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The Fed Must Continue to Supervise Banks

Richard F. Syron

As we examine ways to restructure government to provide better services at lower cost, supervision and regulation of banks is a prime candidate. The current supervisory patchwork, with its overlapping and redundant functions, raises costs for banks and their customers.

Richard F. Syron, President of the Federal Reserve Bank of Boston, agrees that one federal agency should oversee each banking institution. He believes, however, that a recent proposal to eliminate Federal Reserve System involvement in bank regulation and supervision would impede the Fed's ability to carry out its mission as the nation's central bank: to ensure financial stability, to implement monetary policy, and to oversee a smoothly functioning payments system. He describes the strong links between bank supervision and the Fed's other central bank responsibilities, using recent New England experience to highlight the role of the Fed in preventing and containing panics and other banking crises. 3

A Panel Study of Investment: Sales, Cash Flow, the Cost of Capital, and Leverage

Richard W. Kopcke with Mark M. Howrey

This article compares the investment spending for each of 396 corporations during the late 1980s and early 1990s to projections of their spending derived from several basic models of investment. According to these models, capital spending, on average, adheres closely to output, profits, and the cost of capital. The pattern of average forecast errors derived from the statistical models does not correspond very closely to measures of indebtedness, liquidity, size, or type of business. It is not surprising that these variables should influence capital spending so little, once the general business climate (represented by sales or cash flow) has been taken into account.

For the making of economic policy, the evidence suggests that the familiar macroeconomic incentives for investment would be no less effective today than they have been in the past. In particular, the volume of investment spending would appear to respond to monetary and fiscal policies in the customary way. Despite their potential differences, the models agree that monetary or fiscal policy must be unusually aggressive to increase investment spending substantially when the rate of growth of GDP is unusually low. 9

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Massachusetts' Tax Competitiveness

Robert Tannenwald

One of the most important issues facing the Commonwealth of Massachusetts today is maintaining a hospitable climate for business. If Massachusetts' taxes are deterring firms from locating and expanding within its territory, then the Commonwealth should consider ways of making its tax system less repellent. On the other hand, if its tax system is not such a deterrent, the Commonwealth should devote more attention to issues of greater concern to its employers, such as high unemployment insurance taxes, workers' compensation premiums, health care costs, and energy prices.

This article presents guidelines and analytical tools that policymakers will find useful in evaluating their state's business tax climate. Applying these tools to Massachusetts, the study concludes that Massachusetts compares favorably according to the tax burden that should concern profit-maximizing businesses the most: the extent to which taxes depress the long-run rate of return on business investment. On the whole, the Commonwealth's tax structure is neither an asset nor a liability in interstate economic competition. 31

School District Spending and State Aid: Why Disparities Persist

Katharine L. Bradbury

Most decisions about the level of local public school spending are made by local school districts. Their choices are conditioned by local resources and the availability of external funds, mostly from state governments. A major purpose of this substantial state aid is to further the goal of equal educational opportunity by helping to make spending more equal in rich and poor districts.

This article investigates the link between school spending disparities and state school aid by using data on school finances and community attributes to model the determinants of per-pupil operating spending by Massachusetts and Rhode Island school districts. These estimated relationships are used to quantify the impact of recent and newly enacted aid programs on educational expenditures in Massachusetts communities, focusing on their likely effect on spending disparities. 50

The Fed Must Continue to Supervise Banks

Richard F. Syron

President and Chief Executive Officer, Federal Reserve Bank of Boston. These remarks were drawn from a presentation before the Boston Economic Club on January 26, 1994.

As we examine ways to restructure government to provide better services at lower cost, supervision and regulation of banks is a prime candidate. The current supervisory patchwork, with its overlapping and redundant functions, is unnecessarily cumbersome and raises costs for banks and their customers. However, any reform measure also must recognize the essential role banks play in the economy and assure that consumers are protected from financial instability.

A banking institution can now be supervised by as many as four federal agencies. In addition to raising costs, this approach diffuses accountability for policy actions gone awry. Any plan to consolidate bank supervision and regulation should stipulate that only one federal agency supervise each institution.

One supervisor per banking organization could be achieved in a number of ways. A U.S. Department of the Treasury proposal, however, would eliminate Federal Reserve System involvement in bank regulation (setting the rules) and supervision (enforcing the rules). This proposal would undermine the Fed's ability to carry out its mission as the nation's central bank: ensuring financial stability and promoting economic growth.

What Does the Fed Do?

The Federal Reserve has three critical responsibilities: to ensure financial stability, to implement monetary policy, and to oversee a smoothly functioning payments system (delivering checks and transferring funds). These responsibilities are mutually reinforcing and are integrally linked to the banking system.

Monetary policy cannot be conducted in a vacuum. It requires intimate knowledge of the working of banks and financial markets.

Central banks know from the experience of financial crises that regulatory policy and monetary policy directly influence each other. For example, banking crises can undercut monetary policy by discouraging lending and destroying consumer confidence. Furthermore, they can disrupt the ability to make or receive payments by check or to transfer funds. Bank supervision must extend beyond the objective of maintaining the financial health of individual banks to consideration of systemic problems.

Any reform measure must recognize the essential role banks play in the economy and assure that consumers are protected from financial instability.

In managing financial crises, central banks throughout the world intervene to prevent problems in a few banks from spilling over to other banks or to financial markets. A supervisor concerned primarily with oversight of individual institutions has neither the experience nor the mandate to consider the systemic problems, a role for which the central bank is uniquely qualified.

A Better Solution

The dual objectives of regulatory consolidation should be to ensure financial stability and to simplify the regulatory process. However, the first of these two objectives is by far the more important: a well-functioning financial system must be the primary goal.

The goal of a single supervisor for each institution can be achieved without undermining the ability of the Fed to manage crises, implement monetary policy, and supervise banks in a manner consistent with monetary policy. The Federal Reserve should supervise and regulate state-chartered banks while the proposed Banking Commission should supervise and regulate federally chartered banks. The largest bank holding companies, which pose the greatest risk to the broader financial system, would continue to be regulated by the Federal Reserve, while the subsidiary banks in the holding company, regardless of their charters, would be regulated by the regulator of the lead bank.

This plan would provide a more coherent regulatory framework without impairing the ability of the Federal Reserve System to conduct the fundamental functions expected of it. The knowledge, authority, and practical experience gained from regulating and supervising banks enables the Fed to contain panics and other crises when they occur. Even more important, the Fed's intimate knowledge of banks helps it prevent panics from happening at all.

What The Fed Presence Has Meant in New England

The Boston Fed is acutely aware of the strong links between bank supervision and our other central bank responsibilities. Early in 1991, we experienced a series of bank crises that threatened to spread throughout New England. Privately insured credit unions in Rhode Island failed, directly affecting one in three residents of Rhode Island. The safety of $3 billion held in privately insured depository institutions in Massachusetts was also called into question. At the same time, the region's bank with the most deposits, Bank of New England, was failing and five of the seven largest banks in New Hampshire were in the process of failing. These situations threatened a loss of confidence in other New England banks and thrift institutions, potentially resulting in still more serious problems throughout the New England economy.

The Boston Fed provided emergency cash shipments of $320 million to stem bank runs throughout New England; provided examiners to assist banks in preventing runs; warehoused over $2 billion in collateral for emergency loans; and set up alternative payments mechanisms so that affected citizens would have access to their Social Security checks. All of these measures were possible only because the Federal Reserve had a day-to-day, hands-on role in regulating banks and was an active participant in the payments system.

In addition, because of the Fed's economic responsibilities, the Boston Fed has been active in trying to ameliorate the effects of the New England credit crunch, a credit crunch exacerbated by a regulatory approach that focused only on individual banks rather than the banking system as a whole.

Concerns about credit availability problems, which were particularly acute in New England, have contributed to the monetary policy stance of the Federal Reserve and to changes in regulatory policy. These problems could easily have been ignored if the Federal Reserve had no authority to examine or regulate banks.

Crisis Management in New England

It is instructive to review in more detail just how critical the Fed's practical experience was to averting a banking catastrophe in New England in the early weeks of 1991. In late 1990, Boston Fed exam personnel alerted top Federal Reserve management that a number of privately insured institutions in Rhode Island were likely to experience serious solvency and liquidity problems by the end of the year. Federal Reserve bank exam staff, based on their knowledge of the local banking market, informed Federal Reserve officers involved in providing discount window loans, emergency cash shipments, and wire transfers of funds that they should initiate contingency plans immediately.

Bank exam staff began at once to evaluate the solvency of the institutions, as well as the likelihood of bank runs. Because discount window loans must be fully collateralized, Federal Reserve bank examiners were used to appraise collateral offered to qualify for discount window loans and to make sure that the Reserve Bank could perfect its interest in the collateral. The discount function has many similarities to the work of bank examiners, involving as it does the evaluation of loans, appraisals of collateral, and verification of the secured interest; the examiners' work was critical to our ability to respond quickly to the need for establishing sufficient collateral for discount window borrowing. Bank exam staff worked with the management of the involved institutions to explain how to qualify for discount window loans and were active, along with our operations staff, in the preparations for delivery of emergency cash shipments, should they be needed.

At the same time, contingency plans were prepared in case the problem became more widespread. As I have mentioned, in Massachusetts $3 billion in deposits were held in privately insured institutions that potentially could experience runs. Bank of New England already had experienced well-publicized problems (resulting in the warehousing of over $2 billion in collateral for emergency loans), and five of the seven largest depository institutions in New Hampshire were close to failing and susceptible to large withdrawals.

A supervisor concerned primarily with oversight of individual institutions has neither the experience nor the mandate to consider the systemic problems, a role for which the central bank is uniquely qualified.

Moreover, in the last week of December Capitol Bank and Trust of Boston, with over $400 million in assets, was liquidated, resulting in losses to depositors holding more than $100 thousand in deposits. These losses were widely publicized, particularly because they directly affected some Massachusetts cities and towns that held large deposits with the bank.

Closings of Privately Insured Institutions in Rhode Island

On New Year's Day 1991, all the privately insured Rhode Island institutions were closed by newly elected Governor Sundlund. This immediately raised a host of operational problems. Social Security checks that were directly deposited could not be delivered to closed institutions, and alternative systems had to be created so that Social Security beneficiaries could get access to their funds. ATM access to deposits in closed institutions had to be dealt with. Checks on closed institutions had to be returned. All of these activities had to be carried out on a holiday weekend. Because of the Boston Fed's "hands-on" experience with banking institutions and operations, gained from bank supervision and from active involvement in payments issues, we were able to resolve these payments problems quickly and with minimal disruptions. The severe hardship to deposi-

tors and taxpayers created by the insolvency of a private insurance fund (RISDIC) remained, however, and the effects will be felt for years.

The publicizing of the losses to uninsured depositors at Capitol Bank, as well as the plight of privately insured depositors in Rhode Island, significantly heightened the New England public's concern about the safety of their bank deposits. Over the following week, numerous federally insured institutions, primarily in Rhode Island and southern Massachusetts, experienced runs, and toward the end of that week a full-scale run began on Bank of New England.

It is instructive to review just how critical the Fed's practical experience was to averting a banking catastrophe in New England in the early weeks of 1991.

These bank runs resulted in 30 emergency cash shipments from the Federal Reserve Bank of Boston in the month of January, totaling $320 million. Bank examination staff were used extensively to help control the runs. They advised bank management on ways to minimize runs, assessed the health of institutions experiencing runs, and aided in collateral evaluation for discount window loans. They also monitored banks and bank branches for evidence that the situation was deteriorating. Because of the coordinated efforts of our operations and examination personnel, a more serious problem did not develop. Examination and supervision personnel were a critical component in containing the crisis and in preparing contingency plans that would have been used, had the runs become more widespread.

Unique Perspective of the Federal Reserve

A major difference between the Federal Reserve and other agencies is its sensitivity to systemic risk. Other agencies focus on the safety and soundness of individual institutions and the exposure of FDIC insurance to bank actions. The Federal Reserve, in addition to these considerations, must also be aware of how problems can spill over to other participants and markets. Thus potential systemic problems may best be avoided in ways other than increasing the money supply or providing discount window loans. For example, many of the foreign exchange contracts for Bank of New England had losses. Had the supervisors not allowed these contracts to be honored, which would have minimized the cost of one institution's failure, investors might then have been unwilling to enter foreign exchange contracts with any but the most healthy U.S. banks. In this case, minimizing the cost to the deposit insurance fund for one institution conflicted with the need to maintain access to foreign exchange contracts for all other U.S. banks.

Federal Reserve examiners also play an important role in preventing crisis situations. As new bank practices are developed, new risk exposures uncovered, and new regulations adopted, Federal Reserve supervisory staff are particularly sensitive to possible systemic risk. They are in a position to alter bank behavior that poses potential systemic problems, both through changes in regulations and through supervisory activity. They can also communicate their concerns about systemic problems directly to Fed operations personnel at the discount window and in wire transfer. Examiners focused solely on the safety and soundness of individual banks frequently do not have the training and the interaction with payments operations that are critical in identifying possible systemic problems.

Implementation of Monetary Policy

The New England experience also highlights the relationship between bank examination and supervision and the implementation of monetary policy. Despite a rapid expansion of bank reserves, the U.S. economy recovered quite slowly from the recent recession. Contributing factors have been the credit crunch and regulatory actions that have discouraged banks from lending. If capital requirements are binding, additional reserves will not result in more lending.

This problem has been particularly apparent in New England, and the Federal Reserve Bank of Boston has been vocal in its concern over the ways that bank regulation and bank behavior can reduce

the effectiveness of stimulative monetary policy. The realization within the Federal Reserve System that bank regulation was creating a credit crunch contributed to the monetary policies followed since 1989. While monetary policy may not have fully offset the impact of the credit crunch, policy probably would have been less stimulative had the Fed not been aware, early on, that tighter lending policies by banks were a drag on the economy.

More generally, the common indicators of monetary policy—the monetary aggregates, the federal funds rate, and the growth of loans—are all influenced by bank behavior and bank regulation. Understanding changes and taking action in a timely fashion can be achieved only by maintaining contact with examiners who are directly monitoring banks.

Understanding changes in monetary policy indicators and taking timely action can be achieved only by maintaining contact with examiners who are directly monitoring banks.

The banking system is a major transmission mechanism for monetary policy, and it is critical to have personnel in the central bank who have more than an "ivory tower" understanding of bank operations. This can only be obtained by direct contact with banks; it is not available in financial statements and examination reports. Eliminating the Federal Reserve's regulatory and supervisory function would deprive the central bank of complete information about the ways that levels of reserves, movements of monetary aggregates, and fluctuations in the federal funds rate are being affected by regulatory policy and decisions by bank management. Optimal monetary policy is unlikely when the means of understanding the instruments of monetary policy have been removed.

Not only must the Federal Reserve be informed about banks and bank regulation in order to implement monetary policy effectively, the Fed also needs the authority to change bank behavior that is inconsistent with its established monetary policy and with financial stability. This requires both the responsibility for writing the regulations and the responsibility for enforcing those regulations through bank supervision.

A Restatement of the Fed's Proposal

If we were to limit ourselves to a single bank regulator, the choice would be clear: it should be the central bank. One consequence of the Administration proposal would be to make bank regulatory policy more sensitive to concerns of the legislative and executive branches. This experiment has already been tried. The regulation of the savings and loan industry was highly sensitive to the political process, even though it had "independent" regulators. The savings and loan experience demonstrated that funneling credit through a politically sensitive regulatory process can result in short-run gains at far greater long-run costs to the economy. To expect these mistakes to be avoided this time would be excessively optimistic. The incentives would be unchanged, and well-financed lobbying groups overseen by politically responsive regulators remain a recipe for financial disaster.

Because regulatory policy affects monetary policy and systemic risk, at least some independence in decision-making is desirable. Nevertheless, a completely independent agency may be insufficiently sensitive to current policy concerns. The obvious compromise is to have two federal regulators, with non-overlapping jurisdictions. The Federal Reserve should regulate banks critical to its function as a central bank, which clearly include banks active internationally and banks active in a variety of financial markets and derivative instruments. These banks pose potential systemic risk to the payments mechanism and the economy. By and large, they are the largest bank holding companies, which account for the bulk of bank assets and liabilities and pose the most serious systemic risk. In addition, the Federal Reserve would regulate state-chartered banks. These would include many smaller institutions, enabling the Federal Reserve to keep in touch with financial institutions focused on small business lending.

A new Banking Commission would regulate federally chartered banks and thrifts currently overseen by the Comptroller of the Currency and the Office of Thrift Supervision. This organization would be more responsive to the political process but would decide jointly with the Federal Reserve on changes in regulations. This dynamic dialogue would ensure that

considerations central to the Federal Reserve, as well as banking issues of concern to the Administration, were carefully considered.

While consolidation of the bank supervisory process is overdue, issues of bank supervision and regulation affect the entire economy. The ability of the Federal Reserve to contain and prevent financial crises and conduct monetary policy is far more important than overlapping administrative jurisdictions. Together a new Banking Commission and the Federal Reserve System could maintain the principle of one banking regulator per banking organization without sacrificing the ability of the central bank to conduct its major functions.

A Panel Study of Investment: Sales, Cash Flow, the Cost of Capital, and Leverage

Richard W. Kopcke with Mark M. Howrey

Vice President and Economist, and Senior Research Assistant, respectively, Federal Reserve Bank of Boston.

A previous article compared the volume of aggregate investment spending by businesses during the 1980s and early 1990s to projections of spending derived from several basic models of investment (Kopcke 1993). According to these models, capital spending seems to be following a course, familiar from previous business cycles, that corresponds fairly closely with output, profits, and the cost of capital. If the composition of saving, the burden of debt, the supply of credit by commercial banks, or a shift of investors' attention from long-term opportunities to short-term earnings have depressed capital spending during the recent business cycle, the gravity of these forces has not increased conspicuously since the 1960s and 1970s.

The previous research essentially treats all businesses as one enterprise, thereby "averaging out" the decisions of thousands of investors. While a study of aggregate investment can describe accurately the course of total capital spending, by design it cannot describe the distribution of spending. Although the burden of debt, for example, may not have depressed total investment in an unusual way, the difference in leverage among corporations may account for the differences in their capital budgets.

This article compares the investment spending for each of 396 corporations during the late 1980s and early 1990s to projections of their spending derived from models similar to those used for the study of aggregate investment. Similar to the results for aggregate investment, the capital spending for the corporations in this sample did not appear to be surprisingly low, on average, after taking output, profits, and the cost of capital into account. Although the investment spending of many of these corporations often diverged substantially from the course predicted by their sales, profits, or cost of capital, the vigorous spending of some generally offset the torpid spending of others.

This substantial variance in experience suggests that, for explaining the capital spending of specific corporations, the general models used

here are far from complete. Nevertheless, the missing elements seem to be idiosyncratic and difficult to specify. For example, the distribution of forecast errors for corporations with substantial leverage is very similar to the distribution of errors for those with the least leverage. Accordingly, the consideration of leverage, at best, contributes negligibly to the performance of the models. The distribution of errors also has no evident relationship to the variance of cash flow, size, average rate of growth, dividend payment rates, or industrial classification of these corporations. Rather than lacking some universal element such as leverage, the models of investment for each of these corporations appear to lack details specific to each enterprise, its markets, or its technology.

For macroeconomic policy, the disappointing rate of investment by businesses since the 1980s appears to be a general symptom of the relatively slow growth of sales and profits during this economic recovery. Both in the previous study of the total investment spending by all businesses and in this study of investment by specific corporations, those variables commonly mentioned as extraordinary impediments to capital spending appear to correspond little to the pattern of investment.

The first section of this article describes the sample of corporations and the data used in the study. This section also introduces the statistical models, describing their ability to fit the data during the 1970s and early 1980s and to forecast investment spending since the middle 1980s. The second section evaluates the potential contribution of various measures of leverage and liquidity to the performance of these statistical models. The third section is the conclusion.

Table 1
The Models of Investment

Accelerator

$$I_t = a + \sum_{i=0}^{n} b_i Q_{t-i} + cK_{t-1}$$

Neoclassical

$$I_t = a + \sum_{i=0}^{n} b_i \frac{S_{t-i}}{UCC_{t-i}} + cK_{t-1}$$

Cash Flow

$$I_t = a + \sum_{i=0}^{n} b_i \left(\frac{F}{C}\right)_{t-i}$$

q

$$I_t = a + \sum_{i=0}^{n} b_i (q_{t-i} K_{t-1-i}) + cK_{t-1}$$

Explanation of Symbols

C: price index for capital goods
F: cash flow
I: real investment
K: real stock of capital
q: ratio of financial market valuation of assets to the replacement cost of assets
Q: real sales
S: nominal sales
UCC: user cost of capital

I. Models of Investment Spending

Investments are undertaken in anticipation of profit. Assuming that investors' views of the future are grounded in their past experience, statistical models of investment spending use various measures of current and past business conditions to assess investors' perceptions of returns and thereby determine their demand for capital goods.

This article uses four different models to describe the capital spending for its sample of corporations (Table 1).[1] Each represents one way that business conditions may influence the demand for capital. The accelerator model compares the recent trend in sales or output to existing productive capacity in order to estimate investors' demands for new capital goods. The neoclassical model essentially extends the accelerator model by permitting the correspondence between output and capital to vary with the cost of capital, which includes corporate income taxes, and the relative price of investment goods. The cash flow model emphasizes the importance of internal funds, which both fund new investments and indicate the profitability of past investments. Finally, the q model highlights the correspondence between the value of corporations in financial markets and their demand for new capital.

These four models are very basic.[2] Analysts often combine elements from each in order to analyze the effects of policy on investment or to improve fore-

[1] See Kopcke (1993), Berndt (1991), Chirinko (1993), Jorgenson and Siebert (1968), and Jorgenson (1971) for more discussion of these types of models.

[2] For examples of policy analysis, see Bosworth (1985), Auerbach (1991), Henderson with Liebman (1992), and Fazzari (1993). For other studies of investment by specific corporations or industries, see Jorgenson and Siebert (1968), Jorgenson (1971), Elliott (1973), Fazzari, Hubbard and Petersen (1988), Cantor (1990), Galeotti and Schiantarelli (1991), Morrison (1992), Hayashi and Inoue (1991), Hubbard, Kashyap and Whited (1993), Oliner and Rudebusch (1993), and Sharpe (1993) as well as the studies surveyed by these articles.

Table 2
Summary Statistics for the 396 Companies, 1992

	Average	Maximum	Top Quartile	Median	Bottom Quartile	Minimum
Millions of 1987 Dollars						
Real Sales[a]	1,977	93,068	1,267	269	79	1
Real Cash Flow[b]	221	8,944	124	20	4	−1,689
Real Total Assets[c]	2,898	184,632	1,422	317	83	2
Millions of Dollars						
Nominal Sales	2,771	130,590	1,777	375	111	1
Nominal Cash Flow	242	9,881	138	22	4	−1,577
Nominal Total Assets	2,742	191,012	1,568	303	77	1
Percent						
Debt/Asset Ratio	23.3	163.4	33.2	21.0	9.5	.0
Short-Term Debt/Asset Ratio	6.4	159.4	6.1	3.2	.9	.0
Payout[d]		1955.0	77.2	39.7	5.1	−.1
Real Asset Growth	1.6	145.0	5.4	−.1	−3.7	−32.0
q	124.0	949.4	138.4	88.6	68.6	11.4
Cash Flow coverage[e]	2,822.8	404,500.0	1,020.6	442.0	174.8	−10,400.0
Income Coverage[f]	2,803.1	291,600.0	1,065.4	429.6	149.8	−174.1
Investment Grade Rating[g]	77.6					

[a]Real sales used in accelerator model.
[b]Real cash flow used in cash flow model.
[c]Real total assets calculated by adjusting nominal total assets (less property, plant, and equipment) using the consumer price index, and adding real capital stock (see Appendix I).
[d]Payout defined as cash dividends as a percent of cash flow before extraordinary items. An average was not calculated since there were negative cash flows, which would bias the average.
[e]Coverage is cash flow divided by interest expense.
[f]Interest coverage from the Compustat data base, mnemonic icbt.
[g]Of the 396 firms, 37.1 percent reported some form of debt rating on the Compustat data base, of which 77.6 percent was above investment grade. If the senior debt rating was not available on the Compustat data base, the commercial paper rating was used.

casts. The blends can vary over time and over industries. Working models also may include additional explanatory variables, measures of leverage, for example, representing potential determinants of capital spending that do not appear explicitly in any of the four basic models. In any case, the models examined here are often the foundation upon which other models are built and, as such, they are a standard against which potential improvements can be judged.

Description of the Data

This study estimates the basic models of investment for each of 396 corporations selected from COMPUSTAT (see Appendix I for complete descriptions of the data and the analysis). COMPUSTAT contains financial information for more than 14,000 U.S. and Canadian companies, both active and inactive, which have either debt or equity traded publicly. This study considered only domestic manufacturing corporations that reported data continually from 1973 to 1992 without any significant changes in accounting practices. The companies selected represent 51.1 percent of the total assets of active, domestic manufacturing companies recorded by COMPUSTAT in 1992.

The data for COMPUSTAT are taken from reports filed with the Securities and Exchange Commission as well as from company reports and contacts. COMPUSTAT uses these accounting data to create financial statements that are more likely to comprise the same concepts for all firms.[3] This study adjusts some of these data to constant (1987) dollars, as described in Appendix I.

The companies constituting the sample are diverse (Table 2). They range from large, familiar enterprises, such as General Motors and Exxon, to small companies whose sales were less than $1 million in 1992. Some grew continuously throughout the two decades of this study, while the assets, sales, and

[3] See internal memo produced by Compustat titled "Why Compustat?" as well as Zivney and Marcus (1989).

profits of others fell steadily. The capital spending of these companies also varied considerably. Some invested consistently, while the expenditures for others, apart from a few exceptional years, were quite small.

