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INDUSTRY INVESTMENT  
AND REGULATION

George Bittlingmayer

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## INDUSTRY INVESTMENT AND REGULATION

### Abstract

Regulatory uncertainty may delay investment, and some implemented or expected regulatory regimes may reduce the returns to investment. Public utilities, petroleum, telecommunications, automobiles, pharmaceuticals, and other industries offer examples of the industry specific effects of regulation. Some policies, notably antitrust, affect a broader set of industries and influence a variety of business activity, including merger, expansion and joint venture. Case studies suggest that federal antitrust initiatives may also serve as a proxy for other regulatory threats. This paper employs a panel set of 21 major industries covering 1947-1991 to explore the effects of regulation and regulatory uncertainty on investment. It uses antitrust case filings against exchange-listed firms as a proxy for the stringency of antitrust policy and related policy initiatives. Statistically, each extra antitrust case filing is associated with a decline of investment in the same industry of between \$169 and \$361 million (1987 dollars), and each case overall lowers investment per industry by \$34 to \$110 million. Because antitrust initiatives may delay investment or serve as a proxy for other, harder-to-measure policies, these estimates do not reveal the long-run effects of antitrust taken alone. However, they do offer evidence that investment is affected by more than the traditional business cycle and tax variables. The revival of antitrust under Eisenhower and Kennedy's confrontational business policies explain at least part of the low level of investment, 1957-1963, and renewed vigor under Nixon part of the investment decline of the 1970s. The appendix shows that first-difference methods seriously aggravate the bias stemming from errors-in-variables. Since regulatory uncertainty is a difficult-to-measure latent variable, this paper uses original levels to estimate coefficients and bootstrap methods to assess their significance.

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## I. Introduction

Economists have had little success in explaining new capital expenditures. Investment is volatile; factors that in theory should affect it have little influence; and even ad hoc or atheoretical empirical approaches leave much of the variance unexplained. The behavior of new structures seems especially troublesome.

Nearly all work on investment behavior has emphasized factors affecting the cost of investment or the demand for goods. Those factors include interest rates, the price of capital goods, the tax treatment of investment, cash-flow and changes in output. Some approaches include cost-of-investment or demand factors directly, others, like q-theory, indirectly by focusing on the ratio of market value of existing capital to its replacement cost.

Missing in this debate are less easily measured, but nonetheless important influences. Political instability is probably the most obvious example. Political instability is especially likely to affect investment if it threatens to undermine property rights, the enforceability of contracts, the repatriation of profits, and the stability of the monetary standard, for example. Less developed countries provide ready illustrations, as do certain epochs in industrialized countries.

Regulatory initiatives and regulatory uncertainty offer a more subtle version of the same story. In the case of specific industries, such as pharmaceuticals, shifts in the regulatory framework, or even threats of shifts, may affect investment. Other policies, such as environmental and labor law, may very well affect investment across a number of industries. Again, the prospect of legislation and newly enacted legislation with uncertain consequences seem especially likely to affect investment. Since actual regulation, and what may be more important, uncertainty over future regulation, have clearly changed over time, these two factors may account for some of the observed shifts in investment.

Though intuitively appealing, the idea of a link between political or regulatory factors, on the one hand, and investment, on the other, does not fit easily into the debate between Keynesians and monetarists. However, early commentary and some contemporary theory offer starting points. For example, Roosevelt's (1954, ch. 4) study of the 1930's depression and slow revival observes that "the timing of investments may be affected by uncertainties arising from noneconomic [i.e., political or social] sources" and mentions a variety of political and regulatory factors – securities legislation, the National Labor Relations Act, Roosevelt's attempt to restructure the Supreme Court, and the New Deal's shifts in monopoly policy (from supporting business combinations in the NIRA to opposing them with Thurman Arnold's celebrated trust-busting). Friedman and Schwartz (1963, pp. 495-496) mention Roosevelt's treatment approvingly and expand on it. The recent emergence of a

third paradigm in the form of real business cycle theory, and renewed interest in the institutional sources of economic growth have also rekindled interest in the cyclical role of non-monetary factors. Finally, in a development anticipated by Mitchell (1913), Roosevelt and no doubt others, recent theoretical work on the "irreversibility" of investment stresses the role of uncertainty, in particular regulatory uncertainty.

Empirical work does face serious obstacles. A large number of political developments and regulations could conceivably affect investment. A thorough examination would entail the grueling task of learning the institutional details and assembling measures of actual and threatened regulatory actions. Proposed measures would almost certainly prove controversial. An indiscriminate search over many regulatory policies and variables would also raise the danger of data snooping. In addition, many policies (such as the Americans with Disabilities Act) are new and yield too few data points for reliable time series estimates. Studies of developing countries might involve the study of fewer regulations, but they would confront the difficulty of measuring political stability.

The work here deals with these issues – a critic might say it avoids them – by using a measure based on one policy, antitrust. Though less important than it used to be, antitrust is a good candidate for a number of reasons, at least for the U.S. For much of this century, antitrust was the federal government's most prominent economic lever. It was also, de facto federal corporation policy, the response of the central government to the rise and growing power of the modern corporation, or as some observers contend, America's answer to socialism. To this day, antitrust influences merger, stock ownership, expansion by internal growth, and a broad variety of business practices. It has a long and volatile record, its prohibitions have often been unclear, and it has been enforced at one time or another against every major industry group, especially in manufacturing. Two often conflicting and competing agencies – the Federal Trade Commission and the Antitrust Division of the Justice Department – have joint responsibility for enforcement. Episodes of enforcement also often accompanied related policy controversy, as illustrated by experience in pharmaceuticals, steel, oil and automobiles. And the political equilibrium on antitrust often has implications for other types of policy. For example, congress passed legislation establishing the Federal Reserve System on the heels of Teddy Roosevelt's and Taft's assault on big business as a parallel response to the "money trust." Moreover, the Fed's structural features, such as the twelve regional banks, reflected contemporary fears about concentrated power. Based on its own power to shape and, often, reshape business organization and conduct, and on the sorts of other government actions that often accompany it, antitrust seems well suited as a measure of uncertainty-causing economic policy.

Capital markets also support the view that antitrust matters, either by itself or as a proxy for a broader regulatory equilibrium. A growing body of evidence suggests that trust-busting hurts stock prices. Confirming episodes include Theodore Roosevelt's attack on Standard Oil, which coincided with the Panic of 1907; the lax and then strict antitrust policy under Coolidge and Hoover, which coincided with the boom and crash of the 1920s; the revival of antitrust in the late 1930s, which occurred at the same time as the October 1937 crash; and the bear market during Kennedy's 1962 showdown with Big Steel.<sup>1</sup> Additional evidence comes from the lax merger policies under Reagan, which coincided with the 1980s merger and stock market boom. If the stock market offers signals, perhaps noisy ones, but signals nonetheless, of changes in discount rates and future cash flows, these stock market movements are consistent with the view that unsettled antitrust and related loose policy canons also increase uncertainty and lower expected returns.

Clearly, other policies and other dangers also matter. Uncertain monetary policy or high inflation may hamper financial intermediation and the financing of new investment, taxation of corporate income or assets lowers investment returns, and threatened expropriation or forced sales to the state may affect the desire to invest. Shifting and uncertain legal standards illustrate another influence. (In fact, private antitrust enforcement, which I neglect here, grew from infancy into a major line of lawyerly employment during the post-World War II period.) The state, including the judiciary, has many ways of making the returns from investment in real assets less certain, less calculable and less attractive. I focus on federal antitrust because it has a long history, because it affects important aspects of business behavior and can serve as a rough indicator of business policy, because the policy has been volatile, and its implications uncertain, and because enforcement by means of law suits allows the generation of crude but serviceable measures of policy.

