The Impact of Profitability, Financial Fragility and Competitive Regime Shifts on Investment Demand: Empirical Evidence

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The purpose of this paper is to econometrically test the hybrid Post Keynesian-Neo Schumpeterian (evolutionist) theory of investment demand developed in Crotty and Goldstein (1992a, 1992b). In Crotty and Goldstein (1992a, 1992b), a Post Keynesian-Neo Schumpeterian (PK-NS) theory of enterprise investment demand and an associated rate of accumulation are developed in which the optimal investment decision depends on expected profitability, the intensity of competition and the character of the competitive regime,[1] the degree of financial fragility, and managerial attitudes toward the growth-financial safety tradeoff inherent in the investment decision. In this paper, empirical support is obtained from regression analysis of the determinants of the rate of accumulation in U.S. manufacturing between 1954 and 1988. The econometric results strongly support our theory of investment demand.

The paper is divided into three sections. Section I summarizes our theory of investment demand. Section II specifies and conducts econometric tests of the theory. Section III contains our concluding remarks.

I. A Post Keynesian-Neo Schumpeterian Theory of Investment Demand

In Crotty and Goldstein (1992a, 1992b), we develop a PK-NS investment theory that: (1) considers external finance and thus the management-finance relation: (2) includes the separation between ownership and control of the firm and thus the management-stockholder relation; (3) incorporates the influence of Keynesian uncertainty, financial fragility, and Keynes-Minsky instability on accumulation; (4) brings to the forefront of investment theory the character and intensity of competition: strategic shifts in investment policy are triggered by shifts in the competitive regime: (5) provides a careful specification and a rational microfoundation for a positive "invest-or-die" relation between competition and investment; and (6) is formalized as an enterprise optimization problem.

In Crotty and Goldstein (1992a, 1992b) the complete model is developed sequentially. The first paper abstracts from both the Schumpeterian competition effect and the distinction between offensive investment and defensive (innovative cost-cutting) investment and focuses on the Post Keynesian aspects of the investment decision. It places the firm within a stable corespective competitive enivronment. The second paper adds the concepts of a rupture in the competitive status-quo -- a shift from oligopolistic, *corespective* relations to *anarchic*, uncontrolled competition -- and adds different modes of accumulation to the model. We follow the same sequential development in this overview.

The first model has four core assumptions. First, the firm operates in an environment of true, Knightian or Keynesian uncertainty. That is, the future is unknowable *in principle*; it cannot be adequately represented by a set of stable subjective probability distributions that agents believe with certainty to be "the truth".[2] Second, physical capital is illiguid and the accumulation process is substantially irreversible. Third, managers and owners are distinct economic agents with an unresolved principal-agent conflict; under normal circumstances the firm is controlled by management. Fourth, management seeks the long-term growth and financial safety of *the firm itself* (and, through these, its own security and status) and guards its decision-making authority against encroachment by stockholders and creditors. Dividends, like interest payments, are a cost of managerial autonomy -- a constraint -- rather than an objective to be maximized.

At the most abstract level, the investment decision-making problem confronting management is this. The financing of investment, whether internal or external, generates implicit or explicit cash flow commitments to finance capitalists. Under the assumptions of illiquid capital (capital in place cannot be resold at prices high enough to payoff debts or required dividends) and true uncertainty, management can never be sure that investment projects will produce sufficient gross profits to cover the cash commitments generated by their financing. Yet failure to meet these commitments may result in a crisis of managerial autonomy or even in bankruptcy. Thus, capital accumulation is a contradictory process. *Investment is inherently risky, while the failure to invest will ultimately lead to the firm's marginalization or demise*. The firm's drive for growth and profits stressed in Post Keynesian theory, then, is constrained by management's desire for financial security for the firm and decision-making autonomy for itself. In our model, the investment decision creates an unavoidable *growth-safety tradeoff*.

In our (1992a) paper we show that the dynamic capital accumulation problem can be reduced to a sequence of one-period-at-a-time investment decisions, the first step of which can be described as follows. Management tries to maximize a preference function O(G(I), S(1)) where G reflects the firm's growth objectives and S embodies management's concern with both financial safety and decision-making autonomy. G is a function of two subgoals: expected net profits (revenues minus operating costs) net of the dividends and interest payments (or costs of autonomy) associated with each prospective level of investment: and the capital stock in the coming period -- an index of the status and size of the firm.

The S function also has two arguments. The first is an index of the likelihood of an autonomy crisis *in the short run*. Specifically, it is the perceived likelihood, based on management's best estimate of the probability of various demand and cost conditions in the coming period, that expected gross profit flows will fail to cover interest and dividend commitments next period. The second is an index of the firm's perceived vulnerability to an autonomy crisis *in the longer run*, in which concrete forecasts of cost and revenues are virtually meaningless. It is defined as the difference between the current level of debt and the maximum debt level that management considers to be safe. This "safe" debt level is thus a Keynesian or Minskian variable that varies with shifts in management's attitude toward and assessment of risk. To borrow Minsky's terms, these two arguments are indicators of management's perception of the extent to which the firm is either financially fragile or robust in the short and long run. Thus, *S(I) is the vehicle through which the Keynesian-Minskian ideas are incorporated in the model*.

Finally, we consider the firm's relative preference for growth versus safety. Since 0, >0 and 0, >0 (where subscripts denote partial derivatives), the relative growth-safety preference, OJO,, depends on assumptions about O_{GG} and O,,. In our first model we assume that $O_{GG} = 0_{GS} = 0$ and $O_{SS} < 0$: the growth imperative is independent of the size of the firm, while its attitude toward security and autonomy is variable. In particular, we assume that when S is low, or the firm is in a financially precarious position, management responds to the threat to its decision-making autonomy by placing more weight on financial security relative to growth and, therefore, is less willing to undertake inherently risky investment projects. Financial fragility constrains investment.

The optimal solution and comparative static properties of the model can best be understood by analyzing the G-S tradeoff. We show that in the neighborhood of equilibrium the marginal growth gain from an additional unit of I is positive ($G_I > 0$) and the marginal change in security is negative ($S_I < 0$). A G-S tradeoff does exist: faster growth inevitably entails a decline in security. The G-S tradeoff and the optimal level of I, I*, are depicted in Figure I. Since the first order condition for a maximum is $O_G G_I = -O_S S_I$, management maximizes 0 by choosing I such that $G_I = -(O_S/O_G) S_I$: increments in I raise 0 until the point where the marginal growth gains are balanced by marginal security losses.

Comparative static properties and the mechanics of the model are most easily understood by considering changes in the intensity of the G-S tradeoff generated by a parameter change. Consider, for example, how an increase in the firm's profit markup will cause a rise in investment demand. A rise in the profit markup per unit output will

