Banks' Responses to Binding Regulatory Capital Requirements

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In recent years bank regulators have increased their focus on the adequacy of banking organizations' capital ratios.[1] The increased emphasis on capital regulation raises a number of interrelated questions. Is focusing on capital an efficient way to regulate banks? What is the best way to structure capital regulations? How do banks respond to different types of capital regulations? And what are the costs and benefits to banks of different ways of meeting capital regulations? This article focuses on the last two questions, examining banks' responses, and the costs associated with their responses, to capital regulations employed since the early 1980s.[2]

Understanding banks' responses to capital regulations may be helpful in designing regulations that meet regulators' objectives. One objective of capital regulation has been to reduce the number of bank failures. Equity capital provides a cushion to absorb losses that would otherwise cause a bank to fail. Regulators have considered preventing failure an important goal at least in part because of concern that one bank's failure may adversely affect the stability of other financial institutions.[3] Another objective has been to reduce the losses to depositors and the deposit insurer when a bank fails. Both equity and debt subordinated to depositors provide a cushion to reduce the losses to depositors and the deposit insurer in the event of failure. Regulators are especially sensitive to deposit insurance losses because the government not only provides insurance through formal programs such as the Federal Deposit Insurance Corporation (FDIC) but also, in the absence of de jure coverage, has historically been the insurer of last resort.

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While U.S. bank regulators have been refining their approach to capital regulation since the early 1980s (see Table 1), this is not to say that they were previously uninterested in banks' capital levels. During the 1970s regulators were concerned about capital, but there were no regulations that specified minimum capital ratios. At the beginning of the 1980s regulators became dissatisfied with many banks' capital ratios, especially those of the larger banking organizations.[4] As a result, U.S. regulators specified minimum numerical capital-to-asset ratios for almost all banks in 1981; the remaining banks were required to raise their capital-to-asset ratios and were brought under numerical standards in 1983.[5]

The banking industry increased its capital ratios in the years after the 1981 guidelines were adopted. However, the simplistic use of total assets as a risk measure became questionable as banks adjusted their portfolios. Given regulators' concern with preventing failure and protecting the deposit insurer, an appropriate measure of capital adequacy would measure a bank's ability to absorb losses from its portfolio without failing or imposing substantial costs on the deposit insurance agency. During the 1980s, however, banks reduced their investment in high-liquidity, low-return assets and increased their exposure in potentially risky off-balance-sheet transactions, such as letters of credit and over-the-counter derivatives. Thus, capital-to-total-asset ratios that may have been adequate in the early 1980s were likely becoming less adequate later in the decade. As a consequence, the United States, along with other industrialized countries, adopted risk-based capital standards in 1988 that took full effect in 1992.[6] These standards, often referred to as the Basle Agreement, established capital ratios that are dependent on banks' overall exposure to credit risk. Bank supervisors are engaged in on-going efforts to incorporate other forms of risk—for example, standards for market risk were recently adopted.

In response to concerns regarding the thrift bailouts of the 1980s and the potential for a similar bailout of banks, Congress passed the FDIC Improvement Act (FDICIA) in 1991. FDICIA made a number of changes that were intended to reduce taxpayers' and

Table 1
Overview of Major Changes in Capital Regulation, 1981 to 1996

1981	The Federal Deposit Insurance Corporation (FDIC) sets numeric guidelines for all the banks it regulates.
1981	The Office of the Comptroller of the Currency (OCC) and Federal Reserve divide banks into three categories: community, regional, and multinational (the seventeen largest banking organizations). Numeric guidelines are set for the community and regional banks. No standards are set for the multinational banks, but they are encouraged to raise their capital ratios.
1983	The OCC and Federal Reserve impose the regional bank numeric guidelines on multinational banks.
1985	The FDIC, OCC, and Federal Reserve establish a common set of capital guidelines that apply to all banking organizations.
1990	Interim risk-based capital guidelines take effect for all banking organizations. The risk-based guidelines are supplemented with leverage guidelines.
1991	The FDIC Improvement Act, which establishes five capital categories, is passed. Regulators are given a menu of mandatory and optional enforcement actions they may undertake as a bank's capital ratios decline. Regulators ultimately define the categories both in terms of risk-based and leverage ratios.
1992	Final risk-based capital guidelines take effect for all banking organizations. The risk-based guidelines are still supplemented with leverage guidelines.

Note: The table provides only a broad overview of bank capital regulation. Numerous refinements in the measures of both capital and risk exposure occurred during this period. For more detailed discussions of the evolution of capital regulations, see Alfriend (1988), Gilbert, Stone, and Trebing (1985), Keeton (1989), and Wall (1989, 1993).

the government's exposure to problem financial institutions.[7] Among these changes are provisions for prompt corrective action that impose increasingly strict limits on banks as their capital ratios decline. The act provides a classification system with five tiers based primarily on banks' capital ratios, with the lowest tier having a capital-to-assets ratio of less than 2 percent. Regulators are strongly encouraged to close any bank falling into the lowest tier if the bank is unable to raise its capital ratio within ninety days of falling below 2 percent.

The combined effect of the Basle Agreement and FDICIA is to make capital ratios one of the primary measures, for regulatory purposes, of U.S. banks' financial condition. Banks may not respond to these regulations if the regulations are not binding or if the costs of meeting the regulations are greater than the benefits. If banks do respond, they generally do so in one of two ways. A bank may increase its capital ratios as measured under the regulatory standards without reducing either the probability that the bank will fail or the losses to depositors and the deposit insurance agency if the bank fails. This first general category of response will be referred to hereafter as cosmetic changes to the capital ratio. One way for a bank to make cosmetic improvements in its capital ratios would be to reduce its total assets to improve its capital-to-assets ratio while increasing portfolio risk by increasing the proportion of risky assets, as appeared to be happening in the early to mid-1980s. The other way of making cosmetic changes is to exploit differences between capital as measured for regulatory purposes and the bank's true economic capital. A bank may exploit these differences by (1) selling assets that have appreciated in value (but not those with reduced value) to increase capital measured by regulatory accounting, even if this action sometimes reduces the bank's economic capital, and (2) refusing to recognize substantial reductions in the market value of assets.[8]

A second general response to capital regulations would be to increase measured capital ratios in a way that also reduces the probability of failure and the expected losses to depositors and the deposit insurer if the bank should fail. Examples of this type of response include reducing risk exposure and increasing the capital base without taking offsetting measures that increase risks.

Studies of the theoretical determinants of bank capital levels suggest that taxes, deposit insurance, bankruptcy costs, and managerial incentives may play a significant role in determining the optimal level of bank capital. Further, theory suggests that attempts to raise new capital via stock issues could be costly to shareholders because such efforts signal that management has adverse news about the bank.

Empirical evidence on the effectiveness of capital regulation suggests that regulations have had a significant impact on most banks' capital ratios in the period since the 1981 numeric guidelines were imposed. Part of the increase in capital for some banks during at least part of this period appears to have been the result of cosmetic changes. Some theories and empirical evidence suggest that certain banks respond to higher capital ratios by increasing their risk exposure. However, none of the empirical evidence suggests that banks increased their portfolio risk exposure by so much that it more than offset the reduced risk from higher capital. The evidence also suggests that banks may have increased their regulatory capital by selling appreciated assets and delaying the recognition of losses.

Banks also have responded to the regulation by reducing their risk exposure and increasing their capital. Banks reduced their risk exposure via loan sales and perhaps by refusing to make new loans while allowing existing loans to be repaid. Further, banks issued new equity to help meet the regulatory guidelines even though these issues often reduced the price of existing shares, as predicted by some theories.

The next sections of this article review the theoretical determinants of changes in capital and the effectiveness of capital regulation. The article then considers the literature on cosmetic changes to capital ratios and on responses that increase the risk cushion.

*D*eterminants of Capital Strategy

In evaluating its capital position, a bank must consider both the static costs associated with any given capital ratio and the dynamic costs associated with adjusting it. The static costs, and possibly the dynamic costs, depend in part on the penalties regulators impose for inadequate capital ratios. Banks are similar to other corporations, however, in that they are subject to a variety of nonregulatory costs associated with the level and changes in their capital position.

Bank regulators have long considered the maintenance of adequate capital levels an important element of maintaining banks' safety and soundness. Banks with inadequate levels have been subject to a variety of penalties depending on the size of the deficiency, including (1) more frequent and longer examinations,

(2) moral suasion aimed at senior management and the board of directors, (3) denial of applications to acquire banks, (4) formal agreements with their regulator to raise capital and take other actions (such as suspending dividends until capital reaches acceptable levels), and (5) effectively forcing closure by withdrawing the bank's charter or its deposit insurance.

In addition to these penalties, provisions in FDICIA for prompt corrective action include a series of mandatory and optional penalties to be imposed on banks as their capital level declines. In many ways these provisions are not a dramatic change because they do not supply many new penalties and they continue to allow regulators to exercise substantial discretion in imposing penalties. In another sense, however, prompt corrective action is a significant change in that it reduces the potential for regulators to exercise forbearance for undercapitalized banks. Regulators are now required to specify a series of ranges of capital ratios and then choose from a menu of potential penalties associated with each range. Further, FDICIA mandates the development of risk-based insurance premiums, and a bank's capital level is currently one of the two determinants of the risk premium's size.

The regulatory pressure on banks to maintain capital levels is one-sided; regulators will protest capital ratios that are too low, but they virtually never complain about excessively high capital ratios. Market forces, however, could potentially impose varying costs based on both the level of a bank's capital and changes in the bank's capital structure. The theoretical starting point for analyzing market forces is Franco Modigliani and Merton H. Miller's (1958) demonstration that a firm's capital structure (the choice of its debt-to-equity ratio) does not affect its value in perfect markets. An implication of this model is that securities prices are an unbiased estimate of their intrinsic value and, hence, the timing of a sale and the type of security sold by the firm do not affect the value of the firm. Modigliani and Miller established not only the conditions under which capital structure is irrelevant but also conditions under which capital structure may be relevant.[9]

Building on a variety of studies analyzing nonfinancial corporations' optimal capital, Yair E. Orgler and Robert A. Taggart Jr. (1983) developed a market model of optimal capital structure for banks.[10] In their model, lower capital ratios provide banks with more favorable tax treatment and an increase in the value of their deposit insurance. Offsetting these benefits of lower capital ratios are the (eventual) diseconomies of scale in producing deposit services and the deadweight costs of bankruptcy that are partially borne by the banks' owners.[11] Mark J. Flannery (1994) argued that agency costs also may be an important determinant of bank capital structures.[12] Lower capital ratios impose desirable limits on management and reduce the need for shareholder monitoring. Conversely, lower ratios increase the incentives for bank shareholders to have managers undertake riskier projects and to reject some low-risk investments. These costs of reduced capital may be mitigated, Flannery argued, by having the bank issue deposits with very short maturities so that debtholders may take effective action if the bank adopts a high-risk investment strategy. Thus, Flannery contended that banks should issue very short-term debt and maintain low capital ratios (although they would not necessarily be undercapitalized by regulatory standards).

Ronald E. Shrieves and Drew Dahl (1992) and Joseph P. Hughes and Loretta J. Mester (1996) pointed to another agency problem that may influence banks' capital structure—managerial risk aversion. Most individuals are thought to be risk-averse, and there is no good reason for thinking that bank managers are more risk-averse than the average shareholder. However, bank managers have proportionately far more of their total wealth (including human capital) invested in their bank than do most shareholders, and, as a consequence, managers have more to lose from the bank's failure. Thus, bank managers may choose higher capital levels, given their risk exposure, than would be optimal from a shareholder's perspective. Hughes and Mester estimated bank cost functions that allowed for managerial risk aversion and found support for this hypothesis.

An implicit assumption of the static trade-off models of capital structure is that the cost of adjusting a bank's capital structure is zero. Recent work that focuses on information asymmetries between managers and investors has suggested, however, that the process of adjusting the capital ratio may convey important information to shareholders. An important part of the analyses of information asymmetries has focused on the issuance of new securities by corporations. Stewart C. Myers and Nicholas S. Majluf (1984) examined a firm's decision to issue debt or equity and concluded that the announcement to issue equity conveys negative information to the market about the firm's value. That is, a firm issues stock when its stock price is higher than management believes is the firm's intrinsic value and issues debt otherwise. Myers and Majluf's model suggests that firms generally prefer to issue debt rather than equity. Their hypothesis, stated in

general terms, is that actions implying that future earnings will be sufficient to generate adequate capital are a positive signal to shareholders while actions that imply future earnings will be insufficient are a negative sign. Their model approach has been extended to develop hypotheses about other methods of maintaining or raising capital ratios such as recognizing gains on appreciated assets—methods that do not include equity issuance.

Thus, theory suggests a variety of benefits and costs to shareholders associated with higher capital ratios. These benefits include a reduction in taxes, an increase in the value of deposit insurance, and an increase in bank managements' incentive to operate efficiently. The costs include increased dead-weight costs of bankruptcy, diseconomies of scale in producing deposit services, and incentives to take on excessive risk. Theory also suggests that the optimal level of capital from the managers' perspective may be higher than that desired by shareholders if managers are risk-averse. In addition, banks may not always be at their optimum level of capital if adjusting capital ratios is costly. Announcements of new capital issues may be viewed by the market as an adverse signal about the issuing bank's value and hence lead to a decline in the price of the bank's stock.

*D*o Banks Respond to Capital Regulation?

The question of whether banks respond to capital regulation hinges on two issues: Are regulatory capital requirements above those that the market would require for at least some banks? And are the penalties for falling below the regulatory guidelines large enough to induce banks to raise their capital ratios? For the purposes of this analysis, the relevant market requirement is not the standard that would be imposed in the absence of any government intervention but, rather, that which the market would require given the regulatory safety net that has been extended to banks, as noted by Allen N. Berger, Richard J. Herring, and Giorgio P. Szegö (1995). Empirical analysis of this issue may be divided into three periods: prior to the 1981 numeric capital standards, from 1981 to the passage of FDICIA in 1991, and post-FDICIA.

Several studies—Sam Peltzman (1970), John J. Mingo (1975), Alan J. Marcus (1983), and Dietrich J. Kimball and Christopher James (1983)—examined the effectiveness of capital regulations in the period before numeric standards were adopted in 1981. Their results, though mixed, tend to indicate that regulators were ineffective in influencing banks' capital ratios. A problem with interpreting these studies' results is that the regulatory requirements for any given bank organization were set on a case-by-case basis and the factors used to evaluate capital adequacy were likely to be highly correlated with those used by the market. A second problem is that the regulatory penalties associated with varying levels of capital inadequacy were not transparent.

The numeric capital standards imposed on most banks in 1981 gave outside observers (that is, anyone lacking direct access to supervisory reports) a clearer picture of regulatory expectations but failed to clarify the penalty function.[13] Dilip K. Shome, Stephen D. Smith, and Arnold A. Heggestad (1986) raised doubts about whether the 1981 standards were binding. For their sample of ninety-nine bank holding companies, the companies' market value was significantly positively related to their book-equity-to-total-asset ratio in 1981-82. However, this relationship became insignificant in 1983.

Michael C. Keeley's (1988) analysis suggests that the 1981 regulatory standards were effective in causing large bank holding companies with inadequate capital to raise their capital ratios. Keeley divided his sample into capital-sufficient banks (those that met the 1985 capital standards in 1981) and capital-deficient banks (those not meeting the 1985 standards in 1981). He showed that the capital-deficient banks raised their ratios during the 1982-86 period so that almost all met the standards by the end of the period.

