (August 1996): 657. Also see: Ricardo J. Caballero and Guiseppe Bertola, "Irreversibility and Aggregate Investment," *Review of Economic Studies* 61 (April 1994): 223-246.

[71] Andrew Caplin and John Leahy, "Sectoral Shocks, Learning, and Aggregate Fluctuations," *Review of Economic Studies* 60 (October 1993): 777-794.

[72] Ricardo J. Caballero and Mohamad L. Hammour, "The Macroeconomics of Specificity," *Journal of Political Economy* 106 (August 1998): 724-767. For an example of how the development of property rights affects investment, see: Timothy Besley, "Property Rights and Investment Incentives: Theory and Evidence from Ghana," *Journal of Political Economy* 103 (October 1995): 903-937.

[73] Caballero (1999): 844-857.

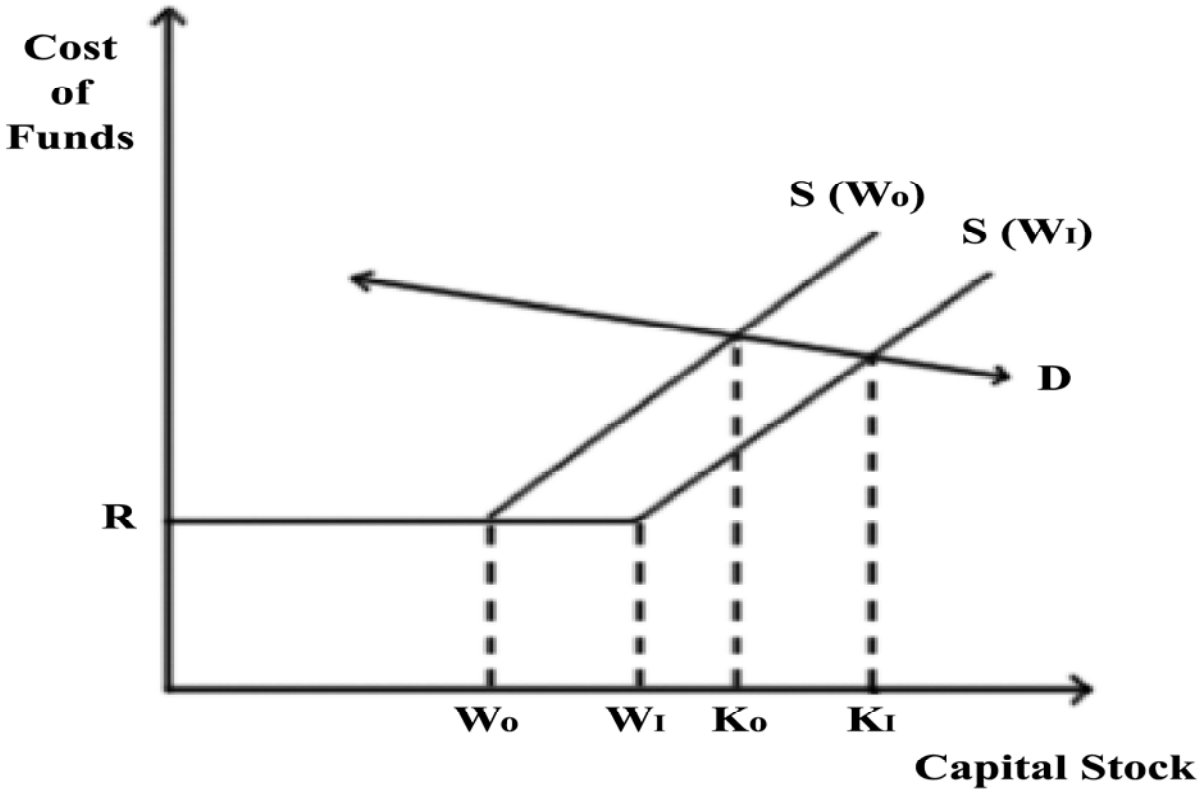

Figure 1 - Effect of a Marginal Income Tax Rate Cut on a Financing Constrained Firm

D = financing constrained firm's demand for funds curve
K_0 = financing constrained firm's capital stock before a marginal income tax rate cut
K_1 = financing constrained firm's capital stock after a marginal income tax rate cut
R = opportunity cost of internal funds expressed as an interest rate
$S(W_0)$ = financing constrained firm's supply of funds curve before a marginal income tax rate cut
$S(W_1)$ = financing constrained firm's supply of funds curve after a marginal income tax rate cut
W_0 = financing constrained firm's internal funds before a marginal income tax rate cut
W_1 = financing constrained firm's internal funds after a marginal income tax rate cut

Based on Hubbard (1998): 196.

Nevertheless, the empirical studies of financing constraints conducted since 1988 have brought economists much closer to a consensus aggregate investment model. Applying different aggregate modeling approaches to various data sets, virtually all of these studies have found that (1) many firms confront financing constraints in an imperfect financial market, (2) proxy variables for financing constraints such as cash flow are statistically significant and independent determinates of aggregate investment, and (3) the addition of such proxy variables to either the neoclassical model or the *Q* model significantly improves the explanatory power of these models.[74]

[74] For general discussion of tax policy implications, see: Steven M. Fazzari, R. Glenn Hubbard, and Bruce C. Petersen, "Investment, Financing Decisions, and Tax Policy," *American Economic Review* 78 (May 1988): 200-205.

From 1958 through 1988, aggregate investment models including the neoclassical model and *Q* model, assumed that firms operated in a close approximation of a perfect financial market. Thus, both the managers of a Miller-Modigliani firm and its external investors and lenders have symmetric information about a firm's prospects. A Miller-Modigliani firm can contract debt or issue equity in whatever amount may be needed to invest in any capital assets with positive net present values at an interest that is set competitively in centralized securities markets and fully reflects the risk inherent in such assets. Thus, a Miller-Modigliani firm does not confront an external finance premium.

Because of the unlimited availability of external funds at competitively determined interest rates, the cash flow from a Miller-Modigliani firm's portfolio of existing capital assets is irrelevant to its investment decision. Therefore, a Miller-Modigliani firm's marginal income tax rate influences its investment decision only to the extent that such rate affects its cash flow from a newly acquired capital asset and thereby changes its effective tax rate.

Aggregate investment models that assume Miller-Modigliani firms operate in a close approximation of a perfect financial market, including the neoclassical model and the *Q* model, favor asset-specific tax relief to stimulate aggregate investment. Asset-specific tax relief includes accelerated depreciation, investment tax credits, and lower differential tax rates on the income from specific capital assets. Such asset-specific tax relief is designed to lower the effective tax rate on specific captial assets. Under a neoclassical model, asset-specific tax relief affects the user cost of capital variable directly. Likewise, asset-specific tax relief directly affects *Q* in the *Q* model.