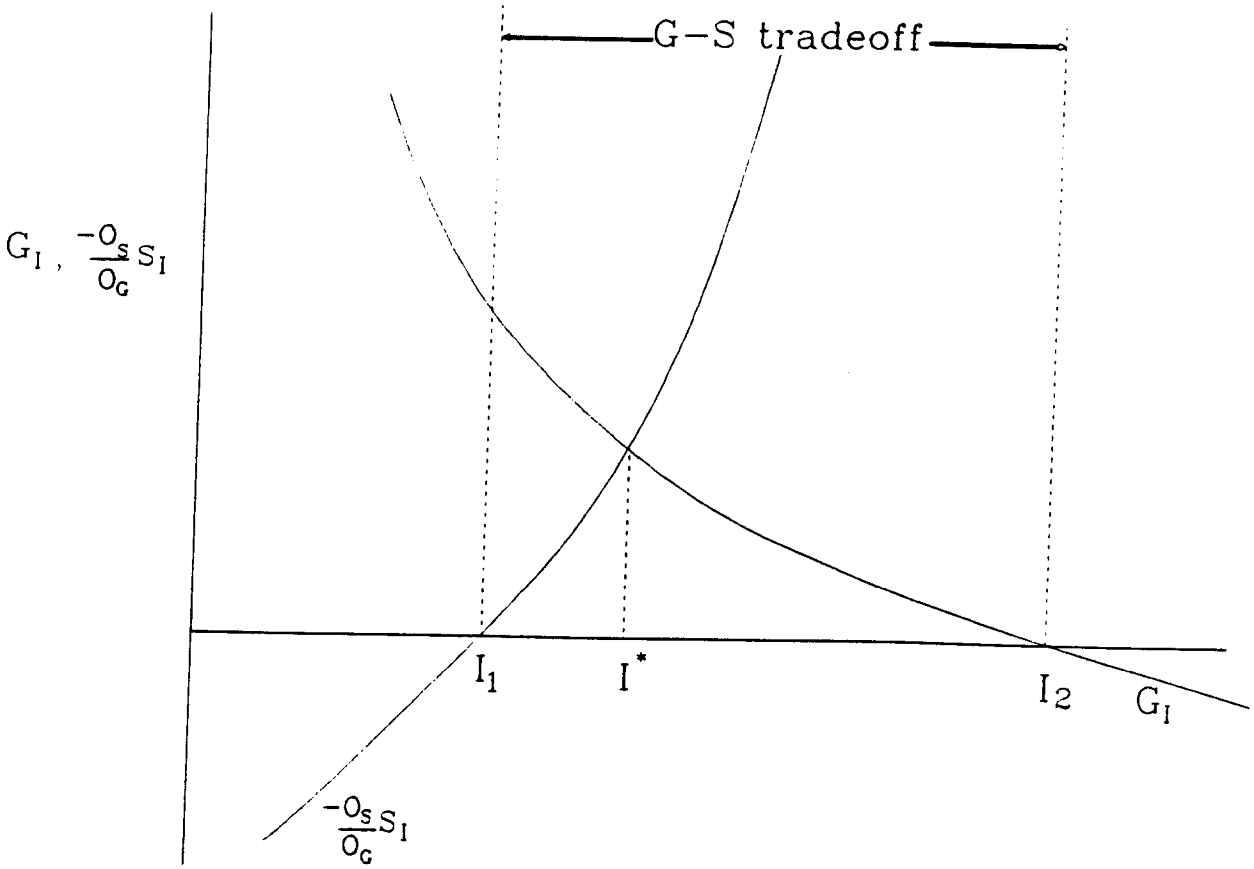


Figure I: the optimal solution and the G-S tradeoff have three distinct positive effects on investment demand. First, it will raise the marginal investment-induced increment to growth by increasing marginal gross profits at every I level (shifting G_I up and to the right). Second, it will reduce the marginal decline in safety. S_I will decline in absolute value as the rise in marginal gross profits lowers the likelihood that additional I will trigger a short-term autonomy crisis by creating more marginal cash flow (shifting $-(O_S/O_G)S_I$ right). Third, it will raise the level of S through higher gross profits that lower the likelihood of a short-term autonomy crisis so that the preference weight on S, 0,, is reduced (shifting $-(O_S/O_G)S_I$ right). Thus, I unambiguously rises as a higher profit markup weakens the G-S tradeoff -- less security need be sacrificed to gain more growth through capital accumulation.

Turning to the financial determinants of investment demand, increases in the initial stock of debt or initial debt-equity ratio and decreases in the prudent level of debt cause a reduction in I. Both parameter changes intensify the G-S tradeoff by lowering S and thereby raising management's preference for safety relative to growth ($(O_S/O_G$ rises). In addition, a decrease in the acceptable level of debt causes the marginal security loss to rise; $-S_I$ increases, so I falls' further. These effects respectively demonstrate that the degree of leverage and management's historically specific and institutionally contingent attitude toward long term financial vulnerability affect I behavior. We also demonstrate that increases in uncertainty raise the intensity of the G-S tradeoff by reducing S and increasing marginal security losses. Thus, the model is infused with important Keynesian insights concerning uncertainty, the importance of financial structures, and secularly and cyclically variable attitudes toward risk.

The micro model thus supports a theory of accumulation in which investment instability can be rooted in the real sector (through changes in the profit markup) or in the financial sector (through changes in the interest rate, the required dividend payout ratio, and the degree of financial fragility), or in both.

We now turn attention to the complex relation between competition and accumulation developed in the work of Schumpeter (see Oakley (1990; pp. 38, 208, and 215) and further elaborated by Nelson and Winter (1982). Our interest in this topic was stimulated by numerous articles in the business press over the past decade describing how many U.S. industrial corporations reacted to the dramatic rise in foreign competition they experienced in the early to mid 1980s by radically altering their basic approach to investment policy, labor relations, cost and quality control, and so forth. That is, they initiated qualitative shifts in their *competitive strategies*. Some aspects of these strategic shifts fit comfortably into standard theories of enterprise decision-making. Others -- such as the unilateral imposition of alternative, hostile labor relations regimes and the undertaking of *major new debt-financed, labor-saving, cost-cutting investment projects in the face of collapsing profit rates* -- did not. However, these investment projects, (which we label "defensive" investment), and the strategic change that fostered them, do fit comfortably with Schumpeter's discussion of the invest-or-die aspects of competitive struggle (see Oakley (1990; pp. 38, 208, 215, and 243). In Crotty and Goldstein (1992b) we extend the basic model to incorporate this key aspect of the role of competition in investment determination.

In our model, the firm makes projections of the determinants of profitability over the course of an intermediate investment planning horizon, then attempts to maximize the function O. However, if this strategy fails to keep the firm in a position to survive the potential competitive struggles that may take place *beyond* the planning horizon, it must be replaced. Suppose that the firm believes that it must maintain its market share above some critical limit below which it will not have the financial, technical, or marketing power to withstand possible future attacks by larger, more powerful competitors. This critical market share then becomes a constraint on the strategy of 0 maximization.

Consider the case in which the firm had been operating for some time in a *corespective* competitive environment, one that made it possible to O-maximize in a satisfactory way. Within this environment, output enhancing/cost-neutral (capital-widening) accumulation will be dominant, and competition and investment will be inversely related because more competition brings lower profits and a decline in safety.[3] Suppose now that foreign competition increases qualitatively, rupturing the pre-existing oligopolistic, corespective relations among domestic firms, and initiating an *anarchic* competitive struggle that will lower profits and raise uncertainty. That is, suppose there is a shift in the competitive regime.

More than likely, the firm's market share constraint will be violated and its long-term viability will be threatened. Then the 0 maximization strategy must be replaced. The firm is now coerced into considering strategies that in the previous, less hostile environment, it thought of as too organizationally disruptive, too unpredictable and too risky to be undertaken. Whereas the firm may have previously relied on a capital widening accumulation strategy, one that reproduced the firm's existing organizational structure including its labor relations regime, it will now have to consider a capital deepening strategy in which the firm invests in order to drastically lower unit costs through an attack on labor -- through labor substitution via massive layoffs and labor process reorganization -- and technical improvement. In other words, the investment demand function is strategy dependent and a rise in competitive intensity that accompanies the shift from a corespective to an anarchic competitive regime will trigger a switch in strategy that will raise the level of defensive investment. In Section II we will test econometrically for the presence of such regime shifts at the end of the 1960s and again in the beginning of the 1980s, periods in which foreign competition appears to have increased significantly.

Of course, labor can be expected to resist this attack on wages and work rules required by implementation of this strategy. And the investment required to implement the cost-cutting strategy must be financed in the face of profit'margins eroded by the outbreak of anarchic competition. Thus, the strategy shift is dangerous for the enterprise; its ultimate results are unpredictable. It may involve internal managerial struggle, conflict with short-horizoned stockholders, a declaration of war on its labor unions (of unknown cost and duration), massive blue and white collar firings, and plant closings. To put the matter neoclassically, the *new* strategy has such large but uncertain potential **"costs of adjustment"** that it will never be optimal over an intermediate-term horizon in which the competitive constraint is satisfied. It will result in a lower value of 0 over the investment planning horizon because of the dramatic decline in s caused by the jump in debt financed investment (though if it is successful it will eventually lower costs and put the firm in a more competitively secure condition).' Thus, the firm must be coerced into adopting the new strategy and financing the new investment by a reproduction-threatening shift from a corespective to an anarchic competitive regime.

In the model we concentrate on foreign competition, define I^O and I^D as **offensive** and defensive investment respectively, and specify the constraint as $C(I^O,I^D) > C*$, where $C = P^f - U(I^O,I^D)$ is the margin between the foreign price of output, P^f, and the firm's cost per unit, U. C* represents the minimum margin that the firm believes it can tolerate without endangering its beyond planning horizon market share and thus its long-term viability. Note that a rise in competitive pressure (i.e., a fall in P^f or a rise in C) reduces the profit markup, and gross profit flows and, therefore, increases the probability of a short-term autonomy crisis.

Thus, the firm's decision-making problem can be represented as:

maximize

$$O(G(I^O,I^D,C),\ S(I^O,I^D,C))$$

subject to $C(I^O,I^D) > C^*$.