A problem with analyzing Keeley's results is that the pressure for higher capital ratios could have come from regulators, as Keeley suggests, but it could also have come from market pressures, as Shome, Smith, and Heggestad's results imply. C. Sloan Swindle (1995) attempted to separate the relative roles of the market and regulators using the regulators' private capital adequacy ratings obtained from Thomas F. Cargill's (1989) study. Swindle's results suggest that banks with lower regulatory capital ratings have higher expected increases in their primary capital ratios. How successful Swindle was in separating market and regulatory effects depends on the degree to which the regulatory ratings contain private information that is not available to the market.[14]

In an attempt to sort out the relative importance of regulators and the market, Larry D. Wall and David R. Peterson (1987, 1988) estimated a pair of equations that allow for separate market and regulatory influence.

They assumed that either the market or regulators exercise a binding influence on any individual banking organization but that determining which influence is binding is an empirical question for any given organization. The two equations assume that a change in the capital ratio is a function of the difference between the optimal and the existing capital ratio. The market and regulatory equations were estimated simultaneously using a disequilibrium estimation technique that provides estimates not only of the equation parameters but also of the probability that capital changes at each bank are best explained by the market model. Wall and D. Peterson's (1987) results for bank holding companies suggested that most of them came from the regulatory regime (that is, their capital changes are best explained by the regulatory model) during the 1982-84 period. In their 1988 study, results for the lead banks of large bank holding companies also suggested that regulatory standards were binding for most banks between 1982 and 1984.[15]

The late 1980s and early 1990s saw several potentially important changes that may have increased both regulatory and market pressure on banks to maintain high capital ratios. The adoption of risk-based standards in 1988 saw increased regulatory interest in banking organizations' off-balance-sheet activities. The passage of FDICIA in 1991 clarified the penalties for banks with inadequate regulatory capital ratios. However, other developments may have led to increased market pressure. The FDIC's resolution of some large failed banking organizations forced some nondeposit creditors to absorb losses that led to increased risk premiums on their subordinated debt, according to Flannery and Sorin M. Sorescu (1996). Further, FDICIA called for the least costly resolution of failed banking organizations; that requirement has been taken to imply that the FDIC should not extend de facto deposit insurance to deposits over the de jure coverage level of $100,000.

To help clarify the relative roles of the market and regulators in the 1988-92 period, Wall and D. Peterson (1995) updated their prior disequilibrium analysis of changes in capital ratios, which assumed that the leverage ratio was the binding constraint rather than the risk-based capital ratios. Their results continued to show that the regulatory standards are binding for the majority of bank holding companies.

Thus, available evidence indicates that regulators have had significant influence on the capital ratios of a large proportion of banking organizations in the period since 1981. The next two sections look at the evidence on the extent to which these increases were merely cosmetic and the different ways that banks could provide real increases in their capital cushion.

Cosmetic Responses to Capital Regulation

Cosmetic changes in bank capital ratios are possible because the measures of both capital and risk are imperfect proxies for the economically relevant variables. Regulators cannot construct perfect measures as long as bank managers have private information about the value or risk of their portfolios. However, even granting the impossibility of perfect measures, the crudeness of current measures offers substantial opportunities for cosmetic improvements in capital ratios. Capital-to-total-asset measures (leverage standards) are easily defeated by reducing low-risk, high-liquidity assets and substituting a smaller quantity of higher-risk, lower-liquidity assets. The existing risk-based standards are slightly more sophisticated, but numerous flaws remain: The standards (1) require that most consumer and commercial loans carry the same risk weighting and do not allow for differing quality within asset classes, (2) do not explicitly incorporate any charge for most noncredit risks such as interest rate risk, and (3) do not explicitly take account of diversification across different types of risk or even across different credit risks. The opportunities for increasing regulatory capital arise because capital is measured using accounting conventions rather than accurate measures of true economic values. Yet a bank's economic capital will determine its long-run viability and the amount of losses to depositors and deposit insurers in the event of failure. Banks can exploit accounting conventions by accelerating the recognition of gains on assets with market value greater than book value while slowing the recognition of losses on assets with market value less than book value.

Changing Measured Risk. Banks may effectively offset an increase in the capital ratios used by regulators by increasing their risk exposure as long as their bank managers have private information that is unobservable to regulators about the riskiness of their credit customers or any of their other risk exposures. Whether bank shareholders would benefit from such risk-increasing activities has been the subject of an ongoing debate.[16]

Yehuda Kahane (1977), Michael Koehn and Anthony M. Santomero (1980), and Daesik Kim and Santomero (1988) showed that an increase in the required equity-

to-total-asset ratio by regulators may induce an increase or decrease in the portfolio risk taken by a bank. The rise in portfolio risk exposure may only partially offset an increase in capital or it may more than fully offset the increase so that the bank becomes riskier.

In a pair of studies, Frederick T. Furlong and Keeley (1989) and Keeley and Furlong (1990) argued that the framework used in prior studies is inappropriate. The problem is that the prior studies took the expected cost of deposits as a constant that is independent of the bank's capital position or risk. At first this assumption might seem reasonable given that deposits are insured and deposit insurance premiums could not be risk-based by law at that time. The assumption of independence is wrong, however, because it ignores the states in which the bank fails and the FDIC pays for the deposits. When the model was adjusted so that the cost of deposits is a decreasing function of the risk of failure (because the FDIC pays depositors when the bank fails), then the results of prior studies did not hold. Banks' incentive to take more risk is greatest at low capital levels, and the incentive decreases as capital increases. One important limitation of these two studies is that banks continue to have an incentive to maximize risk in their models; an increase in capital merely reduces the magnitude of the gains from risk-taking.

Gerard Gennotte and David Pyle (1991) incorporated an adjustment for the value of deposit insurance as suggested by Keeley and Furlong but also allowed for the expected return on an asset to decrease as a bank increases its holdings. Gennotte and Pyle found that if an interior optimum for size and risk exists, then a rise in capital levels will lead to increased investment in the risky asset and a greater probability of failure. Robert B. Avery and Berger (1991) argued that, even if Gennotte and Pyle's results for increased risk of default hold, the expected losses to the deposit insurer are decreasing in the absence of dead-weight liquidation costs of failure or extreme assumptions about the distribution of asset returns.

Sarah B. Kendall (1991) pointed out that other models of banks' incentive to take risk assume that only two end-of-period states are possible: (1) the bank is solvent and hence incurs no penalty or (2) the bank is insolvent and is closed. She noted that a bank could remain solvent but so undercapitalized that it incurs a regulatory penalty. She found that an increase in regulatory capital requirements has an ambiguous impact on its incentive to take more risk depending on its financial condition.

Paul S. Calem and Rafael Rob (1996) developed a model of changes in banks' asset choice and capital ratios. They then simulated the model using parameters estimated over the 1984-93 period. They first considered bank behavior given a constant deposit insurance premium. In this case they found a U-shaped response of bank risk-taking in response to higher capital requirements. Severely undercapitalized banks take more risk in an attempt to return to adequate capital. Banks with minimally adequate capital reduce their risk exposure to reduce the risk that losses will cause them to be undercapitalized. Well-capitalized banks increase their risk exposure to offset the increase in capital. The effect of higher risk-based capital requirements depends on how strong the response of the requirements is to risk (how stringent the requirements are in their terminology). If higher risk-based requirements are not too stringent, they act like higher standards that are not risk-adjusted. However, more stringent standards will reduce portfolio risk. Finally, Calem and Rob considered an ex post penalty for taking losses in the form of ex post risk-based insurance premiums. They found that risk-related premiums had the effect of increasing the range of capital values over which undercapitalized banks took more risk. The risk-related premiums had no impact on better-capitalized banks.

While the theoretical evidence is mixed, the empirical evidence generally suggests that higher capital standards may be at most partially offset by increased risk but do not increase the probability of failure. Shrieves and Dahl (1992) found that, for commercial banks with assets of more than $100 million during the 1983-87 period, an increase in capital is associated empirically with an increase in risk. Their evidence suggests that this relationship is true even for banks for which the regulatory capital ratios are not binding; however, this finding suggests that bank managers may be varying risk and leverage to hit some target for variability of equity. Mark E. Levonian (1992) found similar evidence that bank holding companies with traded options in the late 1980s showed both increased asset risk and capital, resulting in little change in the FDIC's expected losses.

Evidence against the hypothesis that higher capital levels lead to an increase in risk comes from two types of studies: studies of bank failures and studies of banks' involvement in off-balance-sheet activities. Berger, Herring, and Szegö (1995) summarized the findings of the bank failure literature concerning bank capital: "Virtually every bank failure model finds that a higher equity-to-asset ratio is associated with a lower future probability of failure."

Off-balance-sheet items are relevant to the issue of how banks respond to higher capital levels because the

1981 capital standard did not incorporate off-balance-sheet items. Banks seeking to offset the 1981 capital requirements via higher risk could do so by substituting off-balance-sheet items for on-balance-sheet items. Julapa Jagtiani, Anthony Saunders, and Gregory Udell (1995) found that changes in the capital requirements for banks have no consistent impact on the diffusion of off-balance-sheet activities. One caveat in interpreting the analysis of off-balance-sheet activities is that these activities may themselves create countervailing pressure for better capitalization. That is, in almost all cases, banks create a contingent liability to their customers that is valuable to the customers only if the bank can meet any obligation that arises from the off-balance-sheet transaction. Given that off-balance-sheet items are not covered de jure by deposit insurance, bank customers have an incentive to price their off-balance-sheet transactions in a way that reflects the risk that the bank's capital will ultimately be inadequate. G.D. Koppenhaver and Roger D. Stover (1991) found that capital and stand-by letters of credit are jointly determined, with higher levels of the former associated with higher levels of the latter. This result is consistent with the hypotheses that banks offset higher regulatory capital requirements by taking more risk and that off-balance-sheet customers demand higher capital ratios.

In evaluating its capital position, a bank must consider both the static costs associated with any given capital ratio and the dynamic costs associated with adjusting it.

Recognizing Changes in the Market Value of Assets. At any given time, a bank is likely to have some assets that have appreciated in value from their original acquisition cost and others that have declined in value. Yet generally accepted accounting principles (GAAP) and regulatory accounting generally record assets at historic cost rather than at their current market value. Thus, regulatory capital may differ substantially from the economic capital available to support the long-run viability of a bank and reduce losses should it fail. A bank can boost its regulatory capital by accelerating the recognition of gains or losses for assets by selling them, achieving the effect of marking these assets to market. Further, banks have some discretion in the timing of setting aside reserves for bad loans. Thus, a seemingly low-cost way for a banking organization to maintain or increase its regulatory capital ratios is to avoid recognizing losses on depreciated assets and accelerate recognition of gains on assets that have appreciated in value.[17]

Myron B. Slovin, Marie E. Sushka, and John A. Polonchek (1991) recognized the potential for increasing regulatory capital through banks' sale-and-leaseback transactions (for example, selling their headquarters building to outside investors and simultaneously leasing back the building) and divestitures. They argued, however, that these transactions may also send a negative signal to the financial markets about the value of existing assets and the bank's future earnings prospect. Banks with favorable information about their future prospects can, at least within certain ranges of regulatory capital ratios, signal their good news by not selling assets but rather waiting for future earnings to boost their capital. Banks with unfavorable information may find the do-nothing strategy too costly and be forced to engage in these transactions or take other action to boost capital. Slovin, Sushka, and Polonchek (1991) studied sale-and-leaseback transactions and divestitures for banking organizations during the period from 1974 to 1988. Prior studies of nonbank sale-and-leasebacks and divestitures had reported significantly positive abnormal returns to the sellers. In contrast, Slovin, Sushka, and Polonchek found significant negative prediction errors for sale-and-leasebacks and insignificantly positive prediction errors for divestitures. These results support their hypothesis that asset sales represent unfavorable information to investors.

In terms of recognizing losses, evidence suggests that banks manage their loan-loss allowance (reserves). If loan-loss reserves depend solely on expected future losses and they summarize all available information, then they alone should be sufficient to predict future loan charge-offs (the writing off of specific loans). Berger, Kathleen Kuester King, and James M. O'Brien (1991) showed, however, that in predicting the current value of charge-offs the information about lagged nonperforming loans adds significantly to that obtained from the loan-loss allowance. Mary Brady Greenawalt and Joseph F. Sinkey Jr. (1988) showed that loan-loss provisions are used for

income smoothing but did not look at their use for managing capital levels.

One potentially instructive case of banks deferring recognition of reductions in asset values involves banks' loans to Latin America. During the early and mid-1980s a number of large banks experienced a significant reduction in the value of their Latin American loan portfolios, but many of the largest banks did not fully recognize these losses until the late 1980s. Several studies examined the response of bank stock returns to various announcements related to their Latin American loan portfolios. Although securities markets quickly incorporated the implications of various moratoriums and reschedulings into stock returns, the banks took longer to recognize the reduction in values on their GAAP accounting statements.[18] Thus, the purpose of the delay was unlikely to have been an attempt to hide the losses from securities markets. Slovin and Subbarao V. Jayanti (1993) provided evidence consistent with concern about capital exposure. They examined banks' excess stock returns around the times of the Mexican debt moratorium (August 19, 1982) and the Bolivian debt moratorium (May 31, 1984). The set of banks with exposure to each of these countries is broken into two groups: (1) those with adequate regulatory capital ratios and (2) those with inadequate capital ratios. Slovin and Jayanti found that banks with inadequate capital suffered significantly more adverse stock return reactions than did banks with adequate capital. Although loan-loss reserves were formally counted as a part of regulatory capital at this time, Slovin and Jayanti interpreted this fact as suggesting that the market believed that banks with inadequate capital would need to issue new capital, cut dividends, or reduce their asset base. James J. Musumeci and Sinkey (1990) reached a similar conclusion for the announcement of the Brazilian experience (February 20, 1987) using market value (but not book value) capital ratios.

Analyzing the recognition of changes in securities values may be especially interesting because securities may have either gains or losses and trade in relatively liquid markets.[19] Myron S. Scholes, G. Peter Wilson, and Mark A. Wolfson (1990) examined the recognition of securities gains and losses by a sample of mostly very large banks that are on *Bank Compustat* data tapes. They found evidence that banks with lower capital ratios are likely to have smaller recognized losses or larger recognized gains than banks with higher capital ratios. Mark Carey (1994) examined more than 6,000 commercial banks' sales of securities from their investment portfolios, or gains trading. He found that most gains trading is done to boost current earnings or to smooth earnings. Relatively few banks appear to engage in gains trading to boost their capital account, and the magnitude of such trading appears to be small. Carey also found little evidence that gains trading increases bank risk. Perhaps one important reason that gains trading is not done to boost capital is revealed in Carey (1992). He found that gains trading does not improve examiners' evaluations of a bank. Indeed, gains trading tends to reduce a bank's CAMEL rating (see note 14). Carey found that gains trading does not have a favorable effect on the firm's stock price. He suggested that gains trading may be motivated by managerial compensation contracts that emphasize accounting earnings, and he provided some weak evidence to support this hypothesis.

Summary of Cosmetic Changes. One type of cosmetic change that banks may make to their regulatory capital ratios is to increase their capital but at the same time increase their risk. Whether the increase in risk will more than offset the rise in capital and increase their probability of failure is unclear. The empirical evidence provides some indication that increases in capital are partially offset by greater risk-taking. However, none of the empirical studies indicate that higher regulatory capital requirements actually increase banks' risk of failure or the likely losses to depositors and deposit insurers in the event a bank failed. One potentially useful area for empirical work is to test the hypothesis in Calem and Rob (1996) that a bank's response to higher capital requirements may depend in part on their initial capital ratios.