This paper proceeds in Section II by reviewing major developments in antitrust, and focusing on experience in four major industry groups: primary metals, vehicles, petroleum and chemicals. My aim is to bring alive controversies that may be mere history today, but that deserve our attention as long as economists use data from the twentieth century. I also hope to illustrate the connection between antitrust and related policy controversies. Section III presents the theoretical links between investment and antitrust and other sorts of regulation, emphasizing the "new learning" in antitrust, as well as recent advances in our understanding of how uncertainty affects investment. Section IV presents the formal

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<sup>1</sup> Bittlingmayer (1992, 1993) and Heath (1969). Interestingly, the "anti-business" reputation of the Kennedy administration, most dramatically reflected in the steel controversy, led to the 1962 investment tax credit.

statistical model and empirical results using panel data for 21 major industry groups over 1947-1991. The variables are plant and equipment investment, GDP and case filings against exchange listed firms, all at the industry level. The statistical results are based on a version of widely used investment models, augmented with measures of antitrust enforcement. The specification also offers two other innovations. First, I do not use lagged capital stock as an explanatory variable because this is likely to be a seriously flawed measure and because doing so amounts to using a lagged dependent variable. In its place, I use levels of lagged industry GDP (value-added). Second, I reject first-difference methods for dealing with autocorrelated residuals because of the severe bias those methods impart in the presence of measurement error. (See the Appendix.) In their place, I estimate coefficients using original levels of variables and employ bootstrap methods to assess the significance of coefficients.

## II. Antitrust and Related Policies (in One Easy Lesson)

U.S. antitrust is directed at a number of offenses: merger, price fixing and other forms of alleged collusion such as patent licensing, vertical restraint and monopolization. Legal standards and prosecutorial zeal have fluctuated over time for each type of offense. The large, single-firm monopolization case, like that filed against IBM, is probably the most controversial and least stable. See Kovacic (1989) on the last point.

For most of the period 1947-1992, four statutes formed the backbone of federal antitrust. The 1890 Sherman Act prohibits "every contract, combination or conspiracy in restraint of trade" and makes felons of those who "monopolize or attempt to monopolize." The quaint, common-law language provides little concrete guidance, and the actual influence of the law depends on a complex, unstable and politically sensitive interaction of courts, congress and the executive, in particular the use of prosecutorial discretion. Largely in response to early court interpretations and complaints from all quarters about enforcement (too much for some, too little for others), the 1914 Federal Trade Commission and Clayton Acts created a second, nominally independent enforcement agency (the FTC), and prohibited price discrimination and other practices, as well as stock acquisition and interlocking directorates where the effect was "substantially to lessen competition." A long line of criticism regards the FTC as a rogue elephant: ungainly, unfocused, and prone to sporadic, fruitless and controversial campaigns and conflict with business, the courts and congress. Finally, the 1950 Celler-Kefauver amendment closed the "asset loophole" for mergers, but ultimately had the effect of strengthening merger policies overall.

Comparatively minor changes occurred in the 1970s. Congress raised the penalties for criminal convictions from a maximum of \$50,000 and one year in jail to \$1 million and three years in jail in 1974, and it granted to states the right to bring suits on behalf of their residents in 1976.

Mandatory pre-merger notification in 1976 was probably the most far-reaching change. Earlier administrations had instituted pre-merger clearance on an administrative basis, but the practice offered little practical protection. Coolidge's antitrust authorities gave administrative approval to mergers as well as association agreements, but Hoover's attorney general renounced the policy in October 1929 and prosecuted some of the arrangements approved earlier. Eisenhower's authorities issued provisional opinions, but reserved the right to sue later. Kovaleff (1980, p. 71). Most firms simply took their chances in the fifties, and many suits were filed against mergers that had taken place five or ten years earlier. As a result, an increase in merger case filings exposed all firms that had completed a merger within the last decade or longer – essentially all Fortune 500 companies and more – to the possibility of a divestiture suit. Current, legislatively enacted pre-clearance, though lacking explicit safeguards, has largely eliminated that danger. Three points emerge for the work here. First, the long delay in enacting pre-merger clearance illustrates political forces at work: congress and the courts probably opposed pre-merger clearance because it transfers power to the antitrust bureaucracy. Second, pre-merger clearance changes the meaning of merger case filings. And finally, it reduces the legal exposure of merged firms when antitrust becomes more aggressive.

Figure 1 traces the history of antitrust enforcement against exchange-listed firms. Panel A shows the record for all industries, and Panel B separately for durable, non-durable and non-manufacturing sectors, 1947-1991. Figure 2 shows the budget appropriations for the two agencies, the Department of Justice and the Federal Trade Commission, which has consumer protection as well as antitrust duties.

Several features deserve comment. The low level of enforcement during the Korean War is consistent with experience during the First and Second World Wars: an administration with an antibusiness stance restrains enforcement as part of a quid pro quo for business' help with the war effort. Himmelberg (1976) and Hawley (1966). The sharp increase in filings in 1956 followed two years of deliberation by the Eisenhower administration. The *Report of the Attorney General's National Committee to Study the Antitrust Laws*, finally issued in 1955, called for aggressive enforcement. Committee members included Morris Adelman, Milton Handler, Alfred Kahn, Eugene Rostow and George Stigler. The Supreme Court aided the cause of aggressive antitrust by finding in June 1957 that even the unamended Clayton Act applied to vertical and not just horizontal

merger, and deciding in December 1958 that the Bethlehem-Youngstown merger violated the Clayton Act. Kovaleff (1980, pp.17-34, 71-90).

The second increase in filings followed these favorable court decisions and the appointment of Robert Alan Bicks as Antitrust Chief in April 1959. According to Kovaleff, (1980, pp. 114-115), Bicks pursued more vigorous merger enforcement, claiming he wanted to prevent future concentration by applying the law vigorously even in sectors not already concentrated. An October 1959 filing went even further. It sought to divest GM of an earth-mover manufacturer acquired in 1953, although GM had only been a "potential competitor." Filings involving exchange-listed firms increased from 34 in 1959 to 61 in 1960.

The Kennedy Administration initially maintained a strong antitrust posture, appointing a lieutenant of Estes Kefauver to chair the FTC, and an outspoken antibusiness advocate to head the Antitrust Division. A November 1961 speech by the attorney general also signaled a tough stance. However, the 1962 stock market decline and the continuing low levels of investment led to the 1962 investment tax credit. The antitrust chief was also promoted to the FCC in May 1963, in a move interpreted as signaling a less aggressive policy. Figure 2 shows that the appropriations increased in the early sixties, but remained constant until the early 1970s. Enforcement data show that the Johnson Administration continued to scale back enforcement, a factor that may have helped lay the basis for the 1960s merger wave. However, as Johnson's political position weakened, the agencies increasingly came to serve other masters, notably Congress and the political ambitions (or resentments) of the appointees themselves. For example, according to one rumor, outgoing Attorney General Ramsey Clark filed major cases against the major auto companies, IBM and the Atlantic Richfield/Sinclair Oil merger only days before leaving office in January 1969 as a way of saddling the incoming Nixon administration with cases that would cause political difficulties if prosecuted, or abandoned.

Under Nixon and Ford, antitrust authorities kept up the pressure, and budget data show an increased flow of resources to both agencies. In addition to filing a steady stream of merger cases involving large firms, they also sued to alter business practice and in some cases, the structure of entire industries. Industries subject to these sorts of cases include soft drinks (1971), ready-to-eat cereals, aircraft, network television, automobiles (1972), steel, rubber, wallboard, petroleum (1973), sugar (1974), airlines (1975), folding cartons and automobile distribution (1976). The November 1974 suit against AT&T marked the re-emergence of the large-firm divestiture case. As Figure 1 makes clear, however, filings decreased markedly under Carter, and especially under Reagan and Bush. Overall antitrust appropriations reached their peak under Carter, however. This divergence in the two

measures may have reflected the demands of high profile cases against AT&T, IBM and DuPont (for building capacity ahead of demand in titanium dioxide). Alternatively, it may have reflected a conflict between the desires of congress and the executive.