When the competitive constraint is nonbinding, so that the firm is satisfied with both its performance and the structures and strategies that generate it, $I^D = 0$: all I takes a capital widening form that reproduces these structures and strategies. In this situation, the G-S tradeoff is unimpinged and operates as the sole mechanism. However, a decline in P^f that violates the constraint will force a transition in investment policy to the riskier I^D-dominant mode of accumulation. The firm is coerced by competitive pressure strong enough to threaten its reproduction to invest in defensive cost-cutting capital goods that must be debt financed because of the collapse of the profit rate. And because the shift in investment strategy has large costs of adjustment, the amount of defensive investment required to lower unit costs must be substantial.

After the transition to an I^D-dominated strategy, the firm is faced with a choice between I^D and zK^O in the maximization of O where K^O is the stock of capital with the technology associated with I^O and z is the capacity utilization rate of this type of capital. In this situation, the competition effect captures only one of the two channels through which competition impinges on I: it is only a partial effect. The total impact of heightened competition on I is the sum of this positive neo-Schumpeterian effect and the negative effect on I^O caused by the decline in the profit rate and the increase in financial fragility. This total effect is, on a priori grounds, sign indeterminate. Nevertheless, the unique NS competition effect creates an important competition-profitability-fragility nexus. Heightened competition, if it triggers a switch in competitive regimes and in corporate strategies, can coerce the firm into investing more in the face of declining profits than normal growth-safety considerations would dictate. In the midst of both a profit squeeze and a deteriorating financial structure, competition may compel the firm to continue to accumulate capital and thereby postpone the onset of an accumulation crisis while simultaneously creating the preconditions for a subsequent crisis of even greater proportions.[5] This theory of competition thus provides an organic explanation for the seemingly paradoxical stylized facts describing capital accumulation in the 1980s.

With respect to econometric testing, the theory specifies: (1) expected profitability; (2) financial fragility/robustness: (3) the intensity of competition: (4) the costs of autonomy ; and (5) managerial attitudes toward leverage as the main determinants of investment demand. In the next section, we conduct econometric tests of the theory.

II. Econometric Specification and Tests

In this section we: (1) discuss the theoretical specification of an investment equation; (2) consider an appropriate statistical specification for a test of our I theory using time series data for the U.S. manufacturing sector; (3) discuss the data employed; and (4) report the results of our statistical estimation.

II.A Theorectical Specification

In the last section we concluded that our theory of total investment demand can be summarized as

$$I = f(R, C, B) \qquad (1)$$

where R is expected net revenues -- gross profits minus the costs of autonomy, $C = P^F - U$ is an index of international competitive pressure, and B is the level of financial robustness/fragility.

In Crotty and Goldstein (1992a, 1992b) it is shown that our theory of I demand is derived from a theory of the desired (optimal) capital stock, K^*.[6] Thus, our theory of the desired capital stock is summarized as

$$K^* = g(R, C, B)$$

Considering the formal specification of our model, (1) $R = (1-\beta)\Pi - rD$ where r is the nominal interest rate, D is the stock of debt, and β is the dividend payout rate, and (2) B combines the short and long-term indices of financial security: F and D'. Since F is based on the dynamically unstable functional form and parameters of the firm's subjective probability density function for expected gross profits and thus cannot readily be made operational in an econometric sense, we restrict B to equal $D' = D - D' . D^{*}$, an attitudinal variable, can be thought of as also incorporating the influence of the variance of expected gross profits, a component of F. Finally, the level of competition is adequately captured by $C = P^{F} - U$ at this stage of the specification.

We now consider nonlinearities and regime shifts in the formal model. Recognizing that $O_{SS} < 0$ in all cases covered by the model, a nonlinearity exists in the effect of financial fragility on investment demand and K^{*}. The effect of a change in D' on I and K^{*} depends on the existing level of financial security or D'. Thus, the I and K^{*} Functions are nonlinear in D'. Considering the simplest nonlinear form, I and K^{*} are specified as quadratic in D'. This specification allows us to test the important interaction between financial conditions and I demand based on a G-S tradeoff that intensifies at lower values of S and thus results in deeper declines in I and K^{*} for a ceteris paribus increase in D'. While we recognize that other nonlinearities may exist in the model, particularly in the cases where $O_{GG} < 0$, we confine our analysis of nonlinear effects to those associated with D'.[7]

Recognizing that the competitive constraint on the firm's optimization problem is either binding or not binding leads to the possibility of regime shifts in the effect of C on I. When the constraint binds the $\frac{\partial I}{\partial C} > 0$, while in the nonbinding case $\frac{\partial I}{\partial C} = 0$. Thus the coefficient on C term must be allowed to change over different time periods. A specification of this type allows us to isolate periods of competition-coerced offensive investment.

In summary, the theoretical specification of our desired capital stock equation can be restated as

$$K^{*} = g(R, C, D', (D')^{2}) \tag{2}$$

An equation for net investment, I^N, can be derived from equation (2) and the definition for net investment:

$$I^N \equiv K^{*} - K_{-1} \tag{3}$$

where K_{-1} is the actual capital stock in the previous period.

Substituting equation (2) in equation (3) results in a general equation for I^N:[8]

$$I^N = g(R, C, D', (D')^{2}) - K_{-1} \tag{4}$$

If it is assumed that replacement investment is approximately proportional to the capital stock in the previous period, gross investment, I^g, can be expressed as

$$I^g = g(R, C, D', (D')^{2}) - (1-\delta)K_{-1} \tag{5}$$

where δ is the rate of depreciation,

We now consider the functional form of g in equations (4) and (5). In order to separate out the Schumpeterian competition effect from the effect of C on R and thus I, it is necessary for g to be linear in C and R. Expressing the nonlinear relationship between D' and I as a quadratic requires that g is linear in D' and $(D')^2$. The practical restriction that the impact of financial fragility on I is Limited to the effect of D', where D' is not a function of R, implies that g must also be linear in R, D' and $(D')^2$. Finally, the impact of D' on I is independent of the level of C, thus g is linear in D'. $(D')^2$, and C.

Under these restrictions and abstracting from competitive regime shifts, equation (5) can be rewritten as

$$I^g_t = \beta_1 R_t + \beta_2 C_t + \beta_3 D'_t + \beta_4 (D'_t)^2 + (\delta - 1) K_{t-1} + \varepsilon \qquad (6)$$

where $\beta_1 \ldots \beta_4$ are parameters, the t subscript denotes the time period, and ε is a random disturbance term whose statistical specification is discussed in the next sub section.'

II.B Statistical Specification

The statistical specification Of ε_t is now considered. It is assumed that Et $\sim N(0, \sigma^2_t)$, ε_t is heteroscedastic, and ε_t and ε_{t-i} are autocorrelated for all t, and particular values of i, $i \neq t$, which will be determined by statistical tests. It is assumed that σ^2_t is a function of the size of the capital stock just prior to the current period's investment flow. In particular, it is assumed that $\sigma^2_t = aK^2_{t-1}$ for all t where a is a constant. Thus, correcting for heteroscedasticity requires that all variables in equation (6) be deflated by K_{t-1}. The resulting equation can be written as

$$I^g_t/K_{t-1} = (\delta-1) + \beta_1(R_t/K_{t-1}) + \beta_2(C_t/K_{t-1}) + \beta_3(D'_t/K_{t-1}) + \beta_4((D'_t)^2/K_{t-1}) + V_t \qquad (7)$$

where $V_t = \varepsilon_t/K_{t-1}$ is a homoscedastic error term. Equation (7) not only corrects for the heteroscedasticity problem but also establishes an equation for the gross rate of accumulation (I^g_t/K_{t-1}) as a function of the net profit rate, the rate of competition, and the debt equity ratio (contained in D'_t/K_t) -- an index of financial fragility.^{10}

Before making the explanatory variables in equation (7) operational, we make some futher adjustments to the equation to be estimated. First, in order to perserve the nonlinear relationship between the rate of accumulation and the firm's financial security, we substitute $(D'/K_{t-1})^2$ for $(D')^2/K_{t-1}$ in equation (7). Second, we assume that all rates associated with the independent variables are based on K_t rather than K_{t-1} as the scale factor. Incorporating these modifications into equation (7), we can rewrite the rate of accumulation of gross investment equation as

$$I^g_t/K_{t-1} = (\delta-1) + \beta_1(\Pi_t/K_t) + \beta_2 r_t + \beta_3(C_t/K_t) + \beta_4(D'_t/K_t) + \beta_5((D'_t/K_t)^2) + V_t \qquad (8)$$

An equation for the net rate of accumulation is derived by subtracting δ from the right side of equation (8).