Both the neoclassical model and the *Q* model deeply influenced the debate over U.S. tax policy during the last third of the last century. Because of these models, economists examined intensely how U.S. tax policy affects the user cost of capital. When policymakers sought advice on how to stimulate aggregate investment, both the neoclassical model and the *Q* model drove many economists to advocate asset-specific tax relief. Measures such as accelerated depreciation or investment tax credits were thought to be both effective and efficient means of stimulating aggregate investment by lowering the user cost of capital. Although marginal income tax rate reductions could stimulate aggregate investment by lowering the effective tax rate on newly capital acquired assets, some economists thought such reductions were "wasteful;" *i.e.*, a large portion of the tax relief from such reductions augments the cash flow from a firm's portfolio of existing capital assets. Because of the assumptions in both the neoclassical model and the *Q* model, such augmentation does not affect a firm's investment decision and therefore cannot increase aggregate investment.

However, all but one of the empirical studies surveyed in the Appendix found that some large firms in new and rapidly changing industries, many medium-sized firms, and virtually all small firms do not operate in a close approximation of a perfect financial market. Instead, these firms are financing constrained. Because of information asymmetries between a firm's managers and its external investors and lenders and high agency costs, financing constrained firms must pay significant external finance premia over the opportunity costs for internal funds to obtain external funds for investing.[75]

Therefore, the cash flow from a firm's portfolio of existing capital assets is more important to a financing constrained firm than to a Miller-Modigliani firm in making an investment decision. A financing constrained firm that exhausts its internal funds may not have any low-cost external substitute for internal funds available at the margin to finance its investment. When a firm's external finance premium between internal funds and external funds is sufficiently large, financing constraints may force a firm to forgo investing in capital assets with positive net present values.[76]

By lowering a financing constrained firm's average tax burden, a marginal income tax rate reduction augments the firm's cash flow from its portfolio of existing capital assets. Such cash flow

[75] Fazzari, Hubbard, and Petersen (May 1988): 202.
[76] Fazzari, Hubbard, and Petersen (May 1988): 203.

augmentation will stimulate investment in a financing constrained firm (see Figure 1). In contrast, any asset-specific tax relief such as accelerated depreciation, investment tax credits, and asset-specific income tax reductions will not augment a financing constrained firm's cash flow even if asset-specific tax relief were to reduce a newly acquired capital asset's effective tax rate to zero. Therefore, asset-specific tax relief will elicit a smaller investment response among financing constrained firms than among Miller-Modigliani firms. This is because the external finance premia increase the user cost of capital for financing constrained firms above the the market-determined user cost of capital for Miller-Modigliani firms, all other things being equal. If financing constraints are binding on some financing constrained firms, asset-specific tax relief will elicit no investment response among these firms whatsoever.

Thus, the conclusions that financing constraints are widespread and are a significant determinate of aggregate investment have caused economists to modify both the neoclassical model and the *Q* model to include a proxy variable for financing constraints such as cash flow. Including financing constraints in aggregate investment models has profound implications for U.S. tax policy as well.

Taxation affects not only the user cost of capital variable in the modified neoclassical model and the *Q* variable in the modified *Q* model, but also the proxy variable for financing constraints in both models. Because the cash flow from existing capital assets matters in determining aggregate investment, marginal income tax rate reductions are more potent in stimulating aggregate investment than many economists previously thought. Marginal income tax rate reductions should not be viewed as "wasting" tax benefits on existing capital assets. Instead, marginal income tax rate reductions empower financing constrained firms to make investment that they would not make with asset-specific tax relief. This is especially true during an economic downturn when financing constraints are more likely to be binding on financing constrained firms.

These findings do not mean that asset-specific tax relief is impotent in stimulating aggregate investment. Asset-specific tax relief is still a very effective means of stimulating investment in large firms in mature industries. For some large firms in new, rapidly changing industries, many medium-sized firms, and virtually all small firms, however, their external finance premia reduce the effectiveness of asset-specific tax relief in stimulating investment. Marginal income tax rate reductions are more effective in stimulating investment among these financing constrained firms. Because marginal income tax rate reductions are helpful to small- and medium-sized firms, limiting tax incentives for investment solely to asset-specific tax relief tends to favor large firms over small- and medium-sized firms.

B. IMPLICATIONS FOR SMALL BUSINESSES AND FARMS

Small- and medium-sized businesses and farms are also more likely to be organized as sole proprietorships, partnerships,[77] or Subchapter S corporations[78] whose income and expenses flow-through

[77] Partnerships also include limited liability companies (LLCs) and limited liability partnerships (LLPs). Partnerships involve two or more people who agree to share equally in all profits or losses. Partnerships are formed through the legal filing of a certificate of formation. All partners are personally liable for everything done by any partner, the partnership, or any employee. Partnership agreements and state laws limit how an interest in a partnership may be transferred. All partnerships are flow-through entities for tax purposes. LLCs and LLPs are unincorporated business entities that are hybrids between a corporation and a partnership. Like a partnership, LLPs or LLCs are formed through the legal filing a certificate of formation. LLCs and LLPs are flow-through entities for tax purposes. Like a corporation, LLCs and LLPs limit the liability of their members. Unlike Subchapter S corporations, which limit the number of shareholders and require all shareholders to be U.S. residents, LLCs and LLPs have do not have such limitations.

[78] "An S corporation is an incorporated entity that retains the main attributes of the traditional C corporation, such as limited liability, freely transferable ownership, and unlimited lifespan, but, in exchange for certain limitations, receives the benefits of a flow-through entity for income tax purposes. The election to be treated as an S corporation allows income and expenses to pass through the corporate structure to its shareholders, and any resulting tax liability is the responsibility of its shareholders. This benefit eliminates the double taxation on the corporation's net income

to individual income tax returns, than large firms. These "flow-through" businesses and farms are significant contributors to the U.S. economy. In tax year 1998, there were 17,408,809 sole proprietorships, 1,855,348 partnerships, and 2,588,088 Subchapter S corporations whose income and expenses flow through individual tax filings compared to 2,260,800 corporate tax filings. These "flow-through" firms accounted for 28.1 percent of reported business receipts and 41.9 percent of reported net income.[79]

Previously, many economists thought that marginal individual income tax rate reductions mainly affected aggregate consumption and labor force participation. These economists believed that marginal individual income tax rate reductions had only a peripheral effect on aggregate investment through the user cost of capital. However, small- and medium-sized firms (which are generally "flow-through" firms) are more likely to be financing constrained than large firms. For these "flow-through" businesses and farms, the marginal income tax rates that matter are individual income tax rates, not corporate income tax rates. These "flow-through" businesses and farms are the least likely to be able to take full advantage of any asset-specific tax relief. For these "flow-through" businesses and farms, reducing marginal individual income tax rates improves their cash flow from existing capital assets, which is the critical factor in determining their investment. Thus, recent empirical progress in aggregate investment modeling demonstrates that marginal individual income tax rate reductions promote not only aggregate consumption and labor force participation but also aggregate investment.