The scaled back enforcement under Reagan laid the groundwork for the 1980s wave of mergers and restructurings, which was at least in part a corrective for a poorly functioning corporate control mechanism. However, comparatively lax merger enforcement and lack of federal corporate control regulation opened the door to state level antitakeover legislation.

This thumbnail sketch of antitrust does not do justice to the rich contextual nature of antitrust in practice. Four short histories of enforcement in specific sectors offer more detailed context, and some support, I believe, for the claim that antitrust enforcement against a firm or industry is linked with enough dangers to influence investment, either by its direct effects or in conjunction with accompanying policy controversies.

Primary Metals. Big steel was the focus of several visible antitrust enforcement actions. Bethlehem Steel announced its intention of acquiring Youngstown steel in mid-1954, and, as an indication of the interest accorded antitrust, the Eisenhower cabinet itself looked into the deal in a secret session. The merger was formally announced in December of 1956, and the resulting legal case decided two years later. Kovaleff (1980, pp. 79-81). When the creeping inflation of the late 1950s and early 1960s offered a chance to convert a monetary policy problem into a monopoly policy problem, both Eisenhower and Kennedy administrations made steel the focus. A lengthy, 116-day steel strike in 1959 resulted in scheduled wage increases over the next three years. At the urging of vice-president Nixon, the steel industry absorbed the 1960 increase in wages, and did so again in 1961. (It was a time honored practice. Stigler [1952] wrote: "The steel industry ... what with congressional review of prices and presidential coercion of wages, is drifting rapidly into a public utility status.") However, major steel firms finally raised prices in April 1962, following labor negotiations mediated in part by the administration. Kennedy viewed the increase as a double-cross and denounced it passionately, Defense Secretary McNamara directed defense contractors to purchase steel from producers who had not raised prices, and Robert Kennedy's justice department used FBI agents to collect information, subpoenaed documents from the steel companies and ordered a grand jury investigation. It also filed a criminal price fixing case. Senator Kefauver held monopoly investigations on the industry, his subcommittee voting to cite the steel companies for contempt of Congress for refusing to produce cost records. Heath (1970, ch. 8) and Rowan (1964, chs. 6-8). This development is reminiscent of the post-World War I period, when the Wilson

administration attributed the rise in the "cost of living" to monopoly. Other primary metals industries attacked during this period include copper and other non-ferrous metals (1961).

The second major steel industry initiative began in 1969, the first year of the Nixon administration, when the Justice Department attacked LTV's conglomerate acquisition of Jones & Laughlin Steel on the grounds that LTV was a "potential" competitor in steel. It also filed separate suits in 1969 and 1970 against at least five major steel companies for "reciprocal purchase agreements."

Figure 3 A shows the number of cases filed against exchange-listed firms in the primary metals industry (iron, steel and non-ferrous metals), as well as GDP and investment (adjusted for inflation and population sixteen and older). The data show low investment in 1950, 1954-55, 1959-63, and again in 1970-73, despite largely unchanged output. These periods of low investment occurred when the industry was under fire.

Vehicles. Eisenhower himself was concerned in 1954 about General Motors, and directed that government purchases of vehicles not contribute to concentration in the industry. Government actions in a pending suit were also instructive. The Department of Justice had filed a suit in 1949 against DuPont's holdings of General Motors stock, apparently for political reasons. The government lost at the district level in 1954, but the Eisenhower administration appealed the case, ultimately winning at the Supreme Court in 1957. However antitrust soon became wrapped up with other issues. The government conditioned the proposed consent on a favorable capital gains treatment of GM shares (then held by DuPont) that were to be dispersed to DuPont shareholders, but the IRS decided that the distribution of GM stock, held for as long as thirty years at that point, would be taxed at the higher dividend rate. The tax question was appealed to the Supreme Court, and ultimately resolved in favor of DuPont shareholders by legislation.

The prelude to the next round of enforcement is marked by the 1960 spike in enforcement in Figure 3 B, which was generated by a flurry of automotive parts cases involving listed firms. In April of 1961, the Kennedy administration filed a criminal merger suit against a General Motors for its acquisition of two locomotive divisions thirty years earlier. It sued Chrysler the same month for abuse of power in distribution, GM again in October, and Ford for its Autolite acquisition in November. The Department of Justice also filed parallel civil charges to the locomotive case in 1963. No discussion of the 1950s and sixties is complete without mention of the rumored, but never filed divestiture suit against GM, or the January 1969 case filed against the major auto companies for allegedly suppressing smog innovations during the late 1950s and early 1960s by means of a cross-licensing agreement for smog control technology. This last case illustrates another instance in which an extraneous issue, smog control, is linked with antitrust.

Chemicals (Including Drugs). Highly publicized monopoly investigations of the drug industry began in 1959 under Senator Kefauver, who recommended shortening patent life from seventeen to three years and government licensing of drug firms. An antitrust case filed in August of 1961 claimed that the three major producers of antibiotic "wonder" drugs maintained unreasonably high and non-competitive prices. In the wake of the thalidomide tragedy (which struck Europe but not the USA) and some maneuvering by the White House to delete provisions shortening the patent life of drugs, Congress passed the 1962 amendment to the Food, Drug and Cosmetic Act. According to Peltzman (1973), the number of "new chemical entities" declined steadily from their 1959 peak until 1962 and remained well below projected values throughout the 1960s and early 1970s. Again, antitrust was linked with a regulatory effort.

Petroleum Refining. Within months of assuming office, the Eisenhower administration filed a suit against five major oil companies, charging them with participation in a world-wide cartel. Sought-for relief included divestiture of joint ventures in production, refining, transportation and marketing. The case reached its conclusion in stages as defendants signed consent decrees and the Justice Department finally dropped charges against the two remaining defendants in 1968. In its early years, prosecution of the case was heavily influenced by international events, including nationalization of foreign oil assets in Iran, 1951-54, and the Suez Crisis, 1956-57, which threatened oil supplies to Europe during the height of the Cold War. Oil company joint efforts received antitrust immunity while the case was pending. The antitrust case also generated infighting between the Department of Justice and the Interior Department, and monopoly subcommittee hearings in the Senate. In another attack on petroleum refining, Eisenhower antitrust authorities sued to alter gasoline retail practices and filed suits against related sectors such as asphalt. They also pursued a vigorous anti-merger policy, denying each oil merger clearance request placed before it. Kovaleff (1980, p. 117). At the same time, crude oil producers (whose interests often diverge from refiners) sought to limit imports, adding to the uncertainties for refiners. "Voluntary" import restraints under the direction the president were imposed in 1957, and these were replaced by mandatory quotas in 1959, when the president imposed restrictions on refined as well as crude oil. The obvious tension between national security issues, oil import restrictions and antitrust was prominent in discussions at the time. Kaufman (1978, pp. 74-75.). It is possible that the antitrust actions and national security arguments served as cover for the import restrictions, much as the Sherman Act may have served as cover for the McKinley Tariff of 1890.

Regulatory uncertainty for petroleum refining reached another peak in the early 1970s. The FTC's monopolization case filed in July 1973 against the major oil companies

was one of the last major antitrust events in this industry. The case remained active until the early 1980s. Interestingly, few cases were filed in the late 1970s. U.S. energy policy in the mid- and late 1970s was aimed at extracting rents from crude producers, reallocating those rents to east-coast refiners and lowering the price of crude, refiners' chief input.

### III. Antitrust and Investment

We can construct links between antitrust and investment at three levels: by focusing on a stable switch in antitrust policy, by examine the effects of policy uncertainty, and by viewing antitrust as a proxy for other sorts of business regulation.

A Stable Switch in Policy. Consider an extreme antitrust policy, say, exogenous, unexpected and certain divestiture of large firms and a strict limit on future expansion. This sounds preposterous today, but eminent economists, among them George Stigler (1952) in the "Case Against Big Business" proposed "dissolution of a few score of our giant companies . . . by the Antitrust Division acting through the courts." (A year later, Stigler joined the Attorney General's Committee to Study the Antitrust Laws.)