The Performance of the Models

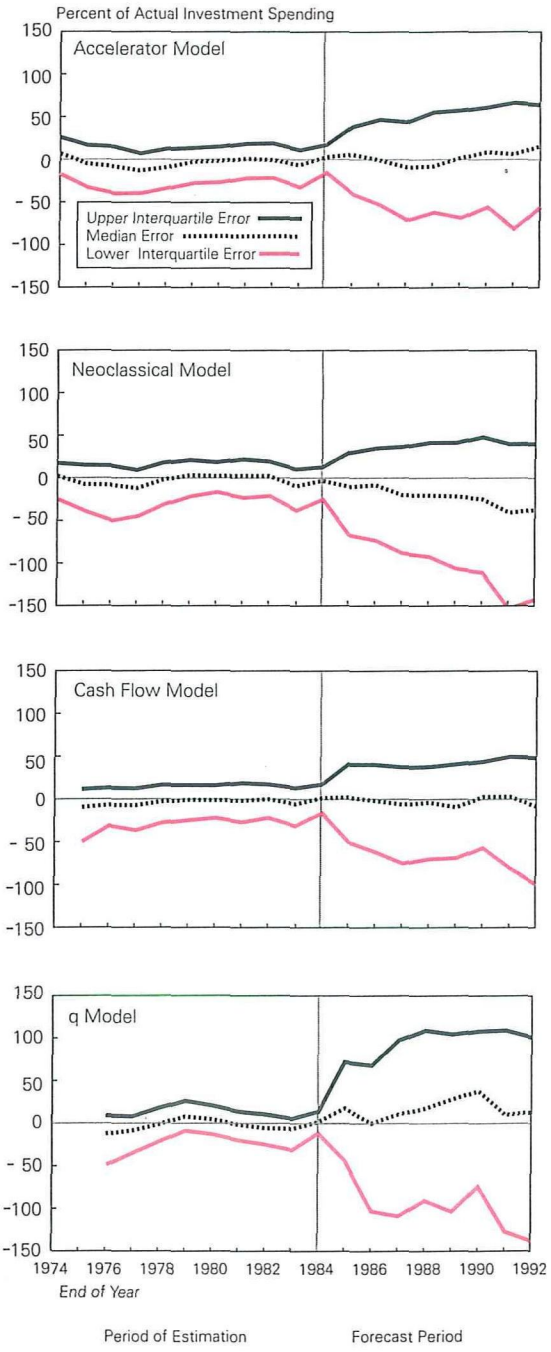
Figure 1 summarizes the ability of the four models to fit and forecast the investment spending of the corporations in this sample. Because the magnitude of the median errors is fairly low, especially for the accelerator and cash flow models, the evidence in these charts suggests that these models describe the trend in capital spending for this sample of corporations fairly well. During the period of estimation, extending from the early 1970s through 1984, the magnitude of the median error in each year averaged less than 6 percent of investment for each of the four models. The magnitude of the median errors during the forecast period, from 1985 through 1992, averaged less than 7 percent of investment for the accelerator and cash flow models. The q model tended to underpredict investment—actual spending exceeded its forecasts—and the magnitude of its median errors averaged about 17 percent of investment. The neoclassical model tended to overpredict investment by about 23 percent of spending.

The dispersion of errors in each year was substantial, indicating that these models lack other variables needed to explain satisfactorily the capital spending for any specific corporation. During the estimation period, the interquartile ranges of errors[4] in the four charts show that the magnitude of the errors often was as great as 25 percent of investment spending for many corporations. During the forecast period, the magnitude of the errors could be at least twice as great.

This substantial dispersion of errors does not necessarily imply that the basic models are a poor foundation for building more customized equations that might represent each corporation's capital spending more accurately. That the demand for capital, on average, should correspond with sales, profits, or the cost of capital seems compelling. Indeed, as noted above, these models describe the trend in capital spending for this group of corporations fairly well despite the considerable changes in business

Figure 1

Forecast Errors of Investment Spending by the 396 Sample Corporations



[4] An interquartile range contains one-half of the errors. The upper line evenly divides the errors above the median; the lower line evenly divides the errors below the median.

conditions during the past two decades. But, the capital spending of emerging enterprises or mature corporations undertaking a major rebuilding may correspond poorly with forecasts that depend only on recent sales, profits, and costs of capital. Capital spending for waning enterprises also may correspond poorly with these basic determinants of investment. Though they may do well for the average corporation, these four models are too general to do well for each corporation.

Models describe best the behavior of the average member of a group, not the behaviors of each constituent.

Nevertheless, the dispersion of errors probably would remain substantial even for the best of models.[5] A company's capital spending can be comparatively "lumpy," varying from modest expenditures one year to substantial expenditures the next; whereas all standard models tend to project a relatively smooth course for capital spending. Models describe best the behavior of the average member of a group, not the behaviors of each constituent. For example, although theory may describe accurately the state of the average molecule in a volume of gas, the state of any specific molecule cannot be predicted very accurately. Similarly, actuaries and doctors may be able to predict the health of large groups of people accurately, but, even with the benefit of very detailed information about one's history and habits, the best models cannot include sufficient information to predict accurately the health of any specific person. However important the universal elements of sales, profits, and the cost of capital may be for determining the general course of investment spending, much of any enterprise's capital budget in a particular year depends on the unique outlook of its managers and on details specific to each enterprise.

Estimating the Models

Each of the four basic models was estimated for each of the 396 corporations from the early 1970s through 1984. Just as the companies were not combined according to their industries, their leverage, their size, or other commonly mentioned characteristics, the coefficients in one company's statistical equations were not constrained to resemble those of another, because the results indicate that the statistical models for the companies constituting these potential groupings can be very dissimilar. For each of the four models, the equations for all companies are constrained only to have the same number of lags.

The charts in Figure 2 show, for each of the four models, the variances of the errors and the sum of the coefficients (the b's in Table 1) for output, cash flow, or the market value for each of the corporations. The charts for the more successful models have more of their points concentrated near the horizontal axis. The vertical scale in these charts represents the proportion of the variance of investment spending that each model fails to explain during the period of estimation. If, for example, the accelerator model explains almost all of the variance of a corporation's investment, that corporation would be represented by a dot near the bottom of the first chart. If, in addition, the sum of the coefficients on the terms measuring output in the accelerator model for this corporation were 0.2, the dot would appear just above this point on the horizontal scale.

The horizontal axes in the second through fourth charts of the figure are scaled to correspond with the horizontal axis in the first chart. For example, cash flow is only about one-tenth of sales, on average, for this sample of corporations. Accordingly, the sums of the coefficients in the cash flow model may tend to be 10 times greater than the sums for the accelerator model.[6] Therefore, the horizontal scale for the cash flow models is 10 times that of the accelerator models. The other two charts are scaled analogously.

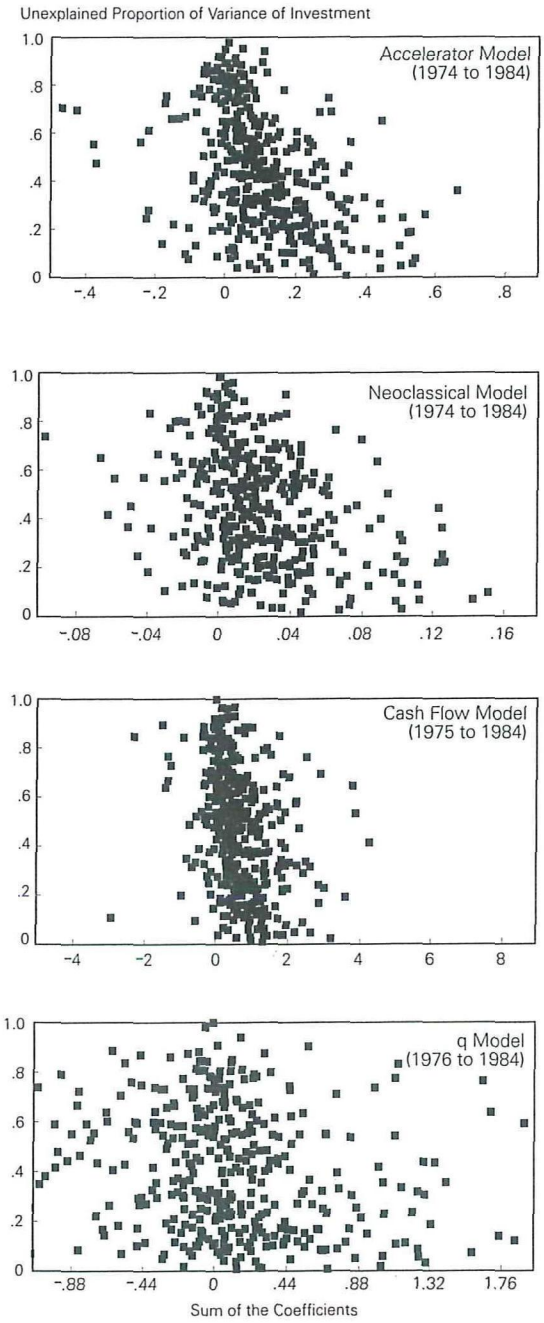
Figure 2 shows that the accelerator, neoclassical, and cash flow models explain the investment spending of most of the corporations in this sample rather well during the period of estimation. The variance of the errors of these models is relatively low for most corporations, and the sums of their coefficients are reasonable. In all three cases, the models explained

[5] See, for example, the results of the studies cited in footnote 2.

[6] If cash flow were a linear function of sales (perhaps including an error term not correlated with investment), and if the coefficient on sales in this function were 0.1, then this predicted relative scaling of coefficients would be fairly accurate. If, however, the relationship were not linear (or any error term in this function were correlated with investment), then the relative scaling could differ significantly from 10. In this sample, the standard deviation of cash flow is also about one-tenth the standard deviation of sales, as would be implied by a linear, nearly homogeneous relationship between cash flow and sales.

Figure 2

Variance of the Errors and Sum of the Coefficients for Each of the 396 Sample Corporations during the Period of Estimation



more than one-half the variance in investment spending for more than one-half of the corporations (see Appendix I for more details). The accelerator and neoclassical models, both of which rely on sales, explain over 40 percent of the variance of investment for more than 70 percent of the corporations. For all three models, the sum of the coefficients is positive for approximately 80 percent of the corporations. This degree of success is remarkable for panel studies.

The charts show only a weak relationship between the residual variance of investment and the sum of the coefficients. Although one might expect to find that the sum of coefficients tended to be greatest when the residual variance was least, a successful fit need not have a large sum. For example, a comparatively low sum would accompany a good fit for corporations with lower capital-to-sales ratios. This is one reason for the horizontal dispersion of points in the charts. For rapidly growing enterprises or for shrinking corporations, the sum of the coefficients can be zero or even negative, because their spending often follows a trend that is correlated best with the size of their stock of capital.

The q model did not fare as well as the other three. The points in its chart are a relatively diffuse cloud. Although the proportion of investment explained by the q model is comparable to that of the other models, the sum of the coefficients is negative for more than 40 percent of the corporations. Furthermore, the incidence of negative sums does not vary greatly with the model's ability to fit the data: The points to the left of zero are essentially as numerous in the lower regions of the chart as they are in the upper regions. These results suggest that the q, in the form used here, may perform best when combined with other determinants of investment spending.[7]

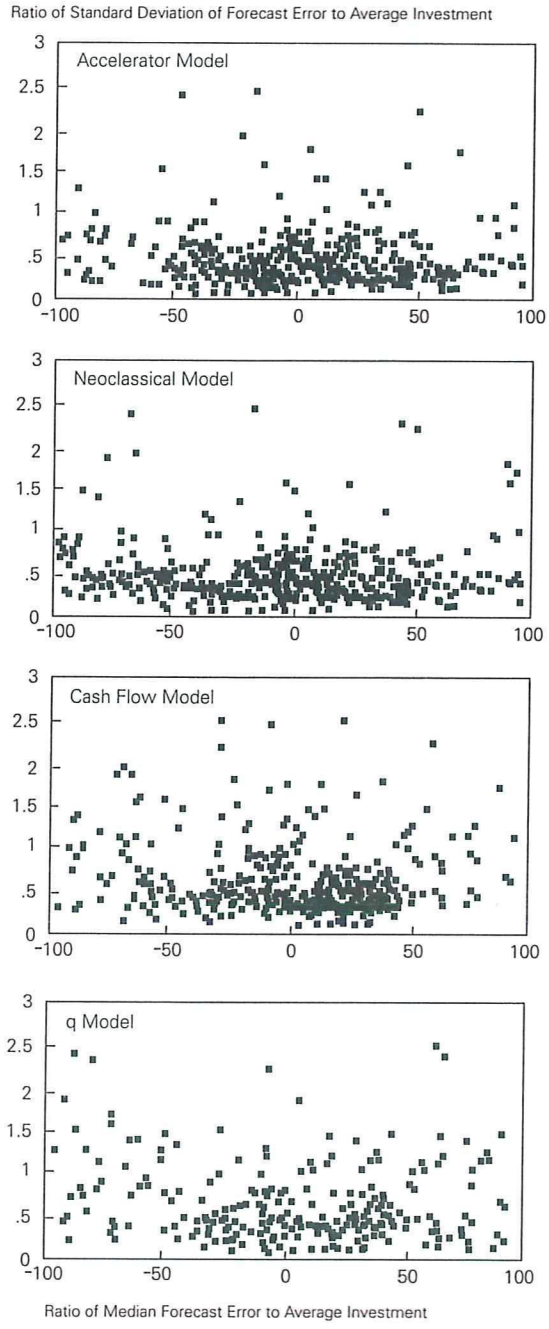
Forecasting with the Models

Figure 3 describes, for each of the models, the variances of errors during the forecast period and the median forecast error for each of the 396 corporations (tables describing these distributions appear in Appendix I). The charts for the more successful models have more of their points concentrated closer to zero on the horizontal axis. The vertical scale represents the ratio of the standard deviation of the forecast error to the average investment for each company.

[7] The difficulties with the q model, no doubt, arise because q is difficult to measure (Klock, Thies, and Baum 1991); furthermore, marginal q, either in place of or in addition to average q, may be an important determinant of investment spending (Kopcke 1993).

Figure 3

Variance of the Errors and the Median Forecast Error for Each of the 396 Sample Corporations during the Forecast Period, 1985 to 1992



The horizontal scale represents the ratio of the median forecast error to the average investment during the forecast period. Accordingly, if the standard deviation of a corporation's forecast error were negligible and its median forecast error were zero, then this corporation would be represented by a point just above zero on the horizontal axis.

The points are dispersed over wide ranges in each of the four charts in Figure 3. Not only, as noted before, can the median errors be substantial relative to investment, but the standard deviations of errors also are very great for many corporations.[8] Nevertheless, these results are reasonably successful for a panel study.

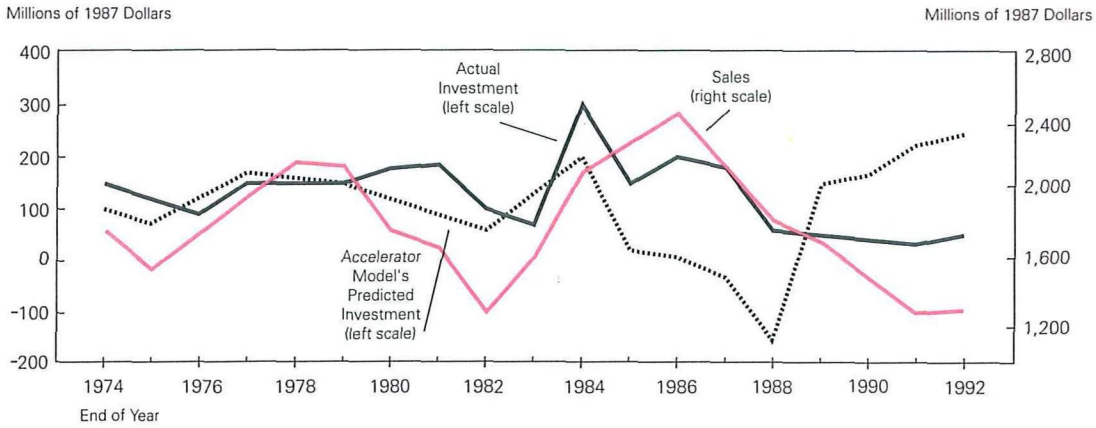
The forecast errors for the accelerator, neoclassical and cash flow models tend to be smaller than those for the q model. Compared to the chart for the q model, the points in the other three charts tend to cluster somewhat closer to zero on the horizontal axis, implying that the standard deviations and median errors are smaller for these three models. The median forecast error is less than 20 percent of investment for about one-quarter of the companies during the forecast interval for the accelerator, neoclassical, and cash flow models. The standard deviation of forecast errors is less than 50 percent of average investment for two-fifths of the companies, and less than 75 percent of investment for two-thirds of the companies. For the q model, the median forecast error is less than 20 percent of investment for only one-seventh of the companies. The standard deviation of errors is less than 50 percent of average investment for only one-quarter of the companies, and less than 75 percent of investment for less than one-half of the companies.

Although substantial errors indicate that a specific statistical equation failed to describe a corporation's capital spending very accurately, these large errors do not necessarily discredit the general theory behind the equation. Many of the points nearest the top of the chart for the accelerator model represent small companies that failed to accomplish their great leap forward: They made comparatively great investments while their sales either remained near or fell to very low rates. For these companies, recent sales

[8] None of the charts show a strong relationship between the standard deviation and the median error. If these charts had used the root mean squared forecast error instead of the standard deviation of forecast errors, then the points in the charts would tend to be higher, the further they were from zero on the horizontal axis. Forecasts with greater average errors typically have greater mean squared errors, because mean squared errors equal the average error squared plus the variance.

Figure 4

Actual and Predicted Investment Spending of USG Corporation



understated management's expectation of future sales, and any model was prone to fail without directly taking these expectations into account. The forecast errors for other companies also could be substantial even though the course of their investment resembled that of their sales after 1984. For example, the median error for USG Corporation was 40 percent of average investment, and the standard deviation of its forecast error was about 1.6 times average investment. Nevertheless, the pattern of USG's investment spending corresponded much more closely to the pattern of USG's sales than these errors suggest (Figure 4). From 1974 to 1992, sales and investment generally rose and fell in concert. Between 1974 and 1984, however, the estimated equation fit investment best by placing a relatively great negative weight on the lagged stock of capital.[9] Consequently, when USG's stock of capital rose considerably in 1985 and 1986 as a result of its rising sales and investment, the equation's forecast of investment fell. When the stock of capital fell after 1987 as its sales and investment fell, the equation's forecast rose.

II. Analysis of Forecast Errors

For all four models of investment, the substantial dispersion of errors in both the estimation and the forecast periods invites further work. This section investigates whether the size of these errors can be reduced by combining the information in the four models or by adding additional variables representing the leverage, size, growth, or industrial classification of the companies in this sample.

The following results suggest that, despite the differences in their explanatory variables, the accelerator, neoclassical, cash flow, and q models contain much the same type of information about the investment spending of the corporations in this sample. The companies for which the accelerator model works best tend to be the same companies for which each of the other models works best. The results also suggest that, once sales, profits, and the cost of capital are taken into account, other general explan-

[9] The estimated equation for USG's accelerator model is:

$$I_t = 824.3 + .119\ Q_t - .059\ Q_{t-1} - .633\ K_{t-1}.$$

The coefficient on the lagged stock of capital reflects two forces. The first tends to make the coefficient negative: More sales entail a greater demand for capital, but the greater is the existing capacity (K_{t-1}), the less new investment is warranted. The faster the company adjusts its capacity to changes in sales, the more negative is the coefficient. The second force tends to make the coefficient positive: The greater is existing capacity, the greater is a company's new investment for the purpose of replacing decaying and obsolete capital. The faster the rate of obsolescence, the greater is the coefficient. Compared to the experience of the forecast period, the data in the estimation period put too much weight on the first force.

Table 3

Results of Comparison of Neoclassical and Accelerator Models for the 396 Firms

1. Percent of Firms in the Same Relative Ranking according to the Standard Deviation of the Forecast Errors/Average Investment (as a percent of all firms)

		Neoclassical Highest 33%	Neoclassical Mid 33%	Neoclassical Lowest 33%
Accelerator	Highest 33%	81.1	16.7	2.3
Accelerator	Mid 33%	12.1	66.7	21.2
Accelerator	Lowest 33%	6.8	16.7	76.5

2. Percent of Firms for Which the Standard Deviation of the Forecast Errors/Average Investment Is Lower for the Neoclassical Model (as a percent of all firms)

		Neoclassical Highest 33%	Neoclassical Mid 33%	Neoclassical Lowest 33%
Accelerator	Highest 33%	8.3	5.6	.8
Accelerator	Mid 33%	.0	7.8	7.1
Accelerator	Lowest 33%	.0	.0	9.8

3. Percent of Firms in the Same Relative Ranking according to the Absolute Value of the Median Forecast Errors/Average Investment (as a percent of all firms)

		Neoclassical Highest 33%	Neoclassical Mid 33%	Neoclassical Lowest 33%
Accelerator	Highest 33%	75.0	18.9	6.1
Accelerator	Mid 33%	17.4	40.2	42.4
Accelerator	Lowest 33%	7.6	40.9	51.5

4. Percent of Firms for Which the Absolute Value of the Median Forecast Errors/Average Investment Is Lower for the Neoclassical Model (as a percent of all firms)

		Neoclassical Highest 33%	Neoclassical Mid 33%	Neoclassical Lowest 33%
Accelerator	Highest 33%	28.8	17.4	6.1
Accelerator	Mid 33%	.0	15.2	42.4
Accelerator	Lowest 33%	.0	.0	23.5

atory variables, such as the burden of debt, do not explain the pattern of errors made by the four basic models.[10] The models do not tend to overstate investment more often for companies with greater-than-average leverage. The distribution of error statistics for companies with substantial debt resembles closely the distribution of error statistics for all companies. Analogous results obtain for companies with relatively little debt.

Comparing the Information in the Models

Tables 3 through 5 compare the structures of the errors of the statistical models. The top panel of Table 3 partitions the sample of 396 corporations into thirds (the three rows): those for which the standard deviation of forecast errors from the accelerator model were highest, average, or lowest. The table then subdivides each third (the three columns) into those corporations for which the standard deviation of forecast errors was relatively great, average, or small using the neoclassical model.

The top panels of the three tables show that the rough ranking of companies by the relative sizes of the standard deviations of their forecast errors is much the same for the four models. In Table 3, for example, of those companies with the greatest standard deviations for the accelerator model (the first

[10] In contrast to these results, a study by Ofek (1993) as well as some of the papers cited in footnote 2 find evidence that greater leverage reduces the demand for investment in some circumstances. Nevertheless, the burden of debt is not absolute; the gravity of debt may be weighed only in the context of prevailing or anticipated business conditions (Kopcke 1989).

Table 4

Results of Comparison of Cash Flow and Accelerator Models for the 396 Firms

1. Percent of Firms in the Same Relative Ranking according to the Standard Deviation of the Forecast Errors/Average Investment (as a percent of all firms)

		Cash Flow Highest 33%	Cash Flow Mid 33%	Cash Flow Lowest 33%
Accelerator	Highest 33%	61.4	31.8	6.8
Accelerator	Mid 33%	29.5	43.9	26.5
Accelerator	Lowest 33%	9.8	23.5	66.7

2. Percent of Firms for Which the Standard Deviation of the Forecast Errors/Average Investment Is Lower for the Cash Flow Model (as a percent of all firms)

		Cash Flow Highest 33%	Cash Flow Mid 33%	Cash Flow Lowest 33%
Accelerator	Highest 33%	18.9	28.8	6.8
Accelerator	Mid 33%	.8	14.4	26.5
Accelerator	Lowest 33%	.0	.0	25.8

3. Percent of Firms in the Same Relative Ranking according to the Absolute Value of the Median Forecast Errors/Average Investment (as a percent of all firms)

		Cash Flow Highest 33%	Cash Flow Mid 33%	Cash Flow Lowest 33%
Accelerator	Highest 33%	55.3	22.0	22.7
Accelerator	Mid 33%	24.2	40.2	35.6
Accelerator	Lowest 33%	20.5	37.9	41.7

4. Percent of Firms for Which the Absolute Value of the Median Forecast Errors/Average Investment Is Lower for the Cash Flow Model (as a percent of all firms)

		Cash Flow Highest 33%	Cash Flow Mid 33%	Cash Flow Lowest 33%
Accelerator	Highest 33%	34.1	22.0	22.7
Accelerator	Mid 33%	.0	26.5	35.6
Accelerator	Lowest 33%	.0	.8	22.7

row of the top panel): 81.1 percent also were among those companies that had the highest standard deviations for the neoclassical model; 16.7 percent were among those with average standard deviations; and 2.3 percent were among those with the smallest. About three-quarters of the corporations, when ranked by the sizes of the standard deviation of their forecast error, are classified the same for the accelerator and the neoclassical models, as shown by the entries along the diagonal of this panel. Moreover, for those corporations whose ranking changes between models, the panel shows no strong evidence that those with the greatest errors for the accelerator model (the first row) are promoted any differently than those with the greatest errors for the neoclassical model (the first column). In other words, this matrix tends to be symmetric with a relatively dominant diagonal.[11] The upper panels of Tables 4 and 5 support similar conclusions comparing the accelerator model to the cash flow and q models. For these two tables, however, corporations ranked as having average errors according to one model are more likely to be reclassified according to the other model, with the number of companies moving up a rank nearly matching the number moving down a rank.

The second panel of the tables shows that the standard deviation of forecast errors tends to be least for the accelerator model. In the second panel of Table 3, for example, only 9.8 percent of the companies with the smallest standard deviation according

[11] Only four of the matrix's nine entries may be chosen (somewhat) independently, because each row and column must sum to one.

Table 5

Results of Comparison of q Model and Accelerator Models for the 396 Firms

1. Percent of Firms in the Same Relative Ranking according to the Standard Deviation of the Forecast Errors/Average Investment (as a percent of all firms)

		q Model Highest 33%	q Model Mid 33%	q Model Lowest 33%
Accelerator	Highest 33%	59.1	31.1	9.8
Accelerator	Mid 33%	25.8	42.4	31.8
Accelerator	Lowest 33%	15.2	26.5	58.3

2. Percent of Firms for Which the Standard Deviation of the Forecast Errors/Average Investment Is Lower for the q Model (as a percent of all firms)

		q Model Highest 33%	q Model Mid 33%	q Model Lowest 33%
Accelerator	Highest 33%	2.3	5.6	3.3
Accelerator	Mid 33%	.0	.5	7.6
Accelerator	Lowest 33%	.0	.0	3.3

3. Percent of Firms in the Same Relative Ranking according to the Absolute Value of the Median Forecast Errors/Average Investment (as a percent of all firms)

		q Model Highest 33%	q Model Mid 33%	q Model Lowest 33%
Accelerator	Highest 33%	52.3	27.3	20.5
Accelerator	Mid 33%	28.0	34.8	37.1
Accelerator	Lowest 33%	19.7	37.9	42.4

4. Percent of Firms for Which the Absolute Value of the Median Forecast Errors/Average Investment Is Lower for the q Model (as a percent of all firms)

		q Model Highest 33%	q Model Mid 33%	q Model Lowest 33%
Accelerator	Highest 33%	9.1	22.7	20.5
Accelerator	Mid 33%	.0	.8	29.5
Accelerator	Lowest 33%	.0	.0	12.1

to the accelerator model had smaller standard deviations according to the neoclassical model. Of those with the greatest standard deviations according to the accelerator model only 14.7 percent had lower standard deviations according to the neoclassical model (the sum of the entries in the first row). The cash flow model performs best against the accelerator model in this respect. In Table 4, just over half of the companies with the greatest standard deviations according to the accelerator model had lower standard deviations according to the cash flow model, and the cash flow model reduced the standard deviations for just over 40 percent of the companies ranked average by the accelerator model.