Another type of cosmetic change involves raising regulatory capital levels in ways that do not increase the market value of capital. Examples of such actions include accelerated recognition of gains (but not losses) via sale-and-leaseback transactions, gains trading with securities, and deferring recognition of loan losses. These actions may sometimes circumvent the regulators. However, some empirical evidence suggests that the market can see through these accounting gimmicks, interpreting them as signs of likely weakness in future earnings and accordingly reducing the stock price of the bank.

Regulators cannot prevent all cosmetic changes to capital ratios, but they should be able to adjust regulatory requirements to offset banks from gaining material improvements through cosmetic changes. In principal, regulators could eliminate all cosmetic changes to equity by requiring mark-to-market accounting. However, Berger, King, and O'Brien (1991) pointed out that market value is an ambiguous concept and some of the

more relevant definitions of market value are not subject to perfect measurement. Nevertheless, they noted substantial opportunities for regulators to adjust for cosmetic changes to capital. Similarly, regulators could, in principal, eliminate all incentives for banks to increase their risk exposure by evaluating the riskiness of each bank's total portfolio. Such measures do not exist, however, and may not be attainable as long as management has private information about the riskiness of its assets. However, regulators can identify many of the strategies a bank can follow to increase its risk, and their ability to identify material increases should be enhanced by focusing more on banks' risk management procedures. Moreover, once regulators identify cosmetic changes to capital ratios, they can, at least in the United States, impose higher capital requirements to offset the cosmetic changes.

*E*ffective Increases in the Capital Cushion

A bank may provide an effective increase in its capital cushion when that is the cheapest alternative or when regulators give the bank no choice. The increase may stem from reducing the bank's risk exposure or increasing its capital levels.

Wayne Passmore and Steven A. Sharpe (1994) analyzed banks' response to inadequate regulatory capital levels in a model in which banks cannot avoid the regulations by making cosmetic changes to capital ratios. Their analysis suggested that the reason a bank is undercapitalized influences the bank's response and that the time horizon under consideration is also important in some cases. Loan levels decline in the short run (before equity capital levels can adjust) in response to a variety of causes of undercapitalization, including an increase in the risk weighting on loans, an increase in the leverage requirement, or an exogenous capital shock. However, some of these causes may spur a short-term rise in securities holdings. The most striking short-run versus long-run difference relates to exogenous capital shocks, which in the long run has no effect on the size or distribution of a bank's portfolio.

Passmore and Sharpe also analyzed one other important case, that of a decline in loan demand. Ordinarily a decline in loan demand would be considered a drop in the quantity of loans demanded at the going contract rate of interest on loans. From the bank's perspective, however, another equally valid interpretation is that the quantity of loans demanded at the going contract rate is unchanged but that the bank's expected rate of return at the going contract rate has dropped because the bank anticipates a higher default rate. The second interpretation is especially relevant when considering the impact of sudden declines in the capital level given that the declines are often caused by an increase in default rates on outstanding loans. A decrease in loan demand by itself causes a short- and long-run decrease in loans, a short-run increase in securities, but no long-run change in securities holdings.

Reducing Risk Exposure. Banks may reduce their actual risk exposure in a variety of ways, including reducing the volume of risky financial activities and investing in financial instruments with low or negative correlations with their existing portfolio (that is, engaging in diversification or hedging). In order to improve their regulatory capital ratios, however, banks must reduce their volume of risky financial activities. Risk reduction through greater diversification and hedging is not explicitly incorporated into the capital standards.

The literature on risk reduction to enhance regulatory capital ratios focuses on banks' reducing the size of their asset portfolios, especially their lending portfolios. Banks may reduce their portfolios either directly by selling off existing loans with other financial intermediaries or indirectly by first converting loans into securities (a process called securitization). Alternatively, banks may shrink their portfolios by refusing to make new loans that have a positive net present value and allowing loan repayments to shrink the portfolios. From a social perspective, it is likely that some type of loan sale is preferable to banks' refusing to make positive net present value loans.

Loan Sales. Loan sales have the potential for improving banks' regulatory capital ratios.[20] Potential loan buyers must worry, however, that the selling bank will sell loans that are of lower quality than the buyer expects and will not adequately monitor the loan after it has been sold. One way of alleviating buyers' concerns is for the seller to retain the risk exposure via a recourse agreement or by having the seller retain a junior claim on a fraction of the loan. The regulatory capital requirements are structured, however, so that a selling bank's capital requirement is not reduced to the extent that the sale of a loan does not reflect a reduction in the seller's credit exposure. For example, if a bank sells 80 percent of a loan but retains 99 percent of the credit risk then the bank will get little or no reduction in its capital requirement.

Gary B. Gorton and George G. Pennacchi (1995) suggested that the incentive for sellers to cheat loan

buyers may be reduced if the seller retains a fractional interest in the loan and desires to maintain a good reputation so that it can engage in future loan sales. Sellers will face reduced capital requirements if the credit risk that is transferred is proportionate to the amount of the loan; for example, if a bank sells 80 percent of a loan with the buyer assuming 80 percent of each dollar of credit losses, then the selling bank need only include the remaining 20 percent of the loan amount in its regulatory capital ratio calculations.

Most of the theoretical analysis of the implications of capital requirements for loan sales focuses on the choice of retaining or selling newly originated loans. Charles T. Carlstrom and Katherine A. Samolyk (1995) suggested that bankers will sell loans even if they cannot precommit to good behavior if the gains from selling are large enough. Kathleene K. Donahoo and Sherrill Shaffer (1991) showed that small changes in capital requirements will not cause banks to start loan sales programs but may increase the volume in existing programs. Large increases may cause banks to enter the market as loan sellers. Flannery (1989) argued that the type of loan sold may depend in part on how regulators treat it. His particular focus was the effect of the supervisory evaluation of loan quality on the incentive to make and retain certain types of loans. However, he noted that his argument also applies to banks' choice of which loans to sell.

Empirical evidence from Christine Pavel and David Philis (1987) suggested that banks subject to binding capital regulation are more likely to sell loans. Katerina Simons (1993) documented the effectiveness of alternative mechanisms in preventing sellers from taking advantage of buyers. She found that the proportion of the loans retained increases monotonically as the ex post quality of the loan declines.

Reducing the Amount of New Loans. Most analyses of reductions in bank lending have focused on the period in the late 1980s and early 1990s that is sometimes called the credit crunch. A major issue in the credit crunch literature is whether binding capital constraints (induced by higher standards or weakened capital bases) resulted in a reduction in bank lending, especially to customers with limited nonbank alternatives. Early analysis identified, and in some cases tested, a variety of possible explanations for the decline in lending, including a reduction in loan supply due to (1) adverse shocks to capital combined with binding regulatory requirements, (2) adverse shocks to capital combined with market pressure for higher capital, (3) an increase in regulatory capital requirements, and (4) less favorable treatment of loans for the purpose of calculating regulatory capital requirements. Other explanations for the lending declines might be reductions in loan demand due to (1) a perceived decrease in expected loan repayments, (2) a weaker economy, (3) a secular decline in bank's market share, and (4) banks' higher capital levels.[21]

Determining which of the above factors contributed to the credit decline is impossible a priori because all of them can be supported by changes in the economic environment in the early 1990s. One complication for empirical analysis is that the explanations are not mutually exclusive, so the real question is not which explanations are true but rather what were their relative contributions to the decline. Recent empirical work has focused on multivariate, cross-sectional studies to sort through the various explanations to the extent permitted by the data. Several studies document the shocks to capital in the early 1990s. For example, Diana Hancock, Andrew J. Laing, and James A. Wilcox (1995) showed that the capital shocks for their sample of large banks were twice as large in the early 1990s. Studies by Shrieves and Dahl (1995) and Hancock, Laing, and Wilcox (1995) found that bank portfolios were more sensitive to these shocks in the early 1990s than in the late 1980s . Thus, capital shocks appear to have played at least a partial role in the decline in lending.

While loan losses appear to have contributed to the decline in lending, the impact of the shocks may have been increased if banks' target capital levels rose because of regulatory or market pressure. One source of possibly increased regulatory pressure was the imposition of risk-based capital guidelines in the late 1980s in addition to a leverage (capital to total assets) standard. The risk-based capital standards focused on credit risk, imposing full capital charges on most types of lending to private firms and individuals but smaller charges (in some cases no charge) for many types of securities. Thus, these standards could have caused banks to reallocate their portfolios from loans to securities. While the imposition of risk-based capital guidelines could provide a partial explanation, empirical analysis by Berger and Udell (1991) found little support for a drop in lending related to risk-based capital.

While the imposition of risk-based capital standards does not appear to be an important factor, an increase in market or regulatory leverage targets appears to have occurred in the early 1990s. Shrieves and Dahl (1995) calculated mean target capital ratios for banks using (1) parameters estimated using 1985-89 data and mean values of the explanatory variables in 1990 to 1991 and (2) parameters and mean values of explanatory

variables from 1990 to 1991. They found that the capital targets were higher using the parameters estimated from the 1990-91 data. Thus, the evidence suggests that in 1990-91 banks had higher capital targets and their loans adjusted more rapidly to capital shocks (including any reduction in lending demand).

However, Steven A. Sharpe's (1995) critical review raised a number of questions about what conclusions may be drawn from this literature. One especially important issue he pointed to is that the capital shocks resulted from loan losses, and these loan losses in turn may signal a decline in the profitability of lending. Thus, Sharpe found it difficult to develop an unambiguous interpretation of the credit crunch papers he surveyed. Consistent with this critique, one could ask, If the problem was due solely to capital constraints, why did the banks not use the loan sales market to fund the loans?

Because banks may respond to binding regulations in a variety of ways, regulators need to consider what response they want to elicit when formulating new regulations.

If regulatory capital requirements played an important role in the credit crunch, then an important question is whether the changes in capital targets were due to changes in regulatory or market pressure, an issue that is outside the scope of the above credit crunch papers. Evidence that regulatory pressure was the dominant factor for at least some banks comes from Joe Peek and Eric S. Rosengren (1995), who focused on lending by banks in New England that were subject to a formal regulatory mandate to improve their capital ratios. Their findings suggest that banks subject to formal orders sought to increase their capital ratios by reducing their loan portfolio significantly faster than banks that were not under a formal order, even after allowing for differences in capital ratios. Two types of additional evidence come from Wall and D. Peterson (1995). First, as previously noted, they found that most banks in their sample had a high probability of coming from the regulatory regime. Further, they found evidence, consistent with Peek and Rosengren's, that banks subject to a formal regulatory order to improve their capital adjusted toward their capital targets at a faster rate than did banks not subject to an order.

Increasing Capital Levels. The other way that banks may effectively increase their capital cushion is by increasing their regulatory capital. Banks can do so by increasing their retained earnings or issuing new securities. An efficiently run bank is already maximizing its profits given its risk level, so the only way it can increase its retained earnings is by taking more risk (which would initially decrease its effective capital cushion) or reducing its dividends. The types of securities a bank can issue to satisfy its regulatory capital requirements have varied over time. The capital standards have given full weight to common and preferred stock issues, including them in their most limited definitions of capital (core capital). The 1981 standards also counted a type of debt security called mandatory convertible debt (debt that had to be refunded with common or preferred stock) as an element of core capital (called primary capital). More recent standards consider mandatory convertible debt an element of total capital (tier one plus tier two capital), not as an equity issue in core capital. Subordinated debt has been included as an element of total capital but not as an element of core capital in the various post-1981 standards.

An understanding of banks' decision to increase regulatory capital comes from two types of studies: (1) those that examine banks' decision to increase their capital and (2) those that focus on stock market reactions to banks' announcements of plans to issue new capital. Connecting the results of these two types of studies is difficult because the studies of decisions to issue new capital focus on banks whereas the stock market reaction studies focus primarily on bank holding companies. Banks that issue capital directly to the market are generally too small to have widely traded stock issues. In contrast, larger banks typically issue capital to their bank holding company parent, which may or may not have issued a capital instrument to fund the purchase.

Dahl and Shrieves (1990) analyzed 753 equity capital issues occurring during 1986 and 1987. They divided their sample along two dimensions: (1) adequately capitalized (a total capital ratio greater than 7 percent) versus undercapitalized banks (a ratio below 7 percent) and (2) independent banks versus banks affiliated with one-bank holding companies versus banks affiliated with multibank holding companies. The sample of holding company banks was subdivided be-

cause independent banks issue securities to the market whereas affiliated banks often issue securities to their parents as noted above, and holding company banks may be managed as part of an integrated unit rather than as stand-alone entities. Not surprisingly, Dahl and Shrieves found that, by regulatory standards, undercapitalized banks are more likely than adequately capitalized banks to issue capital. Further, to gauge the importance of regulatory pressure they calculated, using an equation estimated with only adequately capitalized banks, the probability that an undercapitalized bank will issue capital. They found that undercapitalized banks issue equity more often than would be predicted for similar yet adequately capitalized banks.

Dahl and Michael F. Spivey (1995) examined banks during the 1981-88 period that were undercapitalized according to standards used to implement the prompt corrective action provisions of FDICIA. Their goal was to determine which actions were most likely to result in the bank reaching an adequate capital level by the end of 1989. The study found that less than one-quarter of undercapitalized banks, pre-FDICIA, paid dividends and that dividend payments were not statistically significantly related to the probability of recovery. In contrast, a bank's survival was significantly related to capital injections into the bank, a decision that is under the control of the firm's managers. As Dahl and Spivey pointed out, owners are unlikely to inject capital into banks that will probably be closed by the regulators. Dahl and Spivey's results also suggest that expense control (salary and occupancy expense and interest expense) is significantly related to whether, but not how quickly, a bank becomes adequately capitalized.

Analyzing stock market reactions to bank capital issuance decisions may provide more insight into the private costs of raising new capital. Wall and Pamela P. Peterson (1991) reviewed bank holding companies' decisions to issue several types of new securities between 1982 and 1986. They found significantly negative abnormal returns for common stock but not for preferred stock, convertible debt, mandatory convertible debt, and subordinated debt. They found that the common stock returns were significantly lower than those for mandatory convertible debt (at the 5 percent level) and preferred stock (at the 10 percent level). After further analysis of the characteristics of the issuing firms and the abnormal returns, Wall and Peterson concluded that their results are best explained by a Myers and Majluf-type (1984) model.

The hypothesis that common stock issues may signal adverse private information is supported by Slovin, Sushka, and Polonchek (1992), who analyzed the effect of the issuance announcement on the stock returns of the issuing bank holding companies' competitors. The researchers focused on the issuance decision by money center banks in the United States during the period from 1975 to 1988 and analyzed three groups of competitors: other money center banking organizations, a sample of regional banking organizations, and a sample of investment banking firms. They found that all three groups of competitors showed significantly negative abnormal returns in the wake of the securities issuance announcement. In contrast, similar analysis of the stock returns of the competitors of industrial firms revealed no significant market response on the part of the competitors. These results suggest that the decision to issue common stock may have signaled the market that it overvalued the assets of large financial firms.