Though Stigler's experiment was never performed, some of the cross-section evidence suggest that such a policy would lower growth and investment, even if carried out with lightning speed and absolute certainty. At the industry level, an increase in concentration is on average accompanied by higher productivity growth and lower price increases. Leading firms also generated higher value-added per worker hours. Brozen (1982, ch. 3, citing various studies). Scherer's (1983) study finds that higher concentration is associated with greater R&D intensity, and this in turn leads to higher productivity growth. Similarly, Gupta (1983) finds that firm size is the dominant factor in explaining variations across firms in labor productivity. Finally, the literature on learning-by-doing suggests that cumulative experience in production raises efficiency. See, for example, Irwin and Klenow's (1994) study of memory chips. An aggressive policy of punishing winners in order to also thwart possible monopolists may very well entail costs.

What would be the effect of an outright prohibition of merger? "Merger for monopoly" and merger for empire building have captivated economists. However, the systematic evidence favors the view that mergers solve dynamic problems in monitoring, incentives and the transfer of information. Telser (1984, 1978, ch. 8) offers a theory of innovation that results in differences in costs, and proposes merger as a way of removing the resulting inefficiency. He cites as supporting evidence the strong cross-section correlation between merger intensity, on the one hand, and rates of industry growth and measures of technical innovation on the other.

A clear, consistent and well understood shift to stricter antitrust policy has not been executed. What we do know about firm size and concentration suggests that such a shift



would lower productivity and R&D. Forced divestiture, and a limit on market share or firm size, achieved through merger or otherwise, is also likely to affect competition, though the actual effects have, for obvious reasons, not been studied.

Policy Uncertainty. The suggestion that uncertainty, and antitrust uncertainty in particular, may affect investment dates back at least to Wesley Claire Mitchell's (1913, p. 85) discussion of the business cycle effects of attempts to break up U.S. Steel and other large corporations. "Throughout the year [1911] . . . enterprise on the part of large capitalists was materially checked by uncertainty regarding the legal position of business combinations. Hence all trades that depend upon the volume of new construction put under contract found 1911 a dull year."

More recently, the theory of investment under uncertainty has fleshed out Mitchell's conjecture. Irreversible investment in an industry or for the economy as a whole may decline if economic agents are uncertain about future payoffs. Since the decision to invest now cannot be undone later when the uncertainty is resolved, firms may wait, even if they are not risk averse. Early contributions include Cukierman (1980) and Bernanke (1983). Pindyck (1991) surveys the literature.

Though intriguing, the actual sources of uncertainty that may affect the level of investment have remained vague, and the topic has received little empirical attention. Cukierman (1980) mentions only that "businessmen often talk about increased uncertainties" and refers to "ambiguous and sometimes contradictory statements by government officials." Bernanke (1983) mentions changes in monetary, fiscal, regulatory, or other policy regimes, as well as international, commodity, technology and sectoral shocks. The comparatively small volume of applied work has focused on classic monetary factors. Evans (1984) finds that unexpected interest volatility lowered output. Ferderer (1993) finds a negative relationship between investment and the term premium. However, given the Fed's tendency to lower rates in recessions, the last result may reflect Fed policy rather than investment behavior.

Despite the emphasis so far on monetary factors, Pindyck's survey leaves the door open to other, non-monetary factors of the sort emphasized by Mitchell eighty years earlier:

"Investment spending may . . . be highly sensitive to risk in various forms: uncertainties over future product prices and input costs that directly determine cash flows, uncertainty over exchange rates, and uncertainty over future tax and regulatory policy. . . . If uncertainty over the economic environment is high, tax and related incentives may have to be very large to have any significant impact on investment.

Similarly, a major cost of political and economic instability may be its depressing effect on investment." (Pindyck, 1991, p. 1141)

In the case of antitrust, uncertainty would result in deferred investment if industry organization or industry practices affect costs or revenues, if firms face choices between joint ventures and independent efforts; between vertical integration, long-term contracts and spot-market relations with suppliers and customers; and between expansion into a new product or geographic area by merger or de novo entry.

Proxy. Federal antitrust often reflects an early testing of the waters, either for bigger cases or for other sorts of regulation. Bureaucrats and congressmen are interested in knowing which groups are likely to benefit, which ones gain from action against a particular firm or industry. Various forms of turmoil – hearings, pressure from congress and regulatory action – signal a political threat to rents and may also give congress and the executive an idea of the rents that can be extracted for protection. In other instances, a controversial antitrust action focuses public attention on an industry and lays the groundwork for other efforts. In still a third set of cases, antitrust represents a parting shot at an industry already on the ropes. Consequently, antitrust cases may foreshadow future regulation or reflect regulation already passed and in early stages of implementation.

Several other analytical points deserve attention. First, in a "taxation by regulation" framework, the danger of greater "taxation" will result in less fixed investment and the substitution of more mobile factors. (Antitrust's "tax," above and beyond delayed investment and expansion, may be the forced adoption of less efficient forms of organization, which protects competitors.) Second, antitrust may be endogenous, but the algebraic sign of the endogeneity is unclear. On the one hand, the antitrust authorities may target industries with poor prospects because distressed industries are more likely to collude or propose questionable mergers. Alternatively, the government may target winners. Anecdotes can be marshaled for both points of view. That said, antitrust appears to be less endogenous than, say, the money supply. Third, an increase in filings may signal an increased probability of a catastrophic regulatory environment – the country going socialist – but the catastrophe fails to occur within the sample. If so, coefficient estimates will over-estimate the effects of antitrust. Finally, antitrust and related uncertainty-inducing legislation may affect the timing of investment, but not the long-run level. Consequently, the estimated effects again are poor guides to the long-run effects.

#### IV. Models of Investment

Models of investment emphasize three factors: the cost of capital (itself a function of interest rates, the tax treatment of investment and the relative price of capital goods); the accelerator effect, that is, the influence of permanent increases in demand on the stock of capital and hence on net additions to capital; and replacement demand. In practice, the components of the cost of capital seem to have little discernible effect on investment. [See Clark (1979, 1993) and the ensuing discussions, and Chirinko (1993, p. 1906): "the response of investment to price variables tends to be small and unimportant relative to quantity variables."]

Let  $I_t$  be real gross investment in period  $t$ ,  $K_t$  the real stock of capital,  $Y_t$  the level of real income, and  $\Delta Y_t$  the difference  $Y_t - Y_{t-1}$ . The canonical investment equation takes the form:

$$I_t = \alpha + \beta K_{t-1} + \gamma \Delta Y_t + \varepsilon_t. \quad (1)$$

The coefficient  $\beta$  estimates the depreciation rate of the capital stock, and  $\gamma$  estimates the accelerator effect. In practice, the error term  $\varepsilon_t$  follows an autoregressive process, suggesting omitted variables. This specification appears as Clark's (1979) equation (4), which offered the most parsimonious explanation for past investment, 1954-1973, and best predicted the 1970s investment slump using pre-1974 coefficient estimates.

The results below alter this model by substituting lagged industry gross domestic product,  $Y_{t-1}$ , for the lagged capital stock,  $K_{t-1}$ , and by adding measures of the regulatory variable, antitrust case filings against exchange-listed firms. The use of lagged output in place of lagged capital stock has several rationales. First, Bureau of Economic Analysis estimates of  $K_t$  are averages of past  $I_t$ , with the averages based on assumed linear depreciation rates, largely fixed over time, for different types of capital goods. U.S. Bureau of Economic Analysis (1993, especially M-16 through M-17) contains a sobering and candid account of this procedure and its limitations. Aside from the obvious problems, episodes like the Vietnam War buildup are bound to distort this measure. Many industries made war-specific investments with high actual post-war depreciation rates that are not reflected in the depreciation schedules. Unknown and potentially serious measurement problems aside, another difficulty arises because the measured capital stock is the weighted sum of past investment. A regression of investment on measured capital stock amounts to a regression on lagged dependent variables. This approach "explains" investment by looking at an arbitrarily weighted average of recent investment.