The median errors tend to be the smallest for the cash flow model. The diagonal entries in the third panel of the tables generally are significantly smaller than their counterparts in the first panel; moreover, the entries in the fourth panel tend to be very much greater than their counterparts in the second panel. These observations are most pronounced in Table 4. Consequently, the cash flow model tended to reduce the median forecast error for three-quarters of the companies for which the median errors were greatest according to the accelerator model (the sum of the entries in the first row), and the cash flow model reduced the median error for three-fifths of the companies with average errors (the sum of the second row). But, the cash flow model reduced the median error for only about one-quarter of the companies with the lowest error according to the accelerator model. The neoclassical model (Table 3) also reduced the median forecast error for more than one-half of the companies with great or average errors according

to the accelerator model, and it too reduced the median error for only about one-quarter of the companies with the lowest error according to the accelerator model.

These results do not indicate that any of the four models is better than the rest. This conclusion is supported by comparing each model's forecast errors with the forecasts of the other models (see Appendix II). For most of the companies, the forecasts of one model do not dominate the forecasts of another model. Each of the models, however, does appear to forecast the capital spending better than the other models for a small subset of the companies.

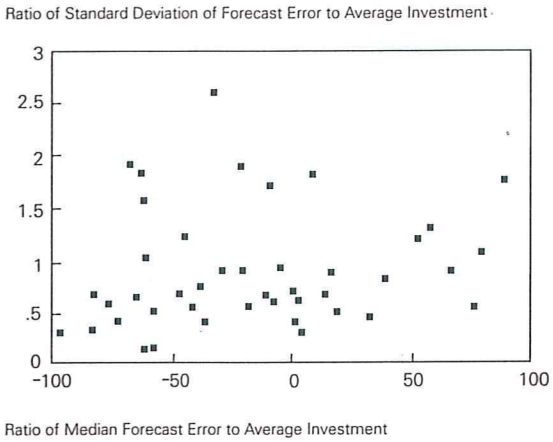
Although the results indicate that the four models contain much the same information, they also might seem to suggest that the cash flow model might be most suitable for those companies whose median forecast errors were relatively great according to the accelerator model (Table 4, the first rows of panels 2 and 4). This possibility is important because, due to imperfections in credit markets, some companies might be constrained by their cash flow from investing as much as warranted by their other "fundamentals."

Further analysis of the evidence, however, suggests that cash constraints do not explain the accelerator model's errors. Instead, the results simply imply that the cash flow model's median errors for each company are not correlated very greatly with those of the accelerator model. Consequently, for those companies for which the median error is smaller than average according to the accelerator model, the median error of the cash flow model tends to be greater. Conversely, when the accelerator model's median errors are greater than average, the median error of the cash flow model often is smaller.

The characteristics of the corporations with comparatively large median errors according to the accelerator model are not consistent with cash flow constraints. Of the 132 companies with the greatest median forecast errors for the accelerator model, for 60 companies this model tended to underpredict investment—capital spending exceeded the forecast. Figure 5 shows the cash flow model's error statistics for the remaining 72 companies, for which the accelerator model overpredicted investment spending. If the cash flow of these companies restricted their capital spending, their median errors should be comparatively small or positive according to the cash flow model. Conversely, large negative errors would indicate that their spending was "slack" compared to their cash flow. As shown in the chart, their error

Figure 5

Cash Flow Model's Error Statistics during the Forecast Period (1985-1992), for the 72 Companies with Greatest Errors of Overprediction by the Accelerator Model



statistics are distributed much like those of all 396 corporations (the third panel of Figure 3), except that the median errors for these 72 companies tend to be more negative than those for the full sample. Many of these 72 companies are large, have investment-grade credit ratings, or have comparatively low leverage. This evidence suggests that the cash flow model does not systematically improve the forecast of investment spending for these companies by detecting binding cash constraints.

The Contributions of Leverage, Liquidity, Size, Growth, and Industrial Classification

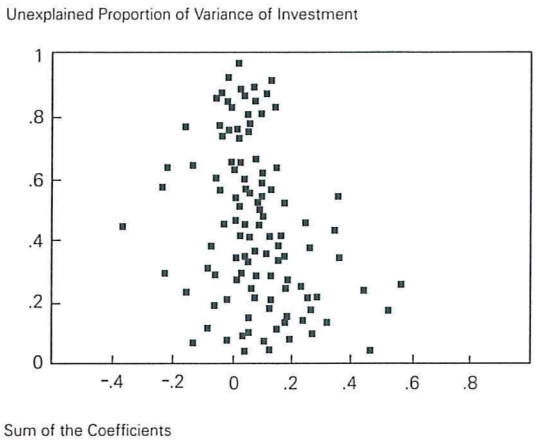
The basic models take no explicit account of the companies' debt burdens, their size, the rate at which they are growing, or their lines of business. This section describes the potential contribution of this additional information by analyzing the correspondence between these new variables and the models' errors.

Companies with similar leverage often are assumed to behave similarly, and companies with very different debt burdens frequently are assumed to behave differently. The evidence in this sample of corporations suggests that the characteristics of capital spending do not depend on leverage. For this

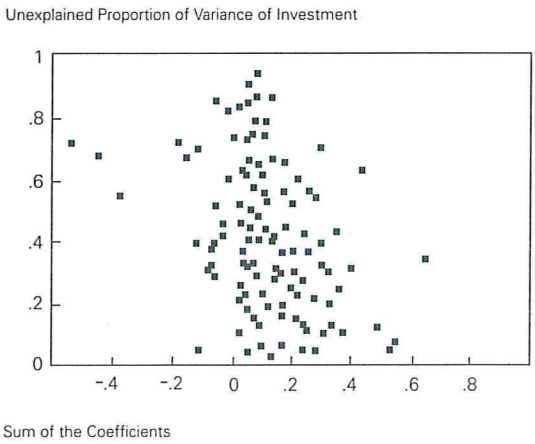
Figure 6

Error Statistics for the Accelerator Model during the Period of Estimation (1974 to 1984) for Subsets of the Sample of Corporations

The One-Third of the Sample with the Highest Debt/Asset Ratio



The One-Third of the Sample with the Lowest Debt/Asset Ratio



reason, among others, this study did not estimate investment equations for groups of corporations with comparable leverage, even though they might be in similar lines of business.

The two panels of Figure 6 show the distributions of the error statistics and the sums of coefficients for the accelerator model, taken from the first panel of Figure 2, for the third of the sample (132 corporations) with the greatest ratios of debt to assets (the upper panel) and the third with the lowest ratios (the lower panel). The distributions of points in the two panels neither differ significantly from each other nor differ significantly from the distribution in Figure 2. These results do not change materially by limiting the comparison to companies in comparable industries. Similar results obtain for the other models. Comparable results also obtain when the burden of debt is measured by the ratio of income before interest expense and taxes to interest expense (the coverage ratio) or by the change in either the ratio of debt to assets or the coverage ratio.

This study also finds that the models' errors for companies with similar leverage tend not to resemble one another. The two panels of Figure 7 show the error statistics for the accelerator model (taken from the first panel of Figure 3) for those 132 corporations with the greatest ratios of debt to assets (the upper panel) and those with the lowest ratios (the lower panel). If substantial leverage, as measured by the debt-to-asset ratio, tended to depress investment beginning in the late 1980s, then the model should tend to overpredict investment for companies with substantial leverage, and points in the first panel should tend to be displaced more to the left than the points in the other panel. Instead, the distributions of points in both of the panels closely resemble each other as well as the distribution of points in Figure 3.[12] Similar results obtain for the distributions of error statistics from the other three models. Comparable results also obtain for the coverage ratio.

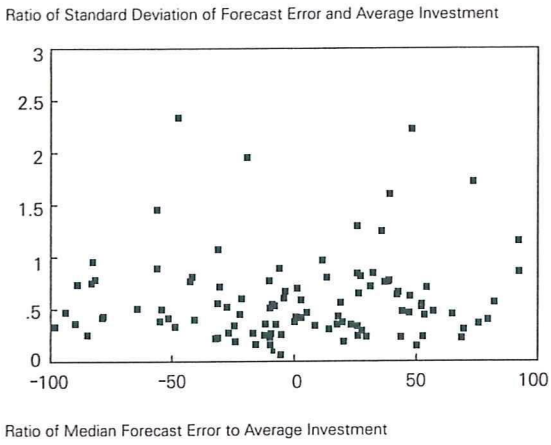
The patterns of the annual errors behind the summary statistics depicted in Figure 6 also suggest that the forecast errors are not similar for companies with comparable debt burdens. The number of positive covariances in the variance matrix of the forecast errors for the 132 corporations appearing in the first panel essentially matched the number of negative covariances, and their pattern corresponded to no simple subgroupings of companies. The forecast errors for company A, for example, may be positively correlated with those of B and C, but B's errors often are negatively correlated with those of C, and so forth. This lack of evident subgroupings also is evident from the principal components of these forecast errors. Many eigen vectors are required to describe

[12] Formal chi-square goodness-of-fit tests do not reject the similarity of these distributions.

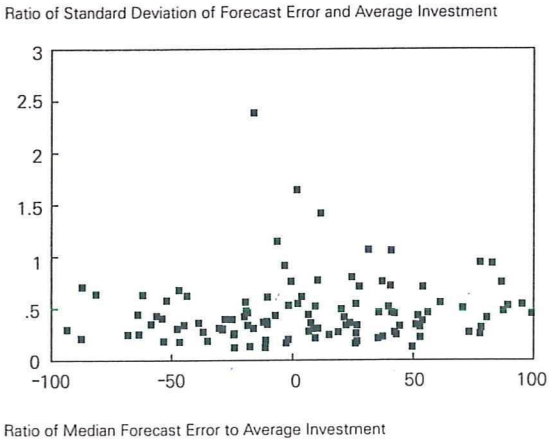
Figure 7

Error Statistics for the Accelerator Model during the Forecast Period (1985 to 1992) for Subsets of the Sample of Corporations

The One-Third of the Sample with the Highest Debt/Asset Ratio



The One-Third of the Sample with the Lowest Debt/Asset Ratio



the structure of the variance matrix, and the structure of each vector is complex. The maximal eigen value of the matrix was only 50 percent greater than the fifth-largest eigen value, and three times greater than the tenth-largest eigen value. The coefficients in the eigen vectors did not weight the companies in a consistent fashion: The coefficients across companies within a vector and for a company across the vectors ranged from substantial positive values to substantial negative values. Again, similar results obtained for both the other models and the other measures of the burden of debt.

This study also compared the distributions of forecast errors to other characteristics of the companies constituting this sample. Analyses similar to the foregoing showed that the pattern of errors bore little resemblance to the ratios of short-term debt to assets, variance of cash flows, dividend payment rates, rates of growth, or sizes of these corporations. Altogether, these results imply that the structure of the basic models' errors does not correspond very closely to common measures of leverage and liquidity.

III. Conclusion

The capital spending of businesses appears to correspond with their sales, profit, and cost of capital little differently today than a decade ago. According to this study of 396 corporations, the average company's investment in each year differs remarkably little from forecasts derived from these basic measures of business conditions. This conclusion, arising from the analysis of distinct corporations, is similar to the finding of a previous study that examined the aggregate investment of businesses (Kopcke 1993).

The capital spending of many of the companies in this study's sample, however, corresponds very poorly with their sales, profits, or cost of capital. These divergences suggest that sales, profits, and the cost of capital do not represent fully an enterprise's particular incentives for investing. Unfortunately, the missing elements seem to be idiosyncratic and difficult to specify. The other influences that account for this dispersion in capital spending might include the leverage, size, or industrial classification of each corporation. Nevertheless, once sales have been taken into account, differences in leverage, for example, do not distinguish companies spending more than predicted by their sales from those spending less. For this sample of corporations, the pattern of average forecast errors derived from the statistical models using sales, cash flow, and the cost of capital does not correspond very closely to measures of indebtedness, liquidity, size, or type of business.

Companies with comparable liquidity or debt burdens do not tend to behave similarly. Not only

does the distribution of average forecast errors correspond poorly with leverage, but also the covariances among forecast errors for companies with comparable leverage are not similar. For example, the forecast errors for companies with substantial leverage tend to change neither in concert nor in simple patterns. Consequently, these findings do not support generalizations contending that companies with more debt are investing less than their sales and cash flows would warrant.

Similar to the conclusion from many studies of the returns on securities, this article finds that investment appears to depend on no more than a few macroeconomic "factors," which seem to be represented adequately by sales and cash flows in common investment equations. This connection between capital markets and capital spending, which is most evident in the q model, also is very much in the spirit of the other models of investment used in this study. If capital formation has been disappointingly weak recently, the unusually slow growth of economic activity undeniably bears much of the responsibility.

Perhaps it is not surprising that leverage, liquidity, and other variables should influence capital spending so little once the general business climate (represented by sales or cash flow) has been taken into account. The choice of leverage, like capital spending, depends on the prospect for profit. A good business climate can foster both investment and debt financing. In these cases, higher leverage does not deter investment; instead, it may appear to facilitate investment. At other times, companies may increase their leverage while they reduce their capital spending, if the return on existing capital is great compared to that foreseen on new investments. In these cases, higher leverage may appear to deter investment. In any of these cases, appearances can be deceiving, because investment and leverage jointly depend on business conditions, and this dependency entails no consistent relationship between indebtedness and investment.

For the making of economic policy, the evidence suggests that the familiar macroeconomic incentives for investment would be no less effective today than they have been in the past. In particular, the volume of investment spending would appear to respond to monetary and fiscal policies in the customary way. This is clearest, of course, for the neoclassical, cash flow, and q models. The success of the cash flow model, for example, implies that the taxation of businesses' income and the cost of financing investments ought to influence capital budgets: Profits and cash flow might increase as a result of either rising sales or a tax cut. But, even for the accelerator model, which lacks an explicit reference to interest rates, policies can affect capital spending by altering the composition or volume of output. Despite their potential differences, the models agree, however, that monetary or fiscal policy must be unusually aggressive to increase investment spending substantially when the rate of growth of GDP is unusually low.

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Appendix I: Methodology, Definitions and Data

Firm data are taken from COMPUSTAT, and are expressed in annual terms. Only U.S. manufacturing firms were evaluated. Firms were eliminated if a significant change in accounting practices occurred during the time period of the study (1973 to 1992) or if the data were not continuous for the entire period. This resulted in a sample of 396 firms. In the following description of the construction of individual variables, the COMPUSTAT mnemonic follows the definition, stated in parentheses in lower case.

Investment: Capital expenditures for the construction and acquisition of property, plant, and equipment, which includes the property, plant, and equipment of acquired companies (capxv). These COMPUSTAT data are adjusted to constant 1987 dollars from book value using data from the U.S. Bureau of Economic Analysis (BEA). The BEA releases data for historical (book) value of investment as well as constant (1987) dollar value, which are classified by 2-digit SIC codes. Thus, it is possible to estimate the constant dollar measure of investment from a given book value, by industry.

KS: Property, plant and equipment, less accumulated depreciation (ppent). The BEA releases historical (book) and constant dollar data for capital stock, which are used in the same manner as in the investment data.

Cash flow: Cash before extraordinary items (ibc) plus depreciation and amortization (dpc). These data are divided by the same investment deflators as above, using the same 2-digit SIC breakdown.

Real sales: nominal sales (sale) were divided by the Consumer Price Index, released by the U.S. Bureau of Labor Statistics.

The user cost of capital is the percent of total investment that went toward equipment of nonfinancial corporate business, measured by the BEA, multiplied by the user cost of capital for equipment (denoted as RE) plus the percent of total investment for structures multiplied by the user cost of capital for structures (RS). Quarterly data were averaged to yield annual figures.

$$RE = (CE)(.15 + D)(1 - ITC - TAX*WE)/(1 - TAX)$$

$$RS = (CS)(.05 + D)(1 - TAX*WS)/(1 - TAX)$$

CE, CS: Implicit price deflators for producers' durable equipment and nonresidential structures, released by the BEA.

The annual economic rate of depreciation is estimated at 15 percent for equipment and 5 percent for structures. D, the discount rate for corporate profits after corporate income tax, equals the Standard & Poor's dividend/price ratio for common stocks plus an estimate of the real rate of growth of nonfinancial corporate enterprises, a constant 4 percent.

Both ITC, the investment tax credit for equipment, and TAX, the statutory effective tax rate paid by U.S. corporations, are taken from the DRI Model of the U.S. Economy. ITC is the weighted average of investment tax credits for autos, office equipment, and other equipment.

WE: The present value of depreciation allowances for equipment using the most "accelerated" formula permitted by law. From 1973:I through 1981:II, equipment was depreciated using Sum of the Year's Digits; from 1981:III through 1986:IV, equipment was depreciated using the Accelerated Cost Recovery System; from 1987:I through 1992:IV, the Modified Accelerated Cost Recovery System was used. Tax life for equipment is the weighted average of the tax life for different classes of equipment taken from the DRI Model of the U.S. Economy. The nominal discount rate used equals INFLATN times (1 + 0.015); 0.015 represents the assumed real rate of discount (after taxes).

WS: Similarly defined for structures. Structures were depreciated according to the 150 percent Declining Balance Method for 1973:I to 1981:II; from 1981:III through 1986:IV, buildings were depreciated according to the Accelerated Cost Recovery System; and the Modified Accelerated Cost Recovery System thereafter. The discount rate used equals INFLATN times (1 + 0.015).

INFLATN: Rate of inflation expected over the coming five years. For 1980:IV through 1992:IV, INFLATN is the aver-

age of the monthly surveys by Richard Hoey, available from the Board of Governors of the Federal Reserve System, FAME Database. Hoey's survey data were regressed on lagged values of the annual rate of change in the CPI for 1980:IV to 1992:IV. The equation was used to obtain expected inflation for the prior periods.

q: The ratio of the market value of assets, denoted MVK, to the replacement value of those assets, RPL.

MKV= CD + LTD + VCS + VPS.

RPL = CKS + OA.

CD: Debt in current liabilities (dlc).

LTD: Total long-term debt (dltt) divided by the NYSE bond index, which measures market value as a percent of par value for all New York Stock Exchange listed bonds. This series is found in the NYSE *Fact Book*.

VCS: The annual average of the monthly closing prices of common stock (prccm) multiplied by the number of shares outstanding at the end of the year (csho).

VPS: Cash dividends to preferred stockholders (dvp) divided by Standard & Poor's preferred stock yields.

CKS: Net property plant and equipment (ppnet) at replacement value. The BEA releases capital stock data in current dollars, as well as historic and constant dollar values, which were used to adjust property, plant, and equipment.

OA: Total assets (at) minus net property, plant, and equipment (ppnet).

All equations were estimated using ordinary least squares. The regressions for the Accelerator and Neoclassical models were fit from 1974 to 1984, using real sales for the Accelerator model and nominal sales divided by the user cost of capital for the Neoclassical model, lagged one year. Both the Cash Flow and q models were lagged two years. Because of the definition of the q model, it was fit from 1976 to 1984, while the Cash Flow model fit began in 1975. All models were forecasted from 1985 to 1992.

Table A1 summarizes the median errors of all models for both the fit and forecast periods. Tables A2 to A5 give a numerical representation of Figure 2, stating the number of firms whose statistics fall into specified intervals. The fit statistic for Figure 2 is the variance of the error term divided by the variance of investment. Tables A6 to A9 do the same for Figure 3, with the fit statistic the standard deviation of the error term divided by average investment.

Table A1
Median Error for Time Analysis

Model	Mean	Mean Absolute
Fit Period		
Accelerator	−3.27	5.23
Cash Flow	−3.47	3.75
Neoclassical	−2.70	5.02
q Model	−2.46	5.55
Forecast Period		
Accelerator	2.53	6.98
Cash Flow	−2.76	4.67
Neoclassical	−22.96	22.96
q Model	16.87	16.87

Table A2
Accelerator Model
Fit Period, 1974 to 1984

	Sum of the Coefficients															
Fit	<−.5	−.5 to −.4	−.4 to −.3	−.3 to −.2	−.2 to −.1	−.1 to 0	0 to .1	.1 to .2	.2 to .3	.3 to .4	.4 to .5	.5 to .6	.6 to .7	.7 to .8	.8 to .9	Total
0 to .1					2	1	6	4	4	3	2	3				25
.1 to .2					1	2	8	13	12	4	1	3				44
.2 to .3				2	2	4	13	17	13	5	1	2				59
.3 to .4						8	19	14	9	5	1		1			57
.4 to .5	1		1			7	26	15	7	2						59
.5 to .6			1	1		6	23	7	6	1						45
.6 to .7	1	1		1	3	5	19	4	2	1	1					38
.7 to .8		1			2	9	18	1	1							32
.8 to .9						12	16	2								30
.9 to 1						3	3	1								7
Total	2	2	2	4	10	57	151	78	54	21	6	8	1	0	0	

Table A3
Neoclassical Model
Fit Period, 1974 to 1984

	Sum of the Coefficients															
Fit	<−.1	−.1 to −.08	−.08 to −.06	−.06 to −.04	−.04 to −.02	−.02 to 0	0 to .02	.02 to .04	.04 to .06	.06 to .08	.08 to .1	.1 to .12	.12 to .14	.14 to .16	.16 to .18	Total
0 to .1						1	6	5	3	3		3		2		23
.1 to .2					2	3	7	7	9	4	3	2				37
.2 to .3				1		5	13	9	9	2	1	3	3			46
.3 to .4				1	2	7	18	17	11	2	2	2	1			63
.4 to .5	1		1	1		7	16	11	4	4			1			46
.5 to .6				2	2	8	17	19	14	3	1					66
.6 to .7	1		1		3	8	18	9	5		1					46
.7 to .8	1	1			2	6	10	6	1	1	1					29
.8 to .9					2	6	15	5								28
.9 to 1						4	7	1								12
Total	3	1	2	5	13	55	127	89	56	19	9	10	5	2	0	

Table A4
Cash Flow Model
Fit Period, 1975 to 1984

	Sum of the Coefficients															
Fit	>−5	−5 to −4	−4 to −3	−3 to −2	−2 to −1	−1 to 0	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	Total
0 to .1						1	8	10	4	1						24
.1 to .2	1			1		2	24	17	1	1						47
.2 to .3						5	23	12	3							43
.3 to .4						7	20	15	4							46
.4 to .5						3	28	10	1		1					43
.5 to .6						7	30	11	2	1						51
.6 to .7	2				2	11	37	7	2	1						62
.7 to .8					2	6	21	4	1							34
.8 to .9				1	1	9	22	2								35
.9 to 1						2	9									11
Total	3	0	0	2	5	53	222	88	18	4	1	0	0	0	0	

Table A5
q Model
Period of fit, 1976 to 1984

	Sum of the Coefficients																
Fit	<−1.11	−1.11 to −.88	−.88 to −.66	−.66 to −.44	−.44 to −.22	−.22 to 0	0 to .22	.22 to .44	.44 to .66	.66 to .88	.88 to 1.1	1.1 to 1.32	1.32 to 1.54	1.54 to 1.76	1.76 to 1.98	<1.98	Total
0 to .1	2		1	1	2	5	11	5	2	5	3	3		1			41
.1 to .2	3		2	3	4	10	11	10	11	2	1	2	1		2	2	64
.2 to .3	3		1	4	5	8	16	6	2	2	3	1					51
.3 to .4	3	2			4	12	6	4	3	4	1	3	1			2	45
.4 to .5	5	3	2	2	3	6	11	9	2		1	1	1			1	47
.5 to .6	2	1	4	4	8	10	10	6	2	3		1			1	1	53
.6 to .7	2		1	2	4	6	10	5	2					1		2	35
.7 to .8		2	1	3	3	7	9	4	2	1	1	1		1			35
.8 to .9	2			3	1	8	5	1				1					21
.9 to 1						1	2		1								4
Total	22	8	12	22	34	73	91	50	27	17	10	13	3	3	3	8	

Table A6

Accelerator Model

Forecast Period, 1985 to 1992

	Median Error as a Percent of Average Investment												
Fit	<−100	−100 to −80	−80 to −60	−60 to −40	−40 to −20	−20 to 0	0 to 20	20 to 40	40 to 60	60 to 80	80 to 100	>100	Total
0 to .25		2		4	7	12	7	11	7			1	51
.25 to .5	5	7	6	10	22	21	20	19	21	10	6	4	151
.5 to .75	11	5	4	5	6	14	9	10	13	4	6	11	98
.75 to 1	9	5		4	1	3	5	8	1	1	3	5	45
1 to 1.25	3	1			1	1		1	1		1	6	15
1.25 to 1.5	4			1			2	2				1	10
1.5 to 1.75	5					1	1		1	1		1	10
1.75 to 2	3					1							4
2 to 2.25													0
2.25 to 2.5	2			1		1			1				5
2.5 to 2.75	1											1	2
2.75 to 3													0
>3	3										1	1	5
Total	46	20	10	25	37	54	44	51	45	16	17	31	

Percent of Firms with Absolute Errors in a Given Range

<20%	<40%	<60%	<80%	<100%
24.7	47.0	64.6	71.2	80.6

Percent of Firms with the Fit in a Given Range

<.25	<.5	<.75	<1	<1.25	<1.5	<1.75	<2	<2.25	<2.5	<2.75	<3
12.9	51.0	75.8	87.1	90.9	93.4	96.0	97.0	97.0	98.2	98.7	98.7

Table A7

Neoclassical Model

Forecast Period, 1985 to 1992

	Median Error as a Percent of Average Investment												
Fit	<−100	−100 to −80	−80 to −60	−60 to −40	−40 to −20	−20 to 0	0 to 20	20 to 40	40 to 60	60 to 80	80 to 100	>100	Total
0 to .25			1	5	5	11	9	4	2	2			39
.25 to .5	12	8	7	18	18	20	19	19	5	5	4	5	140
.5 to .75	21	7	7	9	8	9	8	9	4	3	3	8	96
.75 to 1	11	5	2	4	2	4	4	8	2	2	3	6	53
1 to 1.25	11				2		1	1	1			5	21
1.25 to 1.5	8	1				1	1	1				2	14
1.5 to 1.75	5	1				1	1	1			1		10
1.75 to 2	1	1	1								2		5
2 to 2.25	1								1				2
2.25 to 2.5	5		1			1		1				1	9
2.5 to 2.75	2												2
2.75 to 3	1											1	2
>3	2											1	3
Total	80	23	19	36	35	47	43	44	15	12	13	29	