Marcia Million Cornett and Hassan Tehranian (1994) suggested another way to look for evidence that bank holding companies' common stock issues signal adverse information. They compared the abnormal stock returns of issuing bank holding companies that have capital ratios below regulatory requirements with those of issuing bank holding companies that have adequate regulatory capital ratios. Bank holding companies with capital ratios above the regulatory requirements are likely to be voluntary issuers that could avoid issuing new capital if their managers thought their stock was undervalued. In contrast, bank holding companies with capital levels below the regulatory requirements may have been involuntary issuers of capital in the sense that the regulatory costs of not issuing new capital would exceed any losses from issuing stock that management believed was undervalued. Cornett and Tehranian's results support the hypothesis that voluntary common stock issues had significantly lower abnormal returns than did involuntary issues. The abnormal returns associated with other types of capital issues are insignificant for both the voluntary and involuntary samples.

Summary of Effective Increases in the Capital Cushion. Banks can increase their regulatory capital ratios and their true capital cushions by shrinking their loan portfolio. One way to shrink the portfolio is to sell loans to other financial intermediaries. A possible problem with such sales is that the buyers will discount the loans to reflect the possibility that the seller may be trying to unload its weaker loans. To offset this concern, banks selling loans tend to sell more of their higher-quality loans. Another way of shrinking the portfolio is to refuse to make good new loans while

accepting repayment on outstanding loans. The extent to which this practice has occurred is difficult to measure, however, because banks that have had adverse shocks to their capital may also be in markets with few good lending opportunities. Banks may also increase their regulatory capital ratios by issuing new capital instruments.

One theme that arises in both the discussion of cosmetic changes and the discussion of new capital instruments is that of the stock market's reaction to different ways of meeting the capital regulations. The market rewards banks that can meet capital requirements through profits from ordinary operations without relying on cosmetic accounting changes. On the other hand, banks that must resort to accounting gimmicks or new capital issues are viewed as signaling weak future profitability, and their stock prices drop to reflect that adverse signal.

Conclusion

Bank capital ratios have become a primary measure of banks' financial condition as a result of international efforts to achieve a degree of harmony in bank supervisory rules across countries and the inclusion of prompt corrective action in FDICIA. If this focus on bank capital is to continue, then a better understanding of banks' responses to binding capital regulation would be valuable.

One question about which little is said in this article is, What determines banks' choices from the menu of alternatives when they are confronted with binding regulation? Given that banks are likely to choose the option that has the lowest long-run costs, a better way of stating the question is, What determines the relative magnitudes of cost associated with each of the alternatives? More research on this topic would be desirable.

Because banks may respond to binding regulations in a variety of ways, regulators need to consider what response they want to elicit when formulating new regulations. Presumably the regulations are being imposed to reduce the risk of a systemic problem and the expected losses of the deposit insurance agency. If so, then regulations that encourage cosmetic responses are, by definition, unlikely to accomplish regulatory goals. Whether regulators should care whether banks meet the regulations by reducing the volume of their risky activities or by increasing their capital is less obvious. On the one hand, one could easily imagine circumstances under which a reduction in bank lending would be considered undesirable in the short run. However, pressing banks to undertake the alternative of increasing capital might be even more costly in the long run. A third alternative, which is not feasible under the current guidelines, would be to allow banks to reduce risk exposure by increased diversification or hedging. This option could prove to be the least costly to banks and society in many instances.

Notes

1. For a long-term perspective on bank capital levels, see Kaufman (1992).
2. For a broader discussion of capital regulation see Berger, Herring, and Szegö (1995).
3. For a survey of systemic risk issues both prior to and after the passage of the Federal Deposit Insurance Corporation Improvement Act of 1991, see Wall (1993).
4. Marcus (1983) argued that regulators were successful in preventing any one bank from reducing its capital ratios substantially below the industry average yet were unable to prevent the industry as a whole from ratcheting their capital ratios downward.
5. For a review of the 1981 capital standards, see Wall (1989).
6. For a discussion of the 1988 risk-based standards, see Wall (1989).
7. See Wall (1993) for a discussion of the act.
8. Selling an asset that has appreciated in value may reduce the economic capital of a bank by accelerating the tax the bank pays on its earnings from the asset.
9. See Miller (1995) for a discussion of the relevance of Modigliani and Miller's propositions to banking.
10. For example, see Modigliani and Miller (1963), DeAngelo and Masulis (1980), and Masulis and Trueman (1988) on income taxes and Baxter (1967) and Kraus and Litzenberger (1973) on bankruptcy costs.
11. Diseconomies of scale exist if an increase in volume results in an increase in average unit costs. Dead-weight losses of bankruptcy are costs that arise solely because of the bankruptcy and provide no social value. An example of a dead-weight cost would be the legal costs arising from a bank's failure.
12. See Jensen and Meckling (1976), Barnea, Haugen, and Senbet (1981), and Jensen (1986) for a discussion of agency costs in more general settings.
13. However, even with the setting of numeric targets, the regulatory requirements were not perfectly transparent because supervisors could set higher requirements on a case-by-case basis.

14. Cargill (1989, 357) analyzed the contribution of CAMEL ratings in explaining bank certificate of deposit (CD) rates. (CAMEL [capital, assets, management, earnings, and liquidity] ratings are an index used by examiners to summarize their evaluation of a commercial bank.) He concluded that "confidential CAMEL ratings assigned to banks on the basis of on-site examination are largely proxies for market information." However, CD rates cannot be used to determine whether CAMEL ratings reflect the results of confidential, on-site examinations because by definition this information would not be known to the market. All that can be said is that CAMEL ratings do not contain publicly available information that is not already incorporated in Cargill's other explanatory variables.
15. Bank holding companies and banks are treated separately because some of the factors influencing the two capital ratios may be different. For example, a bank holding company's consolidated capital ratio is likely to influence the firm's tax liability, whereas a subsidiary bank's capital ratio may not influence the bank holding company's overall tax liability. For example, a bank holding company may issue debt and pass it along to a subsidiary bank as equity or issue equity and pass it along as debt.
16. Management may not choose riskier portfolios even if they increase shareholder wealth if managers and shareholders have divergent interests. Noe, Rebello, and Wall (1996) showed how a combination of regulatory policies for bank closure and management compensation may be used to discourage management from following higher risk strategies, even when these strategies are optimal for shareholders.
17. Studies of troubled nonbank firms suggest that managers may make judicious choice of accounting treatments either to avoid violations of debt covenants or to win concessions from unions or the government. Several studies indicate that the closer a firm is to violating its debt covenant restriction, the more likely that the firm's management will select income-increasing accounting choices (Christie 1990, DeFond and Jiambalvo 1994, Skinner 1993, and Sweeney 1994). There is some evidence that firms in financial difficulty may make income-decreasing choices if the lower income increases the likelihood of winning concessions from unions or the government (DeAngelo, DeAngelo, and Skinner 1994).
18. For example, see Smirlock and Kaufold (1987), Bruner and Simms (1987), and Mansur, Cochran, and Seagers (1990).
19. A recent decision (FAS 115) by the Financial Accounting Standards Board effectively requires banks to mark most of their securities portfolio to market for the purposes of determining their capital as measured by generally accepted accounting principles.
20. See Berger and Udell (1991) for a more extensive review of the securitization literature.
21. For a review of many of the issues associated with the credit crunch see Federal Reserve Bank of New York (1994).

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Do State and Local Taxes Affect Relative State Growth?

Zsolt Becsi

The South has experienced a remarkable economic awakening over the past thirty years, with southern states growing at phenomenal rates. At the same time, these states have had, on average, low state and local taxes, and it seems reasonable to infer that tax policies may have contributed to their relative success. However, while policymakers may believe that taxes matter for growth, until recently economic theory suggested otherwise. It was believed that much of long-term growth is determined by automatic forces of convergence, which moved southern states toward catching up with the rest of the nation. But as theoretical growth models have grown more sophisticated, it has been increasingly recognized that the two explanations for the South's strong showing may not be mutually exclusive.

In brief, growth models once assumed that long-term growth was exogenous, or determined by demographic and technological factors but not subject to policy influence. In particular, under this assumption taxes could have only short-term effects on growth rates.[1] Given the same resources and access to technology and mobile inputs of production for all states, the models implied that all should converge over time to a common long-run, steady-state growth rate. More recent models of economic growth allow growth rates to be endogenous, or, simply put, see shocks, including tax policy, as influencing demographic and technological variables. Under certain conditions, taxes may have permanent effects on growth, and convergence is not automatic. Because policies can affect long-term growth, economists are again taking this research seriously. And since convergence need not be automatic, researchers are developing models that go beyond convergence to explain the different growth experiences of regions.

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The empirical literature has tried to resolve the question of whether growth is exogenous or endogenous. Much testing has focused on one particular implication of the simplest exogenous growth models, namely, convergence. Within this framework, some studies have examined the growth effects of taxation, mostly across countries. Evidence that taxes have long-term growth effects is sometimes thought to be evidence against convergence. However, less work has been devoted to determining whether state and local taxes affect relative state growth in the United States and, if so, how strong the effects are. So far the evidence for negative and significant tax effects on growth across countries and across U.S. states has been mixed.

To sort out the main issues, this article presents an overview of relative state growth and relative state and local taxation from 1960 to 1992.[2] After a brief discussion of the theoretical issues, the article surveys simple—but revealing—correlations across states and across time that characterize states' experiences. The correlations indicate convergence, but they also imply that shocks matter for long-term growth. Tax rates are negatively related to growth and are sufficiently variable over time to reasonably explain variations in growth rates. This observation holds true when using average tax rates (ATRs), which describe the relative size of state and local revenues, and, more importantly, for marginal tax rates (MTRs), which measure the effects of a tax system on individuals' choices and ultimately on growth. Since aggregate marginal tax rates for each state are difficult to obtain, they are estimated using a method by Reinhard B. Koester and Roger C. Kormendi (1989).

While the simple correlations are revealing, they are not conclusive. Correlations do not separate out the effects of other influences on growth rates and taxes. For instance, while convergence affects growth rates it may also have a separate effect on tax rates. Because they control for the effects of other explanatory variables, multivariate regressions are useful for separating out, or identifying, the growth effects of taxes. A survey of the empirical literature shows what researchers have done to isolate these effects.

This article argues that the evidence on the growth effects of taxes has been mixed because empirical models imperfectly separate the growth effects of other government policies that occur simultaneously with tax policies. Thus, the estimated tax effects are impure. While a few researchers have grappled with this problem, the solutions offered do not identify tax effects. One purpose of this article is to demonstrate a simple way to get a more nearly accurate specification. Application of the new insights yields regressions in which relatively higher tax rates are found to have a significant negative effect on relative growth rates. At the same time there is evidence for convergence. The final section reviews the results of the regressions performed and summarizes the underlying theoretical considerations.

*F*acts on Growth

Personal income is measured in nominal terms (not adjusted for inflation), which may overstate real (inflation-adjusted) differences if state prices and inflation rates differ. Unfortunately, while using a real measure would be preferable, price indexes for individual states do not span a sufficient amount of time.[3] Using a relative measure cancels the influence of inflation on nominal growth rates, assuming that state and national inflation rates do not deviate systematically. Because more recent personal income data are available, this article uses them to measure output rather than using gross state product (GSP). Personal income comprises labor and capital income received by individuals, such as wages, salaries, rent, dividends, interest payments, and transfer payments. Gross state product, which includes personal income data, has a more inclusive definition of capital income. Still, using personal income data should not obscure long-term growth trends because the two series tend to move in tandem.

The first columns of Table 1 compare relative per capita personal income in 1960, 1976, and 1992 and states' rankings in these years. Comparing relative per capita personal income in 1960 with 1992 figures, the correlation is 0.84 with the rank of the states having a correlation of 0.86. Thus, states' relative per capita personal income tended to be persistent, suggesting a lack of mobility. However, for some states dramatic changes did occur, both up and down. For instance, in 1960 the poorest ten states were among the twelve states in the southeastern region, and on average (unweighted), per capita personal income in those states was 34 percent below the national average. (The two exceptions were Virginia and Florida.) By 1992, only seven of the lowest-ranking ten states came from the Southeast, and the region as a whole stood just 17 percent below the nation. In the interim, Georgia, North Carolina, and Tennessee had leapfrogged out of the bottom ten. While there were these big upward movers

Table 1
Relative Incomes and Growth Rates by State[a]

Region[b]	States	Relative State Per Capita Personal Income (PCPI) (Percent) 1960	Rank	1976	Rank	1992	Rank	Average Annual Differential Growth Rates of PCPI over Different Intervals (Percent) 1961-92	Rank	1961-76	Rank	1977-92	Rank
Far West	AK	22.1	3	56.0	1	10.0	7	–0.38	46	2.12	1	–2.87	50
	CA	21.1	5	14.1	3	7.0	11	–0.44	47	–0.44	45	–0.44	42
	HI	4.1	14	11.8	7	11.0	6	0.22	16	0.48	15	–0.05	27
	NV	23.4	2	11.9	6	8.7	8	–0.46	49	–0.72	49	–0.20	32
	OR	0.6	18	1.7	16	–7.6	28	–0.25	41	0.07	25	–0.58	47
	WA	7.2	10	6.1	11	5.8	12	–0.04	33	–0.07	33	–0.02	26
Great Lakes	IL	17.4	8	12.8	5	7.9	10	–0.30	43	–0.29	41	–0.31	35
	IN	–2.6	21	–3.4	23	–8.9	31	–0.20	38	–0.05	30	–0.34	39
	MI	5.2	11	5.0	13	–2.2	19	–0.23	40	–0.01	28	–0.45	43
	OH	4.8	13	–0.4	18	–6.1	25	–0.34	44	–0.33	43	–0.35	40
	WI	–1.0	19	–2.6	21	–5.3	23	–0.13	36	–0.10	35	–0.17	29
Mideast	DE	21.3	4	8.0	10	5.2	13	–0.50	50	–0.83	50	–0.18	30
	MD	5.0	12	9.4	9	14.1	5	0.29	12	0.28	20	0.29	14
	NJ	19.6	7	13.9	4	26.0	2	0.20	18	–0.36	44	0.75	3
	NY	19.9	6	10.9	8	18.1	3	–0.06	34	–0.56	47	0.45	9
	PA	1.0	17	0.8	17	2.3	15	0.04	26	–0.01	29	0.10	20
New England	CT	25.4	1	15.6	2	30.6	1	0.16	23	–0.61	48	0.94	1
	MA	10.0	9	5.3	12	15.8	4	0.18	20	–0.30	42	0.66	4
	ME	–16.9	36	–16.6	38	–10.5	33	0.20	17	0.02	27	0.39	11
	NH	–2.9	22	–6.2	29	8.1	9	0.34	10	–0.20	40	0.89	2
	RI	–1.7	20	–4.5	25	0.3	18	0.06	25	–0.18	39	0.30	13
	VT	–16.5	34	–15.6	36	–6.8	27	0.30	11	0.06	26	0.55	5
Plains	IA	–9.4	28	–3.3	22	–10.4	32	–0.03	31	0.38	17	–0.44	41
	KS	–4.1	23	–0.5	19	–4.7	21	–0.02	28	0.23	22	–0.27	33
	MN	–5.4	25	–0.9	20	1.7	17	0.22	15	0.28	19	0.16	18
	MO	–5.3	24	–6.4	30	–6.1	24	–0.02	29	–0.06	32	0.02	22
	ND	–21.7	40	–11.0	33	–16.4	38	0.17	21	0.67	12	–0.34	38
	NE	–6.0	26	–4.7	26	–4.8	22	0.04	27	0.08	24	–0.01	25
	SD	–19.1	39	–21.4	46	–15.3	37	0.12	24	–0.14	38	0.38	12

continued

Table 1 (*continued*)