The use of gross product in place of the measured capital stock also has a positive defense. Recent empirical work emphasizes the importance of variables such as sales, cash-flow and value-added in explaining investment behavior. Businesses may not make major investments until they see concrete evidence of an upturn in demand. In addition, businesses may rely on internal financing for cyclically sensitive portions of investment. In fact, time plots and cross-correlation's show a close correspondence in many, though not all, industries between investment and output (GDP) lagged one year. The lag can be easily explained with a time-to-build assumption.

Regulatory stringency or regulatory risk constitutes the novel element in the analysis here. Since no single variable or even cluster of variables can measure the state of current and expected regulation with a high degree of precision, the "true model" must be stated in terms of a latent or unobserved variable  $Z_t^*$ . Adding that variable as well as substituting lagged GDP for lagged capital stock in (1) yields:

$$I_t = \alpha + \beta Y_{t-1} + \gamma \Delta Y_t + \delta Z_t^* + \varepsilon_t. \quad (2)$$

Before discussing the particular measure of regulation used here, recall the general econometric problem raised by mismeasured or latent variables: proxies used in place of  $Z_t^*$  will result in an estimate of  $\delta$  biased toward zero.

An even more serious but largely unrecognized bias emerges if we attempt to correct for autocorrelated errors by taking first-differences. The appendix shows that with measurement error and under assumptions reasonable for the case at hand, first-differencing results in estimated coefficients that may be as low as 5 to 10 percent of their true value. Consequently, my strategy is to use alternate methods of assessing the reliability of coefficient estimates: partitions of the data set and bootstrapping.

To represent some important dimensions of regulatory risk, I use antitrust case filings against exchange-listed firms. Though the focus on listed firms narrows the scope of this variable, the resulting count variable still lumps together a variety of cases. Some cases involve multiple defendants, the charges differ (merger, single-firm monopolization, price fixing, criminal, civil), some are consent decrees, individual cases may or may not be the side show to some other, more diffuse policy struggle, and the penalties for specific charges have varied over time, as has the probability of follow-up private suits. In some instances, major investigations are undertaken, but no case is filed. The monopolization case apparently planned but never filed against General Motors is a prime example.

The lags and leads also deserve discussion. A case filing represents the end of an investigation by one of the two antitrust agencies, the Federal Trade Commission or the

Antitrust Division of the Department of Justice. It also marks the beginning of a legal proceeding, typically a protracted legal dispute. If the government's case begins to look good, private plaintiffs may join the fray with private piggyback suits. As a result, investigations underway and pending cases both imply uncertainty about the legal status of various business practices, or even the legal status of business success. Though news of investigations inevitably leaks, pinning down the actual beginning or even existence of all investigations, even against major firms is a prodigious undertaking. Dates of ultimate resolution are also likely to be difficult to establish. The possibility of appeals and private piggy-back suits makes it unclear when a particular case has in fact ended.

The estimates below do make a distinction between cases filed against firms in a given industry group and cases filed overall. A case filed against primary metals should have a larger dollar effect on primary metals investment than a case filed in telecommunications. Since the errors-in-variables problem is likely to be more severe at the industry level, a larger coefficient for own-industry cases than cases in general would offer especially strong support for the idea that case filings in a given industry affect investment.

Based on this discussion, I modify (2) to explain,  $I_{it}$ , investment in industry  $i$  in year  $t$ . I also use lagged industry output,  $Y_{it-1}$ , as well as changes in industry output,  $\Delta Y_{it}$ , and add lagged and leading counts of cases filed against exchange-listed firms in the same industry  $i$ ,  $Z_{it}$ , and against all firms,  $Z_t$ :

$$I_{it} = \alpha_i + \beta_i Y_{it-1} + \gamma_i \Delta Y_{it} + \sum_{j=-2}^2 \delta_{ij} Z_{it-j} + \sum_{j=-2}^2 \phi_j Z_{t-j} + \varepsilon_{it}. \quad (3)$$

The inclusion of both lagging and leading case filings is justified on two grounds. First, the institutional facts argue for lagging and leading effects, roughly of two years in each direction. Second, using lags and leads amounts to the inclusion of both the mismeasured or proxy variable, as well as instrumental variables for that variable. Note that in an errors-in-variables framework, the pattern of distributed lag (and lead) coefficients is unlikely to follow a well defined U- or V-shape.

Although heteroscedasticity is not an issue here since I do not rely on estimated standard errors, I have adjusted the data for growth in the economy to allow a comparison of my results with other studies and to simplify the bootstrapping. Specifically, I divide all variables by  $POP_t$ , U.S. population sixteen or older, a measure of potential economic output. Denote the resulting per capita variables with an apostrophe, that is,  $I'_{it} = I_{it}/POP_t$  and so on.

The available time series have only 41 annual observations because of the leads and lags. Not surprisingly, individual industry estimates show considerable variation, given that the model attempts to estimate eight parameters, including the constant. Hence, the reported results here are based on models in which the cross-section slope coefficients are restricted to a common value, indicated here by suppressing the industry subscript for all coefficients except  $\alpha_j$ :

$$I'_{it} = \alpha_i + \beta Y'_{it-1} + \gamma \Delta Y'_{it} + \sum_{j=-2}^2 \delta_j Z'_{t-j} + \sum_{j=-2}^2 \phi_j Z'_{t-j} + \varepsilon_{it}. \quad (4)$$

The system of equations in (4) was estimated using joint generalized least squares separately for three industry groups: non-manufacturing, durable goods and non-durable goods. (Pooled cross-section time series estimates with industry intercepts yielded similar results.) Separate estimates for three distinct sets of data offer one type check on the reliability of the estimates.

Bootstrapping offers an alternative strategy for assessing reliability. I used it only for antitrust enforcement, but not for  $Y'_{it-1}$  and  $\Delta Y'_{it}$ , since these variables have a strong track record in other investment studies. I do report their (unbiased) coefficients and their (quite likely biased)  $t$ -statistics.

I carried out the bootstrap calculations as follows. For each industry group (non-manufacturing, durables and non-durables) with industries  $1, \dots, n$ , draw random linked observations of  $(Z_{1t}, \dots, Z_{nt}, Z_t)$  with replacement to create  $n+1$  new synthetic series of own-industry and overall enforcement, and then re-estimate (4). Repeat 1,000 times.

Table 1 presents the summary statistics. Note the high levels of filings in food, chemicals and petroleum, and the low levels in non-manufacturing. (The estimates below exclude utilities since these are governed by a different regulatory framework and the data indicate that neither the few antitrust cases nor industry GDP explains investment by utilities.) The last column reveals relatively low autocorrelation coefficients, which justify a simple strategy of random sampling with replacement in the bootstrap. The low autocorrelations also offer additional justification for the view that these variables contain substantial measurement error.

Table 2 has the estimates. The coefficients on  $Y'_{it-1}$  are interpretable as the long-run share of lagged industry product (GDP) going to industry investment. That share is roughly 6 percent for non-manufacturing, 16 percent for durable goods, and 18 percent for non-durable goods. The coefficients on  $\Delta Y'_{it}$  are estimates of the fraction of short-run changes in industry output going to industry investment, roughly 4 to 6 percent.

In estimates of (4) that use only own-industry cases, each extra case is associated with investment that is lower by \$1.4 billion in non-manufacturing, \$370 million in durable goods, and \$645 in non-durable goods. Because of errors-in-variables, these estimates are biased toward zero, but they probably over-estimate the pure effects of antitrust for two reasons. First, the level of antitrust in one industry is correlated with the general level of antitrust. In other words, these estimates omit a positively correlated measure of the general regulatory climate. In fact, estimates using own-industry as well as all antitrust cases show that the measured own-industry effects decrease markedly, roughly by one half. Second, as mentioned earlier, an increase in antitrust enforcement may be the accompaniment to a broader assault against an industry.