C. QUANTIFICATION OF HOW FINANCING CONSTRAINTS AND TAXES INTERACT

Exact quantification of relative potency of asset-specific tax relief and marginal income tax reductions in stimulating aggregate investment is difficult partly because external finance premia not readily observable and partly because the number of financing constrained firms and size of their external finance premia are related to the business cycle. Unfortunately, there has been scant empirical research quantifying how financing constraints interact with the tax system to affect investment.

One recent empirical study, Carroll, Holtz-Eakin, Rider, and Rosen (2000), analyzed the investing behavior of sole proprietorships, a group of firms that *a priori* are likely to be financing constrained. From the Statistics of Income Individual Income Tax Returns files for tax years 1985 and 1988, Carroll *et al*. employed returns that (1) had filed a Schedule C in 1985, (2) were ages 25 to 55, (3) had not received an earned income tax credit in either 1985 or 1988, and (4) had not been subject to the alternative minimum tax in either 1985 or 1988. Applying various approaches to model investing behavior in 1988, Carroll *et al.* found that the elasticity of investment with respect to the user cost of capital was -1.78 for sole proprietorships. This is significantly higher than the range of -0.25 to -1.0 for

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and capital gains. This is unlike a taxable corporation, which incurs a tax liability at the corporate level on its net income and capital gains, and then again, when profits are distributed to shareholders in the form of dividends, a second tax liability is incurred on those dividends. The elimination of double taxation can result in substantial tax savings for a corporation that is eligible to make a Subchapter S election. … To elect treatment under Subchapter S, an eligible corporation must meet all criteria for an election and file Form 2553, "Election by a Small Business Corporation," with the IRS Submission Processing Center where the corporation files its Federal tax forms. All qualified shareholders of the corporation must consent to the election on Form 2553, and all eligibility requirements must be met prior to election. The criteria for Tax Year 1988 were that the corporation:

- Be a domestic corporation (an unincorporated association, that is treated as a corporation under Code Section 7701, may elect treatment as an S corporation);
- Have no more than 75 shareholders (a husband and wife (and their estates) are counted as one shareholder for this requirement);
- Have only individuals, estates, certain trusts, and exempt organizations as shareholders;
- Have no nonresident alien shareholders; and
- Have only one class of stock."

U.S. Department of the Treasury, Internal Revenue Service, *Statistics of Income Bulletin* 20 (Spring 2001): 48.

[79] Author's calculations from IRS *Statistics of Income Bulletin* data for tax year 1988.

the elasticity of investment with to respect to the user cost of capital that previous empirical studies had found for corporations. Carroll *et al*. attributed this difference to financing constraints among sole proprietorships. Carroll *et al.* calculated that a five-percentage-point increase in marginal individual income tax rates would reduce the proportion of sole proprietorships that would invest in new capital by 10.4 percent and would lower average investment in new capital among sole proprietorships by 9.9 percent.[80] While these findings suggest the importance of financing constraints, further empirical research is needed to quantify fully the effects of the interaction of financing constraints and the tax system on aggregate investment.

V. CONCLUSION

Though more empirical work must be done to achieve a consensus aggregate investment model, Fazzari, Hubbard, and Petersen (1988) and subsequent empirical studies have highlighted the importance of financing constraints in determining aggregate investment. The addition of a proxy variable for financing constraints to aggregate investment models has profound implications for U.S. tax policy.

Aggregate investment models that assume firms operate in a close approximation to a perfect financial market favor asset-specific tax relief designed to lower a specific capital asset's effective tax rate to stimulate aggregate investment. Such asset-specific tax relief includes accelerated depreciation, investment tax credits, and lower differential tax rates on the income from specific assets. In contrast, aggregate investment models that incorporate financing constraints favor marginal income tax rate reductions to stimulate investment. When financing constraints are binding, a firm's cash flow from its portfolio of existing capital assets determines its investment. By lowering the average income tax applied to a firm's portfolio of existing capital assets, a marginal income tax rate reduction would increase a financing constrained firm's cash flow from its portfolio of existing capital assets and should, therefore, stimulate investment.

Some large businesses in new, rapidly changing industries, many medium-sized businesses, and virtually all small businesses and farms are financing constrained. Many financing constrained businesses and farms are proprietorships, partnerships, or Subchapter S corporations whose income and expense flow-through to individual income tax returns. Marginal individual income tax rate reductions – rather than asset-specific tax relief – should stimulate investment among these "flow-through" businesses and farms.

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[80] Robert Carroll, Douglas Holtz-Eakin, Mark Rider, and Harvey S. Rosen, "Entrepreneurs, Income Taxes, and Investment," in *Does Atlas Shrug?*, ed. Joel Slemrod (Cambridge, Massachusetts: Harvard University Press, 2000): 427-455.

APPENDIX – SUBSEQUENT EMPIRICAL STUDIES

A. "*Q*" AND *Q* MODEL STUDIES IN OTHER COUNTRIES

Applying the *a priori* grouping approach, Hoshi, Kashyap, and Scharfstein (1991) examined annual data on firms continuously listed on the Tokyo stock exchange during Japanese fiscal years 1965 to 1986[81] and divided them into two groups of 121 member firms and 24 independent firms based upon whether *Keiretsu no Kenkyu* classifies a firm as a member of a *keiretsu* or not.[82] Using a modified *q* model that included a cash flow variable, a liquidity variable, and an output variable, Hoshi, Kashyap, and Scharfstein found that the coefficients on the average *q* variable, the liquidity variable, and the output variable were statistically significant for member firms, but the cash flow variable coefficient was not. In contrast, the coefficients on the cash flow variable, the liquidity variable, and the output variable were statistically significant for independent firms, but the average *q* variable coefficient was not. Hoshi, Kashyap, and Scharfstein interpret their findings as evidence that independent Japanese firms face financing constraints.[83]

Applying a modified *Q* model to annual data from 687 Japanese manufacturing firms during Japanese fiscal years 1977-1986, Hayashi and Inoue found both the average *Q* variable coefficient and cash flow variable coefficient were both independent and statistically significant for the entire sample. Subdividing the firms into heavy and light industry groups, Hayashi and Inoue found the cash flow variable coefficient became insignificant for heavy industry firms for the last three years in the sample after financial deregulation began, but remained statistically significant and very large quantitatively for light industry firms throughout the sample years.[84]