Percent of Firms with Absolute Errors in a Given Range

<20%	<40%	<60%	<80%	<100%
22.7	42.7	55.6	63.4	72.5

Percent of Firms with the Fit in a Given Range

<.25	<.5	<.75	<1	<1.25	<1.5	<1.75	<2	<2.25	<2.5	<2.75	<3
9.8	45.2	69.4	82.8	88.1	91.7	94.2	95.5	96.0	98.2	98.7	99.2

Table A8

Cash Flow Model

Forecast Period, 1985 to 1992

	Median Error as a Percent of Average Investment												
Fit	<−100	−100 to −80	−80 to −60	−60 to −40	−40 to −20	−20 to 0	0 to 20	20 to 40	40 to 60	60 to 80	80 to 100	>100	Total
0 to .25			2	3	6	4	7	12	1				35
.25 to .5	5	4	4	4	18	29	25	32	10	4		1	136
.5 to .75	5	2	6	9	8	11	9	12	8	2	2	1	75
.75 to 1	7	3	4	5	3	11	7	7	3	7	1	1	59
1 to 1.25	4	1	3	2		2	3	1	2	3	2	3	26
1.25 to 1.5	9	1		1	1	2	3	1	1	1		1	21
1.5 to 1.75	3		2	1		2		1			1	3	13
1.75 to 2	5		3			1	1	1					11
2 to 2.25	1				1							1	3
2.25 to 2.5	2					1				1			4
2.5 to 2.75	1				1			1					3
2.75 to 3													0
>3	3		2				1			1		3	10
Total	45	11	26	25	38	63	56	68	25	19	6	14	

Percent of Firms with Absolute Errors in a Given Range

<20%	<40%	<60%	<80%	<100%
30.1	56.8	69.4	80.8	85.1

Percent of Firms with the Fit in a Given Range

<.25	<.5	<.75	<1	<1.25	<1.5	<1.75	<2	<2.25	<2.5	<2.75	<3
8.8	43.2	62.1	77.0	83.6	88.9	92.2	94.9	95.7	96.7	97.5	97.5

Table A9

q Model

Forecast Period, 1985 to 1992

	Median Error as a Percent of Average Investment												
Fit	<−100	−100 to −80	−80 to −60	−60 to −40	−40 to −20	−20 to 0	0 to 20	20 to 40	40 to 60	60 to 80	80 to 100	>100	Total
0 to .25					2	3	3	4	1	1			14
.25 to .5	6	2	5	2	8	11	12	11	14	11	4	9	95
.5 to .75	10	2	6	3	7	5	8	5	7	6	8	12	79
.75 to 1	6	2	2	2	2	4	4	1	3	6	3	9	44
1 to 1.25	6	1	2	1		2	2	5	4	2	2	14	41
1.25 to 1.5	7	2	1	4		1	1		1	2	3	5	27
1.5 to 1.75	7		2		1		1	1				6	18
1.75 to 2	6	1										4	11
2 to 2.25	5					1						4	10
2.25 to 2.5	6	2								1		5	14
2.5 to 2.75	3								1			3	7
2.75 to 3	1											3	4
>3	17				1	1				1		12	32
Total	80	12	18	12	21	28	31	27	31	30	20	86	

Percent of Firms with Absolute Errors in a Given Range

<20%	<40%	<60%	<80%	<100%
14.9	27.0	37.9	50.0	58.1

Percent of Firms with the Fit in a Given Range

<.25	<.5	<.75	<1	<1.25	<1.5	<1.75	<2	<2.25	<2.5	<2.75	<3
3.5	27.5	47.5	58.6	68.9	75.8	80.3	83.1	85.6	89.1	90.9	91.9

Appendix II

A test presented in Davidson and MacKinnon (1982) was used to compare the relative performance of the models' forecasts. Consider a blended forecast of investment,

$$I = (1 - \alpha)\hat{I}_1 + \alpha\hat{I}_2 + e$$

where I is actual investment, I_1 and I_2 are forecasts for two different models, and α is a weight chosen to minimize total forecast error. This equation may be rewritten as

$$I - \hat{I}_1 = \alpha(\hat{I}_2 - \hat{I}_1) + e.$$

The Model I_1 forecast error is regressed on the difference between the forecast of an alternative model and the Model I_1 forecast. The regression coefficient is the weight assigned to the alternative model's forecast in order to minimize the total forecast errors. For example, consider the case where the error of the accelerator model is regressed on the difference between the cash flow and the accelerator models' forecasts. If the regression coefficient were zero, the cash flow model's forecast adds no information to that already represented by the accelerator model.

Table A10 summarizes the results of the regressions. Each entry shows the proportion of companies for which the regression coefficient had a significant t-statistic. Beginning with the accelerator model, with a 5 percent significance level, the cash flow model's forecast improves upon the accelerator model's forecast of investment for 33.8 percent of the companies. At a 1 percent significance level, the cash flow model's forecast improves the accelerator model's forecast for 15.7 percent of the companies. The table shows that the accelerator model tends to benefit the least by adding other models' forecasts (reading across the different rows), yet contributes the most to the other forecasts (reading down the columns). The q model clearly benefits the most. Nevertheless, the q model contributes to each of the other forecasts, as seen in the last two columns of Table A10.

The coefficients associated with the significant t-statistics tended to center around 0.8 for the majority of the models, with relatively few greater than 1 or less than 0.2. Figure A1 (on p. 30) shows two examples of the distributions of coefficients significant at the 5 percent level. The values of the coefficients imply that if the t-statistic is significant, the forecast of the model most often is weighted about four times that of the original model in order to minimize the forecast error.

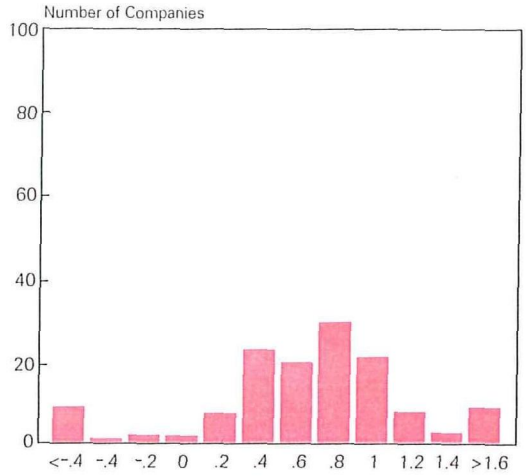
Table A10
Proportion of the Companies for Which the Coefficient for the Difference between Forecasts Is Significantly Different from Zero
Percent of All Firms

	Alternative Model							
	Accelerator		Cash Flow		Neoclassical		q Model	
Original Model	5%	1%	5%	1%	5%	1%	5%	1%
Accelerator			33.8	15.7	31.6	16.9	30.3	15.7
Cash Flow	51.5	32.8			45.7	30.3	37.1	21.7
Neoclassical	43.4	26.0	38.4	21.0			31.6	19.4
q Model	71.5	56.6	62.9	47.0	68.2	52.0		

Figure A1

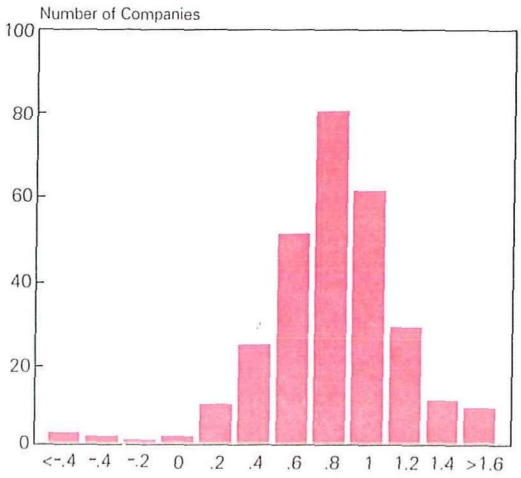
Distribution of the Weights Given to the Alternative Model

Accelerator Model Original and Cash Flow Alternative



Coefficients Significant at the 5 Percent Level

q Model Original and Neoclassical Alternative



Coefficients Significant at the 5 Percent Level

Massachusetts' Tax Competitiveness

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Is Massachusetts' tax system discouraging businesses from locating and expanding within its territory? While this issue is as old as Massachusetts itself, it is one of the most important facing the Commonwealth today. As employers have become increasingly footloose, the importance of maintaining a hospitable business climate has grown. If Massachusetts' taxes are deterring firms from locating and expanding within its territory, then the Commonwealth should consider ways of making its tax system less repellent. On the other hand, if its tax system is not such a deterrent, the Commonwealth should devote more attention to issues of greater concern to its employers, such as high unemployment insurance taxes, workers' compensation premiums, health care cost, and energy prices.[1]

In 1993, Massachusetts, concluding that its business tax climate needed improvement, increased its investment tax credit from 1 percent to 3 percent. Most of the Commonwealth's principal economic competitors[2] also granted their businesses significant tax relief last year, much of it in the form of new tax credits for investment and research and development (Table 1). In New England, businesses enjoyed a tax cut in every state except Maine.[3]

During the last few years, many states, including Connecticut, Massachusetts, and Rhode Island, have conducted in-depth evaluations of their business tax climate.[4] This article is based on the most recent study of Massachusetts' tax competitiveness, conducted by the Massachusetts Special Commission on Business Tax Policy (Commonwealth of Massachusetts 1993). The Commission, chaired by Richard Syron, President of the Federal Reserve Bank of Boston, was created to conduct a broad evaluation of the Commonwealth's business tax policy according to the normative criteria of fairness, neutrality, simplicity, and competitiveness.[5]

The article presents guidelines and analytical tools that policymakers will find useful in evaluating their state's business tax climate.

Section I identifies state and local tax characteristics that, according to both economic theory and anecdotal evidence, exert the most influence on firms' locational choices. Section II shows how many widely cited indicators of tax competitiveness fail to capture these characteristics. Section III presents two indicators that do and uses them to evaluate Massachusetts' tax competitiveness. Section IV summarizes the article and draws policy conclusions.

Relative to its principal economic competitors, Massachusetts compares favorably according to the tax burden that should concern profit-maximizing businesses the most: the extent to which taxes depress the long-run rate of return on business investment. Given this finding, as well as widespread evidence that factors other than taxes are more important determinants of business location, the article concludes that, on the whole, the Commonwealth's tax structure is neither an asset nor a liability in interstate economic competition.[6]

An exception to this general assessment is the modest competitive handicap created by the Commonwealth's relatively high tax burden on upper-income households. Highly skilled, well-informed workers, including business executives who decide where firms locate and expand, generally fall into the high-income category. These workers can raise the cost of doing business at a site by demanding increased compensation to offset high personal taxes. The Commonwealth's tax burden on these households, although average relative to those imposed by its competitors as a group, is well above the national median and significantly higher than those imposed by such economic competitors as Arizona, Illinois, New Hampshire, Texas, and Washington. Lowering taxes on the well-to-do, however, would cost the Commonwealth needed revenue and raise concerns about the fairness of its tax structure.

Massachusetts compares favorably to its economic competitors on the tax burden that should concern profit-maximizing businesses the most: the extent to which taxes depress the long-run rate of return on business investment.

I. State and Local Tax Characteristics That Most Influence Businesses' Choice of Where to Locate and to Expand

Hundreds of empirical studies have addressed this issue. The evidence produced has been conflicting and inconclusive.[7] While some studies have identified tax characteristics that deter firms from locating within a state, other studies have found that these

[1] In a recently released study, the Massachusetts Taxpayers Foundation (1993) noted that the Commonwealth ranks high compared to other states according to these costs of doing business, as well as in wages.

[2] Although Massachusetts' economic competitors vary by industry, the Massachusetts High Technology Council, an interest group representing many of the Commonwealth's major high tech companies, has identified 17 states as the Commonwealth's principal economic competitors. The Council has divided them into three groups: 1) other New England states (Connecticut, Maine, New Hampshire, Rhode Island, and Vermont); 2) other high technology states (Arizona, California, Maryland, North Carolina, Texas, and Washington); and 3) other industrial states (Illinois, Michigan, New Jersey, New York, Ohio, and Pennsylvania).

[3] Whether New Hampshire's businesses as a whole actually received a tax reduction is a matter of some dispute. The state reduced its tax rate on business profits from 8 percent to 7.5 percent in FY94, and from 7.5 percent to 7 percent starting in FY95. Some small and mid-sized businesses, however, were subject to a new tax, in lieu of the business profits tax, called the business enterprise tax. See *Fiscal Facts* (1993). Although the total package of business tax reforms is supposed to be neutral, revenues from the business enterprise tax during the first four months of FY94 have fallen far short of expectations. See *Fiscal Facts* (1994).

[4] For example, see Connecticut Task Force on Revenue (1991), KPMG Peat Marwick (1993), and Commonwealth of Massachusetts (1993).

[5] One of the Commission's most important tasks was to evaluate the desirability of mandatory tax reporting, or "tax disclosure"—requiring businesses to disclose to the public items from their state income tax returns. The Commission produced five working papers, a majority report, and a minority report, all of which are available from the author on request.

[6] Massachusetts' tax system may be a competitive liability in certain industries. For example, Fox (1993) argues that Massachusetts' bank tax creates powerful incentives for banks providing services to customers within the Commonwealth to locate their facilities in other states.

[7] See Tannenwald (1993), Kenyon (1991), Bartik (1991), and Wasylenko (1991) for surveys of those studies conducted since 1980. Literature surveys that include pre-1980 surveys include Due (1961), New York State Legislative Commission on the Modernization and Simplification of Tax Administration and the Tax Law (1984), and Kieschnick (1981).

Table 1
Business Tax Relief Measures Enacted in 1993 by Massachusetts and Its Principal Economic Competitors[a]

State	Type of Legislation
Arizona	Environmental technology incentives created, including various tax exemptions such as a sales tax exemption for sales of paper machine clothing, and a transaction privilege tax exemption for the sale of electricity, natural gas, etc. used in the manufacturing process, and a tax credit for construction costs;
	Research and development tax credit increased.
California	Investment tax credit created;
	Sales tax exemptions for qualified businesses introduced;
	Research and development tax credit created;
	Small business capital gains exclusion from taxation introduced;
	Tax credit allowed against alternative minimum tax for businesses claiming enterprise zone and/or Los Angeles revitalization zone tax credits;
	Sales tax exemption introduced for products used as poultry litter.
Connecticut	Employee training tax credit extended and increased;
	Corporation business tax credit for research and development[b] created;
	Tax credit for the purchase of capital goods by small and medium-sized businesses introduced;
	Corporate profits tax rate reduced.
Illinois	Business tax credits for manufacturing firms created (includes youth training tax credit, dependent care tax credit, and investment tax credit).
Massachusetts	Investment tax credit increased;
	Tax credit introduced for property used exclusively in a certified project within an economic opportunity area;
	Abandoned building tax credit created.
New Hampshire	Business profits tax rate reduced;
	Threshold for exemption from filing a tax return increased;
	Business profits tax credit created for business enterprise tax paid;
	Temporary capital expenditures tax credit created;
	Research and development tax credit created;
	Investment tax credit created;
	Three-year business transition tax credit for firms that have experienced losses in the last two years created.
North Carolina	Investment tax credit created.
Ohio	Tax credit for property used in manufacturing created.
Rhode Island	Surcharge on the corporate income tax repealed;
	Investment tax credit for manufacturers increased.
Vermont	New jobs income tax credit created;
	Manufacturer's investment tax credit created;
	Net operating loss carryback permitted;
	Special tax rate introduced for fuel used in manufacturing.

[a]Massachusetts' principal economic competitors, as identified by the Massachusetts High Technology Council, include Arizona, California, Connecticut, Illinois, Maine, Maryland, Michigan, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Texas, Vermont, and Washington

[b]The only non-incremental R&D credit in the nation.

Source: Commerce Clearing House (1993); *State Tax Notes* (various issues, December 1992 to present).

same characteristics exert no such effect.[8] Virtually all studies have found that factors other than taxes are more important determinants of where a business decides to locate and expand, including the cost of labor, the availability of labor with appropriate skills, regulatory burden, proximity to raw materials, proximity to markets, and climate. These findings have led some policy analysts to conclude that state and local policymakers worry about taxes too much.[9]

The Commonwealth should continue to be concerned about its tax competitiveness for at least two reasons, however. First, while tax characteristics may not significantly affect *interstate* locational choices, tax differences among municipalities clearly do affect site selection within a metropolitan area.[10] Parts of New Hampshire and Rhode Island lie on the fringes of the metropolitan areas of several Massachusetts cities. Large differences in state tax burdens between the Commonwealth and these neighboring states have driven both businesses and households over the border in the past.

Second, most studies have measured tax differences very broadly; few have focused on those interstate tax differences that should matter most to businesses according to economic theory. As discussed more fully below, this flaw can be attributed to the difficulty of constructing relevant measures of tax competitiveness from readily available data.

The Criteria of a Good Indicator of Tax Competitiveness

As argued elsewhere by the author (Tannenwald 1987b, 1993), business executives are primarily interested in making profits. Consequently, they are most concerned about those state and local taxes that impinge on the profitability of their firms. Examples include corporate income taxes, property taxes on industrial and commercial property, and sales taxes on business inputs.

Ideally, measures of tax competitiveness should capture the impact of state and local taxes on the long-run profitability of investment projects. When well-informed business executives weigh alternative sites for a facility, they are concerned about the tax burden that the facility will bear over its lifetime, not just during the first few years of its existence. Furthermore, they are interested in how taxes at all levels of government interact to affect their company's bottom line. For example, they should take into account the deductibility of state and local taxes from federal taxable income. A good indicator of tax competitiveness should take this feature into account, too.

Businesses are also concerned, although to a lesser extent, about the burden of state and local taxes paid mostly by individuals, as opposed to businesses, such as the personal income tax, residential property tax, and retail sales tax. Such taxes can indirectly affect a firm's bottom line by inducing workers to demand higher pre-tax rates of compensation. The extent to which employers must accede to these demands depends on the value and scarcity of workers' skills, the ease with which workers can migrate to sites with lower taxes, and the degree to which workers are aware that alternatives exist.

Workers who are well-informed and endowed with scarce, valuable skills tend to be highly compensated managers and professionals. These workers, including managers responsible for locational deci-

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[8] For example, Wasylenko and McGuire (1985) analyzed determinants of employment growth for 48 states between 1973 and 1980. They found positive, statistically significant relationships between the following tax variables and employment growth variables:

Tax Variable	*Employment Growth in:*
Changes in relative tax effort	Total employment Manufacturing Services
Effective personal income tax rate	Wholesale trade Retail trade Finance
Sales tax rate	Wholesale trade

Wasylenko and Carroll (1993) attempted to replicate Wasylenko and McGuire (1985), examining comparable data from 1981 through 1985. They found all of the above correlations to be statistically *insignificant* over the later time period, except for changes in relative tax effort and manufacturing employment. Taxes did not affect total employment growth in the updated version.

The inability of Wasylenko and Carroll to replicate Wasylenko and McGuire's results led Wasylenko and Carroll to attempt to replicate Helms's (1985) cross-section time-series study done for 1965–1979, which, according to Wasylenko, "yields the most consistent evidence to date that taxes affect economic growth" (Wasylenko 1992). Wasylenko and Carroll attempted to replicate Helms's results for 1967 through 1988. Wasylenko (1992) reported the following results of this attempt:

> We found that in most industry divisions the tax variables switched from being statistically significant in the 1960s and 1970s to being statistically insignificant in the 1980s. In particular, the significance of the tax variable coefficients for manufacturing changed to insignificant between 1983 and 1984, so that studies examining the pre-1984 period cannot be used to discuss the tax effects in the recent period (Wasylenko 1992).

[9] See, for example, Pomp (1987), McGuire (1993), and New York Legislative Commission on the Modernization and Simplification of Tax Administration and the Tax Law (1984).

[10] See Luce (1990), Summers and Luce (1987), McHone (1986), McGuire (1985), Charney (1983), Church (1981), and Wasylenko (1980). However, some studies have found that intrametropolitan tax differentials do not affect business locational decisions, for example, Bradbury, Downs, and Small (1982), and Grubb (1982).

sions, generally fall into the highest income brackets. Consequently, states concerned about their tax competitiveness should compare their average tax burden on well-to-do families with that imposed by competitor states.[11]

Finally, businesses must ultimately choose a municipality as well as a state in which to locate a facility. Businesses are therefore interested in how taxes affect their bottom line at alternative cities and towns, not alternative states. The business tax climate at alternative sites within a state can vary widely. Consequently, a good indicator of tax competitiveness should be capable of making intercity as well as interstate tax comparisons.

Why Useful Indicators of Tax Competitiveness Are Difficult to Construct

The statistics required to construct useful indicators of tax competitiveness are not readily available. Consider, for example, the data needed to assess the degree to which taxes imposed at various sites depress the long-run rate of return to investment projects, such as the construction of a new plant or office building. At a minimum, one would need information concerning the technological, financial, and geographic characteristics of a large sample of businesses and the investment projects that they typically undertake.[12] Acquisition of such information would be prohibitively costly and intrusive.

Business taxes as a percentage of business profits would serve as a crude proxy for the tax burden on business investment. However, the data needed to compute this percentage are not readily available either. State-specific (let alone city-specific) estimates of business profits are not made because a large portion of such profits are earned by multistate and multinational companies. Such companies are so thoroughly integrated that any method of dividing their profits geographically is necessarily arbitrary and imprecise.[13]

Even if profits could be divided geographically and reported jurisdiction by jurisdiction, collections of most state taxes are not reported at the municipal level. If they were, it would be difficult to distinguish state and local taxes paid by businesses from those paid by households. Many taxes, such as the property tax and general sales tax, are paid by both types of taxpayer. State and local governments generally do not publish the amount of sales tax and property tax paid by each type.[14]

If state-specific and city-specific ratios of business taxes to profits could be measured, analysts would have difficulty accounting for the "shifting" of these taxes. The burden of business taxes is ultimately borne by people. While the treasurer of a firm may write the check to the government for taxes owed, the actual burden of the taxes is borne by the business's owners (in the form of reduced after-tax profits), employees (in the form of reduced compensation), or customers (in the form of higher prices). The burden of a business tax, especially the property tax and corporate profits tax, may ultimately be spread across a broad spectrum of individuals residing in many different states (or nations) as households and businesses adjust their behavior to tax-induced changes in prices, rates of compensation, and rates of return. Who ultimately bears the burden of taxes on business property and corporate profits is one of the most contentious issues in public finance.[15] Most economists would agree, however, that the tax burden "sticks" far from where it "hits."

[11] In theory, employers could be equally or more concerned about the tax burden on workers from low- and middle-income households, since their compensation accounts for the bulk of labor costs. This would be possible even though such workers are generally easier to replace from local labor pools than high-income managers and professionals. However, based on discussions with many consultants who advise businesses on locational choices, the author believes that these choices are much more heavily influenced by the tax burden on high-income households.

[12] For example, in order to estimate how building a new factory would affect a manufacturer's federal, state, and local corporate income tax liability, one would need to know, among many other pieces of information, the mix of equipment, structures, inventories, and other assets owned by the manufacturer; the distribution of its payroll, capital stock, and sales among the states and between the United States and other countries; and the manufacturer's experience rating used in the calculation of its unemployment insurance tax liability.

[13] Despite these problems, at least two attempts have been made to estimate corporate profits on a state-by-state basis, one by the U.S. Advisory Commission on Intergovernmental Relations (1993, 1990), and one by Tannenwald (1987b). Both sets of estimates, however, are necessarily based on crude analytical techniques.

[14] One can crudely estimate the allocation of property tax revenues into their residential and nonresidential components if one has separate, state-specific or city-specific estimates of the value of residential and nonresidential property. Estimates based on such data are used in the estimation of the share of a state's taxes for which businesses are liable (see text, Section III). However, comparable state-specific estimates of the value of residential and nonresidential real property are reported only once every five years, with a two- to three-year lag, in the U.S. *Census of Governments*. Official statistics breaking down the value of each state's taxable personal property into its business and individual components are not collected at all.

[15] See McLure (1980) for an overview of views concerning the incidence of state corporate income taxes, and Aaron (1975) for a discussion of the incidence of property taxes.

Lack of available data has also hindered attempts to measure differences among states in the burden of state and local taxes on high-income households. Although many states have computerized files of individual income tax returns, these returns do not reveal the amount of state and local property, sales, and excise taxes paid by each income tax filer. Furthermore, tax officials do not require all sources of income to be reported.[16]

The burden of taxes imposed on households can be shifted, too. For example, the burden of a state's income and property taxes can be shifted through their deductibility from federal taxable income. The federal government recoups the tax revenue lost through the deduction by borrowing, cutting spending, or raising taxes elsewhere. As a result, part of the burden of state and local income and property taxes is borne by households throughout the nation. Section IV will present an indicator of tax competitiveness modified to take into account this particular form of shifting.

II. Some Commonly Cited, Misleading Indicators of Tax Competitiveness

Public officials, interest groups, and researchers have compared states' business tax climates with whatever imperfect data are available. Many of these widely circulated indicators of tax competitiveness are misleading. An analysis of each indicator's strengths and weaknesses is beyond the scope of this article.[17] This section briefly evaluates six of the most frequently cited measures, three indicating that Massachusetts' taxes are not competitive and three indicating that they are.

Three Indicators Showing That Massachusetts' Taxes Are Not Competitive

Statutory corporate tax rate. Some groups, contending that the Commonwealth's business tax climate is unattractive, point to its high statutory tax rate on corporate profits, the seventh highest among the 43 states with a corporate profits tax (Table 2). This indicator fails to take into account other taxes and fees paid by businesses, such as taxes on personal property and net worth, real estate taxes, license taxes, sales taxes on business inputs, and user charges. It also fails to take into account differences in the way in which states define taxable corporate income. Some states with a high statutory rate may define taxable profits narrowly, allowing relatively generous deductions and exclusions or granting generous credits against the tax.

Corporate income tax collections as a percentage of "business-related" income. Massachusetts ranked 12th according to this statistic in FY91 (Table 2). The principal problem with this indicator, apart from its focus on only one business tax, is that business-related income earned by a state's residents is unrelated to the business profits earned within the state's territory. A state's business-related income is the sum of the proprietors' income, dividends, rents, and interest received by its residents. Much of the underlying economic activity generating this income is not located in the state. For example, large mutual funds invest in enterprises operating throughout the world. Consequently, in any given year, the dividends received by Massachusetts residents from these funds can grow rapidly even if business profits earned within the Commonwealth are shrinking.