In the bootstrap, larger negative effects emerged for the simple estimates of own-industry effects in 108 out of 1,000 replications; for durable goods in 27 out 1,000; and for non-durable in 1 out of 1,000. Adding total cases ( $Z_t$ ) lowered the ( $Z_{it}$ ) coefficients and raised the number of times similarly large negative values were generated randomly. Since the own and industry random drawings remain linked in the bootstrap, this result may be due to the strong multicollinearity: the sum of individual industry case filings in durable or non-durable manufacturing industries explain a large fraction of the overall filings. The circumstances call for the equivalent of a test that both summed coefficients are jointly equal to zero. The last line of Table 2 shows that the likelihood of generating estimates jointly below the two original estimates was very low for all three sectors. Only 25 of 1,000 estimates yielded estimates of own and joint effects with larger negative values than the original estimates for non-manufacturing. In durable and non-durable manufacturing the frequencies were 6 and 12 out of 1,000. So, while own industry effects were relatively weak when total enforcement against listed firms was included, occurring by chance between 7 and 30 percent of the time, large joint negative effects of own and overall filings were rare.

## VII. Concluding Comments

My thinly veiled ambition has been to explain some of the variation in industry investment by appealing to a factor neglected in empirical work on investment, though not in a long tradition of lunchtable economics and in some recent theory. The resulting statistical estimates imply that the period of low investment in the late 1950s and early 1960s were due at least in part to a resurgence of aggressive antitrust and related initiatives interpretable as "anti-business." Some of the unexpectedly low investment of the 1970s may have had a similar origin.

Contradiction or corroboration can be sought in other time periods, detailed industry studies and other countries. Examples from the U.S. include the antitrust initiatives before the late 1940s – Teddy Roosevelt's efforts to break up Standard Oil in 1907, Taft's attack on U.S. Steel, the post-World War I monopoly initiative, the lax and then strict enforcement under Coolidge and Hoover, the suspension of antitrust followed by strict enforcement under FDR, and then suspension of major antitrust initiatives during the Second World War. Studies of the firm-level effects of actions against particular firms and industries represent another line of approach. The electrical equipment cases, the FTC's campaign against vertical integration in cement, and the ready-to-eat cereals case offer potentially fertile ground. Studies of the effects of major private lawsuits, whether antitrust suits or not, would also be relevant. Similar studies of other countries face the problem that antitrust, particularly antitrust carried out with visible and contentious lawsuits, remains an American phenomenon. The challenge would be to find proxies in environments where regulatory and political threats cast even more diffuse shadows than in the U.S.

Though tentative, the approach here throws new light on some old issues:

1) The use of first-differences in the presence of measurement error severely exacerbates an already severe econometric problem. Besides offering a stern warning, the result in the appendix may justify a reexamination of work based on time series models that use latent or poorly measured variables.

2) If antitrust partly serves as a proxy, so too may taxation policy. For example, the measured effects of investment tax credits may reflect not the effects of the tax, but rather a changed political and regulatory climate. A short chain leads from Kennedy's April 1962 confrontation with Big Steel, to the stock market collapse and anti-business reputation of his administration, and finally to passage of the 1962 investment tax credit as an effort to reshape that reputation.

3) The long tradition of appealing to "animal spirits" and "business confidence" as sources of fluctuations in investment may reflect the hard-to-measure nature of policy threats.

4) Regulation may be endogenous, but probably not to the same degree as output, interest rates and other commonly used series since it is mediated through a sometimes unstable political process. If so, the use of regulatory variables to explain investment goes at least part of the way toward addressing the complaint that customary explanatory variables in investment equations are themselves endogenous, a point raised by Hall (discussion to Clark (1979, 1993)) and quite likely others.

5) Progress in understanding investment behavior may very well depend on a better understanding of institutional issues and economic history, as well as care in interpreting

statistical results. As noted by Bernanke (1983) uncertainty may be generated endogenously. An exogenous shock may generate a political reaction, difficult-to-measure regulatory risks and even more uncertainty.

6) If antitrust lowers investment, this may explain Sproul's (1993) puzzling finding that, correcting for prices of closely related goods, prices in markets subject to antitrust prosecution increase after a filing. Conceivably, prices rise because defendant industries fail to make investments they otherwise would.

## Appendices

### A. Bias in Regressions of Levels and First-Differences in the Presence of Errors-in-Variables

Consider a model marked by both auto-correlated errors and errors-in-variables. The true model is

$$y_t = \beta x_t^* + \varepsilon_t \quad (A-1)$$

where  $\varepsilon_t = \rho \varepsilon_{t-1} + v_t$ ,  $0 < \rho < 1$ , and  $v_t$  is distributed i.i.d. with mean 0 and variance  $\sigma_v^2$ . The explanatory variable  $x_t^*$  is measured with error:

$$x_t = x_t^* + u_t, \quad u_t \sim \text{i.i.d. } [0, \sigma_u^2].$$

By well known results, the least-squares estimate  $b$  is biased toward zero:

$$b = \frac{\sigma_{y_t x_t}}{\sigma_{x_t}^2} = \beta \frac{\sigma_{x_t^*}^2}{\sigma_{x_t^*}^2 + \sigma_{u_t}^2}. \quad (A-2)$$

In addition, the estimated autocorrelation coefficient will also be biased. Represent the errors-in-variables bias factor as

$$q = \frac{\sigma_{x_t^*}^2}{\sigma_{x_t^*}^2 + \sigma_{u_t}^2}.$$

Then the estimate of  $\rho$  will be

$$r = \frac{(1-q)^2 \beta^2 \sigma_{x_t^* x_{t-1}^*} + \sigma_{\varepsilon_t \varepsilon_{t-1}}}{\{[(1-q)^2 \beta^2 \sigma_{x_t^*}^2 + q^2 \beta^2 \sigma_{u_t}^2 + \sigma_{\varepsilon_t}^2][[(1-q)^2 \beta^2 \sigma_{x_{t-1}^*}^2 + q^2 \beta^2 \sigma_{u_{t-1}}^2 + \sigma_{\varepsilon_{t-1}}^2]]^{1/2}\}}, \quad (A-3)$$

where  $\sigma_{x_t^* x_{t-1}^*}$  represents the covariance of  $x_t^*$  with  $x_{t-1}^*$ . If  $q = 1$  and  $\sigma_{u_t}^2 = 0$ , this reduces to the unbiased estimate  $r = \sigma_{\varepsilon_t \varepsilon_{t-1}} / (\sigma_{\varepsilon_t}^2 \sigma_{\varepsilon_{t-1}}^2)^{1/2}$ . However, under more general assumptions,  $r$  will be biased. Note in particular, that estimated  $r > 0$  even if  $\sigma_{\varepsilon_t \varepsilon_{t-1}} = 0$  but the underlying series exhibits autocorrelation. This result pertains to the bivariate case. However, mismeasurement of one variable leads to biased estimates of all coefficients in the multivariate case, implying that estimated autocorrelation coefficients may also very well be biased there as well.

The bias arising from errors-in-variables becomes more severe if we use some commonly employed remedies for autocorrelated errors. Consider the first difference estimator based on  $\Delta y_t = y_t - y_{t-1}$ , and  $\Delta x_t = x_t - x_{t-1}$ ,

$$b_{FD} = \frac{\sigma_{\Delta y_t \Delta x_t}}{\sigma_{\Delta x_t}^2} = \beta \frac{\sigma_{x_t^*}^2 - \sigma_{x_t^* x_{t-1}^*}}{\sigma_{x_t^*}^2 - \sigma_{x_t^* x_{t-1}^*} + \sigma_{u_t}^2} \quad (A-4)$$

Without measurement error, when  $\sigma_{u_t}^2 = 0$ , this estimator results in unbiased estimates. However, with significant measurement error and sluggish movement of the "true" explanatory variable,  $x_t^*$ ,  $\sigma_{x_t^* x_{t-1}^*}$  is close to  $\sigma_{x_t^*}^2$ , and the bias becomes large, much larger than in the familiar case shown by (A-2).