Applying various specifications of the *Q* model to annual data for 532 British industrial firms during 1976-1986, Blundell, Bond, Devereux, and Schiantarelli (1991) found that average *Q* variable was a significant determinate of investment though its coefficient was small. In the short-run, a 10 percent rise in equity values elicits only a 2.5 percent increase in aggregate investment. Blundell *et al*. also found that the cash flow variable and the output variable had independent and statistically significant effects on aggregate investment.[85]

Some economists have criticized Fazzari, Hubbard, and Petersen (1988) claiming that dividend policy is endogenous, errors in the measurement of a firm's prospects may give an upward bias to the cash flow variable, and the pecking order of finance might be attributable to factors such as the inefficiencies arising from agency problems between a firm's managers and its shareholders rather than the external finance premium.[86] Noting these criticisms, Chirinko and Schaller (1995) applied three

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[81] The Japanese fiscal year begins on April 1 of a calendar year and ends on March 31 of the next calendar year. Thus, Japanese fiscal year 2001 began on April 1, 2001, and ended on March 31, 2002.

[82] *Keiretsu* are Japanese bank-centered industrial groups in which a large city bank is both the major creditor and a large shareholder in various industrial firms. Since the large city bank has stable, long-term relationships with the firms in its *keiretsu*, asymmetric information and agency problems are significantly reduced, and therefore, member firms are unlikely to confront significant financing constraints. In contrast, independent firms may confront financing constraints.

[83] Takeo Hoshi, Anil Kashyap, and David Scharfstein, "Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Group," *Quarterly Journal of Economics* 106 (February 1991): 33-60.

[84] Fumio Hayashi and Tohru Inoue, "The Relationship Between Firm Growth and *Q* with Multiple Capital Goods: Theory and Evidence from Panel Data on Japanese Firms," *Econometrica* 59 (May 1991): 731-753.

[85] Richard Blundell, Stephen Bond, Michael Devereux, and Fabio Schiantarelli, "Investment and Tobin's *Q*: Evidence from Company Panel Data," *Journal of Econometrics* 51 (1992): 233-257.

[86] Jensen (1976) provides an alternative explanation for the pecking order of finance based upon the inefficiencies arising from agency problems between a firm's managers and its shareholders. Dividends "reduce the resources under a manager's control and make it more likely that managers will incur the monitoring of capital markets which occurs when a firm must obtain new capital. Financing projects internally avoids this monitoring and the possibility that funds will be unavailable or available only at high explicit prices. Managers have an incentive to cause their

exogenous tests directly tied to asymmetric information – the maturity of the firm, ownership concentration, and membership in an industrial group – to the annual data from 212 Canadian firms in the Laval and *Financial Post* databases during 1973-1986.[87] Using a modified *q* model, Chirinko and Schaller found that firms in the weak information position in each of three pairings had significantly larger liquidity variable coefficients than firms in the stronger information position.[88] In an earlier study using the same data set, Schaller (1993) found similar results for cash flow variable coefficients.[89] By sorting firms by exogenous information characteristics, Chirinko and Schaller provided strong evidence that these differences are due to the external finance premia rather than other factors. Chirinko and Schaller concluded, "For any important subset of firms, finance constraints are economically important and systematically affect firms in a weak information position."[90]

B. EULER INVESTMENT EQUATION STUDIES

Instead of using proxies for marginal *q*, Whited (1992),[91] Hubbard and Whited (1992),[92] Bond and Maghir (1994),[93] and Hubbard, Kashyap, and Whited (1995)[94] rely on Euler investment equations describing the firm's optimal capital stock to model a firm's investment decision.[95] The Euler investment equations should hold across adjacent periods for *a priori* unconstrained firms, but should be violated for constrained firms. About the Whited (1992) and Hubbard, Kashyap, and Whited (1995) studies, Hubbard (1998) observed:

> *Tests following this approach use panel data on manufacturing firms to estimate the Euler equation. Studies using Compustat data for the United States are unable to reject the frictionless neoclassical model for firms with significant dividend payouts, and the estimated adjustment cost parameters are more reasonable than those found in estimates of the* Q *model. The frictionless neoclassical model is easily rejected, however for firms with low dividend payouts prior to the estimation period. These findings are consistent with the*

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firms to grow beyond their optimal size. Growth increases managers' power by increasing the resources under their control." Michael C. Jenson, "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *American Economic Review* 76 (May 1986): 323-329.

[87] Schaller assumed that (1) lenders should have better information about mature firms and therefore mature firms would have fewer information problems; (2) firms with concentrated ownership should have fewer principal-agent conflicts between shareholders and managers and therefore concentrated ownership would lower the risk that such a firm's managers would misrepresent the quality of a potential investment to lenders; and (3) firms within industrial group should have fewer information problems than independent firms.

[88] Robert S. Chirinko, and Huntley Schaller, "Why Does Liquidity Matter in Investment Equations," *Journal of Money, Credit, and Banking* 27 (May 1995): 527-548.

[89] Huntley Schaller, "Asymmetric Information, Liquidity Constraints, and Canadian Investment," *Canadian Journal of Economics* 26 (August 1993): 552-574.

[90] Chirinko and Schaller (1995): 546.

[91] Toni M. Whited, "Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data," *Journal of Finance* 47 (September 1992): 1425-1460.

[92] R. Glenn Hubbard and Anil K. Kashyap, "Internal Net Worth and the Investment Process: An Application to U.S. Agriculture," *Journal of Political Economy* 100 (June 1992): 506-538.

[93] Stephen Bond and Costas Meghir, "Dynamic Investment Models and the Firm's Financial Policy," *Review of Economic Studies* 61 (April 1994): 197-222.

[94] R. Glenn Hubbard, Anil K. Kashyap, and Toni M. Whited, "Internal Finance and Firm Investment," *Journal of Money, Banking, and Credit* 27 (August 1995): 683-701.

[95] Some economists criticize the use of Euler equations instead of the neoclassical model or *Q* model. See: Stephen Oliner, Glenn Rudebusch, and Daniel Sichel, "New and Old Models of Business Investment: A Comparison of Forecasting Performance," *Journal of Money, Banking, and Credit* 27 (August 1995): 806-826.