Region[b]	States	Relative State Per Capita Personal Income (PCPI) (Percent)						Average Annual Differential Growth Rates of PCPI over Different Intervals (Percent)					
		1960	Rank	1976	Rank	1992	Rank	1961-92	Rank	1961-76	Rank	1977-92	Rank
Rocky Mountains	CO	3.1	15	2.3	15	2.2	16	–0.03	30	–0.05	31	–0.00	24
	ID	–17.7	37	–10.5	31	–18.8	39	–0.04	32	0.45	16	–0.52	46
	MT	–9.2	27	–10.7	32	–20.8	43	–0.36	45	–0.10	34	–0.63	48
	UT	–11.5	31	–18.9	39	–26.2	49	–0.46	48	–0.46	46	–0.45	44
	WY	1.9	16	3.9	14	–6.4	26	–0.26	42	0.12	23	–0.64	49
Southeast	AL	–37.9	47	–24.5	47	–19.8	40	0.57	8	0.84	6	0.29	15
	AR	–47.3	49	–27.7	49	–25.7	46	0.67	3	1.22	4	0.13	19
	FL	–11.4	30	–5.5	28	–2.4	20	0.28	13	0.37	18	0.20	17
	GA	–28.9	41	–16.4	37	–8.5	29	0.64	6	0.79	8	0.49	6
	KY	–33.0	45	–21.2	45	–20.4	42	0.39	9	0.74	11	0.05	21
	LA	–29.0	42	–19.2	40	–23.8	45	0.16	22	0.61	13	–0.29	34
	MS	–60.3	50	–35.8	50	–35.9	50	0.76	1	1.53	2	–0.00	23
	NC	–33.0	43	–19.6	41	–12.2	34	0.65	4	0.84	7	0.47	8
	SC	–45.7	48	–26.1	48	–21.8	44	0.75	2	1.23	3	0.27	16
	TN	–33.7	46	–20.0	42	–13.2	35	0.64	5	0.86	5	0.43	10
	VA	–16.2	33	–3.9	24	3.9	14	0.63	7	0.77	9	0.48	7
	WV	–33.0	44	–20.9	44	–25.8	47	0.22	14	0.76	10	–0.31	36
Southwest	AZ	–9.8	29	–11.7	34	–14.2	36	–0.14	37	–0.12	37	–0.16	28
	NM	–19.1	38	–20.9	43	–25.9	48	–0.21	39	–0.11	36	–0.32	37
	OK	–16.6	35	–12.3	35	–20.2	41	–0.11	35	0.27	21	–0.49	45
	TX	–14.6	32	–5.5	27	–8.7	30	0.18	19	0.57	14	–0.20	31
United States[c]								6.84		6.73		6.94	

[a] States with highest PCPI or highest growth rates receive highest ranking.
[b] States are grouped into eight standard regions defined by the Bureau of Economic Analysis, U.S. Department of Commerce.
[c] Average U.S. growth rate of Per Capita Personal Income.

Source: DRI/McGraw-Hill

in the region, most southern states saw only gradual changes over time. Although most states lacked mobility, the fact that the range of relative per capita personal incomes narrowed over the period suggests convergence. For instance, in order to eliminate outliers, compare the range of relative per capita personal incomes from the fifth-ranked state with that of the state ranked forty-fifth: this range narrowed from 54.1 percent in 1960 to 34 percent in 1976 and then to 26.3 percent in 1992.

Convergence. Before looking at the data more closely for evidence of convergence, what does theory have to say about convergence in exogenous or endogenous growth models?[4] Factors of production are usually classified into broad categories such as land, labor, capital, and raw materials. Capital goods are inputs into production that are themselves produced goods or reproducible. A narrow conception of capital includes only physical capital while a broader definition includes human capital, intangible capital such as knowledge, and other things that enhance the quality of inputs. In exogenous growth models, no matter what the source of reproducible capital is, output is increased with diminishing returns. In other words, output increases become successively smaller when the amount of an input rises. Thus, investment-led sustained growth is not possible because as the stock of capital rises over time, the returns to capital will fall until investment is no longer profitable.

If only initial capital stocks differed across states, diminishing returns to capital in the exogenous growth model would cause convergence of outputs. The driving force for convergence is mobile inputs flowing to areas in which they have the highest returns. States with higher initial capital stocks and lower returns to capital will have an outflow of capital toward capital-poor states, raising returns in the low-return states and lowering them in high-return states. Over time, return differentials will equalize as states adjust to a common long-run, steady-state growth rate. This rate of growth is determined by technology and demographics, both of which are assumed to be exogenous. However, access to different resources or technology or barriers to factor flows may prevent equalization of returns and lead to different steady-state growth rates and nonconvergence.

In endogenous growth models, by contrast, there are no diminishing returns to the expanded notion of capital although there may still be diminishing returns to each individual capital input. Thus, as capital rises the return to reproducible inputs will not fall to the point where investment becomes unprofitable; rather, investment continues, and sustained growth is possible.

The endogenous growth literature has explored several forces that offset the propensity for diminishing returns to reproducible inputs that causes returns to fall. Explanations that have received recent attention involve technology. One explanation considered is that technology and capital broadly defined may have spillover effects. Spillovers occur when one firm's investments unintentionally raise the productivity of other firms' capital, a classic example being that knowledge gained from investing spills over to other firms. Such spillovers may prevent private returns from falling when investment rises. Another explanation is that imperfect competition induces firms to produce innovative goods in order to capture above-normal profits. The technological progress that comes from innovations or quality improvements may keep the productivity of capital high. High returns to investment in capital broadly defined in turn induce additional investments, causing sustained growth.

Because in endogenous growth models returns need not fall to a point at which capital investment is unprofitable, nor will returns necessarily equalize, long-term growth rates need not equalize either. Also, the equilibrating mechanism of factor flows is still possible in endogenous growth models (see Assaf Razin and Chi-Wa Yuen 1995). Endogenous growth models allow a tension between equilibrating transitional forces for convergence and long-run forces for divergence that may or may not yield convergence over extended periods of time. In addition, shocks may occur frequently and be large enough to put a state continually on an adjustment path to new steady-state growth paths. It may therefore be hard to distinguish among the models on empirical grounds.

But what can be inferred from the data about states' growth experiences? Table 1 also shows long-term average growth rates of per capita personal income relative to national growth. For example, from 1961 to 1992, Alabama grew on average 0.57 percentage points faster than the national average annual growth rate of 6.84 percent. Over the period, it was the ninth-fastest-growing state. In fact, most of the Southeast grew faster than the nation. Some of this rapid growth can be explained as a catching-up phenomenon given southern states' lower-than-average per capita personal incomes at the beginning. For instance, in 1960, Alabama had a per capita personal income that was almost 38 percent below the national average and was ranked forty-seventh. By 1992, this rank improved to 40 and per capita personal income improved to slightly less than 20 percent below that of the nation. Even though Mississippi was ranked last in 1960 and 1992,

it grew at the highest rate, or 0.76 percentage points above the national average.

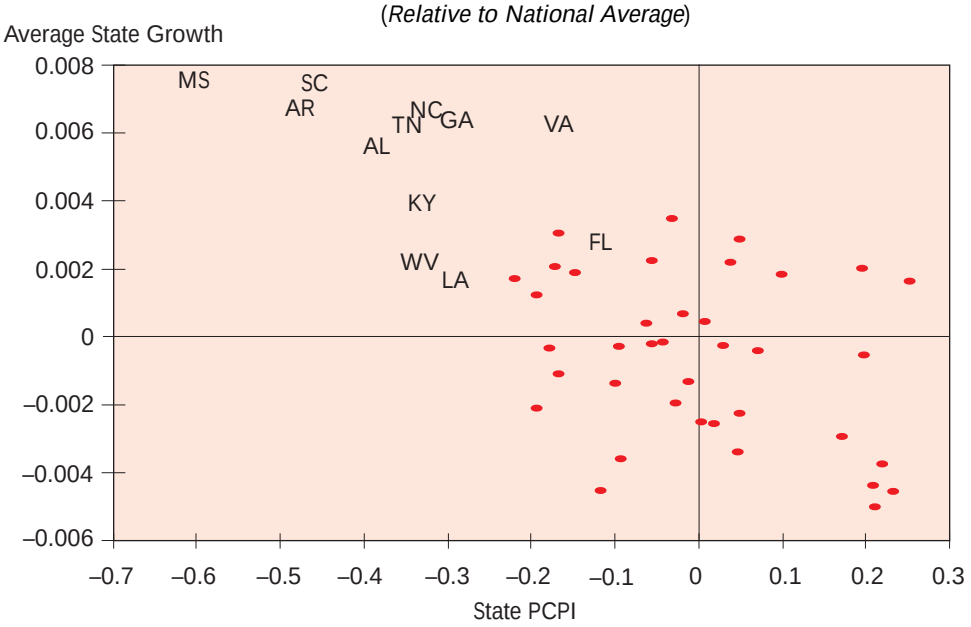
Chart 1 plots the relationship between initial relative per capita personal incomes in 1960 and the average of subsequent annual growth rates from 1961 to 1992. Almost all the fastest-growing states are in the upper left-hand quadrant. States from the Southeast with low initial incomes grew faster and produced nine out of the ten fastest-growing states over this period. In fact, the correlation between initial incomes in 1960 and growth rates is negative across all states, –0.71.

Simple cross-section regressions of long-term state growth rates on initial income generally find a negative relationship between the two variables.[5] In other words, the poorer the state is initially, the faster it grows. Such regressions have been called Barro regressions and are seen as a test for convergence (or "beta-convergence," as popularized by Robert J. Barro and Xavier Sala-i-Martin 1991). The result of beta-convergence is robust to inclusion of other explanatory variables such as population growth rates and savings rates and other, exogenous characteristics that theoretically affect growth rates. Tests of convergence after controlling for other factors in cross-section regressions are called tests of conditional convergence. According to this definition, on balance the average growth rate is greater for poor states that have lower initial incomes than for rich states. Thus, Barro regressions can determine whether there exist states that are catching up and others that are losing ground. But as Andrew B. Bernard and Steven N. Durlauf (1994) have noted, the regressions cannot determine whether states are running the same race or racing to the same point even after controlling for state characteristics. In other words, the cross-section test cannot detect whether there are multiple long-run equilibria or multiple growth paths. Nor can these regressions identify which states are converging and which are not (Danny Quah 1995).

While Barro regressions do not necessarily distinguish between competing models of growth, they are useful for capturing a particular type of convergence. They are also useful because a large body of literature has explored their pitfalls (see, for instance, Ross Levine and David Renelt 1992).[6] More relevant for this discussion, however, is that Barro-type regressions are well suited for finding the growth effects of taxes because, as discussed below, there are good reasons for controlling for initial income in regressions of growth rates on tax rates.

Growth rates used in Barro regressions are usually averaged over long time periods to smooth out short-term variations and to reveal trend behavior. The period from 1960 to 1992 should be sufficiently long to

Chart 1
1960 State PCPI and 1961–92 Average State Growth
(*Relative to National Average*)



● indicates nonsoutheastern states.

smooth out the temporary effects of shocks and leave only permanent effects. However, splitting the sample into two intervals provides additional insights about convergence dynamics as well as about other longer-term shocks to states' economies. The first thing to note is that the growth experiences of different states have been far from uniform. Growth rates for all states from 1961 to 1976 and from 1977 to 1992 had a negative correlation of –0.3. A negative correlation means that on average growth involved setbacks or that states reverted to the mean, and a small correlation suggests that growth was not too persistent. Part of the reason for differences in 1961-76 and 1977-92 relative growth is the oil shocks of the 1970s, which created winners in the 1970 and then losers in the 1980s when oil prices declined. Not only does this lack of persistence suggest that growth is affected by shocks but also that there may be room for state-specific shocks, including taxes. In addition, the variability of growth rates explains why the rankings of relative per capita personal incomes from 1961 to 1992 were so persistent. Growth rates, both positive and negative, would have to be sustained over long periods for rank correlations of relative per capita personal incomes to be lower and for states to show more mobility among rankings.

Convergence to long-run equilibrium in the exogenous growth model implies that initial incomes matter less as time passes and states become more equal. The data are consistent with this assumption. Growth rates over the various subintervals have been less and less correlated with incomes just prior to the start of the interval. For instance, dividing the sample in half shows that, while growth over the 1961-76 period had a –0.66 correlation with initial 1960 per capita personal income, subsequent growth from 1977 to 1992 had only a –0.41 correlation with per capita personal income in 1976. While a dampened relationship of growth with initial per capita personal income is consistent with convergence, it could also be due to large shocks that overwhelm the effect of initial conditions.

In sum, simple correlations involving growth rates and state incomes suggest convergence among the states. But low persistence in growth rates is evidence that shocks may have mattered, too. If shocks matter for growth rates averaged over fifteen years, then it is possible that taxes may have mattered for fifteen-year periods or even longer. Before looking at this possibility in the next section, the following facts about growth in the Southeast should be mentioned. Relative per capita personal incomes in the Southeast are just as persistent as in the nation when comparing 1960 and 1992. Also, because the correlation of initial income in southeastern states in 1960 and the growth rate from 1961 to 1992 is slightly lower than in the nation, convergence within the southeastern states appears to be less pronounced. Dividing the sample period in half shows that among the southeastern states growth rates over the two periods are virtually uncorrelated. This finding is consistent with the correlation of initial incomes with subsequent growth, a measure of convergence. From 1961 to 1976, convergence in the Southeast was faster than in the nation as a whole. However, during the period from 1977 to 1992, the correlation between initial per capita personal income and growth was positive, signaling divergence within the Southeast. So, while all states converged rapidly early on, later some states failed to sustain the pace, and two groups formed that diverged.

*F*acts on State and Local Taxes

What does theory identify as the effects of taxes on growth? Taxes raise the cost or lower the returns to a taxed activity. Taxes therefore create incentives for individuals or businesses to seek out activities that minimize their tax payments, substituting away from activities taxed at a higher rate to those taxed at lower rates. By inducing this substitution, taxes distort behavior in the economy. In turn, the distortionary effect of taxes is that resources are allocated less efficiently and growth may suffer. In particular, when taxes reduce the after-tax return to capital broadly defined, individuals have the incentive to substitute away from investing in physical and human capital or in technical progress, causing growth to slow. In exogenous growth models tax policies tend to have only temporary effects on growth along the adjustment path to long-run steady-state, but in endogenous growth models the effect on growth can be permanent.[7] With geographically mobile inputs to production, after-tax returns tend to be equalized across regions in exogenous growth models in the long-run but need not be in endogenous growth models.