As a third alternative, consider the estimator based on differences in  $y_t$  and original values of the measured variable  $x_t$ . This might be a tempting alternative if  $x_t$  shows a spiky pattern, but  $y_t$  is relatively smooth. Unfortunately, this (misspecified) approach yields

$$b'_{FD} = \frac{\sigma_{\Delta y_t x_t}}{\sigma_{x_t}^2} = \beta \frac{\sigma_{x_t^*}^2 - \sigma_{x_t^* x_{t-1}^*}}{\sigma_{x_t^*}^2 + \sigma_{u_t}^2}, \quad (A-5)$$

which is again not merely biased downward as the result of measurement error, but also as a result of sluggishness in the  $x_t^*$  series.

In all three cases, the extent of the bias depends on three unobservables for the mismeasured series,  $\sigma_{x_t^*}^2$ ,  $\sigma_{x_t^* x_{t-1}^*}$  and  $\sigma_{u_t}^2$ . We can get a rough idea of the magnitude of the bias by looking at variances and autocovariances in cases where we suspect little or no measurement error. For example, investment and real GDP (both per person sixteen or older) in the twenty-one industry groups used here might be viewed as typical well-measured economic series. The average ratio of  $\sigma_{x_t^* x_{t-1}^*}$  to  $\sigma_{x_t^*}^2$ , that is, the autocorrelation coefficient, for these well measured series is 0.86, and the median 0.88. (Remarkably, this ratio is very similar for pairs of investment and GDP series across industries.)

To illustrate the potential bias, assume the median of this measurement of sluggishness for these well measured series applies to a series measured with error, and that half the variance in the mismeasured series is due to error ( $\sigma_{u_t}^2 = \sigma_{x_t^*}^2$ ). This would generate the following attenuated estimators:

Illustration of Effects of Measurement Error	
$\sigma_{x_t^* x_{t-1}^*} / \sigma_{x_t^*}^2 = 0.88, \sigma_{u_t}^2 = \sigma_{x_t^*}^2$	
Transformation of Data	Estimator
Original levels	$b = \beta 0.50$
First differences of $x_t$ and $y_t$	$b_{FD} = \beta 0.11$
First differences of $y_t$ only	$b'_{FD} = \beta 0.06$

Clearly, first-difference regressions and related methods such as Cochrane-Orcutt may greatly compound an already serious bias stemming from poorly measured variables.

Greene (1990) offers a solution under the assumption that the measurement error is independent over time. Consider the case in which the true underlying variable follows an AR(1) process:

$$x_t^* = \rho x_{t-1}^* + w_t, \quad w_t \sim \text{i.i.d.N} [0, \sigma_w^2]$$

The estimator

$$b = \frac{\sigma_{y_t x_{t-1}}}{\sigma_{x_t x_{t-1}}} = \frac{\beta \rho \sigma_{x_{t-1}^*}^2}{\rho \sigma_{x_{t-1}^*}^2} \quad (A-6)$$

provides a consistent estimate of  $\beta$ . This is an instrumental variables estimate, with  $x_{t-1}$  serving as the instrument. However, the asymptotic variance of  $b$  is likely to be high if the correlation between the instrument,  $x_{t-1}$ , and the mismeasured variable,  $x_t$ , is low. For the industries in this sample, the auto-correlation of case filings was typically low, even negative in some cases.

## B. Data

**Investment.** This is the updated new plant and equipment series of the Bureau of Economic Analysis, described in Seskin and Sullivan (1985). All nominal series are deflated using the CPI set equal to unity in 1987. The investment and other BEA series are available on diskette.

**Gross Domestic Product.** Parker (1993) describes this BEA series.

**Antitrust Cases Involving Listed Firms.** Federal Trade Commission cases were hand-compiled from FTC Dockets of Complaints published as part of Trade Regulation Reports by Commerce Clearing House. Reporting of FTC cases is very brief and includes mention only of the first-named defendant. Cases involving monopolization and merger typically involved only one defendant. However, since some cases involved horizontal conspiracy, this source yields an incomplete list of the defendants in FTC cases. Department of Justice cases through 1951 appear in Commerce Clearing House, The Federal Antitrust Laws with Summary of Cases Instituted by the United States, 1890-1951 (1952). Later cases appear in Commerce Clearing House, The Federal Antitrust Laws with Summary of Cases Instituted by the United States, 1952-1956 Supplement (1957); Commerce Clearing

House, Trade Regulation Reporter. Transfer Binder. New U.S. Antitrust Cases Complaints, Indictments, Developments, various dates. DOJ cases include longer descriptions which typically listed all defendants. If a named defendant was ever listed on the New York, American or NASDAQ exchanges, that case was coded as involving at least one listed firm. Exchange listing was determined from a printout of all firms available on the University of Chicago's CRSP tapes. Each case was assigned to one of twenty-one industry groups.

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**Table 1**  
Annual antitrust cases involving at least one exchange-listed defendant, by major industry group, 1947-1991

	Filings per \$100 Billion Industry GDP	Population-Adjusted Filings*			Auto-correlation Coefficient
		Mean	Standard Deviation	Maximum	
<b>Non-manufacturing</b>					
Mining	0.15	0.14	0.47	2.26	-0.09
Transportation	0.35	0.52	0.85	3.45	-0.07
Utilities	0.13	0.10	0.38	1.63	0.35
Wholesale & Retail	0.27	1.45	2.06	8.68	0.05
Finance	0.22	1.20	2.02	10.43	0.71
Business Services	0.24	1.21	1.63	7.79	0.31
Communications	0.48	0.37	0.78	3.04	-0.24
<b>Durable Mfg.</b>					
Primary Metals	2.17	1.59	2.29	9.13	0.28
Fabricated Metals	3.00	1.80	2.21	9.35	0.18
Electrical Machinery	3.28	2.20	3.46	18.70	0.60
Machinery	2.40	2.12	2.11	6.51	0.49
Vehicles	1.97	1.26	1.95	10.91	0.32
Other Trans. Equip.	1.08	0.50	1.10	5.71	-0.05
Stone, Clay, Glass	3.34	1.02	1.36	5.71	0.31
Other Durables	2.36	1.83	2.24	10.65	0.14
<b>Non-Durable Mfg.</b>					
Food	4.07	3.90	3.77	12.68	0.39
Textiles	0.94	0.30	0.81	4.40	0.08
Paper Products	2.70	0.95	1.62	6.92	0.21
Chemicals	4.22	2.66	3.16	10.65	0.15
Petroleum	7.26	1.77	2.27	6.80	0.43
Rubber	3.82	0.84	1.17	3.73	0.12
Other Non-durables	0.57	0.57	1.12	6.23	0.15
Mean	2.05	1.29	1.76	7.52	0.22

\* Divided by index of U.S. population age 16 and over (1987=1).