We now construct the dependent and independent variables from existing data sources. While the gross and net rates of accumulation, GRA and NRA, can readily be constructed from existing data, the expected net profit rate, ENPR, the rate of competition, and D'_t/K_{t-1} need further elaboration.

Under Keynesian uncertainty, we assume that the firm bases its projection of the future net profit rate on the past performance of the net profit rate, NPR. Thus, ENPR $= \sum_{s=0}^{k} \gamma_s(R_{t-s}/K_{t-s}) = \sum_{s=0}^{k} \gamma_s NPR_{t-s}$ where γ_ss are constants and $0 < \gamma_s < 1$. Given that measures of NPR are readily available, ENPR can be constructed.

The level of competition (P^F-U), determines the level of net exports, M-X, where M is imports and X is exports. The rate of competition can be formed by dividing M-X by an appropriate output measure Q which is directly related to the level of K. An alternative, but similar, measure of the rate of competition which is standard in empirical work[11] is the import penetration ratio, IPR: $M/(Q-X)$. In our empirical work we employ the latter. If the firm projects the rate of competition from current and past values of the import penetration ratio, the expected import penetration ratio EIPR $= \sum_{s=0}^{m} \phi_s IPR_{t-s}$ where ϕ_s is a distributed lag coefficient and $0 < \phi_s < 1$.

The case of D'_t/K_t is complicated by the inclusion of an attitudinal variable D^* in D'. Recognizing that $D'_t/K_t = (D_t/K_t) - (D^*_t/K_t) = L-L^*$ where L is the degree of leverage (debt-equity ratio) and L^* is a critical debt-equity ratio based on the manager's attitude to financial risk, we assume that L^* is determined by past values of L and by Z, a vector of variables that control the adjustment of L^* for changes in L. Thus, $L^* = j(\sum_{s=1}^{l} \alpha_s L_{t-s}, Z)$ where Z may include the bankruptcy rate, the rate of hostile takeovers, the frequency of refinancing under financial duress, etc. In other words, it is hypothesized that higher debt-equity ratios, particularly those that rise above recent historical trends, which do not alter the perceived level of financial risk, as captured by Z, are gradually incorporated into the manager's perception of a reasonably safe leverage rate. In periods in which Z indicates that recent L levels are more risky, the adjustment of L^* on the basis of past values of L is less complete and slower as manager's are more reluctant to accomodate to a higher L level: Z determines both 1, the length of the adjustment period, and the α_ss, the extent of the adjustment over that period. Thus, the function j summarizes a behavioral process whereby management may or may not adjust to higher debt-equity ratios.

Under the above specification of L^*, $L-L^*$ is a function soley of present and past values of L where the length of the lag on L is determined by the manager's assessment of the level of financial risk which is unobservable. Thus, the L-L' variable can be constructed as $(L-L^*) = L_t - \sum_{s=1}^{1} \alpha_s L_{t-s} = h(L)$ and the length of the lag, 1 can be estimated econometrically.

An observation on the implications of the L^* lag structure is in order. Increases in L will at first raise L-L' and reduce financial security because L^* is slow to adjust. This will result in a decline in GRA and NRA in the current period. Given the nonlinear specification of the effect of $(L-L^*)$ on GRA, the gradual adjustment of L^* in subsequent periods will result initially in further declines in GRA and then in increases in GRA as L^* rises. The extent of the recovery in GRA, once a new steady state is reached, depends on the extent of the adjustment in L^*. While the extent of the recovery in GRA and thus the extent of the adjustment in L^* can be tested econometrically by calculating the overall impact of $(L-L^*)$ on GRA from the sum of estimated lag coefficients, the proposed time distribution of the effects of L-L' on GRA -- negative effects in the early periods and positive effects in latter periods -- cannot be easily tested.12 Finally, the length of the lag and thus the (un)conservative nature of the adjustment process, based on the degree of perceived risk can be determined in our econometric specification.

Rewriting equation (8) in its operational form and by taking into account the possibilty of (unforseen) gestation lags and a constant term as a result of aggregation,[13] we arrive at an equation for the gross rate of accumulation <u>decision</u>, GRAD:

$$GRAD_t = \beta_0 + \beta_1 ENPR_t + \beta_2 EIPR + \beta_3 (h(L)) + \beta_4 (h(L))^2 + V_t$$

Recognizing that GRA_t is itself a distributed gestation lag on $GRAD_t$, we can write

$$GRA_t = \sum_{s=0}^{p} w_s GRAD_{t-s} \qquad (9)$$

where w_s, for s = 0 . . . p, is a set of lag coefficients and $0 < w_s < 1$ for all s.

Given that a gestation lag of length p on explanatory variables which consist of distributed lags of length q results in a distributed lag of length p + q, the estimating equation for GRA, equation (9), is a distributed lag of length p + k in NFR, of length p + m in IFR, and of length p + 1 in L and L^2. Thus, equations (8) and (9) can be combined to arrive at our basic equation to be estimated:

$$GRA_t = \beta_0 + \sum_{s=0}^{p+k} \beta_{1s} NPR_{t-s} + \sum_{s=0}^{p+m} \beta_{2s} IPR_{t-s}$$

$$+ \sum_{s=0}^{p+1} \beta_{3s} L + \sum_{s=0}^{p+1} \beta_{4s} L^2 + V_t \qquad (10)$$

where β_{i3} and β_0 are parameters to be estimated. Equation (10) is basic in that it assumes that the competition effect on I is constant throughout the entire time period. Thus, the possibility of a competitive regime shift is not considered.

The addition of competitive regime shifts -- alternative values of $\frac{\partial I}{\partial C}$ in different time periods -- is accomplished by the use of a switching regression model. Under the assumption that the switching point (t^*) is known and that $\sigma^2_{v_t}$ for $t < t^*$ and $\sigma^2_{v_t}$ for $t \geq t^*$ are equal, the standard two equation switching regression model reduces to a single equation with slope and intercept dummy variables. Thus, addition of $\beta_5 D_t$ and $D_t \sum_{s=0}^{p+m} B_{6s} IPR_{t-s}$ to equation (10) where $D_t = 1$ for $t \geq t^*$, and $D_t = 0$ for $t \leq t^*$ and β_{i3}, β_0 and β_1 are parameters, captures competitive regime shifts in our model.

The definition and construction of GRA. NRA, r, GPR, IPR, and L are discussed in the next section. The generalized least squares estimates of the parameters in equation (10) and its variants are derived and reported subsequent to the discussion of the data.

II.C The Data

Our theory of accumulation is empirically tested by estimating the distributed lag equation in equation (10). Variants of two equations are tested -- the above equation for GRA and an analogous equation for NRA -- using post-war data, both annual and quarterly. for the U.S. manufacturing sector. The manufacturing sector is chosen because we feel that it affords the best test of the important Schumpeterian competition effect. Alternative choices such as the more highly aggregated nonfinancial corporate business sector or the sectors encompassed by the measures of business fixed investment and gross private domestic investment include industries that have been either heavily regulated or for which competition, particularly foreign competition, is not a viable issue. Worse yet, there is no reasonable index of the degree of competition for these sectors. Thus, we confine our analysis to the manufacturing sector.

We now consider the construction from existing data of the variables contained in equation (10).

GRA. In order to construct a consistent GRA series where the numerator and denominator of GRA are both calculated on the same basis (establishment basis), GRA is constructed from the U.S. Department of Commerce annual capital stock series for manufacturing from 1947-1988 contained in Fixed Reproducible Tangible Wealth in the U.S., 1925-85 and various updates. Gross investment is defined as the change in the year-end constant cost gross capital stock of fixed nonresidential private capital (equipment and structures) plus the constant cost valuation of total discards for all manufacturing. Gross investment in period t is divided by the constant cost valuation of the net capital stock (equipment and structures) lagged one period in order to generate an annual series (1947-1988) for GRA. A quarterly series for GRA is created by estimating the best linear unbiased (BLU) distribution, from annual to quarterly data, of the gross investment variable using a related time series[14] -- new plant and equipment expenditures by manufacturing business from the Department of Commerce survey of plant and equipment expenditure -- and by dividing the resulting investment series by the series resulting from the linear distribution, from annual to quarterly, of the net capital stock.