When talking about the distortionary effects of taxes, economists are really talking about marginal tax rates. Marginal tax rates are here defined as the additional taxes paid when personal income rises by a small amount. For example, for a personal income tax the marginal tax rate describes a person's tax bracket and shows how much taxes are paid on the last dollar earned from working and investing. Because they affect individuals' and firms' decisions on how to spend

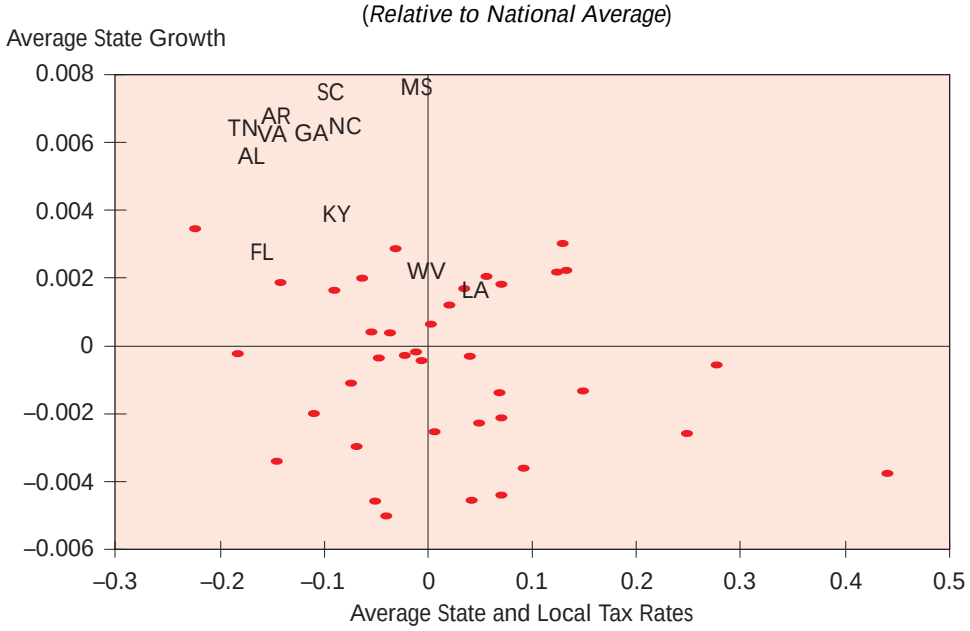
their last dollar, changes of marginal tax rates create distortions of economic decisions and impose burdens on society, including efficiency losses and lower growth. But because information to construct average state marginal tax rates is not easily available, average tax rates are sometimes used to measure the effects of taxation. While average tax rates describe the size of government collections, they may not be a good measure of the burden imposed on society, which depends on how much behavior is distorted.[8]

Average Tax Rates. The first column in Table 2 features average tax rates across states averaged over the 1961-92 period. Average tax rates are defined as the ratio of total state and local tax receipts to state personal income. With the principal exception of Louisiana, southeastern states tend to have much lower average tax rates than the nation. In fact, out of the lowest ten over the sample period, five—Alabama, Tennessee, Florida, Virginia, and Arkansas—are from the Southeast. Also, the (unweighted) average tax rate of the Southeast was 9.34 percent below the nation's. From 1961 to 1992, the average tax rate averaged across all U.S. states increased over time.

How persistent are average tax rates averaged over different time periods?[9] When the sample is divided into two periods, the correlations of average tax rates over the subintervals are positive but not very high. Average tax rates from 1961 to 1976 have a correlation of around 0.3 with average tax rates over the years from 1977 to 1992. Since average tax rates are not too persistent, taxes may be good candidates for shocks that cause growth rates to vary over the subintervals as well as over the longer term, a point made by William Easterly and others (1993). However, the rank correlation of states' tax collections across time periods is more than twice the autocorrelation of average tax rates. In other words, average tax rates were too variable over time to affect rank order significantly. This variability of tax rates suggests that the reforms of the 1970s (or lack thereof for states that did not reform) had little effect on states' rankings when ranked by the relative size of tax collections. In contrast to the nation as a whole, average tax rates in the Southeast were much more persistent or more strongly positively correlated. Average tax rates in the Southeast grew more slowly than in the rest of the nation, causing relative average tax rates in the Southeast to fall.[10]

Chart 2 plots relative average tax rates along with relative state growth rates over the 1961-92 period. The two appear to be negatively related. In fact, the overall correlation is –0.42, and for the Southeast it is almost the same. At the same time, the correlation

Chart 2
Relative Average Tax Rates and State Growth Rates, 1961–92
(*Relative to National Average*)



● indicates nonsoutheastern states.

Table 2
Average and Marginal State and Local Tax Rates by State[a]

Region[c]	States	State Average Tax Rates (Percent)						Estimated State Marginal Tax Rates (Percent)[b]					
		1961-92	Rank	1961-76	Rank	1977-92	Rank	1961-92	Rank	1961-76	Rank	1977-92	Rank
Far West	AK	15.44	50	7.25	1	23.62	50	23.45*	50	13.40*	45	**14.72***	49
	CA	10.65	41	10.70	47	10.60	31	**10.32**	21	13.35	44	**10.68**	18
	HI	11.24	44	10.35	43	12.12	47	12.93	47	12.70	42	13.68	47
	NV	9.45	20	9.55	28	9.34	10	9.18	7	11.30	29	**9.35**	6
	OR	10.00	31	9.30	26	10.71	35	11.32	38	10.64	22	11.97	39
	WA	9.86	28	9.57	29	10.16	25	**10.76**	30	**10.79**	24	11.68	33
Great Lakes	IL	9.27	17	8.58	16	9.97	24	10.35	22	12.26	35	10.58	16
	IN	8.90	10	8.71	20	9.09	7	9.68	11	**10.21**	18	11.08	24
	MI	10.43	37	9.67	31	11.20	41	11.53	42	12.36	39	**11.50**	31
	OH	8.58	8	7.78	2	9.39	11	10.54	26	9.72	10	11.90	38
	WI	11.53	47	11.08	48	11.98	45	**12.24**	45	13.97	47	12.80	46
Mideast	DE	9.53	22	8.61	17	10.45	29	10.88	34	12.29	37	**10.84**	23
	MD	9.63	24	8.94	23	10.32	27	10.26	19	12.29	36	10.13	11
	NJ	9.32	18	8.39	12	10.24	26	10.87	33	12.16	34	11.22	30
	NY	13.09	49	11.75	50	14.43	48	15.01	48	18.54	50	**14.98**	50
	PA	9.40	19	8.85	22	9.95	23	**10.10**	16	12.29	38	**10.04**	9
New England	CT	9.08	13	8.42	13	9.74	16	10.47	25	12.40	40	11.17	29
	MA	10.66	42	10.09	38	11.23	42	10.45	23	15.31	49	9.62	7
	ME	10.50	38	9.94	37	11.05	39	11.70	44	13.27	43	12.52	43
	NH	7.94	1	7.94	4	7.93	1	**8.28**	1	**9.77**	11	**8.96***	3
	RI	9.96	30	9.25	25	10.66	33	**10.82**	32	12.52	41	**10.70**	19
	VT	11.30	45	11.17	49	11.43	43	**11.52**	41	14.77	48	**12.14**	41
Plains	IA	10.34	34	9.92	36	10.76	36	11.33	39	**10.92**	25	12.76	45
	KS	9.81	27	9.70	32	9.92	22	**10.20**	17	9.60	9	11.13	25
	MN	11.33	46	10.67	46	11.99	46	**12.27**	46	**13.47**	46	12.57	44
	MO	8.28	2	8.14	7	8.42	2	8.60	3	10.15	17	9.29	5
	ND	10.28	33	9.85	34	10.70	34	**10.79**	31	**8.69**	2	**11.14***	27
	NE	9.57	23	8.80	21	10.33	28	10.65	28	11.07	26	**10.72**	20
	SD	10.14	32	10.50	45	9.79	19	8.94	5	**9.92**	13	8.73	2

continued

Table 2 (*continued*)

Region[c]	States	State Average Tax Rates (Percent) 1961-92	Rank	1961-76	Rank	1977-92	Rank	Estimated State Marginal Tax Rates (Percent)[b] 1961-92	Rank	1961-76	Rank	1977-92	Rank
Rocky Mountains	CO	9.72	25	9.63	30	9.81	20	**9.85**	12	**10.14**	16	10.33	14
	ID	9.47	21	9.44	27	9.50	13	**9.97**	14	9.11	6	11.15	28
	MT	10.88	43	10.28	42	11.47	44	**11.36**	40	**11.79**	32	10.81	21
	UT	10.36	35	9.85	33	10.87	37	11.28	37	**10.37**	19	**11.71**	35
	WY	12.73	48	10.11	40	15.35	49	**16.24***	49	**11.39**	31	**14.31***	48
Southeast	AL	8.39	3	7.98	5	8.79	5	8.92	4	9.05	5	**8.98**	4
	AR	8.57	7	8.31	9	8.84	6	9.32	8	**8.71**	3	10.23	13
	FL	8.45	5	8.45	14	8.45	3	**9.15**	6	**8.83**	4	10.14	12
	GA	8.92	11	8.36	11	9.48	12	9.99	15	10.13	15	10.48	15
	KY	9.10	14	8.47	15	9.72	15	10.47	24	10.69	23	11.70	34
	LA	10.38	36	10.24	41	10.52	30	**10.65**	29	**11.34**	30	**11.53**	32
	MS	9.81	26	9.87	35	9.74	17	9.58	9	**10.59**	21	**9.90**	8
	NC	9.15	15	8.64	19	9.65	14	10.21	18	10.09	14	10.82	22
	SC	9.06	12	8.35	10	9.77	18	10.28	20	9.84	12	**10.66**	17
	TN	8.40	4	8.17	8	8.64	4	**8.58**	2	9.38	8	**8.64**	1
	VA	8.54	6	7.89	3	9.19	9	9.64	10	10.50	20	10.09	10
	WV	9.94	29	9.22	24	10.65	32	11.13	35	11.20	28	**11.75**	36
Southwest	AZ	10.64	39	10.37	44	10.90	38	11.27	36	11.80	33	12.05	40
	NM	10.65	40	10.10	39	11.19	40	11.65	43	**11.16**	27	12.20	42
	OK	9.23	16	8.61	18	9.85	21	10.60	27	8.42	1	11.84	37
	TX	8.62	9	8.14	6	9.09	8	9.89	13	9.13	7	11.13	26
United States		9.92		9.40		10.44		10.75		11.98		11.21	

[a] States with highest tax rates are ranked lowest.
[b] Bold numbers represent that the constant term in the regression was insignificant; asterisks represent that adjusted R^2 was less than 0.95.
[c] States are grouped into eight standard regions defined by the Bureau of Economic Analysis, U.S. Department of Commerce.

between average tax rates and relative per capita personal incomes in 1960 is 0.33. This positive correlation presents a potential problem because it is difficult to distinguish the influence of convergence and taxes on growth. For example, suppose the positive correlation occurred only because of convergence and that taxes are passive without any independent growth effects.[11] Because convergence implies a negative correlation between initial incomes and subsequent growth, taxes and growth may—indirectly through convergence—be negatively correlated for completely spurious reasons. Alternatively, suppose there is no convergence but that taxes do have negative growth effects: the positive correlation between taxes and growth would imply convergence (again, spuriously) indirectly through the tax effects. Any regression of growth rates on average tax rates would need to control for the correlation of tax rates and initial incomes to isolate convergence and tax effects on growth.

The observation on the relation between average tax rates and growth rates also tends to hold true for the subintervals. For all states, the average tax rate has negative correlations with growth over the period from 1961 to 1976 and from 1977 to 1992 of –0.36 and –0.62, respectively, and the numbers for the Southeast are very similar. These data indicate that states with high growth rates also have relatively low tax revenues. Stronger negative correlations over time suggest a smaller role for taxes as a revenue source for such states and localities. Or, if there were a good reason to think that average tax rates were a sound measure of marginal tax rates, one could infer a larger negative growth effect of taxes. This possibility will be explored below.

Marginal Tax Rates. The above section surveyed average tax rates across states mainly because they have been popular for inferences about tax effects on growth. This section turns to marginal tax rates, which are the better theoretical measure of what influences behavior and ultimately growth because changes of the tax rate on the last taxable dollar create individual incentives to change behavior and lower tax burdens. In contrast, the average tax rate does not create behavioral changes but reflects the changes of the marginal tax rate and changes of the tax base induced by behavior changes. Before estimating marginal tax rates and characterizing them across states and time, this section will first show how marginal tax rates and average tax rates are related.

To see the relationship between marginal tax rates and average tax rates, consider a linear flat tax. Not only has the concept received a lot of public attention, but the flat tax is also a useful device for estimating marginal tax rates, as seen below. With a linear flat tax, tax revenues are the sum of revenues independent of behavioral changes and revenues that depend on behavioral influences through changes of income (or another measure of the tax base). Such a tax takes the following form:

$$Revenue_s = l + MTR \bullet Income_s. \qquad (1)$$

Here *MTR* • *Income* is revenues that respond to income changes, and the coefficient on income, *MTR*, gives the effect on tax revenues of a small change in income in period *s*. In other words, *MTR* is the marginal tax rate of the flat tax. The constant *l* designates tax revenues that are not affected by behavioral changes; nor does this "lump-sum tax" influence individual incentives. For this reason lump-sum taxes are also nondistortionary. While lump-sum taxes are not collected in practice, they are implicit in tax schedules that are either progressive or regressive. If the lump-sum tax is positive, the tax function is said to be regressive. If the lump-sum tax is negative—a lump-sum transfer—the tax schedule is progressive. Only if the lump-sum tax is zero is the tax schedule proportional. Finally, to see how average tax rates, denoted *ATR*, and marginal tax rates are related, divide both sides of equation (1) by income:

$$ATR_s = \frac{l}{Income_s} + MTR. \qquad (2)$$

Thus, for a regressive (progressive) flat tax, the average tax rate is greater (smaller) than the marginal tax rate and the average tax rate falls (rises) when income rises. A tax is proportional when the average tax rate equals the marginal tax rate or the average tax rate is the same for all income levels.[12]

Koester and Kormendi (1989) propose a simple way of finding an average marginal tax rate that holds as a linear approximation.[13] Basically, the estimation procedure is to estimate equation (1) by regressing total tax revenues on a constant, *l*, and income. Using the sum of state and local tax revenues and state personal income in the regression provides an estimate of the average marginal tax rate over all taxed units. The estimated marginal tax rate is not any one individual's marginal tax rate, but with certain restrictions it could be interpreted as a representative individual's tax rate. In addition, one must assume that the tax base is income or that any other tax base (such as property or sales) is proportional with income in order for this equation to be a measure of what affects behavior.

Also, as Koester and Kormendi point out, the method is robust as long as there are no structural changes to the tax schedule during the sample period. This premise may not be tenable, though. During the 1960s many states adopted new sales tax and income tax systems. During the 1970s many big changes occurred such as the tax limitation movement, and during the 1980s there were major federal and state tax reforms.[14] Thus, it makes sense to investigate the stability of the marginal tax rate estimates over time by splitting the sample in two and considering if and how marginal tax rates differ.

Table 2 shows the results of the Koester and Kormendi-type ordinary least squares (OLS) regressions that estimate the above equation for all states individually. These regressions use Halbert White's (1980) formula for correcting for the possibility that the variances of the error terms change over the sample. All the estimated marginal tax rate coefficients are significant at the 5 percent level. Most regressions are estimated with high accuracy, with only seven of the 153 regressions having adjusted R^2s lower than 0.95. Regressions for Alaska and Wyoming tend to have low measures of fit. For the estimated marginal tax rates in Table 2 that are in bold type, the regression constant was insignificant. An insignificant constant implies that the tax system was not significantly different from proportionality or that the difference between the average tax rate and the estimated marginal tax rate in the table was insignificant.[15]

The aggregate average tax rate in Table 2 was less than the aggregate marginal tax rate for all periods reviewed. However, the two displayed dissimilar behavior over time: while the aggregate average tax rate tended to increase, marginal tax rates fell. In other words, differences between the two tax rates suggest that the progressivity of the state and local tax system for the United States as a whole fell over time. Looking at disaggregate behavior of the states, one finds that the marginal tax rates of individual states were more persistent than the average tax rates across subsamples. The autocorrelation of marginal tax rates was 0.46 comparing 1961-76 with 1977-92 while for average tax rates it was 0.3. Still, marginal tax rates in the sample are not highly persistent but vary over time, so they may explain some of the low persistence of state growth rates across time.