> *cross-sectional differences noted by Fazzari, Hubbard and Petersen (1988) styled tests.*[96]

Using a sample of 325 publicly traded U.S. manufacturing firms from the Compustat industrial database, Whited (1992) tested whether two variables of financial distress – (1) a firm's market value debt to equity ratio and (2) its interest coverage ratio – affect a firm's investment decision. Whited found that these variables "enter[ed] the investment equation with the right sign and [were] most significant."[97] Then, Whited divided the sample separately on the basis of three *a priori* indicators of financing constraints: whether a firm has a bond rating, its market value debt to equity ratio, and its interest coverage ratio. For each of the *a priori* constrained groups, Whited found that the Euler investment equation was strongly rejected.

Dividing 428 U.S. manufacturing firms from the Compustat industrial database during 1976-1987 into high and low dividend payout groups, Hubbard, Kashyap, and Whited (1995) used Euler investment equations to test whether a cash flow and tax payment instrumental variable should be added to the *Q* model. The addition of the tax payment instrumental variable should reduce any measurement errors of a firm's prospects that may be correlated with a firm's cash flow. Hubbard, Kashyap, and Whited were unable to reject the *Q* model for high dividend firms but rejected the *Q* model in favor of the modified *Q* model for low dividend firms. Hubbard, Kashyap, and Whited then allowed the modified *Q* model to vary with macroeconomic conditions as well as firms' individual fortune through the addition of a variable representing the spread between the risk-free and risky interest rates. "Taking account of macroeconomic conditions significantly improves the performance of the model."[98]

Agriculture is a natural industry for the effects of asymmetric information and internal net worth on investment because (1) agriculture is information intensive and therefore difficult for creditors to monitor, (2) agriculture has large working capital requirements, and (3) the largest component of farmers' net worth – the value of their land – is observable. Applying an investment model based on Euler investment equations to annual data from U.S. Department of Commerce, Bureau of Economic Analysis and various publications of the U.S. Department of Agriculture during 1914-1987, Hubbard and Kashyap (1992) found that farmers' collaterizable net worth is an important determinate of farmers' investment in agricultural equipment. Euler equations held during adjacent periods when farmers' net worth is high, but did not hold when the shadow price of external finance was high and farmers' net worth was low; *i.e.* when financing constraints bind. Therefore, Hubbard and Kashyap rejected the neoclassical model and support an "internal funds" model of investment under asymmetric information.[99]

Applying Euler investment equations to annual data from 625 British manufacturing firms in the Datastream International database during 1971-1986, Bond and Meghir (1994) found "excess sensitivity of investment to a measure of cash flow when the investment model is estimating using the full sample of companies. … This finding is inconsistent with the standard neoclassical model but consistent with the hierarchy of finance alternative."[100]

Commenting on these studies, Hubbard (1998) observed:

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[96] Hubbard (1998): 209.
[97] Whited (1992): 1427.
[98] Hubbard, Kashyap, and Whited (1995): 685.
[99] R. Glenn Hubbard and Anil K. Kashyap, "Internal Net Worth and the Investment Process," *Journal of Political Economy* 100 (June 1992): 506-534.
[100] Stephen Bond and Costas Meghir, "Dynamic Investment Models and the Firm's Financial Policy," *Review of Economic Studies* 61 (April 1994): 198-199.

> *The estimated effect of cash flow on the shadow price of funds is economically important. All else being equal, a 25 percent decline in cash flow implies an increase in the discount rate of more than 40 percent.*[101]

Applying Euler investment equations to annual U.S. aggregate data during 1957-1988, Auerbach and Hassett (1992) sought to relate aggregated investment directly to the determinates of *Q*.[102] Auerbach and Hassett found "a permanent increase of one percentage point in the cost of capital … will initially reduce the ratio of investment to capital ratio by 0.253 percentage points, or roughly 1.5 percent of gross investment. … This range [for $1/\alpha$] of 0.066 to 0.090 is considerably larger than estimates typically found in the literature studying aggregate investment … implying lower adjustment costs [α of 11.1 to 15.2]."[103] Reestimating their model with a cash flow variable, Auerbach and Hassett found that the cash flow variable exerted a significant influence on investment. Auerbach and Hassett reported similar results for structures. Auerbach and Hassett concluded that a comprehensive measure of the user cost of capital variable that includes expected fluctuations in productivity and taxes "is successful in explaining the level of investment in both equipment and structures. Tests of this specification show taxes playing a clear role."[104]

However, Oliner, Rudebusch, and Sichel (1995) criticized the use of Euler investment equations. Oliner, Rudebusch, and Sichel tested the ability of two Euler investment equations to forecast aggregate investment against the predictive power of four aggregate investment models: the accelerator model, the neoclassical model, the modified neoclassical model, and the *Q* model. [105] Using quarterly aggregate data for the U.S. business sector during 1952-1992, Oliner, Rudebusch, and Sichel found "the forecast performance of both Euler equations is substantially worse than that of the traditional models. … [T] he inability of the Euler equations to forecast investment spending even one quarter ahead suggests that these models are misspecified."[106]

C. DIRECT FORECASTING STUDIES

Another alternative approach developed by Abel and Blanchard (1986) is to forecast marginal *q* – the expected present value of current and future profits generated by an incremental unit of capital – directly instead of using proxies.[107] Using a vector autoregressive forecasting framework, the effect of cash flow may be broken down into two components – one that forecast the future profitability under Miller-Modigliani conditions (called "fundamental" *q*) and the other that is attributable to financing constraints. This allows economists to test whether cash flow is an independent and significant variable in determining investment at firms that are identified *a priori* as financing constrained by such factors as size, bond rating, commercial paper rating, or dividend payout.[108]

Applying vector autoregressive approach to annual data on 428 U.S. manufacturing firms in the Compustat industrial database during 1979-1989, Gilchrist and Himmelberg (1995) sought to determine whether the predictive power of cash flow variable regarding investment is solely attributable to its fundamental role in predicting an investment's future profitability or whether cash flow exercises an

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[101] R. Glenn Hubbard, "Capital Market Imperfections and Investment," *Journal of Economic Literature* 36 (March 1998): 209.
[102] Alan J. Auerbach and Kevin A. Hassett, "Tax Policy and Business Fixed Investment in the United States," *Journal of Public Economics* 47 (1992): 141-170.
[103] *Ibid*. 153-155.
[104] *Ibid*. 162.
[105] Stephen D. Oliner, Glenn D. Rudebusch, and Daniel Sichel, "New and Old Models of Business Investment: A Comparison of Forecasting Performance," *Journal of Money, Banking, and Credit* 27 (August 1995): 806-826.
[106] *Ibid*. 824.
[107] Andrew B. Abel and Oliver J. Blanchard, "The Present Value of Profits and Cyclical Movements in Investment," *Econometrica* 54 (March 1986): 249-273.
[108] Hubbard (1998): 210.