NRA. The NRA series, both annual and quarterly, are constructed analogously to the GRA series by subtracting the constant cost valuation of depreciation from gross investment.[15]

NPR. Net profits are defined as profits (net of operating expenses) before taxes (with IVA) minus interest paid, minus dividend payments, minus federal, state, and local profits tax liability plus the capital consumption adjustment for the corporate manufacturing sector where all series are in current dollars. The NPR is constructed by dividing net profits by the current cost valuation of the net capital stock for corporate manufacturing.16 The series that comprise the numerator of NPR are from the U.S. Department of Commerce, NIPA from 1947-1988. The annual series on NPR is derived from annual data on these series, while the quarterly series is generated from quarterly data on profits and the linear distribution of the capital stock, tax liability, and net interest series.

IPR. The import penetration ratio is defined as the value of manufacturing imports for consumption to the value of manufacturing shipments less the value of manufacturing exports, which is the percentage of the manufacturing sector's domestic market that is captured by imports. Annual import and export data were compiled from various issues of *U.S. Commodity Exports and Imports as Related to Output* (U.S. Department of Commerce) for the years 1958-1986. Manufacturing shipments data were compiled from various issues of *Current Industrial Reports* (U.S. Department of Commerce). Given the limited time span for the import and export data, the annual IPR series was extended to cover the years 1947-1986 by using the BLU forecast and backcast of the IPR from a forecasting and a backcasting equation based on a related time series -- an economy wide IPR derived from NIPA data on imports, GNP, and exports.[17] Finally,, a quarterly series for IPR from 1947-1988 is generated from the BLU distribution of IPR using a related time series from 1958-1986 and the BLU backcasts and forecasts for the remaining quarters.[18]

L. The leverage ratio employed is the debt-equity ratio. The L series is compiled from the debt-equity ratio for manufacturing in various issues of the *Quarterly Financial Report for Manufacturing Corporations*, 1947-1988 (U.S. Department of Commerce). The series is available on both an annual and quarterly basis. The debt component of the ratio is based on the market value of the current stock of debt, while the equity component is based on book value. To our knowledge, no current value series for manufacturing equity is available.

The quarterly series for GRA, NRA, NPR, IPR and L are depicted in figures 1-5 in Appendix A.

III. Results

Regression results for the basic GRA and NRA equations based on quarterly data for 1954:2-1988:2 are reported in Table I. Results based on annual data for 1954-1988 are reported in Appendix B. Table I and Appendix B report the current period and first period lag coefficients, the sum of lag coefficients for each variable, AR (autoregressive) coefficients and a series of summary statistics. All equations are estimated using generalized least squares (GLS) with the Cochrane-Orcutt proceedure to correct for serial correlation. Lag structures are estimated by a polynomial distributed lag (PDL).[19] Reported summary statistics include R^2, the Durbin-Watson statistic (d), and the Q statistic (portmanteau test) based on 8 and 25 (Q_8, Q_{25}) lags for annual and quarterly equations[20] and the critical value of L where $\frac{31}{3L} = 0$.

All distributed lag coefficients lie on an unrestricted sixth degree polynomial in the quarterly equations and an *unrestricted* fourth degree polynomial in the annual equations.21 In order to prevent an upward bias in the length of the lag, lag lengths *were* chosen on the basis of F > 2 associated with tests of linear restrictions rather than the maximum $\bar{R}^2$. Quarterly lag lengths for GPR, IPR, L and L^2 are respectively: 14, 12, 28, and 28. Annual lag lengths are respectively: 4, 4, 7, and 7. Finally, the results for annual equations are reported as a means of verifying that the linear distribution and BLU distribution (using related time series) techniques employed in the generation of some quarterly series have not unduly influenced our quarterly results. Given that the results for annual and quarterly equations are qualitatively similar, we focus on the quarterly results.

The results in Table I and Appendix B provide strong empirical support for the PK-NS theory of accumulation developed in Section I. In particular, the overall Schumpeterian competition effect, which isolates the firm's response to increased competitive pressures holding other factors, particularly the profit rate, constant, is large and significant. The manufacturing sector responds to increased competition by defending its existing capital through new investment, presumably qreared at cost reduction rather than output enhancement. Based on the equations in Table I, a .01 increase in IPR results respectively in a .0165 and .0139 increase in GRA and NRA.[33]

While the results reported here cannot provide conclusive support for the behavioral mechanisms outlined in our theory, they are not inconsistent with our theory and in combination with the other results they allow us to explain the stylized facts of the post-war period in a manner that supports our behavioral theory: firm's are coerced by competitive pressures to take on increased risks and higher levels of debt which were previously not optimal in the hope of surviving the competitive onslaught, thus increasing financial fragility in an already crisis prone environment.

In addition, the NPR has an important impact on GRA and NRA. A one percent increase in NPR results in approximately a one percent overall increase in the rate of accumulation. The profit rate acts as the traditional attractor of new investment. Higher expected profits signal profit advantages that the profit maximizing firm in a competitive environment cannot afford to passover if it is to improve or maintain its competitive position and thus its chance of survival.

The NPR result also establishes an important micro-macroeconomic linkage for the transmission of economic crisis. Ceteris paribus, changing macroeconomic conditions that affect microeconomic profitability can result in an accumulation crisis.

The nonlinear effect of financial security on investment/accumulation is also strongly supported by our results. The overall effect of L on GRA can be expressed as $\partial GRA/\partial L = \hat{S}_L + 2\hat{S}_{L^2}L$ where $\hat{S}_L$ and $\hat{S}_{L^2}$ are respectively the sum of the lag coefficients for L and L^2 and $\partial NRA/\partial L$ is defined analogously. The results in Table I reveal that $\partial GRA/\partial L \gtrless 0$ and $\partial NRA/\partial L \gtrless 0$ for $L \lessgtr .311$ and $.321$. From appendix A, it can be shown that $\partial GRA/\partial L < 0$ and $\partial NRA/\partial L < 0$ from 1966:4, the beginning of the period in which the first rapid Post-war rise in L takes place. Between 1966:4 and 1988:2, $\partial GRA/\partial L$ and $\partial NRA/\partial L$ range respectively between 0 and -2.64 and 0 and -2.35 and decrease steadily throughout the period as L rises. Statistical tests reveal that in the relevant range of L, that $\partial GRA/\partial L$ and $\partial NRA/\partial L$ is statistically indistinguishable from zero in the period 1954-1966. Thus $\partial GRA/\partial L$ and $\partial NRA/\partial L$ is effectively zero in the early period and increasingly negative through the latter period (1967-1988) when L rises dramatically: as the G-S tradeoff intensifies the firm reduces its investment demand and the rate of accumulation. In the relevant historical period, the absolute size of the decline in investment per unit rise in L is related to the degree of debt leverage: at higher values of L, $|\partial GRA/\partial L|$ and $|\partial NRA/\partial L|$ increase. These results establish the important linkage between financial conditions and the rate of accumulation discussed above.

This result is different from the typical Post Keynesian

Table I. Rate of Accumulation Equations, Quarterly Data 1954:2-1988:2*

Independent Variable and Summary Statistic	Dependent Variable - Equation No.	
	GRA-EQ. (1)	NRA-EQ. (2)
Constant	-.320	-.391
	(-3.25)	(-4.08)
NPR		
Current Period	.057	.055
	(2.76)	(2.64)
1 Period Lag	.076	.075
	(4.47)	(4.43)
Sum of Coefficients	1.01	1.03
	(6.96)	(7.19)
IPR		
Current Period	.076	036
	(.319)	(.150)
1 Period Lag	.067	.050
	(.375)	(.278)
Sum of Coefficients	1.65	1.39
	(3.27)	(2.79)
L		
Current Period	.010	.053
	(.040)	(.206)
1 Period Lag	-.025	.006
	(-.224)	(.051)
Sum of Coefficients	2.23	2.109
	(3.68)	(3.59)
L^2		
Current Period	.001	-.034
	(.004)	(-.122)
1 Period Lag	-.026	-.051
	(-.211)	(-.420)
Sum of Coefficients	-3.58	-3.28
	(-3.47)	(-3.26)
Critical L	.311	.321
AR(1)	.880	.876
	(21.71)	(21.24)
R^2	.969	.975
d	1.85	1.81
Q_{25}	26.9	28.0

● t statistics in parentheses

treatment of debt leverage and investment demand. Our theory is based on $L-L^*$ rather than L alone. The inclusion of L^*, an attitudinal variable towards financial risk, implies that higher levels of L do not necessarily deter investment. It is only when higher levels of L are perceived as unsafe that investment is adversely affected. Our approach emphasizes the historically specific attitudes of managers towards financial risk.