Revenue burden is a poor indicator of tax competitiveness because it fails to focus on those taxes, fees, and charges of greatest concern to business.

Personal income tax burden. Personal income tax burden is the ratio of state and local personal income taxes paid to statewide personal income. In FY91 the Commonwealth had the third highest personal income tax burden in the nation. While nationwide state and local personal income tax collections were 2.3 percent of personal income, in Massachusetts they were 3.9 percent. Only two of the Commonwealth's principal economic competitors, New York and Maryland, imposed a higher personal income tax burden (Table 3).

The income tax is only one of several taxes that households pay. Moreover, personal income tax burden does not necessarily reveal the income tax bur-

[16] Examples of income sources not reported on income tax forms include employer contributions to 401(k) plans, Individual Retirement Accounts, pension plans, medical insurance premiums, and employee contributions to 401(k) plans, health reimbursement accounts, and dependent care reimbursement accounts.

[17] A more extensive analysis is provided in Tannenwald (1993).

Table 2
State Tax Rates on Corporate Profits as of 2/1/93 and State and Local Corporate Tax Collections as a Percent of Business-Related Income, FY 1991

State	Highest State Tax Rate as of 2/1/93		State and Local Collections as a Percent of Business-Related Income, FY 1991	
	Percent	Rank	Percentage	Rank
Massachusetts	9.5	7	2.10	12
Other N.E.				
Connecticut	11.5	3	2.38	6
Maine	8.93	15	1.34	31
New Hampshire	8	20	1.91	15
Rhode Island	9	11	.98	39
Vermont	8.25	18	.95	41
Other High Tech				
Arizona	9.3	9	1.25	33
California	9.3	9	2.78	5
Maryland	7	27	1.09	36
North Carolina	7.75	25	1.90	16
Texas	X	X	.00	47
Washington	X	X	.00	47
Other Industrial				
Illinois	4.8	43	1.55	26
Michigan	X	X	4.28	2
New Jersey	9	11	2.13	10
New York	9	11	2.01	13
Ohio	8.9	16	1.95	14
Pennsylvania	12.25	1	1.76	19
All Other				
Alabama	5	38	1.26	32
Alaska	9.4	8	9.92	1
Arkansas	6	31	1.37	30
Colorado	5.4	37	.69	45
Delaware	8.7	17	3.35	4
District of Columbia	10	5		
Florida	5.5	36	.73	44
Georgia	6	31	1.66	23
Hawaii	6.4	30	2.20	9
Idaho	8	20	1.25	33
Indiana	3.4	45	1.47	27
Iowa	12	2	1.41	28
Kansas	4	44	1.69	21
Kentucky	8.25	18	1.67	22
Louisiana	8	20	2.23	8
Minnesota	9.8	6	2.27	7
Mississippi	5	38	1.83	18
Missouri	5	38	.24	46
Montana	6.75	28	1.74	20
Nebraska	7.81	24	.93	42
Nevada	X	X	.00	47
New Mexico	7.6	26	.93	42
North Dakota	10.5	4	1.64	24
Oklahoma	6	31	1.10	35
Oregon	6.6	29	1.07	37
South Carolina	5	38	1.40	29
South Dakota	X	X	.96	40
Tennessee	6	31	1.85	17
Utah	5	38	1.61	25
Virginia	6	31	1.02	38
West Virginia	9	11	3.50	3
Wisconsin	7.9	23	2.12	11
Wyoming	X	X	.00	47
Median	7.6		1.58	

X = Not applicable (state does not tax corporate profits).
Source: Commerce Clearing House (1993); US Bureau of Economic Analysis; U.S. Bureau of the Census.

den imposed by a state on its high-income households, a more important competitive consideration.

Three Indicators Showing That Massachusetts' Taxes Are Competitive

Revenue Burden. Perhaps the most widely cited indicator of a state's tax competitiveness is its revenue burden, the sum of its taxes, fees, and charges as a percentage of its personal income. In FY91, Massachusetts' revenue burden ranked 38th among the 50 states and compared favorably with those of its 17 principal economic competitors (Table 3).

While widely cited, revenue burden is a poor indicator of tax competitiveness because it fails to focus on those taxes, fees, and charges of greatest concern to business. By including all revenue sources in its numerator, the ratio provides no insight into the burden of either business taxes (which should estimate business taxes relative to profits) or of household taxes (which should estimate household taxes relative to household income.)

Property tax burden. Property tax burden is the ratio of statewide property tax collections to statewide personal income. Fifteen years ago, when the Commonwealth had one of the highest property tax burdens in the nation, the notion that the Commonwealth's property taxes are a competitive plus would have been considered impossible. Yet, in FY91 the Commonwealth's property tax burden ranked 11th when compared with those of its 17 principal competitors and was the lowest in New England by far. Nationally, the Commonwealth's property tax burden was less than 10 percent above the national

Table 3

Personal Income Tax, Property Tax, and General Own-Source State and Local Revenues per $1,000 of Personal Income, Fiscal Year 1991

	Personal Income Tax Revenues per $1,000 of Personal Income		Property Tax Revenues per $1,000 of Personal Income		State and Local Own-Source Revenues per $1,000 of Personal Income	
State	Amount	Rank	Amount	Rank	Amount	Rank
Massachusetts	38.74	3	36.08	21	144.31	38
Other N.E.						
Connecticut	5.54	41	43.72	12	130.21	47
Maine	26.95	15	45.64	10	157.07	22
New Hampshire	1.54	42	61.65	1	122.17	50
Rhode Island	22.25	29	45.78	9	146.83	34
Vermont	25.25	20	51.43	4	167.73	13
Other High Tech						
Arizona	20.04	32	39.92	14	169.87	10
California	26.55	16	30.67	29	158.73	21
Maryland	40.10	2	27.78	35	136.78	43
North Carolina	31.13	11	22.68	39	141.66	41
Texas	.0005	45	39.43	16	147.59	33
Washington	.00	46	32.08	27	162.83	17
Other Industrial						
Illinois	18.97	35	37.88	17	135.70	44
Michigan	23.89	23	47.92	8	161.49	19
New Jersey	17.02	36	48.97	7	142.11	40
New York	42.69	1	48.98	6	194.12	4
Ohio	31.44	10	30.43	30	146.12	36
Pennsylvania	22.67	25	29.10	31	134.08	45
All Other						
Alabama	19.36	33	11.00	50	145.26	37
Alaska	.00	46	57.53	2	523.91	1
Arkansas	22.88	24	16.54	46	133.71	46
Colorado	22.43	26	35.64	23	154.13	27
Delaware	34.32	8	14.94	49	166.11	15
Florida	.00	46	36.18	20	149.21	32
Georgia	25.53	19	29.04	32	150.74	30
Hawaii	36.30	5	20.32	41	188.83	5
Idaho	28.00	12	27.83	34	155.68	24
Indiana	25.88	17	33.23	25	149.85	31
Iowa	27.85	13	39.67	15	165.64	16
Kansas	19.27	34	37.74	18	151.81	29
Kentucky	35.30	6	17.71	45	157.06	23
Louisiana	12.56	39	18.31	44	176.81	8
Minnesota	35.09	7	37.53	19	184.32	7
Mississippi	13.88	38	25.83	37	154.43	26
Missouri	22.13	30	21.05	40	124.03	49
Montana	22.33	28	33.36	24	154.71	25
Nebraska	21.37	31	41.99	13	162.45	18
Nevada	.00	46	23.04	38	146.81	35
New Mexico	16.30	37	15.16	48	201.65	3
North Dakota	11.54	40	32.40	26	185.90	6
Oklahoma	24.69	22	16.11	47	160.20	20
Oregon	38.63	4	49.90	5	169.54	11
South Carolina	25.19	21	27.34	36	153.24	28
South Dakota	.002	44	36.07	22	142.22	39
Tennessee	1.19	43	19.96	42	129.63	48
Utah	27.61	14	28.45	33	166.43	14
Virginia	25.63	18	31.78	28	139.44	42
West Virginia	22.38	27	19.08	43	168.24	12
Wisconsin	33.79	9	44.41	11	170.27	9
Wyoming	.00	46	53.92	3	247.76	2
U.S. Average	22.71		34.88		155.38	
Median	23.38		32.81		154.57	

Source: U.S. Bureau of the Census (1993) and author's calculations.

median, ranking 21st among the 50 states (Table 3). The gap between the Massachusetts property tax burden and the U.S. median has narrowed steadily over the past 15 years, primarily because of Proposition 2½, the Commonwealth's formal property tax limitation (Commonwealth of Massachusetts 1986).

Business executives do not see all property taxes in the same light, however. They regard residential property taxes as a personal cost, diminishing their disposable income and that of their employees. Nonresidential property taxes are a cost of doing business that diminishes their firm's profitability. Consequently, the burden of residential property taxes is best estimated by dividing them by personal income, while the burden of nonresidential property taxes is best estimated by dividing them by profits. As discussed above, the data needed to construct these ratios are not readily available. Lumping all property taxes together and dividing them by personal income provides little useful information to executives trying to estimate the impact of these taxes on their firms' after-tax rate of return.

"Business's Share." Business's share is the percentage of total state and local taxes for which businesses, as opposed to individuals, are liable.[18] At just under 21 percent, the Commonwealth ranked 48th out of 50 states according to this statistic in 1990 (Table 4). Some public interest groups have erroneously concluded from this ranking that businesses are taxed lightly in Massachusetts and are not paying their "fair share" of the total tax bill.[19]

Both contentions indicate how widely this statistic is misunderstood. The share of a state's taxes collected from businesses has nothing to do with how heavily or how fairly the state taxes its businesses. Rather, this share is determined primarily by the characteristics of the state's economy, especially its labor intensity.

Labor is compensated primarily in the form of wages and salaries. Owners of capital are compensated for the use of their property in the form of profits. Consequently, wages and salaries are large

Table 4
Business's Share of State and Local Taxes, FY 1990, and Index of Tax Effort, 1988

	Business's Share as Percent of Total Taxes, FY90		Index of Tax Effort (National Average = 100), 1988	
State	Percentage	Rank	Value	Rank
Alaska	78.77	1	127	2
Wyoming	68.34	2	94	26
Montana	51.51	3	102	13
Delaware	45.71	4	84	44
Louisiana	44.08	5	90	35
Texas	42.81	6	88	40
West Virginia	42.62	7	88	40
New Hampshire	37.32	8	66	50
Kansas	36.62	9	104	11
Florida	34.51	10	82	48
Alabama	33.80	11	84	44
New Mexico	32.97	12	99	18
North Dakota	32.44	13	91	33
Tennessee	32.43	14	83	47
Connecticut	32.19	15	90	35
Mississippi	32.15	16	94	26
Oklahoma	31.95	17	89	37
Kentucky	31.91	18	88	40
Arizona	31.81	19	96	23
Nevada	31.21	20	69	49
Washington	31.02	21	102	13
Pennsylvania	30.95	22	97	21
South Carolina	30.50	23	96	23
California	30.09	24	94	26
New Jersey	29.52	25	101	16
Missouri	29.42	26	86	43
Illinois	29.25	27	102	13
Virginia	29.11	28	91	33
Michigan	28.73	29	112	5
Oregon	28.71	30	99	18
New York	28.53	31	152	1
Ohio	28.44	32	97	21
Colorado	28.42	33	89	37
Utah	28.23	34	106	9
Vermont	26.84	35	100	17
North Carolina	26.57	36	93	30
Indiana	26.19	37	93	30
Georgia	25.45	38	89	37
Maryland	25.42	39	108	8
South Dakota	25.35	40	95	25
Arkansas	24.38	41	84	44
Minnesota	24.22	42	112	5
Hawaii	24.12	43	112	5
Idaho	24.08	44	93	30
Rhode Island	23.73	45	104	11
Maine	23.23	46	105	10
Nebraska	21.03	47	98	20
Massachusetts	20.72	48	94	26
Wisconsin	20.37	49	119	3
Iowa	19.31	50	113	4
U.S. Average	30.31		100	
Median	29.47		94.5	

Note: ACIR (1990) describes tax effort as "the extent to which a state utilizes its available tax bases . . . Tax effort is determined by comparing a state's actual revenues with its estimated capacity to raise revenues. It is computed by dividing a state's *revenue per capita* (actual collections divided by population) by its *capacity per capita* and multiplying by 100. The result can be interpreted as the intensity with which a state uses its tax bases, relative to the national average of 100 (p. 13)."

Source: Tannenwald (1993); U.S. ACIR (1990).

[18] The methodology for estimating business's share was developed in 1981 by the U.S. Advisory Commission on Intergovernmental Relations (1981).

[19] For example, in a flyer supporting a proposal to require publicly traded corporations in Massachusetts to divulge publicly certain items from their state income tax return, the Tax Equity Alliance of Massachusetts asked:

> Business's share of all taxes collected in Massachusetts is low—49th of all 50 states (only Nebraska is lower). Why is corporate Massachusetts paying an ever-shrinking share of the pie, when the rest of us are paying more?

More on Business's Share of Taxes

The share of a state's taxes paid by businesses, as opposed to households, depends primarily on the labor intensity of the state's economy. It is also influenced by a state's per capita income, the importance of extractive industries to its economy, and the importance of agriculture.

1. *Business's share and per capita income.* Per capita income is negatively correlated with business's share. States with high per capita income have unusually rich personal income tax bases, giving them a high yield from any given income tax structure. Massachusetts ranks 5th in per capita income.

2. *Business's share and extractive industries.* The three states in which businesses pay the highest share of taxes by far are Alaska, Wyoming, and Montana (Table 4), each of which has an economy dominated by the extraction of fossil fuels. These states, as well as others rich in extractable natural resources, generate a large fraction of their revenue by levying severance taxes and property taxes on natural resources. The burden of these taxes is borne by energy consumers throughout the world, companies engaged in mineral extraction, or owners of mineral rights, not by business as a whole. In these states, business's share bears no relationship to how heavily the typical business is taxed. Massachusetts has virtually no capacity to impose severance taxes because it has practically no extractable natural resources.

3. *Business's share and agriculture.* Clear-cut exceptions to the rule that states with high business's share are capital-intensive lie outside the dotted oval in the upper-left and lower-right quadrants of Figure 1. Note that states outside the oval in the lower-right quadrant (high capital intensity, low business's share) are farm states. Modern agriculture is a relatively capital-intensive industry. State and local governments tend to tax farmers lightly because of the volatility of their income, the illiquidity of their assets, and their political clout.

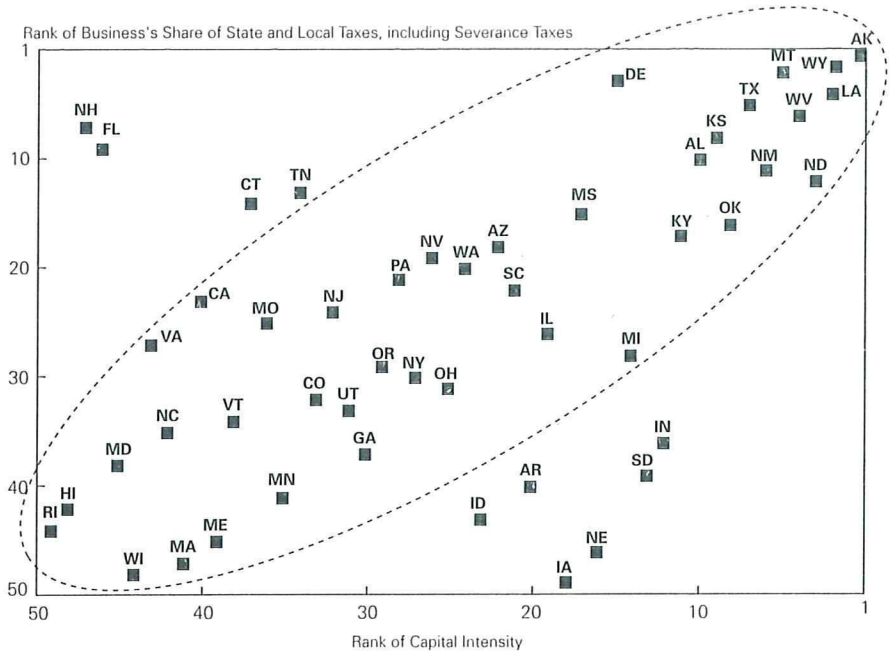
4. *Labor-intensive states with high business share.* The states lying outside of the dotted oval in the upper-left quadrant of Figure 1 (labor-intensive, high business share) are Connecticut, Florida, New Hampshire, and Tennessee. None of these states had a broad-based personal income tax in 1990. Until recently, Connecticut had a long-standing strategy of taxing personal income lightly in order to compete with New York, a state imposing the highest personal income tax burden in the nation, for both businesses and households within the New York City metropolitan area. New Hampshire's lack of either a broad-based income tax or a retail sales tax can be explained in part by a desire to compete with high-income-tax Massachusetts for residents and businesses within the greater Boston metropolitan area. Florida has rejected a broad-based personal income tax in part to compete for retirees.

5. *Summary of Factors Affecting Business's Share.* Labor intensity, per capita income, the importance of extractive industries, and the importance of agriculture explain almost 70 percent of the variation in business's share in FY90.[20] Massachusetts is a labor-intensive state largely devoid of mining, whose residents enjoy one of the highest average incomes in the nation. These factors, not how heavily or fairly business is taxed, are responsible for the small proportion of taxes paid by business in the Commonwealth.

6. *Further problems with business's share.* Estimates of business's share are necessarily imprecise because it is extremely difficult to divide revenues from some taxes into their business and household components. However, even if business's share could be clearly identified, business's share would still be a poor proxy for business taxes as a percentage of business profits. Most states that collect a high share of their taxes from businesses impose a low overall tax burden. The U.S. Advisory Commission on Intergovernmental Relations (ACIR) periodically compares states in terms of "tax effort"—the taxes they collect relative to the taxable resources at their disposal.[21] Among the 10 states with the highest business shares in 1990, eight had a tax effort at or below that of the median state (Table 4). In each of these eight states, businesses are paying a high share of a total tax bill that is low relative to the state's taxable resources. In these states, business taxes as a percentage of profits could be average or low, even though business's share of total taxes is high.

Figure 1

States Ranked According to Capital Intensity and Business's Share of State and Local Taxes, 1990



Source: Capital stock data – Munnell, Alicia H. "How Does Public Infrastructure Affect Regional Economic Performance?" *New England Economic Review*, Sept./Oct.1990, pp. 11-32; Employment data – U.S. Bureau of Economic Analysis; Business's share data – Appendix, Massachusetts Special Commission on Business Tax Policy, *Massachusetts' Tax Competitiveness* and calculations by staff of the Massachusetts Special Commission on Business Tax Policy.

relative to profits in a state with a labor-intensive economy. Furthermore, in such a state, the value of residential property is large relative to the value of nonresidential property, other things equal, because of the relatively small stock of plant and equipment. Taxes on profits and nonresidential property are the two largest state and local business taxes. Taxes on personal income (the most important component of which is wages and salaries) and residential property are two of the largest state and local taxes on individuals. Consequently, business's share tends to be high in capital-intensive states and low in labor-intensive states such as Massachusetts. The positive relationship between capital intensity and business's share is demonstrated in Figure 1 by the states falling within the dotted oval.

Other economic characteristics that influence business's share, as well as other reasons why it is a

[20] The regression equation demonstrating the explanatory power of these variables is:

$$BS = .0036(K/L) - .0006AGR + .0004SEV + .0000022PY + .1511$$
$$(3.67)^{**} \quad (-2.13)^{*} \quad (2.07)^{*} \quad (1.66) \quad (2.95)^{**}$$

Degrees of freedom: 44 $R^2 = .68$

Note: Numbers in parentheses are t-statistics

**Significant at the 1 percent level, two-tailed test

*Significant at the 5 percent level, two-tailed test

Variables

BS = Business's share of state and local taxes, FY90. See Tannenwald (1993, Appendix D) for method of calculation and sources of data.

K/L = Capital/labor ratio, 1990. See Tannenwald (1993, Appendix E) for method of calculation and sources of data.

AGR = Value of farmland per capita, 1990. Source: U.S. Advisory Commission on Intergovernmental Relations (1993).

SEV = Severance tax capacity per capita, 1988. Source: U.S. Advisory Commission on Intergovernmental Relations (1990).

PY = Personal income per capita, 1990. Source: U.S. Bureau of the Census (1993).

Number of observations: 49. (Alaska is excluded, because its estimated business's share is so extreme.)

[21] See note, Table 4, and U.S. Advisory Commission on Intergovernmental Relations (1990, 1993) for a further description of tax effort and related concepts, as well as a detailed explanation of how the Advisory Commission's index of tax effort is calculated.

poor indicator of tax competitiveness, are discussed in the accompanying Box.

III. The Representative Firm and Representative Household Approaches to Evaluating Tax Competitiveness

Given the difficulty of constructing indicators of tax competitiveness from available "hard data," public policy analysts should consider alternative strategies for evaluating their state's business tax climate. Two promising alternatives are the "representative household" and the "representative firm" approaches.

The Representative Firm Approach to Evaluating Tax Competitiveness

This approach enables policy analysts to view taxes paid by firms at alternative locations through the eyes of a profit-maximizing business executive in the process of choosing a site for a new facility. How would such an executive evaluate the "tax climate" at each site? Such an approach reveals the degree to which business taxes imposed at a given site depress the after-tax rate of return on marginal business investment projects.

In 1993, the Massachusetts Special Commission on Business Tax Policy used this approach to evaluate the competitiveness of several of the Commonwealth's cities.[22] Specifically, the Commission "located" hypothetical firms representative of selected manufacturing industries at five sites within Massachusetts, 10 sites in competitor states, and one fictitious site at which no state and local taxes are imposed.[23] It assumed that pre-tax rates of return and costs other than taxes were the same at each site. The Commission computed annual total local, state, and federal tax liabilities and the net after-tax cash flow of each firm 60 years into the future.[24] The Commission assumed that the pre-tax rate of return on all investments undertaken by the representative firms is 25 percent.

The Commission assumed that each firm builds a new facility at each of the 16 sites, including the firm's current site. This expansion requires the firm to invest in new equipment, structures, inventories, and financial assets and to hire more workers. As a result of the expansion, each firm makes larger profits and pays more taxes. By comparing after-tax cash flows before and after expansion, one can calculate the long-run rate of return of the new facility at each site for each representative firm. By assumption, differences across sites in rates of return reflect only differences in state and local tax burdens. (See Appendix I and S.H. Brooks Co. 1993 for methodological details.)

The measures generated by this approach meet most of the criteria of a good indicator of tax competitiveness. They take into account most business taxes and how they affect a firm's return on a project over the project's entire lifetime.[25] They also capture how taxes at all levels of government interact to affect a firm's bottom line. Finally, the approach permits comparisons of tax competitiveness across cities and towns, not just states.

Two empirical studies performed by Leslie Papke (1987, 1991) support this approach's validity. In both studies, Papke used the same methodology as the Special Commission on Business Tax Policy to measure the degree to which state tax structures depress the rate of return on marginal business fixed investment. Her 1987 study estimated the impact of this effective tax rate on the rate of capital formation within a state, while her 1991 study investigated its impact on business starts. She found both impacts to be negative and statistically significant.

The representative firm approach has its drawbacks. Even within a given industry, firms vary widely in asset mix, capital-labor ratio, geographic dispersion of factors of production, and other characteristics that affect state and local tax liability. No one firm is truly "representative" of the industry as a whole. In a similar vein, within a given state, municipalities, counties, and special districts vary considerably in the taxes they impose. Consequently, it is difficult to pick one city or town whose tax characteristics are representative of a whole state. However, the representative firm approach permits policy analysts to test the sensitivity of their results to varying assumptions concerning all of these variables.

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[22] The Commission hired Dr. Stephen H. Brooks to assist in this evaluation. Dr. Brooks had assisted the Massachusetts Special Commission on Tax Reform in a similar evaluation based on the representative firm approach. See S.H. Brooks Co. (1993) and Commonwealth of Massachusetts (1986).

[23] One site, Memphis, Tennessee, is located in a state not included in the list of Massachusetts' principal economic competitors compiled by the Massachusetts High Technology Council. However, Memphis is a competing location for clothing manufacturers, one of the industries included in the analysis.

[24] While a 60-year time horizon seems long, simulations assuming a 30-year time horizon produced similar results.

[25] Fees and charges are not taken into account, an omission that tilts the results against sites located in states (such as Massachusetts) that rely relatively lightly on fees and charges for revenue.

Table 5
After-Tax Rates of Return on New Facilities of Representative Firms at Selected Locations, for Selected Industries, Assuming Tax Laws in Effect as of January 1, 1993
Percent

	Apparel		Fabricated Metals		Computers		Electronics		Instruments	
Site of New Facility	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank
Bedford, MA	16.4	11	17.5	7	17.7	7	17.6	6	17.2	7
Chelmsford, MA	16.6	6	17.7	4	17.9	4	17.7	4	17.4	4
Foxboro, MA	16.5	7	17.6	5	17.8	5	17.7	4	17.4	4
Greenfield, MA	16.5	7	17.6	5	17.8	5	17.6	6	17.3	6
Waltham, MA	16.3	14	17.4	9	17.6	8	17.5	9	17.1	10
Average of MA Sites	16.5		17.6		17.8		17.6		17.3	
Los Angeles, CA	16.5	7	17.3	12	17.4	12	17.3	12	17.1	10
Stamford, CT	16.4	11	17.2	13	17.3	13	17.2	13	16.9	13
Rockford, IL	16.5	7	17.5	7	17.6	8	17.6	6	17.2	7
Hagerstown, MD	16.9	2	18.0	2	18.1	2	17.9	2	17.7	2
Nashua, NH	16.7	3	17.4	9	17.5	11	17.4	11	17.1	10
Poughkeepsie, NY	16.7	3	17.9	3	18.0	3	17.8	3	17.5	3
Greenville, NC	16.4	11	17.2	13	17.2	14	17.2	13	16.9	13
Lancaster, PA	15.8	15	16.7	15	16.8	15	16.8	15	16.5	15
Memphis, TN	16.7	3	17.4	9	17.6	8	17.5	9	17.2	7
El Paso, TX	17.5	1	18.4	1	18.5	1	18.4	1	18.0	1
"Tax-Free Site"	18.6		19.0		19.2		18.9		18.8	

Note: "Tax-Free Site" is a fictitious location in which no state and local taxes are collected.
Source: S.H. Brooks Co. (1993), Table 9.