independent role in determining investment by alleviating financing constraints. Gilchrist and Himmelberg found that cash flow had no predictive power beyond its fundamental role for firms with either a bond rating or a commercial paper rating. For firms without these ratings, however, cash flow did exercise an independent role, supporting the financing constraint hypothesis for these firms.[109]

Gertler and Gilchrist (1994) divided more than 7,000 U.S manufacturing firms in the *Quarterly Financial Report for Manufacturing, Mining, and Trading Corporations* into large firm and small firm samples with 30th percentile of the sales as the dividing line. Applying the vector autoregressive model to quarterly data for both samples during 1958-1994, Gertler and Gilchrist found that small firms account for a significantly disproportionate share of the decline in sales, inventory, and short-term debt following a monetary tightening. Large firms are able to carry inventory through higher short-term borrowing as sales decline, while small firms are not and must therefore cut their production quickly. Their findings support the existence of financing constraints on small manufacturing firms.[110]

Following the approach of Gertler and Gilchrist (1994), Bernanke, Gertler and Gilchrist (1996) used "bank dependency" rather than size as the means for differentiating U.S. manufacturing firms in the *Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations* during 1977-1991.[111] Bernanke, Gertler, and Gilchrist found that "classifying firms by financial criteria rather than size did not qualitatively change nature of the results." Bank-dependent firms account for a disproportionate share of the decline in sales, inventory, and short-term debt following a monetary contraction.[112]

D. CONTEMPORARY STUDIES APPLYING OTHER STATISTICAL TECHNIQUES

To determine how firms respond to a decline in their cash flow and collateral value when investment opportunities are held constant, Owen (1996) examined investment at non-petroleum subsidiaries of major oil firms following the sharp decline in crude oil prices from $26.60 in December 1985 to $12.67 in April 1986. Owen found a statistically significant difference between investments by subsidiaries of oil firms and by other firms in the same industry during this period. Large decreases in the cash flow and collateral value caused oil firms to reduce investments in their non-petroleum subsidiaries when other firms in the same industry were maintaining or increasing their investment. Thus, even for some of the largest corporations in the world, financing constraints may, at times, be binding.[113]

Oliner and Rudebusch (1996) divided more than 7,000 U.S. manufacturing firms from the *Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations* into large firm and small firm samples with the 15th percentile of the capital stock distribution as the dividing line. Applying a model for gross investment that includes a lagged sales variable, a lagged cost of capital variable, and a lagged cash flow variable to quarterly data for both samples during fourth quarter 1958-fourth quarter 1992, Oliner and Rudebusch found that the lagged cash flow variable coefficient was significant for small firms, but not for large firms. Using three different definitions of a tightening of monetary policy, Oliner and Rudebusch added a dummy variable to indicate a period of monetary tightness.[114] Whatever

[109] Simon Gilchrist and Charles P. Himmelberg, "Evidence on the Role of Cash Flow for Investment," *Journal of Monetary Economics* 36 (1995): 541-572.
[110] Mark Gertler and Simon Gilchrist, "Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms," *Quarterly Journal of Economics* 109 (May 1994): 309-340.
[111] Bernanke, Gertler, and Gilchrist define "bank dependent" as any firm at which bank loans constitute at least 50 percent of its short-term liabilities.
[112] Ben Bernanke, Mark Gertler, and Simon Gilchrist, "The Financial Accelerator and the Flight to Quality," *Review of Economics and Statistics* 78 (February 1996): 1-15.
[113] Owen A. Lamont, "Cash Flow and Investment: Evidence from Internal Capital Markets," *Journal of Finance* 52 (March 1997): 83-109.
[114] The definitions of monetary tightening are (1) the "Romer dates" of December 1968, April 1974, August 1978, October 1979, and December 1988, (2) a quarter in which the federal funds rate rose at least 75 basis points, and (3) a quarter in the term spread (defined as the federal funds rate minus the rate on the 10-year Treasury note) increased by at least 65 basis points.

definition was used, the lagged cash flow variable was an important determinate of investment during the period of monetary tightness among small firms, but not among large firms. On average, the effect of lagged cash flow on investment rose by 17 percent during periods of monetary tightness. Oliner and Rudebusch concluded that small firms perceive a rise in their external finance premia during a monetary contraction and rely more heavily on internal funds to finance their investment while large firms do not experience an increase in their relative cost of external funds.[115]

Applying a model for the change in the capital stock that includes a lagged change in sales variable, a lagged change in user cost of capital variable, and a lagged cash flow variable to data from 4,095 U.S. firms from the Compustat "full coverage" database for investment, sales, and cash flow and to Data Resources, Inc., databate for the user cost of capital for 24 types of equipment and two types of structures during 1981-1989, Chirinko, Fazzari, and Meyer (1999) found that coefficient on the change in user cost of capital variable (or β_u) was -0.502, which can be interpreted as the elasticity of the user cost of capital with respect to investment. Because of potential biases in this estimate, Chirinko, Fazzari, and Meyer reestimated β_u using the instrumental variable technique and found that β_u ranged from -0.060 to -0.557. Chirinko, Fazzari, and Meyer reestimated β_u against using instrument variable technique with parsimonious lag lengths and found that β_u ranged from -0.218 to -0.260. Thus, Chirinko, Fazzari, and Meyer concluded that -0.25 was the best estimate for the elasticity of the user cost of capital with respect to investment.[116]

Additionally, the "tax reform as a natural experiment" studies of Cummins, Hassett, and Hubbard (1994 and 1996) reestimated their models after the addition of a cash flow variable. With regard to U.S. tax reforms, Cummins, Hassett, and Hubbard (1994) found the cash flow variable coefficients were positive and significant in both the modified neoclassical model and the modified *Q* model, indicating that the addition of a cash flow variable helped to predict aggregate investment over and above the beginning of the period user cost of capital variable or *Q* variable, respectively. However, the addition of a cash flow variable did not alter the study's conclusion that the user cost of capital variable coefficients and the *Q* variable coefficients were statistically and economically significant in years following a U.S. tax reform and were insignificant in other years.[117] After including a cash flow variable, Cummins, Hassett, and Hubbard (1996) reestimated a modified *Q* model using international data. Once again, the cash flow variable coefficients were economically and statistically significant, but did not alter their result that the Q variable coefficients were economically and statistically significant in 12 of the 14 countries surveyed.[118] These findings provide additional support for the widespread presence of financing constraints.