Average tax rates of the southeastern states declined relative to the nation's because they did not increase as fast as the rest of the nation's. Marginal tax rates in the region started out much lower relative to those in the rest of the nation than indicated by their average tax rates. Southeastern marginal tax rates (unweighted averages) were 18.1 percent lower than the nation's during the 1961-76 period. But from 1977 to 1992, when marginal tax rates in the nation fell, southeastern marginal tax rates rose and converged to the national average.

If one were to plot state marginal tax rates and growth rates for the nation, one would find a negative relation that is reflected in a negative correlation of –0.39. Just as for average tax rates, the negative relationship of the marginal tax rate and growth rates has grown stronger over time, with correlations going from –0.36 during 1961-76 to –0.47 during 1977-92. For the Southeast, the numbers are again similar. This finding suggests that taxes may have had a stronger influence over the latter half of the sample. As before, these simple correlations do not control for other variables such as the initial per capita personal income and convergence effects. Because marginal tax rates across all states are positively related to initial per capita personal incomes, it is difficult to disentangle the influence of convergence and taxes on growth. Thus, the separate effects will need to be isolated before anything definitive can be said about the growth effects of taxes. Nonetheless, the low persistence of marginal tax rates suggests that tax rates could well explain the variability of growth rates over time. Also, the negative correlation between marginal tax rates and growth rates supports that taxes have a negative growth effect. The discussion below will explore whether this result holds when common influences such as the effect of convergence are controlled for.

*E*mpirical Evidence

Before proceeding to the regressions used in this study, this section reviews related empirical studies of taxation and growth. This review shows how previous studies have dealt with the problems pointed out above and identifies some other relevant issues. While the previous section argues that to isolate tax effects from convergence effects on growth one has to control for initial income and use the correct measure of taxes, namely marginal tax rates, this section shows that identifying tax effects also requires limiting the influence of other government variables. More specifically, the issue is how the government's budget, which equates revenues to expenditures and transfers, is balanced after marginal tax rates change. The way the government's budget is balanced may have independent

effects on the economy and growth. Unless these influences are properly controlled for, estimates of tax effects may include the effects of other fiscal policies. The presence of these effects may explain why few studies have found significant and negative growth effects of marginal tax rates. While some studies have grappled with these problems, they have fallen short in some areas, as the discussion will make clear.

A number of cross-section studies have analyzed the relationship of taxation and international growth differences. As Peter N. Ireland's (1994) review of the literature concludes, while some of these studies find tax rate effects on long-term growth and appear to support endogenous growth theories, others find no significant effects. He suggests that part of the problem may be that few studies average growth rates over sufficiently long time intervals (to smooth out short-run fluctuations) to be able to distinguish among theories.

It appears that state and local taxes have temporary growth effects that are stronger over shorter intervals and a permanent growth effect that does not die out over time.

Also important is that few measures used as tax variables are robust determinants of growth after other explanatory measures are considered. For instance, Koester and Kormendi (1989) have argued that previous studies may have mistakenly found negative long-run growth effects of taxation, if both tax and growth rates are related to the level of initial income. To control for this possibility, Koester and Kormendi add the initial level of income to cross-country regressions of growth that use different tax measures. While they find that both the average tax rate and marginal tax rates have negative effects on growth in separate regressions, the coefficients on the average tax rate and marginal tax rates are not significant. More recently, for a broad cross-section of countries, Easterly and Sergio Rebelo (1993) concluded that the evidence that tax rates matter for growth is fragile. Only the marginal income tax rate estimated using Koester and Kormendi's method, and the ratio of income taxes to personal income, survive inclusion of other explanatory variables (such as initial income, and government expenditures and nontax revenues) in their cross-country regressions. Other tax variables used to measure the effective rate of taxation obliterate the effect of initial income so that it is difficult to isolate convergence effects from the effects of tax policy.

There have been a few studies looking for evidence on the growth effects of state and local tax policy. As Alaeddin Mofidi and Joe A. Stone (1990) noted, the empirical findings have been mixed with estimated effects ranging from positive to negative. Tax rates may be significant in simple regressions, as in the international literature, but multivariate regressions that add more explanatory variables can result in insignificant coefficients on tax rates. For instance, L. Jay Helms (1985) argued that higher taxes may stimulate economic activity if used to finance appropriate expenditures. Thus, a regression should consider all sources and uses of government funds to be able to interpret the coefficient on taxes. Helms estimated a pooled time-series, cross-section regression using annual data for the period from 1965 to 1975. After controlling for all sources and uses of funds except transfers to individuals, Helms found a negative and significant growth effect of taxes. Thus, controlling for nontax items to balance the budget becomes doubly important. It helps interpret the sign of the tax rate coefficient, which may be positive if taxes primarily finance the appropriate spending, or, in Helms's case, negative if taxes primarily finance welfare transfers. Also, judicious choice of explanatory nontax variables will affect the significance of the estimated tax coefficients.

By contrast, John K. Mullen and Martin Williams (1994) took another approach suggested in Koester and Kormendi. They excluded expenditure variables in their growth regressions in order "to disentangle average from marginal tax effects." Specifically, they tested whether increases in the marginal tax rate that are revenue-neutral—with simultaneous reductions in transfers to keep revenues unchanged and so keep the budget balanced—reduce real GSP growth rates over 1969-86. To find revenue-neutral marginal tax rate effects, Mullen and Williams include both the average tax rate and the marginal tax rate in their growth regression, and they find negative coefficients on both, with only the marginal tax rate significant. However, the regression has low explanatory power, with an R^2 equal to 0.192. Also, while the coefficient for initial income is negative, suggesting beta-convergence, it is also insignificant.

The theoretical literature typically analyzes the effects of balanced-budget marginal tax rate shocks. Usually, nondistortionary lump-sum transfers are used to balance the government's budget. This practice isolates the distortionary effects of taxes because one does not have to worry about the effects of other government policies. But sometimes expenditures are allowed to adjust. By including government expenditures in the growth and tax regressions, researchers try to control for expenditure effects and isolate pure distortionary effects. Helms (1985) controls for expenditures but excludes welfare transfer payments from the regression. The interpretation of the estimates is that taxes finance distortionary welfare transfers, not lump-sum transfers as would be required to uncover the distortionary effects of taxes. To correctly identify the distortionary tax effects requires an empirical specification that controls for all nontax revenue sources and all expenditures and welfare transfers. In this case, the lump-sum tax implicit in the tax schedule adjusts to keep revenues constant and the government's budget in balance.[16]

Mullen and Williams (1994) and Koester and Kormendi (1989) propose a short cut around including all expenditure and nontax revenue items in growth regressions. By controlling for average tax revenues when marginal tax rates change, they hoped to isolate revenue-neutral tax policy. Revenue-neutral marginal tax rate effects would isolate the distortionary effects of taxes because the budget would be balanced without expenditures, distortionary transfers, or nontax revenues changing. However, controlling for average tax rates means neutrality of average revenue but does not imply revenue neutrality. Thus, these studies do not isolate the distortionary tax effects on growth. However, the marginal tax rate changes that are regressivity-neutral might do so.

To see that holding average tax rates fixed does not mean that revenues are unchanged, consider equation (2) and totally differentiate it. The flat tax schedule can be changed only by changing the intercept, *l*, or the slope of the tax schedule, *MTR*. The combined total effects of such shocks on average revenue collections are

$$\frac{\Delta ATR}{ATR} = \left(\frac{MTR}{ATR}\right)\frac{\Delta MTR}{MTR} + \left(\frac{L}{ATR \bullet Income}\right)\left(\frac{\Delta L}{L} - \frac{\Delta Income}{Income}\right), \qquad (3)$$

where the implied changes in income are also included and Δ denotes change. Equation (3) says that the percentage change in average tax rates is equal to a weighted average of the percentage change of marginal tax rates and the percentage change of the average lump-sum tax, which is the ratio of nondistortionary taxes implicit in the tax schedule to personal income. Notice that the average lump-sum tax rises when income falls, which might happen when marginal tax rates increase. Differentiating the regressivity index, *ATR*/*MTR*, yields[17]

$$\Delta\left(\frac{ATR}{MTR}\right) = \frac{ATR}{MTR}\left(\frac{\Delta ATR}{ATR} - \frac{\Delta MTR}{MTR}\right). \qquad (4)$$

This equation states that regressivity falls or progressivity increases when the percentage change of average tax rates is smaller than the percentage change of marginal tax rates.

There are several natural tax experiments that one can analyze with the last two equations. For instance, Mullen and Williams (1994) and Koester and Kormendi (1989) consider an ATR-neutral change of marginal tax rates. Average revenue neutrality requires that $\Delta ATR = 0$, or no change of the average tax rate. To accomplish this condition and satisfy equation (3), there must be offsetting lump-sum tax reductions when the marginal tax rate increases. Such a policy also implies a rise in progressivity because now $\Delta(ATR/MTR) = -ATR/MTR \bullet \Delta MTR/MTR$ in equation (4). Since total tax revenues are the product of the income tax base and the average tax rate—or *Revenues* = *ATR* • *Income*—and the average tax rate cannot change, revenues will change only if income changes. Because an increase in the marginal tax rate tends to lower income, an ATR-neutral increase of marginal tax rates implies a negative effect on tax revenues. Thus, ATR-neutrality does not imply revenue-neutrality. A problem results because something must be done to offset the resulting budget deficit and keep the government's budget in balance. For instance, the deficit might be offset by reductions in expenditures. However, changes in expenditures have their own growth effects that must be kept separate from the growth effects of taxes. The upshot is that growth-and-marginal tax rate regressions that control for average tax rates but not for expenditures have not isolated the distortionary effects of taxes. The effects estimated in such regressions are in fact a mixture of tax and spending effects.

Alternatively, a progressivity-neutral tax policy may come closer to isolating the distortionary effects of taxation. Such a policy requires no change in progressivity, or $\Delta(ATR/MTR) = 0$ in equation (4), which implies $\Delta ATR/ATR = \Delta MTR/MTR$ in equation (4). Thus, average revenue collections increase. The increase of the average tax rate offsets the negative effect of a smaller tax base on revenues. In other words, it offsets $\Delta Y/Y < 0$ in

equation (3). Thus, a progressivity-neutral increase of marginal tax rates has a smaller negative revenue effect than an ATR-neutral tax increase. This result can be seen by looking at the percentage change of revenues, which equals the percentage change of income plus the percentage change of the average tax rate, or $\Delta Revenues/Revenues = \Delta Y/Y + \Delta ATR/ATR$. For any marginal tax rate increase $\Delta Y/Y < 0$, but $\Delta ATR/ATR > 0$ for a progressivity-neutral shock while for an ATR-neutral shock $\Delta ATR/ATR = 0$. Thus, revenues fall by a smaller amount for a progressivity-neutral tax increase than for an ATR-neutral tax increase, so the implied budget deficit is also smaller, requiring a smaller expenditure offset. A regressivity-neutral tax change therefore comes closer to isolating the distortionary effects of taxes in simple growth regressions where expenditures are not controlled for.[18]

Controlling for Progressivity. This section reports the results of simple cross-section regressions that control for progressivity in order to isolate the effect on growth of the marginal tax rate changes. To find the effects of relative tax rates on relative growth rates, dependent and explanatory variables in the regressions are expressed as log differences from their national averages. The explanatory variables include relative initial average personal income, *RPCPI*, relative marginal tax rates, *RMTR*, and relative regressivity, *RR*, where regressivity is defined as *ATR*/*MTR* (and relative progressivity is the inverse of *RR*.) As argued above, controlling for regressivity adds precision to the estimate of the distortionary effect of marginal tax rates and a meaningful interpretation. Thus, the discussion focuses primarily on the coefficient for *RMTR*, which is expected to be negative. To get a sense of how large the tax effects are, the coefficient for *RMTR* is compared with the coefficient on *RPCPI*, which measures the effect of initial conditions (or convergence).

The first cross-section regression estimates growth effects with OLS after White's correction. This regression uses a sample of all fifty states, *j*, where data are averaged for the 1961-92 period and initial income is from 1960. Equation (R1) presents the results of the regression where standard errors are in parentheses and significance values in brackets:

$$RG6192_j = -0.00003 - 0.0115\ RPCPI60_j \quad \text{(R1)}$$
$$(0.0003)\quad (0.0016)$$
$$[0.93]\quad [0.000]$$

$$-0.0054\ RMTR6192_j - 0.0067\ RR6192_j + e_j,$$
$$(0.0027)\quad (0.0056)$$
$$[0.043]\quad [0.24]$$

where $R^2 = 0.63$, adjusted $R^2 = 0.573$, the standard error of estimate (*SEE*) is 0.0022, and the number of observations, *N*, is equal to 50.

The regression shows a negative relation between relative growth and both relative initial income and relative marginal tax rates. Both coefficients are significant at the 5 percent level. The coefficient on *RPCPI* implies that for a state with an initial per capita personal income that is 60.3 percent below the national average, as Mississippi in 1960 is in Table 1, one would expect growth from 1961 to 1992 to be 0.693 percentage points above the national average. Because Mississippi's marginal tax rate was 11.6 percent below the nation in Table 2, one would expect this fact to increase the relative growth rate by 0.063 percentage points. Combined, the regression predicts growth for Mississippi to be 0.756 percentage points above the nation. (Mississippi's actual growth rate was in fact 0.763 percentage points higher.) The estimated effect on growth of relative marginal tax rates is slightly less than half that of initial per capita personal incomes. A state's marginal tax rate would have had to be roughly 21 percent below the national average marginal tax rate of 10.75 percent during 1961-92 to offset the negative effects on growth of an initial per capita personal income that was 10 percent above average.

Next, this section investigates whether there have been changes over time in the responsiveness of relative growth to relative marginal tax rates. These same OLS regressions (with White's correction) are used when the time period is split into two subsamples. For 1961-76

$$RG6176_j = 0.0006 - 0.0223\ RPCPI60_j \quad \text{(R2a)}$$
$$(0.0008)\quad (0.0024)$$
$$[0.49]\quad [0.000]$$

$$-0.0131\ RMTR6176_j - 0.0235\ RR6176_j + e_j,$$
$$(0.007)\quad (0.014)$$
$$[0.064]\quad [0.084]$$

where $R^2 = 0.615$, adjusted $R^2 = 0.539$, $SEE = 0.004$, and $N = 50$. For 1977-92

$$RG7792_j = -0.0007 - 0.0032\ RPCPI76_j \quad \text{(R2b)}$$
$$(0.0008)\quad (0.0052)$$
$$[0.38]\quad [0.53]$$

$$-0.0196\ RMTR7792_j - 0.0194\ RR7792_j + e_j,$$
$$(0.0068)\quad (0.0098)$$
$$[0.004]\quad [0.048]$$

where $R^2 = 0.398$, adjusted $R^2 = 0.354$, $SEE = 0.0046$, and $N = 50$. The results reveal that the marginal tax rate has negative growth effects that are weakly significant during 1961-76 and strongly significant over 1977-92. The growth effects of the marginal tax rate not only strengthened over time but increased relative to the effect of the initial position of the states. The coefficient on initial per capita personal income is only significant in the first equation, indicating that in 1977-92 catching up was less important for states' growth than previously. In fact, this finding indicates nonconvergence of growth rates. Also, equations (R2) indicate that the medium-run growth effects of marginal tax rates were larger than the long-run effects in equation (R1), a result consistent with the exogenous growth model, which predicts smaller growth effects the longer the time horizon is.