One set of computations performed by the Commission using this approach is presented in Table 5. Each row in the table summarizes the results of a set of simulations in which one of the cities is assumed to be the site where the industry-specific representative firms expand. Each of the cities, including the assumed expansion site itself, is treated as an alternative pre-expansion site for the firms.[26] Consequently, 16 rates of return are calculated at each expansion site, one for each possible pre-expansion site. Each entry in Table 5 presents the average of the 16 rates of return computed at the expansion site for each industry-specific representative firm.[27] The higher the average rate of return, the lower the tax burden on the new facility.

The differences in return on assets (ROA) across sites shown are generally small. When the highest and lowest ROAs in each industry are thrown out, the range of ROAs is between 0.6 and 0.8 of a percentage point, depending on the industry analyzed.[28] The average ROAs at the Massachusetts expansion sites generally rank high. In the manufacture of fabricated metals, computers, and electronics, seven of the non-Massachusetts sites have a lower ROA and only three have a higher ROA. Interestingly, given New Hampshire's reputation as a low-tax state, in four industries at least four of the five Massachusetts sites have a higher average ROA than Nashua, the one site included in the sample from New Hampshire. The lower average ROAs at Nashua reflect the city's relatively high property tax.

[26] This is appropriate since, in making its tax system competitive, Massachusetts attempts to attract the investment of firms located at sites throughout the country (and, for that matter, the world).

[27] In theory, the dispersion across sites in the average rates of return presented in Table 5 could be biased downward by the disproportionately large representation of sites from one state (Massachusetts) in the 16-site sample. In fact, this dispersion is similar even when only one Massachusetts site is included, rather than five. Furthermore, the inclusion of a fictitious site that levies no state and local taxes ("Tax-Free") exaggerates the inter-site dispersion in average effective rates of return.

[28] There are two outliers: Lancaster, Pennsylvania and El Paso, Texas. El Paso always has the highest ROA (the lowest tax burden) because Texas is the only state represented among the sites that has no corporate income tax. The difference in ROA between these extreme cases varies between 1.6 and 1.8 percentage points, depending on the industry analyzed.

Two factors are primarily responsible for the favorable rankings of the Massachusetts sites. First, the Commonwealth's taxes on nonresidential property are relatively low. Second, its recently enacted 3 percent investment tax credit is a relatively attractive subsidy for purchases of plant and equipment. As can be seen in Table 1, however, many competitor states have also recently enacted attractive business tax credits, many of which will become effective over the course of 1994 and 1995. Consequently, the competitive advantage created by the Commonwealth's tripling of its investment tax credit will be narrowed.

Moreover, while the Commonwealth's investment tax credit boosts the relative ROAs at the Massachusetts sites, it does not significantly increase these ROAs in absolute terms. Simulations performed by the Commission indicate that the tripling of the Commonwealth's investment tax credit in 1993 from 1 percent to 3 percent raised the ROA at each Massachusetts site by about 0.2 of a percentage point. This small increase in ROA improved the ranking of the Massachusetts sites only because the variation in ROAs across sites is so small.

The Commission found that other cuts in the Commonwealth's business taxes would also exert small effects on the ROAs at the Massachusetts sites. For example, a reduction in the statutory corporate income tax rate from 9.5 percent to 7.5 percent, which would be widely viewed as a significant tax cut, would also reduce these ROAs by only an estimated 0.2 of a percentage point. This estimated impact is so small because state and local taxes generally account for only 1 to 2 percent of total business costs.[29] The small fraction of total costs accounted for by such taxes is reflected in the last row of Table 5. The row presents the results of simulations for "Tax-Free Site," the fictitious site at which no state or local taxes are collected. The ROAs at Tax-Free Site are only 1.3 to 2.1 basis points higher than the average for all of the Massachusetts sites.

The Representative Household Approach

In this approach, the hypothetical taxpayers whose tax burdens are compared across sites are households instead of businesses. Unlike approaches that rely solely on readily available aggregate data, this approach allows policy analysts to focus on the tax burden imposed by competing jurisdictions on high-income households.

Like the characteristics of "representative" firms, the characteristics of representative high-income households are difficult to identify. Nevertheless, policy analysts using the representative household approach can test the sensitivity of their results to modifications of assumed household characteristics. In many cases, varying these characteristics within reasonable ranges does not significantly affect estimated relative tax burdens borne by hypothetical households at alternative locations.

The best-known analysis utilizing the representative household approach, published annually by the Government of the District of Columbia (DC), compares the state and local tax liabilities of representative families of four residing in DC and the largest city of each state (Government of the District of Columbia 1993). DC performs such comparisons for representative families at four income levels: $25,000, $50,000, $75,000, and $100,000. Taxes taken into account include state and local personal income taxes, property taxes, general sales taxes, motor fuel taxes, motor vehicle registration fees, and motor vehicle excise taxes. These taxes account for over 75 percent of state and local tax collections nationwide.

Table 6 presents DC's 1992 results for its representative high-income family (annual income of $100,000), modified to eliminate some of the biases in DC's estimation procedure. (These biases are discussed in Appendix II.) The table takes into account the way that the burden of state and local personal income taxes and property taxes is lightened by their deductibility from federal taxable income.[30]

The dispersion across sites in household tax burdens is much greater than the dispersion across sites in business tax burdens reported in Table 5. At the site with the highest household tax burden (Bridgeport, CT), the representative high-income family paid 13.2 percent of its income in state and local taxes (Table 6, column 6). The comparable percentage at the site with the lowest household tax burden (Anchorage, AK) was 2.4 percent, almost 11 percentage points lower.

[29] This was the range suggested by consultants advising businesses interviewed by the staff of the Massachusetts Special Commission on Business Tax Policy. See Tannenwald (1993, p. 28).

[30] Federal taxpayers who itemize deductions may deduct their state and local income and property tax payments from federal taxable income. Since the representative high-income family is assumed to itemize and to be in the 28-percent marginal federal income tax bracket, each deducted dollar of state and local income and property tax reduces federal tax liability by $.28. The net burden of each deducted tax dollar is therefore $.72. In order to take deductibility into account, the representative household's income and property tax bills were therefore multiplied by 0.72.

Table 6

Estimated Burden of State and Local Taxes on Households for a Family of Four with an Annual Income of $100,000 in 1992

Rank	Largest City	State	(1) Income Tax	(2) Property Tax	(3) Sales Tax	(4) Auto Taxes	(5) Total Major Household Taxes: Amount[a] ($000)	(6) Total Major Household Taxes: Percent of Income
1	Bridgeport	CT[b]	3,240	6,018	1,596	2,359	13.2	13.2
2	New York City	NY[b]	6,641	1,556	2,655	199	11.1	11.1
3	Newark	NJ[b]	2,371	6,947	1,327	234	10.9	10.9
4	Providence	RI[b]	2,634	4,620	1,476	1,400	10.1	10.1
5	Detroit	MI[b]	4,643	3,624	949	342	9.6	9.6
6	Portland	ME[b]	4,073	2,404	1,567	1,397	9.4	9.4
7	Baltimore	MD[b]	3,948	3,896	1,231	358	9.4	9.4
8	Philadelphia	PA[b]	5,445	2,500	1,187	195	9.3	9.3
9	Milwaukee	WI	3,818	3,183	1,516	352	8.9	8.9
10	Washington	DC	4,879	1,321	1,786	331	8.3	8.3
11	Los Angeles	CA[b]	3,517	1,621	1,987	1,127	8.3	8.3
12	Columbia	SC	3,589	1,182	1,687	1,677	8.1	8.1
13	Boston	MA	4,142	1,734	1,213	987	8.1	8.1
14	Minneapolis	MN	4,213	1,398	1,543	885	8.0	8.0
15	Columbus	OH[b]	4,272	1,719	1,492	341	7.8	7.8
16	Omaha	NE	3,151	1,585	1,642	1,429	7.8	7.8
17	Louisville	KY	4,784	649	1,664	707	7.8	7.8
18	Honolulu	HI	4,923	1,125	1,173	524	7.7	7.7
19	Virginia Beach	VA	3,057	1,346	1,365	1,910	7.7	7.7
20	Atlanta	GA	3,012	1,478	2,021	1,136	7.6	7.6
21	Wichita	KS	2,935	1,246	1,516	1,874	7.6	7.6
22	Charlotte	NC[b]	3,704	1,076	1,839	848	7.5	7.5
23	Salt Lake City	UT	3,607	1,010	2,043	753	7.4	7.4
24	Portland	OR	4,826	2,064	0	275	7.2	7.2
25	Boise City	ID	4,244	803	1,701	343	7.1	7.1
26	Des Moines	IA	3,277	1,515	1,461	713	7.0	7.0
27	Charleston	WV	3,496	421	1,878	1,169	7.0	7.0
28	Denver	CO	2,797	1,080	2,000	1,062	6.9	6.9
29	Kansas City	MO	3,285	930	1,583	1,105	6.9	6.9
30	Burlington	VT[b]	3,441	1,865	1,282	268	6.9	6.9
31	Little Rock	AR	3,883	597	1,614	719	6.8	6.8
32	Oklahoma City	OK	3,505	611	1,843	778	6.7	6.7
33	Phoenix	AZ[b]	1,860	1,602	1,835	1,219	6.5	6.5
34	Chicago	IL[b]	1,740	2,002	2,043	390	6.2	6.2
35	Jackson	MS	2,467	880	1,576	1,228	6.2	6.2
36	Albuquerque	NM	3,256	954	1,669	269	6.1	6.1
37	Wilmington	DE	4,432	1,278	0	273	6.0	6.0
38	Indianapolis	IN	2,730	811	1,203	1,221	6.0	6.0
39	Birmingham	AL	2,387	503	2,246	725	5.9	5.9
40	New Orleans	LA	1,678	409	2,444	1,124	5.7	5.7
41	Billings	MT	3,286	1,113	0	1,156	5.6	5.6
42	Manchester	NH[b]	0	4,549	0	841	5.4	5.4
43	Sioux Falls	SD	0	1,448	1,943	1,809	5.2	5.2
44	Fargo	ND	1,740	1,228	1,593	327	4.9	4.9
45	Seattle	WA[b]	0	1,332	1,992	1,311	4.6	4.6
46	Las Vegas	NV	0	1,327	1,679	1,097	4.1	4.1
47	Houston	TX[b]	0	1,618	1,930	363	3.9	3.9
48	Jacksonville	FL	0	1,863	1,644	295	3.8	3.8
49	Memphis	TN	0	426	2,305	417	3.1	3.1
50	Cheyenne	WY	0	603	1,287	1,006	2.9	2.9
51	Anchorage	AK	0	2,226	0	168	2.4	2.4

[a]Sum of (1) + (2) + (3) + (4).

[b]One of Massachusetts' principal economic competitors, as identified by the Massachusetts High Technology Council.

Note: The figures in columns (1) and (2) equal the representative family's estimated personal income and property tax liabilities, respectively, multiplied by 0.72 to reflect 1) the fact that state and local income and property taxes are deductible from federal taxable income and 2) the assumption that the representative family's marginal federal tax rate is 28 percent. Consequently, taxpayers who itemize their deductions on the federal return bear a net burden of only $0.72 on every dollar of state and local personal income or property taxes paid. Although some state and local automobile taxes (motor vehicle excise taxes based on the value of the automobile) are also deductible from federal taxable income, the figures listed in column (4) do not take such deductibility into acount.

Source: Government of the District of Columbia (1993); Case and Cook (1989); and author's calculations. See Appendix II for the methodology used to estimate housing values underlying estimates of property taxes in column (2).

When residing in Boston, the representative high-income household bore a high state and local tax burden relative to that borne at most of the 50 other sites. The household's tax burden in Boston, almost 8.1 percent of income, ranked 13th and was 1.1 percentage points above the median (at Des Moines, IA). Boston ranked high for two reasons: 1) its housing is expensive, forcing its homeowners to spend a large fraction of their income on property taxes, and 2) Massachusetts imposes a high personal income tax burden.

In general, Massachusetts should feel fairly comfortable about its tax competitiveness.

However, Boston stood 10th among the 18 cities when ranked along with the largest city of each of its 17 principal competitor states. In general, Boston compared favorably with cities in other industrial and New England states but unfavorably with cities in other high tech states. The high-income family's tax burden was significantly higher in Boston than in several competitor sites, including Phoenix, Arizona; Chicago, Illinois; Manchester, New Hampshire; Seattle, Washington; and Houston, Texas.

The implications of the DC study for Massachusetts' tax competitiveness, as opposed to Boston's, should be drawn cautiously. If DC had used a sample of municipalities other than the largest city in each state, Massachusetts might compare less favorably with its rivals than does Boston in Table 6. The reason is that, in many states other than the Commonwealth, the local tax burden on households is significantly lower outside the state's largest city than within it. In these states, municipalities have the option of supplementing their property tax revenues by imposing local income, payroll, and sales taxes. Frequently, a state's largest city imposes these taxes at higher rates than most other municipalities in the state. Detroit, New Orleans, and Philadelphia are cases in point.

In Massachusetts, by contrast, the only broad-based tax available to Boston, or, for that matter, any other municipality, is the property tax. Boston's lack of broad-based tax options limits its capacity to impose higher taxes than other cities and towns within its state. The relatively small portion of the total state and local tax revenues collected at the local level in Massachusetts further limits the difference between the state and local tax burden on Boston's households and the comparable burden on households residing in other municipalities within the Commonwealth.

IV. Summary

In general, Massachusetts should feel fairly comfortable about its tax competitiveness. Its tax system is not a major competitive liability, inducing a large number of business firms to pass up the Commonwealth's cities and towns for sites in other states. Factors other than the Commonwealth's taxes, such as its high cost of labor and health care, its harsh climate, and its distance from important, growing consumer markets in the Southeast and Southwest, are more significant drawbacks.

The Commonwealth's relatively heavy tax burden on high-income households is a mildly anti-competitive feature of its tax system. These households include among their ranks many well-informed professionals and business managers possessing scarce, valuable skills, who can raise the costs of doing business at a site by demanding compensation to offset high personal taxes.

Appendix I

More on the Methodology Used in the Representative Firm Approach

This methodology is set forth in detail in S.H. Brooks Co.(1993). The first step is to construct a mix of assets for each representative firm based on published industrywide data. Each asset type is assigned an economic service life and is assumed to depreciate in a straight line. Based on this information, one calculates the constant-dollar fraction of the initial capital stock of each asset type that must be purchased each year in the steady state to maintain the capital stock's constant-dollar value. Each asset type is assigned a vector of price deflators, which are used to determine the current-dollar investment streams needed to maintain the constant-dollar value and the current-dollar value of the capital stock in each year.

It was assumed that in each year the rate of return on the capital stock, net of economic depreciation but before taxes, is 25 percent. With the exogenous variables assumed and endogenous variables calculated up to this point, one can apply federal, state, and local tax laws to determine the stream of cash flow in each year under the assumption that no expansion takes place. In each year, cash flow takes into account after-tax returns to investment as well as the cost of the investment. The whole exercise is repeated assuming

that the representative firm expands by 10 percent but maintains the same mix of capital by asset type.

The figures reported in Table 5 are the internal rates of return to the new investment stream, which includes both the initial investment and the stream of investment needed to maintain the initial investment's constant-dollar value.

This internal rate of return, r, is calculated according to the following formula:

$$E^0 = \frac{[C^{1n} - C^{1o}]}{[1-r]^1} + \frac{[C^{2n} - C^{2o}]}{[1-r]^2} + \cdots + \frac{[C^{60n} - C^{60o}]}{[1-r]^{60}}$$

where: E = the investment representing the expansion (assumed to to take place in year 0)
C^n = the cash flow assuming no expansion
C^o = the cash flow assuming expansion takes place.

Appendix II

Methodology for Estimating Residential Property Values of Representative High-Income Households Used in DC Study and the Computations Reported in Table 6

The methodology used in the DC study consists of the following two-step procedure:

1) The city's median housing value, as reported from the latest decennial Census of Housing, is divided by its median family income, as reported in the latest decennial Census of Population.

2) The resulting ratio, Q, is reduced by 5 percent to arrive at the ratio of housing value to income for the representative high-income household in each city. This adjustment reflects the assumption that high-income households allocate a smaller percentage of their income to housing than the median household.

Note that DC uses the ratio of median housing value to the median income of all families—renters as well as homeowners—as the benchmark for the housing-to-income ratio of the representative high-income family in each city. However, these families are assumed to own their own home. A more relevant benchmark, therefore, would be the ratio of median housing value to the median income of homeowners. In most cities, the median family income of homeowners is considerably higher than that of renters. In 1989, for example, the median income of homeowners in Boston city proper was $41,741, while the median income of renters was $20,918 (U.S. Bureau of the Census and U.S. Department of Housing and Urban Development 1991). DC's estimated ratios of housing value-to-income are therefore biased upward.

Other things equal, this bias should be less severe in cities with a relatively high incidence of owner-occupancy of homes. In such cities, the median income of homeowners is likely to be closer to the median income of all families. According to the *Annual Housing Survey* (U.S. Bureau of the Census and U.S. Department of Housing and Urban Development 1991), 31 percent of Boston's housing units were owner-occupied in 1989, far lower than the 49 percent average for central cities throughout the nation. In fact, Boston had the lowest incidence of owner occupancy among the 11 cities singled out for in-depth analysis in the 1989 American Housing Survey for the United States (Table A-1).

Table A-1
Owner and Renter Occupancy of Year Round Housing Units in 1989, for 11 Central Cities

Central City	Total Occupied Housing Units (000)	Owner-Occupied Units as a Percent of Total	Renter-Occupied Units as a Percent of Total
Boston, MA	229.2	31.1	68.9
Dallas, TX	380.6	46.3	53.7
Detroit, MI	385.6	57.4	42.6
Fort Worth, TX	167.1	58.5	41.5
Los Angeles, CA	1195.5	40.6	59.4
Minneapolis, MN	156.8	52.7	47.3
Philadelphia, PA	607.0	64.8	35.2
Phoenix, AZ	312.7	56.7	43.3
San Francisco, CA	309.8	34.7	65.3
Tampa, FL	115.2	54.3	45.7
Washington, D.C.	249.8	38.7	61.3

Source: U.S. Bureau of the Census, Annual Housing Survey Division.

Consequently, the upward bias in the estimated property values of Boston-based households is especially severe.

A second source of bias that tilts the DC study against Boston is its failure to take into account the deductibility of state and local personal income and property taxes from federal taxable income. As noted in footnote 30, each deducted state and local tax dollar reduces the federal taxes of a household in the 28-percent federal marginal tax bracket by 28 cents. The net burden for such households of each dollar of state and local income or property tax paid is therefore 72 cents. Massachusetts relies more heavily on income and property taxes than most states. Consequently, failure to take the deductibilty of these taxes into account is another source of upward bias in DC's estimates of the relative tax burden borne by Boston-based households.[31]

[31] By contrast, DC's procedure for estimating the 1991 value of residential real estate owned by representative high-income households in alternative cities produced an estimate for Boston that was biased downward. The latest decennial Census data available in 1991 were for 1980. Since 1980, the ratio of median housing value to median family income in Boston has risen much more rapidly than in the nation as a whole. Therefore, using the 1980 ratio of median housing value to median family income as a benchmark imparted a downard bias to the estimate of real estate prices in Boston in 1991. As a result, the 1991 property tax bill of the representative high-income family in Boston ranked 48th out of 51 cities. The total tax burden on Boston's high-income household ranked 26th among all cities. Nevertheless, Boston's ranking with respect to its principal economic competitors was similar in 1991 and 1992. Whereas in 1992, Boston ranked 9th out of 18, in 1991 it ranked 7th. As in 1992, Boston compared favorably with the majority of other New England states and industrial states, but ranked above the median for high tech states.

The Modified DC Methodology Used in the Preparation of Table 6. The methodology used in Table 6 modifies that used in the DC study to eliminate these two sources of bias. In each city, the value of residential property owned by the representative high-income household was assumed to equal 1.885 × the city's median housing value, as reported in the 1990 U.S. Census of Population. The assumed 1.885 ratio was derived from Case and Cook (1989). Case and Cook arrayed all homeowners residing in the Boston Metropolitan Statistical Area from lowest to highest family income. The median income of all families in the ninth (second-to-highest) decile was $95,287, close to the $100,000 income of the representative high-income households used in the DC study. The median housing value of families in the ninth income decile was $318,000. In the tenth income decile (the highest), the median family income was $224,000 and the median housing value was $720,000. The housing value of a family with an income of $100,000, H($100,000), was estimated by interpolating as follows:

$$H(\$100{,}000) = \$318{,}000 + (\$100{,}000 - \$95{,}287) \times (\$720{,}000 - \$318{,}000)/(\$224{,}000 - \$95{,}287) = \$332{,}720$$

The median housing value in the Boston Metropolitan Area in 1987 was $176,500. $332,720/$176,500 = 1.885. For each city in the DC study, this ratio was assumed to equal the ratio of the median housing value in the city to the housing value for the representative high-income household residing in that city.

In Table 6, the deductibility of state and local personal income and property taxes has been taken into account by multiplying the representative high-income household's income tax and property tax liabilities by 0.72. This fraction was chosen because the household is assumed to itemize its deductions and to be in the 28 percent federal marginal income tax bracket.

Despite these modifications, Boston's ranking in the DC study is not that different from its ranking in Table 6. In the unmodified DC study, the Boston household ranks 10th out of the 51 cities in the sample, and 9th out of the 18 cities located in either the Commonwealth or one of its principal rival states. As in the modified results reported in Table 6, Boston compares most favorably with the largest city of other New England states and least favorably with the largest city of other high-tech states.

Failure of DC Study to Take User Charges into Account. A third source of bias in the DC study that works to Boston's disadvantage, although not corrected for in Table 6, is its failure to take into account the fees and charges paid by representative households residing in each city. In 1991 Massachusetts' state and local fees and charges as a percentage of personal income ranked 49th out of the 50 states and the District of Columbia, and 16th when compared with its 17 principal rival states (U.S. Bureau of the Census 1993). Boston would compare more favorably with other cities in the DC study if fees and charges were taken into account.

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School District Spending and State Aid: Why Disparities Persist

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Most decisions about the level of local public school spending are made by local school districts. The choices they make are conditioned by local resources—which means rich districts typically spend more per pupil than their poorer neighbors—as well as by the availability of external funds. State governments are by far the largest "external" source of funds, providing about half of all public school dollars nationwide. One of the major purposes of this substantial state aid is to further the goal of equal educational opportunity by helping to make spending more equal in rich and poor districts.

State governments encourage equal spending among local districts by designing the formulas that distribute their aid funds in such a way that they provide both money and incentives for poorer districts to spend more than they otherwise would, while providing less of a subsidy for richer districts' school spending. Poor districts also typically tax themselves at higher rates to support schools. Nevertheless, in most states and certainly in the New England states (see Bradbury 1993 for documentation), rich districts still average noticeably higher spending per pupil than poor districts.

This article investigates the link between school spending disparities and school aid. It addresses the question of whether inequality in spending persists because the "incentives" embedded in the aid formulas are ineffective, because localities respond in perverse ways to the incentives, because insufficient funds are channelled into aid, or because of other factors not related to aid.

Part I describes the factors and forces, including school aid, that help to determine local public school districts' spending levels. Part II uses regression analysis to sort out the importance of various factors associated with interdistrict variations in per pupil school spending in two of the New England states—Massachusetts and Rhode Island. These two states represent the two basic approaches to distributing school aid that are used by state governments nationwide. Part II also

indicates what the regression results imply about the degree to which current aid distributions reduce interdistrict spending disparities. Part III then examines recently enacted legislation for school finance reform in Massachusetts, investigating its likely impact on intrastate school spending disparities. Part IV offers conclusions.

I. The Determinants of Local School District Spending

An extensive economics literature has examined the determinants of school spending per pupil. This earlier research suggests that, in deciding how much to spend, decisionmakers in local school districts consider the quality of education they (and the residents they represent) would like to provide, the costs of providing it, and the resources available to finance the spending. In this local decisionmaking context, states' use of aid dollars (to help shape local outcomes) rather than spending mandates (to require certain local outcomes) can be seen as an attempt to honor the differing preferences or desires of district residents, while offsetting or minimizing the influence of resource differences and, in some states, cost differences.

Preferences and Institutions. Local voters' preferences regarding desired educational output (quantity and quality of schooling) in their district do not directly determine school spending. Those preferences are filtered through the local political or electoral institutions that approve school budgets.

Parents' support for education varies among school districts, as does the fraction of voters who are past, present, or future public school parents.[1] In some districts, voter approval of school board or school committee budgets is needed; in others, voters elect those school officials, but do not directly review their budget decisions.[2]

Costs. Any desired educational output requires different amounts of per-pupil spending when local production costs differ. These costs vary for several reasons, including input price variations (for example, inter-area wage differences), possible economies of scale, and different student characteristics that make it more expensive to educate some students (for example, bilingual pupils or those with special needs) to any specific attainment level.

Resources. The local resources that can be tapped for schools vary considerably across school districts in most states. These variations are largely attributable to differences among districts in the amount of taxable property per pupil, since most school systems rely heavily (if not exclusively) on property taxation for locally raised funds.

Locally available school revenues also reflect variation in the bases of non-property taxes, if any, used for schools, and explicit tax or spending limitations. Furthermore, the resources available for schools depend on nonschool public demands on the local tax base as well as private demands on taxpayer resources. For example, two property-tax-dependent communities with identical property values per pupil may not raise the same school revenue per pupil because of heavy commuter demands for police and highway services competing for revenues in one, or higher resident incomes (making it easier for them to pay any given property tax bill) in the other.

States' use of aid dollars rather than spending mandates can be seen as an attempt to honor the differing preferences of district residents, while offsetting resource differences.

In addition to local resources, federal and state aid dollars are available to support local schools. Some of these funds are earmarked for specific purposes, such as transportation, school construction, or teachers' pensions, or for specific student populations; others can be pooled with general school revenues. Most states distribute the bulk of school aid funds through "equalization" formulas that provide general-purpose money to school districts in inverse relation to local wealth or revenue-raising ability and in proportion to the student population. The measure of student population is sometimes "weighted" to incorporate cost or need factors.

Although school aid funds must be spent on schools, districts can implicitly divert some of the revenue to other public or private purposes by choos-

[1] Note also that parents' desires are often constrained by their own and their neighbors' ability to pay, as discussed below, but a distinction is being made here between their "tastes" and what their resources allow their "effective demand" to be.