E. WORKING CAPITAL STUDY

Some critics of Fazzari, Hubbard, and Petersen (1988) charge that the strong relationship between cash flow and investment that Fazzari, Hubbard, and Petersen found in low dividend payout firms is not evidence of financing constraints, but instead represents investment demand not captured by *Q* or other variables in the modified *Q* model. To determine which of these two explanations is correct, Fazzari and Petersen (1993) examined the effect of working capital on fixed investment. If the critics are correct, cash flow should have a positive relationship with working capital in a modified *Q* model. On the other hand, if Fazzari and Petersen are correct, cash flow should have a negative relationship with working capital in a modified *Q* model because financing constrained firms invest in working capital as a buffer

[115] Stephen D. Oliner and Glenn D. Rudebusch, "Is There a Broad Credit Channel for Monetary Policy?" *Federal Reserve Bank of San Francisco Economic Review* 1 (1996): 3-13.
[116] Robert S. Chirinko, Steven M. Fazzari, and Andrew P. Meyer, "How Responsive is Business Capital Formation to Its User Cost? An Exploration with Micro Data," *Journal of Public Economics* 74 (1999): 53-80.
[117] Cummins, Hassett, and Hubbard (1994): 32-48.
[118] Cummins, Hassett, and Hubbard (1996): 252-258.

stock to soften the fluctuations in fixed investment that would otherwise occur because of changes in cash flow.

Applying modified *Q* models to annual data from Fazzari, Hubbard, and Petersen during 1970-1979, Fazzari and Petersen found that the working capital investment was excessively sensitive to changes in cash flow. When working capital was included in the modified *Q* model as both a source and a use of funds, the working capital variable had a negative coefficient, confirming working capital's negative relationship with cash flow. When the smoothing role of working capital is held constant, Fazzari and Petersen found that the impact of financing constraints on aggregate investment is much larger. Using a cash flow variable as the sole proxy for financing constraints understated their effect on investment.[119]

F. HISTORICAL STUDIES

Examining U.S. data during 1894-1909, Calomiris and Hubbard (1989) found that financing constraints were important determinates of aggregate investment and output. Unexpected monetary deflation simultaneously reduced the net worth of borrowers and increased the real value of their debts, raising the probability of default. Higher default risk increased the probability of bank failures. In the absence of federal deposit insurance, banks sought to protect themselves against runs. To reduce their loan to deposit ratios, banks curtailed lending to financing constrained firms. Without bank loans, financing constrained firms were forced to forgo investment and sharply reduce output.[120]

Calomiris (1993) found that financing constraints amplified the contractive effects of monetary deflation during the Great Depression. The negative effects of deflation on balance sheets raised the external finance premia for financing constrained firms and increased the demand for liquidity among individuals. Banks slashed their lending in response to the higher risk of bank runs, forcing financing constrained firms to cut their output and investment radically.[121]

Calomiris and Hubbard (1995) examined the result of a unique tax experiment – the federal surtax on undistributed corporate profits of 1936-1937.[122] External finance was costly during the 1930s. Based on Securities and Exchange Commission (SEC) data, Calomiris and Hubbard found that "a substantial number of firms faced a shadow price differential between external and internal funds in excess of 20 percent." Examining data on 273 U.S. firms in 1936, Calomiris and Hubbard grouped these firms into three samples: firms with a marginal surtax of 12 percent or less, firms with a marginal surtax of 17 percent, and firms with a marginal surtax of 22 percent or 27 percent to correspond with retention rates of less than 20 percent (type A), 20 percent to 40 percent (type B), and 40 percent or more (type C). *A priori*, type C firms were the firms most likely to confront financing constraints. Following the methodology of Fazzari, Hubbard, and Petersen (1988), Calomiris and Hubbard used a modified *Q* model to test these groups for the sensitivity of fixed investment to cash flow. While fixed investment in type A

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[119] Steven M Fazzari and Bruce C. Petersen, "Working Capital and Fixed Investment: New Evidence on Financing Constraints," *Rand Journal of Economics* 24 (Autumn 1993): 328-342.

[120] Charles W. Calomiris and R. Glenn Hubbard, "Price Flexibility, Credit Availability, and Economic Fluctuations: Evidence from the United States, 1894-1909," *Quarterly Journal of Economics* 104 (August 1989): 429-452.

[121] Charles W. Calomiris, "Financial Factors in the Great Depression," *Journal of Economic Perspectives* 7 (Spring 1993): 61-85.

[122] Seeking additional federal revenue, President Franklin D. Roosevelt proposed replacing the federal corporate income tax with a tax on undistributed profits on March 3, 1936. Instead of replacing the existing corporate income tax, Congress enacted Roosevelt's proposal as a surtax in addition to the corporate income tax with progressive rates from 7 percent on the first 10 percent of earnings retentions to 27 percent on retentions exceeding 60 percent. The surtax had a significant effect on dividend payouts only in 1936 and 1937. Opponents claimed the surtax was unfair to growing firms with high external finance costs. In 1938, Congress substantially reduced the surtax and allowed it to expire on December 31, 1939. The surtax generated $145 million in 1936 and $176 million in 1937 compared with regular corporate income tax collections of $950 million in 1936 and $1,150 million in 1937.

and type B firms was not sensitive to cash flow, the cash flow variable was a statistically significant determinate of fixed investment in type C firms.

Because firms with high external financing costs and a high sensitivity of investment to changes in cash flow will "self-insure" by accumulating working capital when cash flow is high and drawing working capital down when cash flow is low, Calomiris and Hubbard tested whether working capital is sensitive to changes in cash flow. Calomiris and Hubbard found that the cash flow variable was indeed a statistically significant determinate of working capital in type C firms. Finally, Calomiris and Hubbard tested whether cash flow sensitivity should be attributed to financing constraints or to inefficiency costs associated with shareholder-manager conflicts as suggested by Jenson (1976). Calomiris and Hubbard divided type C into high q and low q groups. If financing constraints accounted for the sensitivity of investment to cash flow, then the cash flow variable should be significant for high q type C firms. This suggests that financial constraints forced such firms to forgo some potential profitable investment. If inefficiency costs associated with agency problems between managers and shareholders accounted for the sensitivity of investment to cash flow, then the cash flow variable should be significant for low q type C firms. This suggests that managers invest all available cash flow even though investment opportunities may only be marginally profitable. Calomiris and Hubbard found that only high q type C firms demonstrate a sensitivity of investment to cash flow. This conclusion provided strong support for the financing constraints explanation.[123]

G. STUDIES OF OTHER MEASURES OF BUSINESS ACTIVITY

Empirical studies that examine how financing constraints affect other types of business activity such as employment, research and development expenditures, inventory, output prices and entrepreneurship corroborate the general finding that financing constraints have a significant effect on aggregate investment. Sharpe (1994) examined data from 2,192 U.S. manufacturing firms during 1959-1985 regarding employment and financing constraints. Sharpe found that employment at highly leveraged firms is more sensitive to demand and financial market conditions than less leveraged firms.[124]