With respect to the length of the L and L^2 lags and the overall effect (discussed above), the long lag length suggests that <u>the adjustment of L^* in response to an increase in L is verv slow and</u> a negative overall L effect on GRA and NRA suggests that the adjustment is <u>incomplete</u>. Both these results are to be expected. A lag length of 7 years, depending on the length of the gestation lag, suggests between a 4 and 5.5 year adjustment period. In an historical period characterized by two large increases -- from 1965 - 1970 and in the 1980s -- in L one would expect a conservative managerial attitude towards financial risk, particularly in the latter years when firms were compelled to reluctantly take on new debt due to increasing competitive pressures, Thus, L^* is likely to adjust slowly. Under the same circumstances, it is also expected that the adjustment in L^* is only partial: ceteris paribus, increasing financial fragility has kept management consistently uncomfortable with its degree of leverage.

In general, the full lag structures, not reported here, take on the standard inverted U shape that is expected when expectational and gestational lags are combined. With the exception of the lag structure for L and L^2, discussed above, the lag distributions imply a gestation lag from 1.5-Z years and an expectational lag of 1.5-2 years in length. Both lags seem reasonable on a priori grounds.

Finally, an examination of the residuals associated with the six equations reported in Table I reveal that we have avoided a problem in estimating (forecasting) investment in the 1980s that has troubled more standard investment equations (theory q, the neoclassical model) are not endemic in our model. Other models have systematically underpredicated the strength of investment in the late 1970s and 1980s.[23] In constrast, an examination of the residuals in our equations show that the problem of systematic underprediction is not present. Our equations tend to be as likely to generate positive residuals as they are to generate negative residuals.

To complete the empirical evaluation of our theory of investment demand, we test for the existence of competitive regime shifts. We consider equations with both two regimes and three regimes. In the former the switching point is t = 1970 -- five years after the beginning of the first percipitous rise in the level of international competition. In the latter, the switching points are $t_1 = 1970$ and $t_2 = 1980$ -- where 1980 marks the beginning of a second wave of intensified foreign competition and what is perceived as a concerted response on the part of U.S. manufacturing firms. Switching results are reported for both GRA and NRA equations in Table II.[24] The appropriate F-tests reveal that the linear restrictions associated with the single regime equations (without slope and intercept dummies -- Table I) are rejected at the 5% and 8% percent level of significance when compared respectively to the three regime and two regime models.[25]

Table II. Competitive Regime Shift Equations, Quarterly Data 1954:2-1988:2*

	Dependent Variable - Equation No.			
Independent Variable and Summary Statistic	GRA (2 Regimes)	NRA (2 Regimes)	CRA (3 Regimes)	NRA (3 Regimes)
Constant (Early Period)	-.466 (-1.78)	-.561 (-2.13)	-.256 (-3.02)	-.346 (-3.97)
Constant (Middle Period)			-.250	-.340
Constant (Late Period)	-.462	-.557	-.246	-.336
NPR				
Current Period	.060 (2.58)	.057 (2.46)	.033 (1.46)	.028 (1.24)
Sum of Coefficients	.814 (4.33)	-820 (4.36)	1.08 (7.17)	1.09 (7.07)
IPR-Early				
Current Period	.113 (1.25)	.141 (1.26)	.211 (.684)	.219 (.213)
Sum of Coefficients	2.42 (1.47)	2.37 (1.39)	1.85 (1.43)	1.62 (1.36)
IPR-Middle				
Current Period			.165 (.439)	.210 (.562)
Sum of Coefficients			1.38 (2.35)	1.13 (1.98)
IPR-Late				
Current Period	.092 (.367)	.057 (.226)	.118 (.615)	.089 (.631)
Sum of Coefficients	2.03 (2.65)	1.84 (2.31)	1.70 (3.22)	1.41 (2.65)
L				
Current Period	.286 (.913)	.263 (.847)	.672 (2.12)	.682 (2.17)
Sum of Coefficients	3.16 (2.21)	3.16 (2.22)	1.61 (3.67)	1.63 (3.56)
L^2				
Current Period	-.261 (-.917)	-.233 (-.826)	-.644 (-1.87)	-.643 (-1.88)
Sum of Coefficients	-5.18 (-2.31)	-5.08 (-2.26)	-2.44 (-3.39)	-2.35 (-3.13)
Critical L	.304	.311	.331	.347
AR(1)	.926 (33.47)	.929 (35.89)	.725 (8.70)	.738 (8.90)
R^2	.971	.977	.981	.985
d	2.04	2.01	1.99	1.96
Q_{25}				

*t statistics in parentheses

The results in Table II are consistent with our previous findings on the relationship between the net profit rate, the debt-equity ratio and the rate of accumulation. The addition of regime shifts confirm our hypothesis that three distinct periods exist. Our estimates reveal that in the period 1954:2-1969:2 that the competitive constraint on the manager's investment decision is not binding -- despite the relatively large value for the sum of lag coefficients in this early period, the **overall** $\frac{\partial I}{\partial IPR}$ cannot be statistically distinquished from a value of zero. If the period 1970:1-1988:2 is undividied, we find that the competitive constraint operates in this period and that for a one percent increase in the foreign share of the U.S. domestic market there is approximately a two percent increase in the rate of accumulation.[26] If we subdivide this period, we find that between 1970:1 and 1979:4 and between 1980:1 and 1988:2 the defensive investment effect is operable. The effect is stronger in the latter period with the import share elasticity of the rate of accumulation is 1.7 compared to 1.38 for GRA and 1.41 compared to 1.13 for NRA. These differences between middle and late periods are statistically significant. This division of the post-war experience with international competition into specific regimes is an important aid for understanding qualitative distinctions in the nature of the accumulation process.

IV. Conclusion

The main objective of this paper has been to summarize and, more importantly, empirically support a Post Keynesian-Neo Schumpeterian micro-founded theory of accumulation. It has been argued that the optimal investment decision depends on the level of expected profitability, the degree of competition, and the degree of financial fragility. It is further argued that the coercive role of competition on investment demand is qualitatively and quantitatively distinct in different time periods. Empirical support for our theory is obtained from a polynomial distributed lag regression analysis of the determinants of the rate of accumulation in the U.S. manufacturing sector between 1954-1988 (where competition is confined to the degree of international competition). Our econometric results establish a strong Schumpeterian competition effect -- increases in the intensity of competition compel the firm to undertake additional investment in order to defend its existing illiquid capital. It is shown that the size of this effect varies over three distinct historical periods. Our results also strongly support the notion of a Post Keynesian growth-financial security/autonomy tradeoff in the determination of the level of investment: ceteris paribus, perceived increases in the degree of "unsafe" leverage lead to reductions in the rate of accumulation and thus the growth objectives of the firm. In addition, our results support the standard strong positive effect of expected profitability in theories of accumulation.

In addition, the profit rate-competition-financial security nexus allows us to explain important trends in the post-war accumulation of capital. In particular, the tendency to a strong rate of-accumulation in the face of declining profit rates and increasing financial fragility is explained by this nexus.