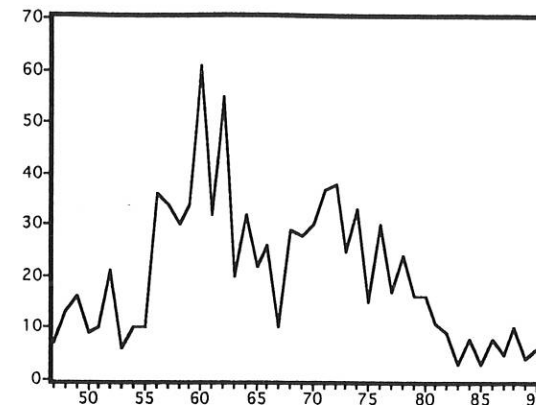
**Table 2**

GLS system regressions of annual industry investment on lagged industry GDP ( $Y_{i,t-1}$ ), change in industry GDP ( $\Delta Y_{i,t}$ ), and industry and total antitrust case filings involving at least one exchange listed firm, years  $t-2$  through  $t+2$ , ( $Z'_{it-j}$  and  $Z'_{t-j}$ ,  $j = -2$  to  $2$ ), 1949-1990. All variables are divided by U.S. population aged sixteen or older. Cross-section slope coefficients are set equal to one another, and the constant (not reported) is free. Parentheses give t-statistics, and brackets percent of bootstrap estimates yielding larger negative effects than original estimates. Joint p shows the percent of bootstraps estimates in which both industry and total antitrust effects have larger negative effects than the original estimates.

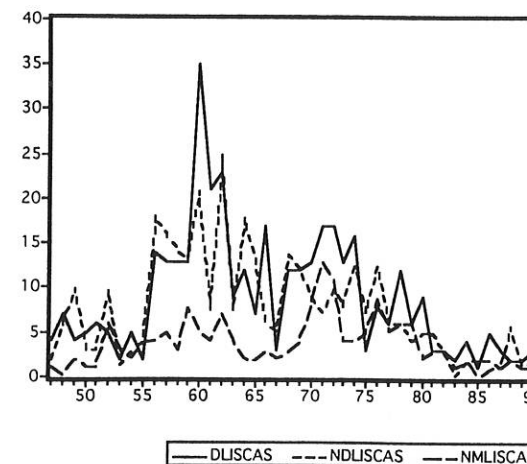
Estimated Effects of:	Non-Manufacturing Six Industries		Durable Manufacturing Eight Industries		Non-Durable Manufacturing Seven Industries	
$Y_{i,t-1}$	0.064	0.058	0.159	0.165	0.177	0.180
t-stat.	(48.9)	(44.9)	(31.9)	(31.7)	(20.2)	(21.2)
$\Delta Y_{i,t}$	0.043	0.037	0.058	0.054	0.057	0.049
t-stat.	(4.4)	(3.8)	(6.1)	(5.9)	(1.9)	(1.9)
$\Sigma Z_{it}$	-1.445	-0.683	-0.370	-0.169	-0.645	-0.361
p	[.108]	[.286]	[.027]	[.295]	[.001]	[.074]
$\Sigma Z_t$		-0.110		-0.034		-0.053
p		[.137]		[.097]		[.099]
Joint p		[.025]		[.006]		[.012]

**Figure 1**

A. Antitrust cases filed involving at least one exchange-listed firm, 1947-1991.

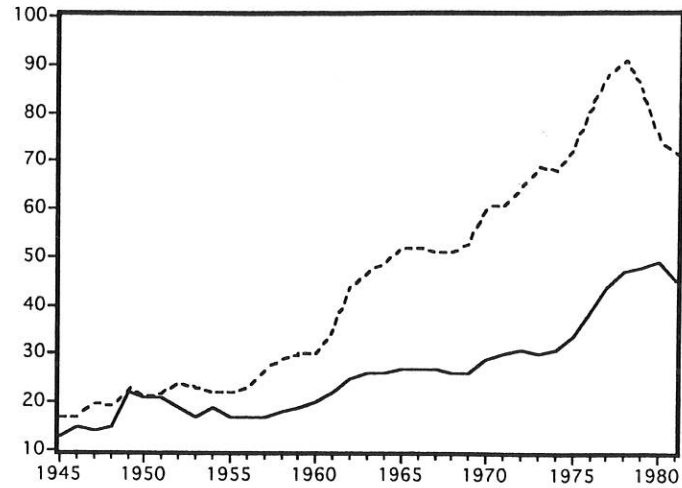


B. Cases against exchange-listed firms by sector: durable, non-durable and non-manufacturing, 1947-1991.



**Figure 2**

DOJ Antitrust Division (—) and FTC (---) appropriations, 1945-1981, adjusted for inflation and population aged sixteen and older (1981=1)

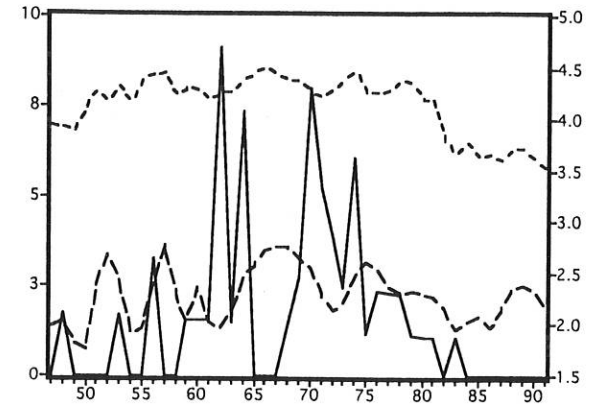


Source: Shughart (1990), Table 4.1, p. 84 and Table. 4.3, p. 90. DOJ data appeared in the U.S. Budget. FTC data were obtained by Shughart from the FTC.

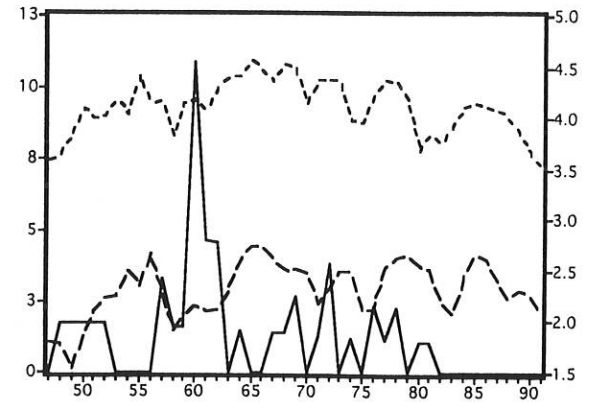
**Figure 3**

Number of antitrust cases filed involving at least one exchange-listed firm (—), natural log of real investment in plant and equipment (— —) and natural log of real GDP (---), selected major industry groups, 1947-1991, all variables adjusted for population aged sixteen and older (1987=1).

A. Primary Metals



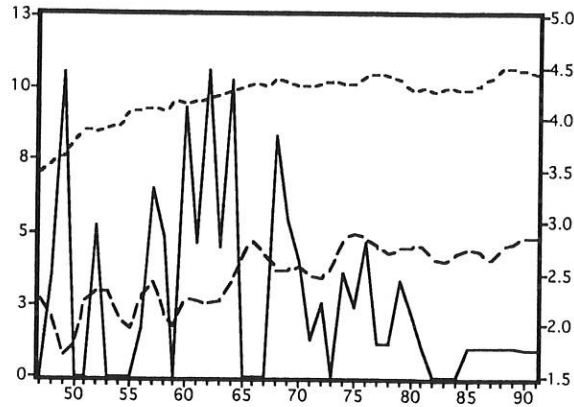
B. Vehicles



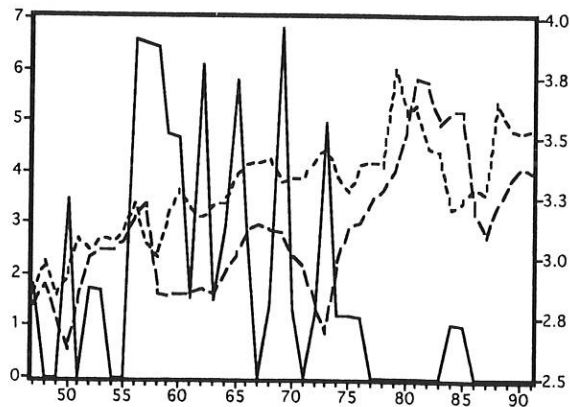
(continued on next page)

Figure 3 continued

C. Chemicals and Allied Products



D. Petroleum Refining



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