Examining data from 179 small U.S. firms in high-technology industries during 1983-1987, Himmelberg and Petersen (1994) concluded *a priori* that these firms likely confronted financing constraints. Himmelberg and Petersen found that cash flow was a statistically significant determinate of both research and development expenditures and investment in equipment and structures in these firms. Himmelberg and Petersen obtained elasticity of cash flow with respect to research and development expenditures of 0.67 and an elasticity of cash flow with respect to investment in equipment and structures of 0.82.[125]

Examining annual data for 933 U.S. manufacturing firms with fiscal years ending in the fourth quarter of the calendar year during 1980-1982 from the Compustat industrial database, Kashyap, Lamont, and Stein (1994) found that (1) a liquidity variable as measured by cash and marketable securities on a firm's balance is a significant determinate of inventory and (2) a bond market dummy variable (based on whether a firm has a Standard and Poors bond rating) is also a significant determinate of inventory. Then, Kashyap, Lamont, and Stein examined other years including 1974 and the 1974-1989 period. Liquidity variables are significant for 1974 recession but not for the overall period. Interpreting their findings,

[123] Charles W. Calomiris and R. Glenn Hubbard, "Internal Finance and Investment: Evidence from the Undistributed Profits Tax of 1936-37," *Journal of Business* 68 (October 1995): 443-482.
[124] Steven A. Sharpe, "Financial Market Imperfections, Firm Leverage, and the Cyclicality of Employment," *American Economic Review* 84 (September 1994): 1060-1074.
[125] Charles P. Himmelberg and Bruce C. Petersen, "R&D and Internal Finance: A Panel Study of Small Firms in High-Tech Industries," *Review of Economics and Statistics* 76 (February 1994): 38-51.

Kashyap, Lamont, and Stein concluded that a reduction in bank lending to financing constrained firms during recessions diminishes their ability to hold inventory.[126]

Financing constraints affect output pricing of firms in imperfectly competitive markets. Examining data from 20 manufacturing industries during 1959-1989, Chevalier and Scharfstein (1995) found that, when controlling for concentration, markups were counter-cyclical, but investments in equipment and structures were pro-cyclical in industries dominated by small firms. Chevalier and Scharfstein concluded that small firms, which *a priori* are likely to be financing constrained, raised their prices relative to their competitors, reduced their investments, and thereby gave up market share in order to enhance their cash flow during recessions.[127] Examining supermarket prices during the recession in oil-producing states following the sharp decline in oil prices in early 1986 and during the 1990-1991 recession, Chevalier and Scharfstein (1996) found that supermarket firms, which had undergone a leveraged buyout and therefore were financing constrained, raised their prices and gave up market share during these two recessions. Other supermarket firms, which were not financing constrained, raised their prices in local markets in which their primary competitor was highly leveraged.[128]

Finally, financing constraints affect the ability of an entrepreneur to establish and sustain a small business. Examining data on young men ages of 24 to 34 from the *National Longitudinal Study of Young Men*, Evans and Jovanovic (1989) found that financing constraints were binding on entrepreneurs. As a result, entrepreneurs use a suboptimal amount of capital to start their businesses.[129] Examining federal income data for sole proprietors in 1981 and 1985, Holtz-Eakin, Joulfaian, and Rosen (1994) sought to determine whether the receipt of an inheritance in 1982 or 1983 affected the survival rate of these sole proprietorships in 1985. Holtz-Eakin, Joulfaian, and Rosen found that receipt of an inheritance makes a small, but significant increase in the survival probability for sole proprietorship. Holtz-Eakin, Joulfaian, and Rosen concluded that financing constraints exert an important influence on business formation and investment.[130]

H. DISSENTING STUDY AND HUBBARD'S RESPONSE

One study dissented from the general findings of the significance of financial constraints, however. Analyzing the sample of 49 low dividend payout firms that Fazzari, Hubbard, and Petersen (1988) identified as financing constrained, Kaplan and Zingales (1997) employed management's discussion of liquidity and capital resources in their 10-Ks to divide these firms into five groups based upon the likelihood of financing constraints. Kaplan and Zingales observed "a total of 85.3 percent of the firm-years in which we find no evidence of financing constraints that restrict investment." Moreover, Kaplan and Zingales found that investment displayed a greater sensitivity to cash flows in firms that the authors classify as less constrained than firms classified as more constrained. After positing a number of possible alternative explanations for the findings of Fazzari, Hubbard, and Petersen (1988) and other

[126] Anil K. Kashyap, Owen A. Lamont, and Jeremy C. Stein, "Credit Conditions and the Cyclical Behavior of Inventories," *Quarterly Journal of Economics* 109 (August 1994): 565-592.
[127] Judith A. Chevalier and David S. Scharfstein, "Liquidity Constraints and the Cyclical Behavior of Markups," *American Economic Review* 85 (May 1995): 390-396.
[128] Judith A. Chevalier and David Scharfstein, "Capital Market Imperfections and Countercyclical Markups: Theory and Evidence," *American Economic Review* 86 (September 1996): 703-725; and also see: Judith A. Chevalier, "Do LBO Supermarkets Charge More? An Empirical Analysis of the Effects of LBOs on Supermarket Pricing," *Journal of Finance* 50 (September 1995): 1095-1112.
[129] David S. Evans and Boyan Jovanovic, "An Estimated Model of Entrepreneurial Choice under Liquidity Constraints," *Journal of Political Economy* 97 (August 1989): 808-827.
[130] Douglas Holtz-Eakin, David Joulfaian, and Harvey S. Rosen, "Sticking It Out: Entrepreneurial Survival and Liquidity Constraints," *Journal of Political Economy* 102 (February 1994): 53-75.

empirical studies, Kaplan and Zingales concluded that sensitivity of investment to cash flow does not provide evidence for financing constraints.[131]

In reply, Hubbard (1998) contended that the managerial information from 10-Ks was too subjective and there were too few firms in the Kaplan and Zingales' groups to provide statistically meaningful results. Furthermore, Hubbard argued that the firm-years that Kaplan and Zingales classified as financially constrained are actually financially distressed since the criteria for their inclusion was a firm's violation of its debt covenants and its renegotiation of debt payments. Financially distressed firms may be restricted from making new investments with their internal funds, and therefore financially distressed firms may not display a strong responsiveness to cash flow.[132]

[131] Steven N. Kaplan and Luigi Zingales, "Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?" *Quarterly Journal of Economics* 112 (February 1997): 169-215.
[132] Hubbard (1998): 207.

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