APPENDIX A

Figure A.1 Rate of accumulation for gross investment

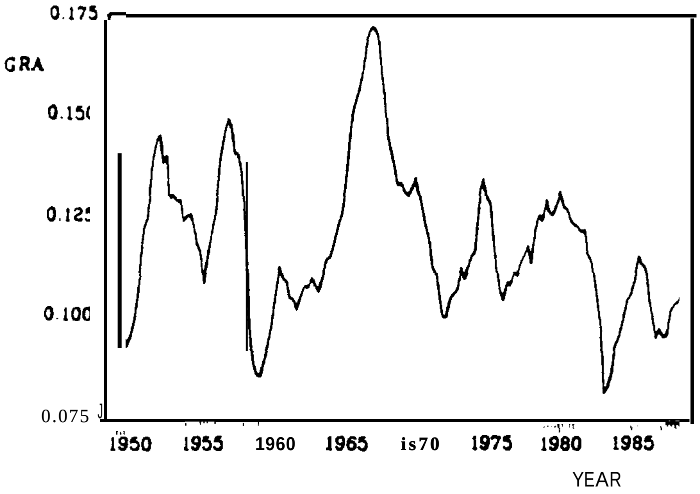


Figure A.2 Rate of accumulation for net investme

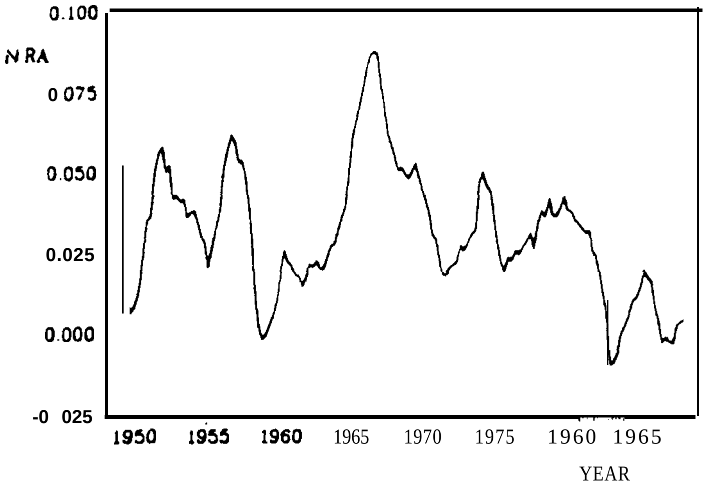


Figure A.3 Net profit rate

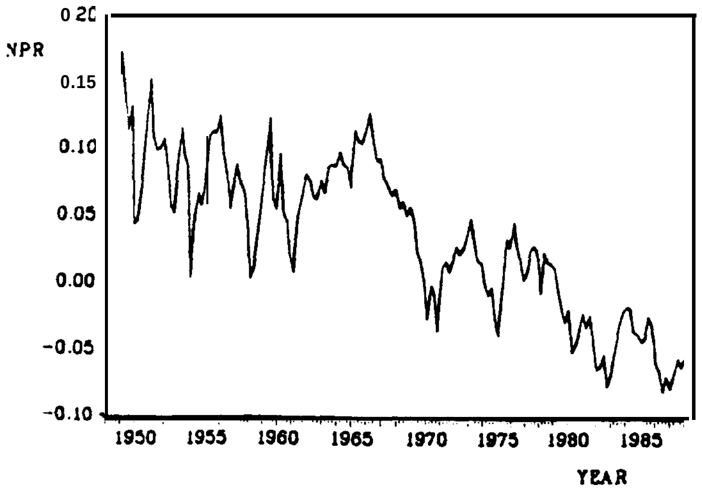


Figure A.4 Import-penetration ratio

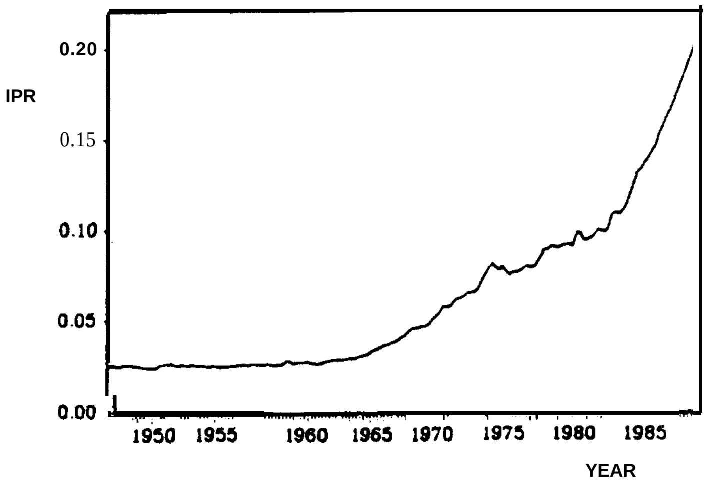
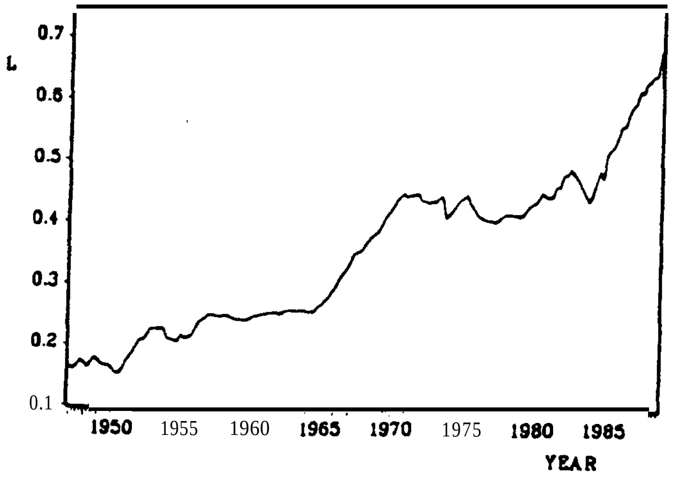


Figure A.5 Debt-equity ratio



Appendix B

Rate of Accumulation Equations, Annual Data 1954-1988*

	Dependent Variable - Equation No.	
Independent Variable and Summary Statistic	GRA-EQ. (B.1)	NRA-EQ. (B.2)
Constant	-.393 (-2.64)	-.449 (-3.17)
NPR		
Current Period	.227 (2.39)	.223 (2.40)
1 Period Lag	.368 (2.42)	.339 (2.29)
Sum of Coefficients	1.46 (3.66)	1.43 (3.70)
IPR		
Current Period	.829 (2.06)	.732 (1.85)
1 Period Lag	.365 (.653)	.197 (.361)
Sum of Coefficients	2.15 (1.69)	1.79 (1.44)
L		
Current Period	.641 (.954)	.722 (1.11)
1 Period Lag	-1.22 (-3.39)	-1.17 (-3.33)
Sum of Coefficients	2.45 (3.15)	2.27 (3.09)
L^2		
Current Period	-.816 (-1.14)	-.863 (-1.24)
1 Period Lag	.932 (1.91)	.897 (1.87)
Sum of Coefficients	-3.98 (-2.72)	-3.56 (-2.56)
Critical L	.307	.318
AR(1)	.518 (3.53)	.500 (3.36)
R^2	950	.961
d	2.41	2.39
Q_8	8.51	8.94

Footnotes

[1] Crotty (1991a) posits two distinct modes of interfirm relations or competitive regimes. In a regime characterized by corespective competitive relations, firms compete within a implicit set of understandings that rule out those forms of competitive struggle most damaging to the profit and growth prospects of the industry as a whole. For example, corespective relations allow firms to control the pace of technical change in order to minimize the "slaughter" of constant capital and the financial fragility that constant technical change can cause. They allow firms to "plan" the rate of obsolesence. Corespective relations also make it possible for the firms to adopt long-term, high-wage, high-skill labor relations policies.

When corespective interfirm relations are destroyed by the outbreak of uncontrolled, dog-eat-dog competition, a regime of anarchic competition prevails. Under anarchic competition firms are forced to adopt whatever strategies offer the best hope for short term survival no matter how inefficient or dangerous they are for the industry as a whole in the long run.

While these two modes of competition are derived from a Marxian analysis, the basic concepts are also consistent with the notion of Schumpeterian competition.

[2] Competition is a continuous process of struggle over market shares, growth rates, profits and survival, a struggle that varies in intensity over time but never permanently ceases. Competition therefore generates an unstable, dangerous, and above all unpredictable environment within which the firm operates. Within this environment there is no unique or optimal profit or expected profit

maximizing investment decision.

This type of competition therefore generates "true" or Keynesian or Knightian uncertainty within which the future is <u>unknowable in principle</u>. Neoclassical theory uses a subjective probability density function to capture the effect of "risk", but as has been stressed by Fost Keynesian writers, this approach is adequate only for successive outcomes produced by a knowable and unchanging generating mechanism. However, the outcomes in economics are not so generated: institutions, knowledge and agent preferences all change with each successive "draw".

Keynes rejected the probability calculus and its implications for the theory of investment and portfolio selection. He insisted that firms and wealth-holders could never obtain the information they needed to make rational decisions, yet had to make them nevertheless. As a result, firms develop phychological, sociological, and institutionally-specific strategies for dealing with investment decisions under Keynesian uncertainty. Such strategies introduce instability and an historical open-endedness into the theory of investment.

[3] Capital widening is typically defined as accumulation without significant technical change. It expands capacity without changing the capital-labor ratio. Capital deepening accumulation, on the other hand, does involve substantial technical change and a rise in the capital-labor ratio. Capital-deepening investment is a weapon used by capital against labor; it allows firms to fire workers and increase the reserve army while maintaining their capacity to produce.

Here we use the terms more broadly. Capital widening refers to investment that takes place within and reproduces a stable corespective competitive regime. Such investment does not disrupt the existing state of capital-labor relations and does not destroy the ability of the competing firms to control the pace of technical change and manage the rate of obsolescence. Capital deepening investment threatens both the state of capital-labor relations and the corespective relations among firms. See Crotty 1990a for a discussion of these distinctions.