[2] Tax or spending limitation measures may further influence such votes or budgeting; these, however, represent another form of resource constraint and will be discussed below.

ing to raise less money for schools from local sources than they would in the absence of the aid. Poorer districts, for example, may use some of the aid to reduce their "excess" tax burdens; as noted earlier, their tax rates are typically higher than those in richer districts.

The manner in which resources affect spending decisions is conditioned, in some cases, by the way the funds are made available, in particular, the "price" the district's residents "pay" to receive them. For example, some states distribute their basic equalizing aid through matching formulas that provide a certain number of cents for each dollar the district raises locally, with the number of cents—the matching rate—being higher for poor districts than rich districts. In the presence of such aid, districts, especially those with high matching rates, may decide to spend more because state aid covers part of each additional dollar of spending. Similarly, if the fraction of a district's property taxes "exported" outside the district is high because of the presence of commercial or industrial property or seasonal residents, local residents are likely to vote for higher spending, other things equal, because they believe they pay a smaller fraction of each additional dollar.

II. Explaining Disparities in School Spending in Two New England States

The previous section outlined the factors that help to determine the amount each school district decides to spend per pupil. A district's choice reflects the interplay of local preferences, costs of producing educational services in the local market, and the internal and external resources available to finance school spending, including school aid. The next subsection attempts to quantify the importance of each of these factors in determining school spending outcomes in Massachusetts communities. The following subsection focuses on school aid, analyzing and interpreting its role in the local school spending decision. The exercise is then repeated for Rhode Island, where the basic school aid formula matches local spending rather than being invariant to spending, as in Massachusetts.

Estimated Equations: Massachusetts

Table 1 reports the estimated effects of a wide variety of factors on school district operating spending per pupil, based upon data for school districts in Massachusetts for the school year 1990–91, the latest year for which complete data are available. In Massachusetts, the basic unit of all local government, including schools, is the municipality; the entire area of the state is divided among 351 cities and towns. For purposes of this analysis, therefore, the individual observations are cities and towns, and communities that are members of regional school districts have their proportional share of that district's enrollment, spending, and aid figures attributed back to them.[3]

Column (1) of Table 1 reports results when total operating spending per pupil is the dependent variable; these are discussed immediately below. Column (2) replaces total operating with instructional spending per pupil; differences between the operating and instructional results are summarized later. Overall, the explanatory power of the equations is high for a cross-sectional analysis. Most of the variables included in the equations have the expected effects on school spending.

Resources. The results indicate that available resources are a very important determinant of school spending. The size of the property tax base, amount of resident income per capita, and the amount of state aid for schools (other than school construction aid) and for municipal purposes all contribute to greater per pupil spending. These variables obtain estimated coefficients that are positive and significantly different from zero with greater than 99 percent confidence.[4] By contrast, the estimates indicate no significant effect on school operating spending of federal school aid or of state aid for school construction.[5]

Communities with greater ability to export property taxes to nonresidents (as measured by the frac-

[3] Sixteen communities were dropped from the analysis because of townwide enrollments below 100 and 13 were dropped on account of missing or imperfect data, bringing the total included in the analysis to 322. A majority (173) of the 322 communities operate their own dependent school district. Eighty-four of the 322 communities have banded together to form regional high school districts, while providing elementary education locally; 65 other towns are members of regional K–12 districts. Communities participating in regional school districts are assumed to spend (per pupil) what the regional district of which they are a member spends, and similarly are assumed to receive their pro-rated share of the regional district's school aid. Their "share" depends on their fraction of the regional district's enrollment, which also determines their contribution to the regional district's budget. All nonschool variables are measured for each community individually.

[4] Theory suggests resident income has two kinds of effect on school spending: its strong coefficient probably reflects an element of preferences as well as available resources.

[5] The school construction aid finding is not surprising since construction aid represents reimbursements from the state for prior years' construction expenditures, which are not part of operating spending, even contemporaneously.

Table 1
Per-Pupil School Spending Regressions: Massachusetts
Table entries are estimated coefficients and standard errors; the latter are in parentheses.

Explanatory Variable	Dependent Variable: Spending Per Pupil		Explanatory Variable	Dependent Variable: Spending Per Pupil	
	Total Operating (1)	Instructional (2)		Total Operating (1)	Instructional (2)
Constant	2449***	2003***	*Indicators of Costs:*		
	(898)	(579)	Average annual wage at all establishments ($000)	5.96	10.6***
Measures of Resources:				(5.81)	(3.8)
Income per capita, 1989 ($000)	86.6***	41.9***	Log of number of students	−233***	−130***
	(7.8)	(5.0)		(38)	(24)
Equalized property tax base per pupil ($000)	.992***	.665***	Enrollment growth, 1986–91 (percent change)	−4.43*	−2.94**
	(.096)	(.062)		(2.29)	(1.48)
Nonresidential property tax share	1354***	586***	Special education students (percent of all students)	13.6	10.5
	(248)	(160)		(16.6)	(10.7)
City or town at Prop 2½ levy limit for at least 3 years	−116**	−53.3	Bilingual students (percent)	38.4**	32.6***
	(55)	(35.3)		(15.2)	(9.8)
Federal aid per pupil	.110	−.142	Occupational day students (percent)	1.75	−2.83
	(.298)	(.192)		(11.6)	(7.49)
State school construction aid per pupil	−.0123	−.135*	Residential students (percent)	201	101
	(.115)	(.074)		(202)	(130)
State non-construction school aid per pupil	.227***	.0946**	Low-income students (percent)	−20.2**	−12.0**
	(.057)	(.0370)		(8.3)	(5.37)
State municipal aid per pupil	.415***	.237***	Pre-kindergarten and kindergarten students (percent)	25.8*	8.11
	(.056)	(.036)		(14.3)	(9.22)
Measures of Preferences and Institutional Factors:			Grades 5–8 students (percent)	6.15	−9.93
Town is member of regional K–12 district	−130	−93.9		(14.8)	(9.54)
	(102)	(65.5)	High school students (percent)	44.3***	28.1***
Town is member of regional high school district	148**	58.8		(10.3)	(6.7)
	(73)	(47.2)			
Percentage of households with school-age children	−12.9*	−2.77	R-squared	.80	.79
	(7.6)	(4.90)	Adjusted R-squared	.79	.77
Percentage of resident children attending private schools	.304	−5.59*	Number of observations	322	322
	(4.94)	(3.19)	F-statistic	50.8	45.7
Percentage of population age 65 and older	−4.84	2.44	Mean of dependent variable	4,973	3,205
	(10.6)	(6.84)	Standard error of regression	409	264

*Significantly different from zero with better than 90 percent confidence.
**Significantly different from zero with better than 95 percent confidence.
***Significantly different from zero with better than 99 percent confidence.
Note: Dependent variables are for school year 1990–91; explanatory variables refer to school year 1990–91 or to fiscal year 1991 unless otherwise noted.
See Appendix A for variable definitions and means.

tion of the property tax levy falling on nonresidential property) also appear to spend more on schools, indicating some degree of "price" response. And communities severely constrained by Proposition 2½ (Massachusetts' property tax limitation measure), spend significantly less on schools than less constrained districts.[6]

Preferences and Institutional Factors. The estimated coefficients on the variables measuring preferences and institutional factors are more mixed; these variables are generally less important than resources in determining school spending. Communities that are members of a regional high school district appear to spend more per pupil than communities providing

local schools. Whether this difference results from the loosened political control of each individual member community on the group outcome or from cost factors cannot be determined. But regional K–12 districts do not spend significantly more or less per pupil than local K–12 districts.[7]

The percentage of households with school-age children obtains an unexpected negative sign. The political process would be expected to lead to a positive effect, the argument being that if more voters care about the schools, they will be able to muster more political clout to keep public school spending up. But the estimated negative sign suggests the variable is playing the role of a resource measure: if more of a community's households have children, the school resources are spread more thinly. By contrast, the fraction of the population that is elderly has no effect on operating spending, and neither does the fraction of the community's school-age children attending private schools. Voter self-interest would lead one to expect these variables to exert a negative influence on per-pupil public school spending.

Costs. The cost factors show most, but not all, of the expected effects on school spending. The measure of wages in the local labor market obtains a positive coefficient, but it is statistically indistinguishable from zero. The student count suggests that economies of scale are operative over the relevant range of district sizes.[8] The estimated coefficient on enrollment growth indicates that districts with growing enrollment spend less per capita than stable districts, while districts with declining enrollment spend more. This result suggests that spending adjustments take time when the number of students changes, that is, total spending (not per student) displays some inertia, perhaps because staff-to-student ratios shift in the short run before hiring or reducing staff can occur.

Another important element of school costs is the mix of students served by the school district, and any special programs or educational approaches they may require (or the state may mandate). Two sets of student mix variables were included in the equation: (1) grade mix and (2) student groups believed to be more costly to educate (as reflected in the Massachusetts school aid formula, which weights these students more heavily in distributing aid). The latter categories include special education students (day and residential), bilingual students, occupational students (taking vocational courses in a regular or vocational high school), and students from low-income families.

The regression estimates indicate that districts with a greater fraction of special education or occupational day students do not spend significantly more per pupil than districts with fewer of these students, other things equal, but communities with more bilingual students typically do spend more. The low-income fraction of students obtains a negative coefficient that is significantly different from zero, probably indicating that this variable is picking up an aspect of resource availability rather than testing the hypothesis that poor children are more costly to educate.

It is generally believed that more money is spent per pupil on high school students than on elementary students, and that kindergartners cost less to educate, largely because they receive fewer hours of schooling per day and hence less teacher time. The estimates in Table 1 are consistent with the former hypothesis, but not the latter. Districts with a greater fraction of students in high school do spend more per pupil, and districts with a greater fraction of students in pre-kindergarten and kindergarten also appear to spend more, other things equal.

Instructional Spending. Column (2) in Table 1 reports a similar regression with *instructional* spending per pupil, rather than total operating spending per pupil, as the dependent variable. Because instructional spending is a subset of operating spending, the coefficients are generally smaller in magnitude, but otherwise the results are similar to those reported for total operating spending, with a few exceptions.

[6] The equation includes a dummy variable equal to 1 for communities with property tax levies within 0.1 percent of their levy limit in all three fiscal years, 1989–91. The levy limit is the maximum amount the community is allowed to raise under the rules of Proposition 2½, unless the voters pass an override, which raises the levy limit. Since the levy limit rises only 2.5 percent per year plus an allowance for new growth, a community is likely to be cutting or limiting the growth of all "controllable" elements in the budget after three or more years of bumping against the limit.

[7] Regionalization is intended to provide these smaller towns with the economies of scale available to local schools in the Commonwealth's medium-sized and bigger communities; this coefficient estimate may indicate success along that dimension. That is, in the absence of the regional district, these communities might well spend more because they are small.

[8] The logarithm form indicates that the cost savings from adding another child are greater at smaller sizes than in the biggest districts. Note also that just as the regional district dummy variables may be picking up cost elements as well as voting behavior, this size coefficient could also indicate that bigger cities have greater difficulty mustering support for school spending.

Most striking is that average wages in the local community have a significant positive effect on instructional spending per pupil (in contrast with no effect on total operating spending). This probably reflects the greater importance of salaries in the instructional figure.[9] Also related to costs, the fraction of pre-K and kindergarten student enrollment has no significant effect on instructional spending, a result that is more consistent with expectations than the operating spending result.

Some institutional and preference factors also have different impacts on instructional spending. Districts in which a greater fraction of school-age children attend private or parochial schools typically spend less on public school instruction, other things equal, although the result is not strong statistically; this variable has no effect on total operating spending.[10] And regional high schools do not spend significantly more on instruction than their local or regional K–12 counterparts, even though they do spend more in total; the greater expense associated with regional high schools is apparently something other than instruction.

On the resource side, bumping repeatedly against a Proposition 2½ levy limit does not significantly reduce instructional spending. This result might reflect districts' attempts to protect instruction even as they were forced to limit total operating spending.[11]

Massachusetts School Aid Results—Further Implications

For most of the 1980s, Massachusetts did not distribute incremental school aid dollars through the school aid formula. Each fiscal year (until aid was cut in 1990), all cities and towns received the school and municipal aid they had received the year before, and additional state aid to local governments was distributed through the "additional assistance" formula. This formula reflected both local revenue-raising ability and a number of cost factors including the weighted pupil count that also appeared in the school aid formula. The additional assistance formula determined the "bottom line" of new aid funds to each city or town, and then the basic equalizing school aid formula (Chapter 70) was used simply to label some fraction of those additional aid dollars as school aid.

As in most states, a variety of other aid programs also provided state funds for school and municipal purposes, although the bulk of the new dollars each year in the 1980s came through the additional assistance formula. Statewide, general purpose (nonconstruction) school aid and municipal aid together averaged about $2,100 per pupil, and school aid accounted for slightly over half of that sum. School spending statewide was about $5,000 per pupil and local public education represented about two-fifths of all local government spending.

Given the way each year's new aid was calculated and labeled, it is not at all surprising that the coefficients shown in Table 1 imply that municipal aid funds (measured per pupil) make a contribution to school spending just as do school aid funds.[12] Indeed, the coefficient on municipal aid is significantly bigger than the school aid coefficient.

The size of the coefficients suggests that for every additional dollar of state aid per pupil, school operating spending rises by 23 to 42 cents.[13] (Instructional spending rises 9 to 24 cents.) The remaining 58 to 77 cents presumably goes toward nonschool local spending (as is the intention of municipal aid) or to local property tax reductions.

A simple calculation quantifies the role of school aid funds in reducing school spending disparities between rich and poor communities in Massachusetts

[9] Plant maintenance, transportation, and food are examples of spending categories included in the total operating figure but not in instructional spending that might have a large non-personnel component.

[10] Also, the weak (and wrong-signed) effect of households with school-age children on operating spending is indistinguishable from zero for instructional spending.

[11] Stories abound of districts cutting supplies, maintenance, and auxiliary programs to maintain, or at least minimize deterioration in, teacher-pupil ratios.

[12] The Commonwealth's additional assistance/school aid calculation was the same for communities that were members of regional school districts (and where, therefore, the school district was not a dependent part of the city or town government) as for communities operating their own schools. The school aid going to the regional school was subtracted proportionally from each member town's additional assistance funds. However, because regional districts are governmentally independent of municipal governments, the school aid to regions might be more likely to "stick" as school spending, rather than leaking out as other municipal spending or tax reductions. This hypothesis is supported by estimates (not shown) indicating a significantly bigger coefficient on school aid for communities that are members of regional school districts than for communities with dependent schools. The coefficients on municipal aid do not differ significantly between the two groups of communities.

[13] Note that 40 cents corresponds to the schools' 40 percent share of local spending. That is, an estimated coefficient of 0.4 on all aid would be consistent with expenditure by each city or town of aid funds in proportion to the school–nonschool shares of the budget. In fact, in an equation (not shown) in which the (nonconstruction) school aid and municipal aid are combined, the coefficient on combined per pupil aid is 0.324. Not surprisingly, this combined coefficient lies between the school and municipal aid coefficients shown in Table 1.

in fiscal year 1991 (FY1991). The existing pattern of school spending in Massachusetts was not grossly unequal between rich and poor communities, but it was more unequal than in the other New England states (see Bradbury 1993). On average, the richest one-fifth of communities in Massachusetts spent about $1,800 (or 42 percent) more per pupil on schools than the poorest fifth,[14] and this disparity would have been even greater if state aid funds were not allocated in a redistributive (pro-poor) pattern.

The poorest one-fifth of communities received almost $1,600 more school and municipal (combined) aid dollars per pupil than the richest one-fifth, on average. The estimated regression coefficient implies that the combined aid dollars raised per-pupil spending in the poorest quintile by more than $500 relative to the richest quintile.[15] Put another way, if school aid were distributed equally to all districts per pupil, according to these estimates the richest quintile of towns would average per-pupil spending almost 60 percent (instead of 42 percent) higher than their poorest neighbors. This disparity is almost entirely due to the direct effect of resource disparities on communities' ability to spend on schools.

The fundamental difference between state aid to schools in Rhode Island and in Massachusetts is that most of the aid dollars are "matching" in Rhode Island.

Because only about one-third of school and municipal aid combined shows up as school spending, an attempt to use aid alone to substantially raise spending among the poorest communities would be quite expensive. For example, the poorest one-half of the communities had roughly a $225 million shortfall in FY1991 school spending compared with what they would have spent at the statewide per-pupil average. Thus, if the state wanted to induce them to spend at the average, the regression implies that it would take a total of about $700 million in additional aid.[16]

Estimated Equation: Rhode Island

Table 2 reports the estimated effects of a similar list of factors on school district spending in a pooled sample of Rhode Island and Massachusetts cities and towns during school year 1991. Because Rhode Island consists of only 39 cities and towns, it is impossible to estimate equations similar to those in Table 1 using Rhode Island communities alone.[17] Instead, the observations were pooled, with Rhode Island coefficients estimated separately for those variables which a priori reasoning suggested would operate differently, specifically state aid to schools and municipalities, plus two variables found empirically to have different coefficients in the two states. Thus, coefficients on all the variables other than the constant, those related to state aid, property tax base, and federal aid were constrained to be the same in Rhode Island and Massachusetts.[18]

The fundamental difference between state aid to schools in Rhode Island and in Massachusetts is that most of the aid dollars are "matching" in Rhode Island. That is, just as in Massachusetts, aid is given

[14] The communities are ranked by equalized property value per pupil and then divided into five equal groups (with 64 or 65 communities in each). Each one-fifth of the distribution is called a quintile.

[15] To simplify the calculations, the coefficient on combined general purpose school and municipal aid (0.324) described in footnote 13 is used in this simulation of the combined aid shift.

[16] This would amount to about a 30 percent increase in the total aid budget to the 322 communities in the sample. Of course, such a program should not be enacted even if the expense were not a problem because it would make aid dependent on existing spending levels, rewarding low-spending communities with more aid and penalizing towns that have made extra effort to fund their schools.

[17] The number of Rhode Island observations is further reduced to 36 by eliminating the smallest community (with only 112 students townwide) from the analysis and dropping two other districts with incomplete data. As for Massachusetts, data for regional school districts (two K–12 districts and one regional high school) are attributed back to member cities and towns. With only 36 observations, regressions with 25 variables (like those in Table 1) would be extremely unreliable because the degrees of freedom would be so limited. Indeed, attempts to estimate even pared-down versions of such equations resulted in very good measured "fit" but highly unstable coefficient estimates. Appendix C reports a bare-bones regression (using only the Rhode Island observations) which confirms the general importance and magnitude of the coefficient estimates for a few key variables.

[18] All the variables were tested, in groups (resources, preferences, costs), to ascertain whether the Rhode Island coefficients were significantly different from the pooled coefficients. The estimated Rhode Island differentials were significantly different from zero only for the tax base and federal aid variables. Furthermore, data for Rhode Island school districts were not available for some of the variables used in the Massachusetts equation, so the variable list for the pooled equation is somewhat shorter.

Table 2

Per-Pupil School Spending Regressions: Rhode Island and Massachusetts

Dependent variable is operating school spending per pupil; table entries are estimated coefficients and standard errors; the latter are in parentheses.

	R.I. Matching Aid Variable:			R.I. Matching Aid Variable:	
Explanatory Variable	Aid Dollars (1)	Matching Rate (2)	Explanatory Variable	Aid Dollars (1)	Matching Rate (2)
Constant	1864**	2005**	*Measures of Preferences and Institutional Factors:*		
	(861)	(866)			
Rhode Island dummy	−1010*	−524	Town is member of regional K–12 district	−151	−141
	(611)	(595)		(95)	(96)
Measures of Resources:			Town is member of regional high school district	147**	154**
				(70)	(71)
Income per capita, 1989 ($000)	93.2***	92.5***	Percentage of households with school-age children	−14.7**	−15.4**
	(7.0)	(7.1)		(7.1)	(7.2)
Equalized property tax base per pupil ($000)	.972***	.969***	Percentage of resident children attending private schools	1.82	2.24
	(.080)	(.081)		(4.71)	(4.75)
R.I. differential – equalized property per pupil ($000)	1.69***	1.43**	Percentage of population age 65 and older	−12.6	−13.5
	(.56)	(.61)		(9.8)	(9.9)
Nonresidential property tax share	1295***	1288***	*Indicators of Costs:*		
	(231)	(233)			
City or town at Prop 2½ levy limit for at least 3 years	−123**	−120**	Average annual wage at all establishments ($000)	7.82	7.70
	(54)	(54)		(5.62)	(5.66)
Federal aid per pupil	−.027	−.031	Log of number of students	−234***	−234***
	(.269)	(.272)		(36)	(36)
R.I. differential – federal aid per pupil	1.29**	1.22**	Special education students (percent of all students)	9.05	7.37
	(.54)	(.54)		(15.2)	(15.4)
Massachusetts State Aid Variables:			Bilingual students (percent)	8.77	9.23
				(9.47)	(9.54)
Non-construction school aid per pupil	.200***	.196***	Pre-kindergarten and kindergarten students (percent)	30.0**	28.5**
	(.051)	(.052)		(14.1)	(14.2)
Aid to municipalities per pupil	.410***	.408***	Grades 5–8 students (percent)	17.8	15.7
	(.054)	(.054)		(13.9)	(14.0)
Rhode Island State Aid Variables:			High school students (percent)	53.1***	52.9***
				(9.7)	(9.8)
Matching school aid (see column head for variable)	.541***	12.8**	R-squared	.81	.81
	(.178)	(6.4)	Adusted R-squared	.80	.79
Non-matching school aid per pupil	2.07*	2.59**	Number of observations	358	358
	(1.16)	(1.16)	F-statistic	57.3	56.3
Aid to municipalities per pupil	1.43	.943	Mean of dependent variable	5,073	5,073
	(2.26)	(2.27)	Standard error of regression	409	412

*Significantly different from zero with better than 90 percent confidence.

**Significantly different from zero with better than 95 percent confidence.

***Significantly different from zero with better than 99 percent confidence.

Note: Dependent variables are for school year 1990–91; explanatory variables refer to school year 1990–91 or to fiscal year 1991 unless otherwise noted.

See Appendices A and B for variable definitions and means.

in direct proportion to the number of students and in inverse proportion to local property wealth, but unlike in Massachusetts, school aid in Rhode Island also depends on the district's actual spending, with a lag. The state's basic "operating aid" in any year reimburses a fraction of districts' operating expenditures two years earlier, and the aid formulas for bilingual ("limited English proficient") education, public hous-

ing, and school construction use the same or a similar matching rate for spending related to those programs. Matching rates in FY1991 ranged from a minimum of 28.5 percent for the richest districts (this legislated floor was reduced to 9 percent by FY1994) to a maximum of 99 percent in the poorest district.[19]

When aid is matching, it is thought to encourage more spending by making it cheaper for any district to raise each incremental dollar for schools (because aid reimburses a fraction of each dollar raised locally), and more so for poorer districts because they enjoy higher matching rates. Rhode Island is the only New England state with a matching school aid formula, so it provides a useful contrast with Massachusetts' approach. In Massachusetts, neither the school aid formula nor the "additional assistance" (municipal aid) formula reflects a community's actual spending or tax rates. Hence these aid dollars arrive independent of local behavior. That is, unlike Rhode Island, state aid programs in Massachusetts offer no price incentive to spend incremental, locally raised dollars on schools.

Column (1) in Table 2 reports estimates that ignore the matching aspect of aid in Rhode Island, including measures of aid dollars per pupil for schools and municipalities, just like the variables included (separately) for Massachusetts. Column (2), by contrast, reports estimates from an equation that includes each Rhode Island district's matching rate instead of the number of matching aid dollars.

The aid coefficients in column (1) indicate a greater effect on school spending of each school aid dollar in Rhode Island than in Massachusetts; the coefficient on Rhode Island's matching aid suggests that spending per pupil is about 54 cents higher for each additional dollar of matching aid. However, this estimate in all probability overstates the marginal effect of aid dollars on spending.[20] (The results for non-matching school aid and for municipal aid are discussed in the next subsection on "further implications.")

The estimated coefficient on the school aid matching rate in column (2) is positive and significantly different from zero. The size of the coefficient implies that a community with a 65 percent matching rate, for example, would spend $250 more per pupil than a community with a 45 percent matching rate, other things equal; for changes like this around the average, about 40 percent of each matching aid dollar goes into school spending.[21] Thus, it is more plausible to deduce that roughly two-fifths of school aid in Rhode Island goes into school spending, not 54 percent as the biased results in column (1) suggest.

Aside from the aid variable that differs between the two equations, the coefficients in column (2) are very similar to those in column (1). School spending is not only more closely tied to school aid in Rhode Island than in Massachusetts but apparently also more closely tied to several other measures of resources. The Rhode Island coefficient on property tax base per pupil is significantly higher than the Massachusetts coefficient.[22] And the same is true of the coefficient on federal school aid, which is positive in Rhode Island and zero in Massachusetts.

Rhode Island School Aid Results—Further Implications

Both equations in Table 2 indicate a significant positive effect of non-matching school aid on spending, probably because the non-matching programs provide funding for special education and vocational education, which add to costs. By contrast, general

[19] This 99 percent maximum includes a bonus for regionalization. Aid in Rhode Island in FY1991 also reflected transportation costs, so districts enjoyed a higher matching rate if they had above-average transportation costs per pupil. Note that the matching rate applies to *qualifying* "operating" spending (and other specific matched expenditure categories), not to total operating school spending per pupil. Communities' matching rates were fairly stable from year to year from the mid-1980s on. After FY1991, the nominal matching rates exaggerated the state government's contribution to local schools, since the basic equalizing aid program ("operations aid") and the other school aid programs were not fully funded.

[20] Note that reverse causation (from school spending to school aid) is technically eliminated by the lag built into the aid formula: the aid dollars are proportional to spending two years earlier, not to the spending measured in the dependent variable. Since spending is undoubtedly correlated over time, however, this estimated coefficient is almost certainly biased upward. By contrast, the matching *rate* does not depend on spending, even with a lag; it depends on local revenue-raising potential. Thus the equation that includes the matching rate instead of the matching dollars (column 2) does not suffer from simultaneity bias.

[21] Correcting for the difference between the reported (nominal) matching rate and the percentage of all operating spending that matching aid represents, such a 20 percentage point rise in the nominal matching rate would yield $600-plus in aid to a community with average spending.