[4] This discussion abstracts from the important distinction between long term and short term strategies emphasized in Crotty 1991a.

[5] It should be noted that the thesis that a dynamic theory of competition is required to make sense of the simultaneous occurrence of a falling rate of profit, rising financial fragility, and a stronger than expected rate of accumulation is not original here. Pollin (1986), for one, stated it quite clearly. What is original, we believe, is our demonstration that such behavior is consistent with a rational enterprise investment strategy.

[6] This equivalence requires that gestation lags are unforeseen and that all costs of adjustment with the exception of those associated with a change in the mode of accumulation are negligible.

[7] The $\theta_{GG} < 0$ assumption is necessitated by the mathematical structure of the model, particularly the behavior of U. It ensures that cuts in I^W are not the primary method by which firms reduce costs to meet the competition. Given that it is commonplace for actual firms to meet the competition through increases in cost-cutting investment, the $\theta_{GG} < 0$ assumption is particular to the structure of our model and need not be incorporated in the econometric

specification.

[8]We implicitly assume that K_{-1} is not equivalent to K^*_{-1}. Under Keynesian uncertainty, it is realistic to assume that the adjustment to the previous period's desired capital stock is slow and under the Schumpeterian concept of competition, discontinous changes in investment strategies are possible. Thus it is consistent with the core assumptions of our analysis to assume that $K_{-1} \neq K^*_{-1}$ and that I^N is based on K^*_{-1}.

[9]Equation (6) restricts the coefficient on II and rD to be the same. Thus the effect of the interest rate is subsumed in the net profit term. This restriction is justified on both theoretical and econometric grounds. On the theoretical level, our theory focuses on the importance of net (of costs of autonomy) profits rather than gross profits. Dividends and interest payments are viewed as a constraint on the firm that must be paid to preserve managerial autonomy. After these payments are made, the resulting profits are what is relevant for the firm's investment decisions. On the econometric level, if we separate out rD from R we create a potentially severe multicollinearity problem because rD is collinear with the other debt terms, (D-D'). More importantly, a potential interpretation problem exists in distinguishing between the effect of the debt-equity ratio (financial fragility) and of autonomy costs on I in the heteroscedastic corrected form of equation (6) (discussed below) which is normalized by K. Given the importance of the nonlinear financial security effect in our theory, we choose on both econometric and theoretical grounds to subsume the rD effect in R.

[10]In constrast to typical adjustments for heteroscedasticity

where both sides of the equation are divided by potential GNP Or GNP, (see Clark (1979)) and the deflated K_{t-1} term remains on the right hand side, our correction for heteroscedasticty establishes an equation for the rate of accumulation and eliminates the spurious correlation and artificial goodness of fit created by the similar time trends in K_{t-1} snd I_t^g, thus establishing a more rigorous test of our theory.

[11] See Pugel (1978) and Goldstein (1986a).

[12] The combination of gestation lags and expectational lags makes it difficult to isolate the expectational lag structure. In addition, the inclusion of a nonlinear $L-L^*$ term implies that the sign of $\frac{\partial I}{\partial L_{t-i}}$ for all i depends on the size of L_t relative to L_{t-i} and on the relative size of coefficients in the expectation function for L^* (as a function of L). Ceteris Paribus, the larger L_t and the larger the coefficients on periods prior to L_{t-i} the more likely $\frac{\partial I}{\partial L_{t-1}} < 0$. Finally, given the high degree of multicollinearity in the sample data, it may be unrealistic to hope to distinguish from our estimation results the fine detail of the lag structure proposed by our theory.

[13] A constant term is included because the aggregated equations that we test at best approximate the sum of the equations for all firms.

[14] See Chow and Lin (1971). The equation employed is $GI = -1.75 + .64PE + .84T - .03T^2$ with an AR1 correction ($\rho = .86$), estimated for 1347-1988, where GI is gross investment, PE is the new plant and equipment expenditure survey series and T is time. For the above equation $R^2 = .84$ and the t-statistics are respectively -.27, 11.98, 1.39, and -2.21.

[15] In addition, the form of the equation used for the BLU distribution of net investment is altered: $NI = -18.56 + .65PE + .35T - .06T^2$ with AR1 correction ($\rho = .86$) where NI is net investment and T is time. For this equation, $R^2 = .81$ and the t statistics are respectively -2.99, 12.50, 0.60, and -4.12.

[16] In the annual series, the midyear, rather than end-year, value of the capital stock is used where midyear values are derived as the average between two end-year values.

[17] The forecasting equation used to generate the BLU forecasts of IPR is: $IPR = -0.010 + 0.076IPRE + 0.0007T$ with an AR1 correction ($\rho = .63$), where IPRE is the economy wide IPR and T is time. This equation is estimated for the period 1974-1982 and has $R^2 = .94$ and respective t statistics -.753, 1.88, and 5.18. The backcasting equation employed is: $IPR = 0.017 + 0.21IPRE - .0001T$ with no AR correction. The equation is estimated for the period 1958-1964 and has $R^2 = .76$ and t statistics 1.28, 1.91, and -0.38. Separate forecasting and backcasting equations are employed to capture the (distinct historical trends in the IPR in these two time periods.

[18] The forecasting and backcasting equations are described in N.17. The distribution equation: $IPR = -0.018 + 0.0553IPRE + 0.0008T$ with an AR1 correction ($\rho = .74$) and $R^2 = .95$.

[19] The restricted sample size, compared to data availability from 1947-1988, are necessitated by lags of up to seven years, autocorrelation corrections and observations lost in the linear distribution of certain variables.

A complete set of all distributed lag coefficients is available from the authors upon request.

[20] The Q-tests *are also* conducted for annual lag lengths of 5 and 10 and quarterly lag lengths of 15, 20, and 30 with the same qualitative results: the null hypothesis, no autocorrelation, cannot be rejected.

[21] The degree of the polynominal is chosen by a sequential test of the significance of the coefficients on the actual PDL variables -- linear combinations of lagged independent variables. Parameter estimates, particularly the sum of lag coefficients are extremely robust with respect to the degree of the polynomial used. In the quarterly and annual equations polynomials respectively of degrees 4-7 and 2-4 produce very similar results.

[22] In neoclassical theory, increased competition can never lead to an increase in cost-cutting as opposed to output-enhancing investment because all firms are cost-minimizing at all times. An increase in competition caused by new entrants lowers output-augmenting investment by existing firms because it lowers the marginal product of capital. However, <u>industry</u> output-augmenting investment will rise because greater competition means a lower average price and greater industry output, ceteris paribus.

Our results must be distinguished from the neoclassical treatment of competition. To the extent that our IPR reflects changes in foreign competition, the sign on the competition variable is both the sign of the firm and industry response to competition.- In neoclassical theory, both of these responses cannot be positive.

[23] See Clark (1979) and Kopcke (1985).

[24] The integration of slope dummies into a polynomial distributed lag of the form $y = \alpha + \beta_0 X_t + B_1 X_{t-1} + \ldots \beta_{p-1} X_{t-p+1}$ requires an

lag of the form $y = a + \beta_0 X_t + B_1 X_{t-1} + \ldots \beta_{p-1} X_{t-p+1}$ requires an estimation equation of the following form:

$$y = a_1 Z_1 + \ldots + a_N Z_N + C_1 D^* Z_1 + \ldots C_N D^* Z_N$$

where Z_i are specific linear combinations of $X_t \ldots X_{t-p+1}$ generated by the restrictions requiring that β_i lies on a polynomial of degree N-1, $a_1 \ldots a_N$ and $C_1 \ldots C_N$ are parameters, and D is a dummy variable. The equations reported in Table II use such a specification and their AR1 variant is estimated using nonlinear least squares. Estimates of $\beta_0, \ldots \beta_{p-1}$ are derived from the nonlinear least squares estimates of $a_1 \ldots a_N$ and $C_1 \ldots C_N$ by use of the above mentioned restrictions.

[25] The F-statistics associated with the acceptance of the 3 regime model over the single regime model are respectively 2.36 and 2.30 for the GRA and NRA cases. F-statistics for the 2 regimes models are 1.88 and 1.83.

[26] It is important to note that this is not the total effect of competition on investment but only the defensive response of investment. The total effect, dI/dIPR, can be expressed as $\frac{\partial NPR}{\partial IPR} \cdot \frac{\partial GRA}{\partial NPR} + \frac{\partial GRA}{\partial IPR}$ -- the sum of the indirect effect working through the profit rate and the defensive investment or Schumpeterian competition effect. Thus the total effect will be smaller than the direct (Schumpeterian) effect.

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