[22] This coefficient may also be picking up some measurement differences between the two states. Average per-pupil school spending is higher in Rhode Island than in Massachusetts, at least in part because the measure of school spending is defined somewhat differently in the two states. At the same time, property values are generally lower in Rhode Island. If the spending difference were additive, it would show up in the Rhode Island constant term, but apparently it is not.

purpose municipal aid has no statistically significant effect on school spending in Rhode Island, but a sizable effect, as discussed earlier, in Massachusetts. Rhode Island has a much smaller per-pupil municipal aid pool and has not experienced a blurring of the distinctions between school and municipal aid similar to Massachusetts' experience with "additional assistance" in the last decade.

If Rhode Island's matching school aid were not focused on poorer districts, interdistrict spending disparities would be greater, just as in Massachusetts. In FY1991, the richest seven school districts in Rhode Island averaged spending per pupil almost $800 higher (or 14 percent) than the poorest seven districts.[23] Matching rates for school aid were much higher, on average, in the poorest quintile (80 percent) than in the richest (34 percent). According to the regression estimates, this matching rate differential raised spending per pupil in the poorest seven towns, on average, by almost $600 per pupil relative to the richest seven. Thus, the regression estimates indicate that in the absence of the equalizing influence of pro-poor matching rates, the richest quintile would spend, on average, 25 percent more than the poorest, instead of 14 percent.

Comparing Aid Results for Rhode Island and Massachusetts

State aid comprised a similar fraction of school budgets in Massachusetts and Rhode Island in FY1991, but Rhode Island's aid has a slightly greater equalizing impact. Average per-pupil aid amounted to 40 to 45 percent of average per-pupil school spending in the two states. While spending disparities are considerably larger in Massachusetts than in Rhode Island, as noted earlier, existing aid programs raise spending in the lowest quintile by $500 per pupil in Massachusetts and $600 in Rhode Island relative to the richest quintile.

A comparison of the derived estimate of aid's marginal effect on spending in Rhode Island with the estimated aid coefficient for Massachusetts is consistent with the hypothesis that aid formulas with matching provisions provide more incentive than non-matching aid formulas for districts to spend incremental dollars on schools, although the difference (between approximately 0.3 and 0.4) is not very big. While it is perilous to assume that estimates from one state would hold in another, the similarity of the other coefficient estimates makes this comparison of the aid results interestingly suggestive.

III. School Finance Reform Proposals in Massachusetts: Potential Effects on Spending Disparities

Massachusetts enacted education reform legislation in 1993 that changed responsibilities and standards, added school aid dollars, and altered the distribution formula for the aid. The current fiscal year (1994) represents the first year of a seven-year phase-in period for the additional state funding and associated local spending requirements. The Box summarizes how the new law affects communities' school aid and constrains their school spending.

Table 3 (p. 62) reports the results of several simulations of the impact on school spending disparities of the changes in Massachusetts' new aid program for schools. The first panel reports the actual FY1991 spending and aid distribution. Line (A) uses coefficient estimates from the Massachusetts regressions to simulate the likely effect on FY1991 per-pupil spending of the change in aid that occurred from FY1993 to FY1994.

The additional aid dollars and formula change are redistributive—the simulated spending disparities are smaller than actual FY1991 disparities—but the impact is not large in the first year. With the addition of $140 million statewide, school and municipal aid combined rose an average of $203 per pupil between FY1993 and FY1994. The bottom quintile received $335 more aid per pupil in FY1994, on average, and the top quintile averaged $102 more. The new formula does not result in a significant shift of aid resources toward the poorest districts in the first year because it operates only at the margin: all districts are guaranteed their previous year's school aid plus a minimum per-pupil increment; the remaining new aid funds are then distributed according to a modified foundation plan, with "equity" and "overburden" adjustments (see the Box on pp. 60–61).

This simulation of the impact of aid changes alone ignores other aspects of Massachusetts' educational reform legislation that alter its effect on spending disparities. In addition to adding state aid dollars and changing the formula, the new law imposes specific school spending requirements on local governments. The aim is that all districts will be spend-

[23] These data indicate smaller FY1991 spending disparities in Rhode Island than those shown in Bradbury (1993) because the three districts dropped from the regression sample on account of missing or imperfect data would all have fallen into the richest quintile. The tax base disparities among the quintiles are also smaller in this subsample.

Fiscal Aspects of Massachusetts' 1993 Education Reform Legislation

The basic idea of Massachusetts' new school finance provisions is that all communities must be spending at least their foundation amount after a seven-year phase-in period, and additional aid dollars from the state will help communities attain the foundation once they are making a reasonable effort to fund schooling from their own resources. Maintenance-of-effort provisions insure that the new aid goes into school spending, not tax relief (except for "equity" aid, which explicitly provides tax relief).

Definitions

Three key concepts determine how each community's spending and aid are affected by the education reform law in FY1994: foundation spending level, local effort, and municipal revenue growth factor. These concepts are used in calculating each district's aid and spending, as described below.

Foundation Spending Level. As in other states with "foundation" school-aid programs, the foundation spending level for each district reflects the state's estimate of the spending required to provide an adequate education in that district. In Massachusetts, the fiscal year 1994 (FY1994) foundation is very close to $5,500 for each pupil in the district, with adjustments for grade mix, local wages, and the fraction of students from families with below-poverty-level incomes. The foundation will change over time to reflect statewide changes in costs.

Local Effort. A measure of "effort" indicates how heavily each community is taxing itself to fund its public schools (local or regional). Effort is calculated as local property tax funds for schools divided by the local income-adjusted property tax base.

Municipal Revenue Growth Factor (MRGF). The MRGF is a measure of the probable growth rate of total revenues (other than school aid) available to each community. Each community's MRGF for FY1994 reflects the combined percentage increase resulting from increases in four components: the 2.5 percent automatic property tax levy limit increase allowed under Proposition 2½, the contribution of "new growth" to the property tax levy (estimated by averaging the previous three years), general-purpose municipal aid increases from FY1993 to FY1994, and FY1992–93 growth in local receipts (such as the motor vehicle excise) other than specific service fees such as water, sewer, and trash. The MRGF for FY1994 averages about 3 percent statewide.

Calculations

For each community, the state calculates a minimum spending level for FY1994, consisting of a minimum local contribution plus FY1994 school aid (except for "equity aid" defined below). The minimum local contribution and the aid amount depend on two criteria that categorize communities with respect to the preliminary impact of the new law on their finances. First, the community's local effort is compared with the statewide "standard of effort,"

ing at or above their "foundation" levels after the seven-year phase-in,[24] with the additional funds required to get there supplied locally or by the state (the division between them depends mostly on local ability to raise revenue and effort in doing so).

Row (B) in Table 3 indicates the impact on spending disparities of bringing all communities to at least their foundation in the first year instead of moving toward the foundation over seven years. The effect of using the foundation as a floor is a marked reduction in spending disparities between rich and poor districts, because most districts spending below their foundations are poor. The poorest quintile's spending in FY1993 averaged about $900 per pupil below their FY1994 foundation; the richest quintile's spending was $1,100 above. Row (B) shows that if all communities below their foundation were to raise spending to reach it, the richest quintile would spend only 18 percent more than the poorest, on average.[25]

The foundation, however, is not the only constraint placed on spending. Even for communities already spending more than their foundation, spend-

[24] "Net school spending" in the aid calculations and local requirements is not defined in the same way as the operating spending measure examined here. Net school spending includes expenditures made by the city or town government on behalf of the schools, for such items as fringe benefits. Net school spending excludes school transportation and debt service expenditures. Districts might not achieve the foundation goal in seven years if state contributions do not grow at the same pace as local, or because of waivers that can be (and were, in FY1994) granted by the Departments of Revenue and Education.

Fiscal Aspects of Massachusetts' 1993 Education Reform Legislation (continued)

which for FY1994 is an effective tax rate of 0.94 percent of taxable property values. Second, a community's FY1993 spending is compared with its foundation spending level. Communities taxing themselves more lightly than the statewide standard of effort are expected to contribute more from local funds. Communities making above-standard effort may be eligible for "equity" aid and communities spending below their foundation may be eligible for "foundation" aid. Equity aid need not be spent on schools; it may be used for tax relief.

Communities whose effort falls below the statewide standard of effort must increase spending each year by at least their municipal revenue growth factor. If they are currently spending above their foundation, then their local contribution must rise by their municipal revenue growth factor, and spending will rise by that amount plus any increase in their school aid. All communities are guaranteed their previous year's school aid (base aid) plus "minimum aid" of $50 per pupil in FY1994 and $25 additional per pupil in the ensuing fiscal years. These high-spending, low-tax communities receive no school aid above this guarantee.

Communities with below-standard effort that are spending below their foundation must raise their local contribution by the municipal revenue growth factor plus the additional amount needed to attain the standard or their foundation by the end of a seven-year period. These communities also receive no aid above the guarantee, except to the degree that meeting the standard of effort would still leave them with below-foundation spending (so they are eligible for foundation aid), or unless they have low property values. If their property values are below 95 percent of the statewide average, the state will provide transitional "overburden aid" to be repaid from later years' nonschool aid funds.

Communities whose effort exceeds the statewide standard of effort are not required to raise additional funds locally (until their effort falls to the standard). Communities with above-standard effort that are spending above their foundation may level-fund, and in some cases reduce, their local contribution. They receive the guaranteed minimum and base aid, and may receive "equity" aid to the degree that they would have to make effort above the standard even to achieve foundation spending.

Communities with above-standard effort that are spending below their foundation receive additional school aid to help them reduce their effort to the standard and attain their foundation spending level by the end of the seven-year phase-in. Foundation aid fills part of the gap between the foundation and what base aid, minimum aid, and last year's local contribution raised by the municipal revenue growth factor would cover; equity aid partly fills the gap between last year's local contribution raised by the municipal revenue growth factor and the standard of effort.

ing increases are required in most cases. The reform plan requires communities with implicit school tax rates below a defined standard (0.94 percent of taxable property values) to increase locally raised revenues for schools; at the same time, it promises at least some additional school aid dollars each year.

For each town, the reform plan calculates a required amount of school spending each year as the sum of a required local contribution and aid from the state; this calculation reflects required movements toward both the foundation and the standard of effort. Wealthy, high-spending districts as well as poor, low-spending districts are required to increase their spending. Indeed, the plan has equalizing effects on local effort or tax rate differentials as well as on spending disparities across quintiles: the local contributions (locally raised funds for schools) of rich districts rise from FY1993 to FY1994, on average, while the local contributions of poor districts fall on account of aid increases. This represents a reduction in interdistrict fiscal disparities, but on the local tax effort side of the ledger, not the spending side.

[25] The legislation stipulates a seven-year phase-in period rather than an immediate move to the foundation because of budgetary and institutional difficulties that would result from the sizable increase in school spending that would be required in some communities to jump to the foundation in one year. Neither the state aid budget nor local communities' revenues could finance the spending increase in one year. Furthermore, it would probably be difficult for the schools in communities spending the least to effectively employ such a sizable infusion of money without a gradual phase-in.

Table 3
Impact of New FY1994 School Aid Formula in Massachusetts
By Quintile of Equalized Property Value per Pupil (in dollars except ratios)

	Average (N = 322)	Poorest Quintile	Second Quintile	Middle Quintile	Fourth Quintile	Richest Quintile	Ratio: Richest/ Poorest
FY1991 Actual Spending and Aid:							
School spending per pupil	4,973	4,263	4,509	4,758	5,270	6,065	1.42
Municipal and school aid per pupil	2,153	2,995	2,463	1,920	1,982	1,402	
School aid per pupil	1,474	2,493	1,950	1,349	939	641	
Simulations with FY1993–94 Changes in Aid and Requirements							
Simulated School Spending per Pupil If:							
(A) FY1993–94 combined aid increase added to school spending in the manner of FY1991 combined aid	5,038	4,371	4,591	4,819	5,316	6,098	1.40
(B) All districts spending less than FY1994 foundation in FY1993 are brought up to adjusted foundation	5,423	5,179	5,187	5,177	5,463	6,111	1.18
(C) FY1993–94 dollar increase in "required" school spending added directly to spending or (A), whichever is higher	5,198	4,523	4,718	4,974	5,468	6,310	1.40
(D) (B) or (C), whichever is higher	5,500	5,195	5,206	5,208	5,572	6,323	1.22

Notes: School aid is aid for schools excluding construction aid; municipal aid excludes tax-related or tax-replacement aid; combined aid is school and municipal combined.

Source: Author's calculations based on data from Massachusetts Department of Revenue, Division of Local Services, Municipal Data Bank. Simulation (A) is based on estimated regression coefficients; (B) adds the difference between FY1994 foundation and FY1993 net local spending, when positive, to FY1991 actual spending; (C) adds the difference between FY1994 net spending requirement and FY1993 net local spending to FY1991 actual spending and compares the result with (A), choosing whichever is larger; (D) combines (B) and (C).

To calculate the impact of the reform law's minimum spending requirements, simulation (C) assumes that communities will respond to the incremental aid as the regression equation predicts, *unless* the spending requirements mandate even more additional spending.[26] The results show higher average spending for simulation (C) than for (A), but the same spending disparity. Thus, the spending requirements do not reduce spending disparities more than the aid alone. To a large degree, these spending changes may also be quite similar to what would occur simply in response to rising school costs, including enrollment increases.

The final row (D) in Table 3 takes a stab at simulating the potential longer-run impact on school spending disparities of the new school finance law. Row (D) combines the scenarios simulated in rows (B) and (C). That is, it shows the spending pattern that results if districts are assumed to spend at least their foundation amount, and more if the FY1993–94 aid increase would elicit such a response or the FY1994 spending restrictions would require it. Thus, the simulation involves the full seven-year adjustment to the foundation, but only one year of new aid and adjustment toward the standard of effort. The data indicate considerably more equalization than the first year of the program (C), but less equalization than the move to the foundation alone (B) because, as noted earlier, the "effort" requirements add to spending even for rich districts.

[26] As noted earlier, the spending definition for the requirements differs from the operating spending measure employed here, so an additive approach was taken. The spending requirements are assumed to add to FY1991 per-pupil spending the difference between the FY1994 net spending requirement and FY1993 net local spending. The results are virtually identical if a percentage increase is calculated for FY1993–94 and applied to the FY1991 base. The entries in line (C) choose, for each district, the higher of (i) the predicted spending resulting from the combined aid simulation and (ii) the predicted spending resulting from the required spending increment. These simulations, like the reform program itself, beg the question of whether the spending requirements can be attained only with overrides in some towns.

The difficulty in predicting the long-run impact of the plan on spending disparities centers on the uncertain future paths of the foundation, education costs, and richer districts' resources. To the degree that the foundation is adjusted upward over time to reflect rising school costs and hence continues to reflect an "adequate" education package, as is planned, it may catch up to some wealthier communities' spending levels. To the degree that actual costs and the revenues of communities spending above foundation grow faster, increases in required effort as well as the direct effect of cost and resource increases on spending will cause their school outlays to outstrip the foundation. As a result, spending disparities will be larger than those shown in row (D), although smaller than they were in FY1991 under the previous aid approach.

Other states, including California and New Jersey, have imposed spending caps on rich districts to minimize disparities as state funds are used to raise spending in poorer districts. While such caps reportedly create at least as many problems as they solve, they contrast markedly with this Massachusetts approach, which not only allows high-spending districts to spend more but requires some of them to do so.[27]

In summary, while it is difficult to judge spending impacts on the basis of changes for only one year, the basic fiscal outlines of Massachusetts' education reform plan appear to move the Commonwealth toward reduced school spending disparities between rich and poor communities. The key factor determining the plan's longer-term impact on spending disparities is the degree to which the substantial equalizing impact of an adequate floor under the spending of poor districts is eroded by failure of that floor to rise as fast as many richer communities' educational costs or preferred service levels.

IV. Conclusions

School spending per pupil is higher in rich than in poor school districts within a state for a variety of reasons. Most important, rich districts by definition have more resources available locally to finance school spending, and this and other research has shown that local resources are key determinants of per-pupil school spending. In school year 1990–91, the school aid provided by state governments in Massachusetts and Rhode Island, while directed more at poor than at rich communities, did not fully offset the spending disparities resulting from local resource disparities.[28] The regression results and aid impact calculations reported in this article yield some conclusions about the reasons for aid's inability to further equalize spending.

The basic fiscal outlines of Massachusetts' education reform plan appear to move the Commonwealth toward reduced school spending disparities between rich and poor communities.

Communities use the aid dollars they receive to add to school spending, to add to nonschool spending, and to reduce local taxes. In Massachusetts and Rhode Island, one-fifth to two-fifths of each aid dollar shows up in school spending. Thus more aid dollars channeled through the school aid formula would reduce spending disparities. Nevertheless, relying solely on aid to bring about equal spending is expensive when districts are allowed to set their own spending levels and resources are unequal. By the

[27] The approach presumably involves political problems as well; some of the rich high-spending districts are likely to feel that the reforms impose restrictions on them without substantially helping them, since they receive only minimum aid. Many, however, would increase their spending more than required even in the absence of the requirements.

[28] As noted earlier, the poorest quintile in Massachusetts receives about $1,600 more aid per pupil than the richest quintile, which adds an estimated $500-plus to school spending in the poorest quintile relative to the richest, according to the regression estimates. But other coefficients imply that income and property tax base differences lead the richest quintile to spend about $1,700 more dollars per pupil than the poorest. The actual spending disparity between the richest quintile and the poorest is $1,800.

Rhode Island communities in the poorest quintile enjoy matching rates more than 40 percentage points higher, on average, than the richest quintile, which adds an estimated not-quite-$600 to relative spending in the poorest communities, on average. But income and property tax base differences add almost $1,600 to spending in the richest quintile relative to the poorest, according to the estimates. Property tax base disparities between the richest and poorest quintile are much smaller in Rhode Island than in Massachusetts, but the estimated coefficient on property tax base is significantly higher in Rhode Island than in Massachusetts.

same token, the equalizing impact of the aid would be greater if the dollars were distributed in a more pro-poor way.[29]

Furthermore, each state aid dollar would go further toward equalizing school spending if local districts' responses were greater, that is, if more than one-fifth to two-fifths of each aid dollar found its way into school spending. Rhode Island's pro-poor matching aid delivers more "bang per buck" than non-matching aid in Massachusetts, but not much more. Direct minimum spending requirements to bring up the lowest-spending districts (with aid to cover the increased cost) have a greater impact on the effectiveness of each dollar of aid; the Massachusetts simulations bringing below-foundation districts up to their foundations indicate the power of a mandated spending floor—at an adequate educational level—in reducing spending disparities.

In sum, spending disparities between rich and poor districts persist in the face of redistributive aid programs, at least in Massachusetts and Rhode Island, for most of the reasons hypothesized in the introduction: the "incentives" embedded in the aid formulas for poor districts to spend more than rich are not very strong (perhaps in order to buy rich as well as poor districts into the plan); the spending responses of school districts to aid dollars are relatively weak (the aid that does not go into reducing spending disparities presumably helps to reduce tax rate disparities, however); and the dollars funneled through state aid formulas are not very large relative to total school spending.[30]

These findings shed some light on why school finance is a perennial issue in the United States. No widely acceptable resolution has surfaced regarding the basic trade-off between the state's interest in equal educational opportunity, on the one hand, and on the other, local government control of schools with its associated dependence on local (and hence unequal) resources.

[29] In Massachusetts in FY1991 the richest quintile averaged $1,400 in school and municipal aid per pupil, while the poorest received $3,000 per pupil. If the same dollars were redistributed to give the richest quintile $400 per pupil and the poorest $3,500, for example, the aid would raise spending by $1,000 in the poorest quintile relative to the richest, rather than $500. Similarly, in Rhode Island, reducing the minimum matching rate (as has occurred since FY1991) should cause any total aid pool to reduce spending disparities to a greater degree.

[30] The fraction of school spending covered by state aid for schools is below the national average in Rhode Island and Massachusetts. (See Table 2 of Bradbury 1993.) If general purpose municipal aid is added to school aid in Massachusetts, the sum still appears to be below the national average school aid fraction.

Appendix A

Variable Definitions, Sources, and Means: Massachusetts

Variable	More Detailed Definition	Mean (N = 322)
Dependent Variable: Total operating school spending per pupil	Integrated operating cost (IOC) divided by net average membership (NAM); IOC is a comprehensive school spending measure.	4,973
Instructional spending per pupil	Instructional costs per FTE pupil; instruction includes supervision, principals, guidance, and textbooks as well as teaching	3,204
Measures of Resources: Income per capita, 1989 ($000)	Per capita census money income in 1989 (in thousands of dollars)	17.8
Equalized property tax base per pupil ($000)	1990 Estimated market value of taxable property (EQV, in $000) divided by NAM	548
Nonresidential property tax share	Tax levy on commercial, industrial, and personal property as percent of total levy	.205
City or town at Prop 2½ levy limit for at least 3 years	Dummy variable = 1 if excess capacity was less than 0.1% of community's levy limit in fiscal years 1989, 1990, and 1991	.317
Federal aid per pupil	Federal aid for schools divided by NAM	169
State school construction aid per pupil	Aid from the state for school construction projects divided by NAM	168
State non-construction school aid per pupil	All state school aid other than school construction aid divided by NAM	1,474
State municipal aid per pupil	All non-school aid except for distributions of state-collected taxes or abatement reimbursements divided by NAM	679
Measures of Preferences and Institutional Factors: Town is member of regional K–12 district	Dummy variable = 1 if town does not operate its own school district	.202
More Measures of Preferences and Institutional Factors: Town is member of regional high school district	Dummy variable = 1 if town operates only elementary schools	.261
Percentage of households with school-age children	Percentage of households with members under age 18 in 1990	36.4
Percentage of resident children attending private schools	Percentage of resident children in school (January 1990) attending private schools	8.2
Percentage of population age 65 and over	Percentage of all residents who were age 65 or older in 1990	12.9
Indicators of Costs: Average annual wage at all establishments ($000)	Total annual payroll divided by average annual employment in establishments subject to unemployment compensation laws	22.8
Log of number of students	Natural logarithm of net average membership (NAM)	7.26
Enrollment growth, 1986–91 (percent change)	Percentage change in NAM from 1986 to 1991	1.02
Membership Mix:	Percentage of NAM in each category, as defined for purposes of pupil weighting in the basic school aid formula	
Special needs		5.3
Bilingual		.8
Occupational day		3.4
residential		.1
Low-Income		6.5
Enrollment Mix:	Percentage of enrollment (in October) in each grade level group	
Pre-K and kindergarten		9.8
Grades 1–4		33.6
Grades 5–8		29.6
High school		27.1

Note: Variables refer to school year 1990–91 unless otherwise noted. NAM is net average membership, an enrollment measure. These data were obtained from (or were derived with author's calculations from data obtained from) the Massachusetts Department of Education or the Massachusetts Department of Revenue, Division of Local Services, Municipal Data Bank, except as follows: Average wage data were taken from Massachusetts Department of Employment and Training, "Employment and Wages in Massachusetts' Cities and Towns, 1982–1991," printed 9/92. Data on the percentage of households with members under age 18 and percentage of children attending nonpublic schools were obtained from Edith R. Hornor, Editor, *Massachusetts Municipal Profiles, 1991–92*, 1991, Information Publications. Percent of population age 65 and older obtained from U.S. Census of Population.

Appendix B

Variable Definitions, Sources, and Means: Rhode Island

Variable	More Detailed Definition	Mean (N = 36)
Dependent Variable:		
Total operating school spending per pupil	Total operating school spending divided by average daily membership (ADM)	5,966
Instructional spending per pupil	Including K-12 instruction, voc. and tech., regular instruction of spec. needs, libraries, instructional media, and guidance	3,234
Measures of Resources:		
Income per capita, 1989 ($000)	Per capita census money income in 1989 (in thousands of dollars)	15.9
Equalized property tax base per pupil ($000)	Full value based upon 1990 market value of property (in $000) divided by ADM	473
Nonresidential property tax share	Tax levy on commercial, industrial, and personal property as percent of total levy	.328
Federal aid per pupil	Federal aid for schools divided by ADM	210
Matching school aid per pupil	All state school aid with a matching component divided by ADM	2,155
Matching rate	Operations aid "share ratio"	54.5
Non-matching school aid per pupil	School aid with no matching component divided by ADM	292
Aid to municipalities per pupil	All non-school aid except for distributions of state-collected taxes or abatement reimbursements divided by ADM	39
Measures of Preferences and Institutional Factors:		
Town is member of regional K–12 district	Dummy variable = 1 if town does not operate its own school district	.139
More Measures of Preferences and Institutional Factors:		
Town is member of regional high school district	Dummy variable = 1 if town operates only elementary schools	.056
Percentage of households with school-age children	Percentage of households with members under age 18	46.4
Percentage of resident children attending private schools	Percentage of resident children in school attending private school	12.9
Percentage of population age 65 and over	Percentage of all residents who were age 65 or older in 1990	13.7
Indicators of Costs:		
Average annual wage at all establishments ($000)	Total annual payroll divided by average annual employment in establishments subject to unemployment compensation laws	19.9
Log of number of students	Natural logarithm of net average membership (NAM)	7.94
Special education percentage	Percentage of public and private school children with special needs	13.7
Bilingual percentage	Percentage of ADM who are "limited English proficient"	2.9
Enrollment mix:		
Pre-K and kindergarten	Percentage of enrollment (in October) in each grade level group	8.3
Grades 1–4		33.6
Grades 5–8		30.5
High School		27.6

Note: Variables refer to school year 1990–91 unless otherwise noted. ADM is average daily membership, a public school enrollment measure. These data were obtained from (or were derived with author's calculations from data obtained from) the Rhode Island Department of Education, except as follows: Per capita income figures from the U.S. Census were provided by the Rhode Island Department of Economic Development. Percentage of households with school-age children and percentage of population 65 and over were obtained from the U.S. Census of Population. Average wage data were provided by the Rhode Island Department of Employment and Training.

Appendix C

Per-Pupil School Spending Regression: Rhode Island

Dependent variable is operating school spending per pupil

Explanatory Variable	Estimated Coefficient (Standard Error)
Constant	1658** (793)
Income per capita, 1989 ($000)	99.5*** (26.7)
Equalized property tax base per pupil ($000)	2.38*** (.51)
Federal aid per pupil	.893* (.442)
Matching rate for school aid (%)	16.8*** (5.8)
Non-matching school aid per pupil	1.72* (1.00)
R-squared	.59
Adjusted R-squared	.52
Number of observations	36
F-statistic	8.54
Mean of dependent variable	5966
Standard error of regression	367

*Significantly different from zero with better than 90 percent confidence.

**Significantly different from zero with better than 95 percent confidence.

***Significantly different from zero with better than 99 percent confidence.

Note: Dependent variables are for school year 1990–91; explanatory variables refer to school year 1990–91 or to fiscal year 1991 unless otherwise noted.

See Appendix B for variable definitions and means.

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