There are many potential problems with the above regressions that have not been addressed here.[19] Nonetheless, the regressions give a "first-pass" conclusion that regressivity-neutral marginal tax rate increases reduce growth. Since regressivity-neutral tax changes are "almost" revenue-neutral tax changes, one can infer that growth rates are reduced when tax rates rise. But one must bear in mind that offsetting changes in nondistortionary transfers are occurring in the background, something that is not likely to happen in practice. Also, tax effects appear to be relatively stronger the shorter the sample period is. But even as the sample period lengthens, and the tax effect diminishes, the tax effect still remains (economically and statistically) significant. Thus, tax effects have a temporary component that diminishes over time as well as a permanent component that does not disappear. While this is evidence for a hybrid endogenous growth model with the transitional dynamics of an exogenous growth model, it could also be that the sample period was still too short to elicit true long-term effects. Also, even though the results are consistent with economic theory, they are not necessarily exploitable. In other words, it is not clear that a given change in tax rates will produce changes in growth rates consistent with the regressions in this article. Care must be taken to ensure that the regressions are structural and robust to other specifications. Only then could one say that the regressions indicate causality and not just happy circumstance.[20] Future work will need to address these issues.

By contrast to the regressions above, proceeding as Mullen and Williams (1994) did and controlling for relative average tax rates rather than relative regressivity to determine the strength of ATR-neutral marginal tax rate changes results in insignificant and positive coefficients on the marginal tax rate and significant and negative coefficients for the average tax rate. As argued before, there is a simple economic answer that suggests that this sort of regression is misspecified. Controlling for average tax rates does not control for expenditures and so does not isolate the distortionary effects of taxes. When controlling for average tax rates, the coefficient on the marginal tax rate encompasses both the purely distortionary effect of taxes as well as the effects of other variables that must adjust to maintain the government budget identity. ATR-neutral tax changes therefore still require that other expenditures' terms be controlled for in regressions that purport to identify the distortionary effects of taxes. Thus, the method is a dubious shortcut and explains why estimating progressivity-neutral marginal tax rate effects is preferable.

Conclusion

Thirty-five years ago the Southeast by and large lagged behind the nation, but in the meantime strong growth rates have propelled the region forward. Was this progress due to convergence, or have state and local taxes affected relative state growth? To understand the role of taxes for growth, this article reviews states' growth experiences and the history of state and local taxes in the United States from 1960 to 1992. That states' growth rates of per capita personal income are negatively correlated with their initial levels reflects convergence of incomes. At the same time, the rankings of states' per capita personal incomes have been fairly persistent because states' growth rates tend to fluctuate over time.

These fluctuations may have been caused by changing taxes. State and local tax rates fluctuated approximately as much as growth rates, making them good candidates for explaining variable state growth rates. This relationship holds true for both states' average and marginal tax rates. However, the two should not be confused. Average tax rates only measure the size of government collections, and marginal tax rates create distortions to individual behavior and the economy as a whole. Distortions occur when households and firms change their work, consumption, or investment behavior to minimize tax payments. When households substitute away from investment in physical or human capital or technological progress, growth ultimately suffers. However, marginal tax rates are difficult to

come by and must be estimated. Marginal tax rates, estimated using a method of Koester and Kormendi (1989), generally were higher than average tax rates, but the gap narrowed as marginal rates fell and average tax rates rose when comparing 1961 with 1976 and 1977 with 1992. Thus, state and local taxes became less progressive for the United States overall and more states had tax systems that were indistinguishable from proportionality.

While the simple correlations above suggest that a relationship between taxes and growth exists, regressions can put the hypothesis to the test. The main problem is isolating the tax effects on growth. First, one needs to control for variables that affect both growth rates and tax rates, such as initial incomes that govern the rate of convergence but for independent reasons may also influence taxes. One also needs to keep separate changes in the marginal tax rate from changes in other government policies while not violating the government's budget constraint, which equates revenues to government purchases and transfers. There are two ways to accomplish this goal, namely, either hold all spending and transfers constant or keep revenues fixed. In both cases, when marginal tax rates are raised nondistortionary transfers implicit in the tax schedule adjust to keep revenues the same.

Previous empirical work has attempted to isolate the effects of marginal tax rates either by controlling for all expenditure items except welfare transfers or by controlling for average tax revenues. Neither method correctly identifies the distortionary effects of taxation, however. Real-world transfers are not distortionary because welfare alters incentives and creates distortions that must be kept separate from those of taxes. Controlling for average tax revenues when marginal tax rates increase implies a fall in revenues and a budget deficit. To get around this problem, this study proposes controlling for progressivity when marginal tax rates change. Progressivity-neutral tax increases cause smaller revenue reductions than if average tax rates do not change. In other words, progressivity-neutral tax changes are more likely to be revenue-neutral. In turn, the offsetting policy changes that balance the budget in the background are smaller so that the estimates more accurately reflect the effect of taxes.

This article focuses on a specific question: Do state and local taxes affect relative state growth? The study finds that relative marginal tax rates have a statistically significant negative relationship with relative state growth averaged for the period from 1961 to 1992. These results are economically significant because controlling for progressivity with greater accuracy than other specifications uncovers the effect of taxes. Also, the growth effect of taxation appears sizable, especially when compared with the effect on growth of initial state conditions, or the convergence effect. Aggregate marginal tax rates that are 20 percent below the national average have the same positive effect on state growth rates as initial incomes that are 10 percent below average. Reestimating the regressions when the sample period is split in half shows that the tax effects grow even stronger when compared with the convergence effect, which is insignificant in the latter half of the sample. Thus, it appears that state and local taxes have temporary growth effects that are stronger over shorter intervals and a permanent growth effect that does not die out over time, at least for the sample considered. This finding also supports the inference that part of growth is endogenous and susceptible to policy influence.

Finally, while one can conclude that state and local tax rates (relative to those of other states) affect relative state growth in both the short term and long term, there is a caveat that should precede any policy recommendation. Specifically, to isolate the growth effect of tax rates the regressions estimate the effect of a particular policy. Since a revenue-neutral change in aggregate state and local marginal tax rates is not likely to occur in practice, one should not extrapolate to more likely scenarios such as revenue-altering changes in tax rates or other fiscal policies that may accompany tax reform. Given this caveat, the results have the following policy implication. If growth is a policy objective, one should, at the very least, assess whether tax policies are out of line with other states. If long-term growth rates seem too low relative to other states, lowering aggregate state and local marginal tax rates is likely to have a positive effect on long-term growth rates. This likelihood is greater if the reduction in marginal tax rates is sustained rather than temporary. However, such a policy also reduces the progressivity of the tax system. No matter what emphasis is placed on growth, states should be aware of the potential trade-offs as they make choices to encourage economic growth.

Notes

1. For surveys of exogenous and endogenous growth models see, for example, the *Journal of Economic Perspectives* (Winter 1994), especially articles by Romer (1994), Grossman and Helpman (1994), and Pack (1994) and references therein.
2. The perspective does not distinguish among the composition of state and local taxes across states, although it may be very important for state growth. For instance, a plausible explanation for the higher growth rates of southeastern states may be their lower reliance on property taxes for revenues and greater reliance on nontax revenue sources. The article also ignores the regional pattern of federal and state and local government expenditures and transfers that is thought to have particularly stimulated the Southeast and may soon be reversed with federal government retrenchment.
3. The American Chamber of Commerce Researchers Association cost-of-living index of U.S. metropolitan areas is inappropriate for this study because it extends back only to the mid-1980s. Similarly, statewide GSP price deflators can be obtained only up to 1989 as of this writing.
4. See note 1 for references. For a comprehensive overview of the convergence literature see Barro and Sala-i-Martin (1991, 1992, 1995); Sala-i-Martin (1994) presents an overview of cross-sectional regressions.
5. Initial income can be interpreted as a proxy for the initial capital stock under broad or narrow definitions. Initial conditions such as whether initial capital is below or above its long-run level determines the transition path to steady-state.
6. For other criticisms of Barro regressions see, for instance, Quah (1993a, 1993b, 1995), Bernard and Durlauf (1994), Pack (1994), Kocherlakota and Yi (1995), and Carlino and Mills (1995).
7. See Ireland (1994) for a simple overview that contrasts the effects of taxation in simple exogenous and endogenous growth models. For more on tax effects in endogenous growth models see, for instance, Stokey and Rebelo (1995) and citations therein.
8. Average tax rates are perfect proxies for marginal tax rates only when the tax system is proportional or when the two are equal. Benson and Johnson (1986) have argued that nationwide the state and local tax system is close to proportionality: property taxes are roughly proportional, and sales taxes are regressive and income taxes, progressive.
9. Unless otherwise stated, all correlations involving tax rates use relative tax rates where relative is defined as logarithmic differences with the aggregate tax rate.
10. For more on this topic, see Bahl and Sjoquist (1990) as well as Gold (1991).
11. Koester and Kormendi (1989) studied the effect of this positive correlation but offered little explanation for it. Easterly and Rebelo (1993) explored the determinants of the correlation, suggesting that it could arise because of fiscal endogeneity such as scale effects in the costs of administering fiscal programs or voting.
12. Two simple ways of measuring the degree of progressivity of a flat rate tax schedule in equations (1) and (2) are by the ratio of the average tax rate to the marginal tax rate or by their difference. Thus, a flat tax schedule is progressive (regressive) if $ATR/MTR < (>) 1$ or if $ATR - MTR < (>) 0$. How progressive a tax system is tells how distortive the tax is. More progressivity implies greater efficiency loss for society: marginal tax rates must be higher for a given level of expenditures because as transfers increase, more revenues must be raised.
13. Among more recent studies that use this method are Easterly and Rebelo (1993), Mullen and Williams (1994), and Garrison and Lee (1995). More generally, one could include exclusions, deductions, and exemptions, or one could have multiple tax brackets or a nonlinear tax function. The virtue of the approach is its simplicity, but there may be a significant bias in assuming linearity instead of a nonlinear specification.
14. Briefly, the relevant historical background can be summarized as follows. From 1961 to 1971, ten states adopted a general sales tax, ten states adopted a broad-based personal income tax, and nine adopted a corporate income tax (U.S. Advisory Commission on Intergovernmental Relations 1994). In the late 1970s and 1980s the tax limitation movement caused a number of legislative controls on taxes to be enacted. During the 1980s two major federal income tax reforms lowered tax rates, broadened tax bases, and increased the emphasis on economic development as opposed to equity. While state reforms echoed federal reform themes, the cutback in the flow of federal grants caused rising state and local taxes and user fees in the 1980s.
15. With a significant constant, comparing estimated marginal tax rates and average tax rates gives an indication of how progressive a tax system is. For the nation as a whole, state and local taxes are progressive; the aggregate average tax rate is less than the marginal tax rate for the United States. Using any measures from note 12, overall progressivity fell over time. However, the aggregate estimate may overstate the case for progressivity. While most states appear to have a progressive tax system, for a large number of states one can reject progressivity or regressivity in favor of proportionality. Also, more states have become insignificantly different from proportionality from one subsample to the next. Comparing average tax rates and marginal tax rates for the Southeast, one sees that most states are progressive. However, the Southeast tended to be less progressive than the nation, except for the 1977-92 period.
16. But the regression would also suffer from multicollinearity because it would essentially be estimating a budget identity that equates all sources and uses of government funds.
17. See note 12 for a discussion of this index. One common measure of progressivity is the ratio MTR/ATR, where the ratio is greater than one if taxes are progressive. A regressivity index can be thought of as the inverse of the progressivity measure, or ATR/MTR. Using these indexes,

regressivity and progressivity are referred to interchangeably.

18. The closer the state and local tax system is to proportionality, the more precise is the approximation of the distortionary effect on growth for a regressivity-neutral tax policy. Of course, as states move toward proportionality, average tax rates become a better proxy for marginal tax rates.
19. Potential trouble spots are that the explanatory variables may be endogenous, that there exist high correlations among explanatory variables, or that some important variables were omitted. These possibilities temper any policy inferences one might want to make from the regression results.
20. Also, the level of aggregation in this study does not allow specific conclusions about how the composition of a state's state and local taxes affects growth. Nor does the study allow inferences about how other nontax revenues enter the mix. For the Southeast, it may be that the low tax rates (and a tilt of the revenue mix toward nontax sources) spurred growth, but the Southeast's mix of relatively low property and income taxes may also have been important.

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FYI

Tracking Manufacturing: An Update on the Survey of Southeastern Manufacturing Conditions

R. Mark Rogers

At the end of 1991, the Federal Reserve Bank of Atlanta began a survey of manufacturers in Sixth Federal Reserve District states.[1] This Survey of Southeastern Manufacturing Conditions has been valuable in helping gauge the strength of the southeastern economy over the past four years of recovery and expansion. In March 1995 the implementation of seasonal adjustment procedures substantially improved the survey by making the data easier to interpret. The seasonally adjusted data make time series comparisons much easier than they were when only unadjusted data were available. As a result, the data provide a clearer picture of the past four years as well as current conditions and manufacturers' expectations.

Why does the Federal Reserve Bank of Atlanta conduct this survey? Like the eleven other Reserve Banks across the nation, the Atlanta Fed monitors economic conditions in its region. Its most important reason for doing so is to contribute to the Federal Reserve System's task of setting appropriate monetary policy. The Atlanta Fed also releases the information in the survey (at aggregate levels only) to the public so that interested citizens can have additional current information on the region's economy. In the Southeast, one of the most important influences on the economy's performance is manufacturing activity. It is more variable than most other sectors and is generally a higher-wage sector.

Consequently, to augment its analysis of economic conditions in the region, the Atlanta Fed's research department in late 1991 launched the first

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comprehensive survey to focus solely on changes in indicators of manufacturing activity in the Southeast. Because turnaround is rapid—less than three weeks for gathering, compiling, and reporting the data—the survey provides recent information on the southeastern economy, information not available from other sources.

*W*hat's in the Survey?

The Atlanta Fed's manufacturing survey covers manufacturing plants in all or parts of the six states in the Sixth Federal Reserve District. This monthly mail-in survey is distributed to about 230 selected firms with plants located in these states. The survey's panel of manufacturers is patterned on the distribution of industries according to the two-digit standard industrial classification (SIC) for shipment values from the Census Bureau's quinquennial Census of Manufactures in 1992. Table 1 shows the current distribution of survey respondents according to the two-digit SIC classification; the table also gives 1992 Census of Manufactures shipment values for Sixth District states and the United States. Tabulated responses are not weighted by firm size, nor are adjustments made for variances in response rates by industry from an "ideal" distribution.

For the most part, the survey design and operation is little changed from when reports were first released to the public in November 1992.[2] The survey asks for information about a broad range of activities: production, shipments, new orders, order backlogs, materials inventories, inventories of finished goods, number of employees, average employee workweek, prices received for finished products, prices paid for inputs (nonlabor), capital expenditures, new orders for exports, and supplier delivery time. Responses to the survey are qualitative—not for specific levels such as dollar amounts. For each question respondents are asked to report activity as being an "increase" or a "decrease" or as showing "no change" (a) from the previous month, (b) from the same month a year ago, and (c) in terms of expected levels of activity six months from the current month. In addition to the questions specific to the manufacturer's own plant, each respondent is asked for an evaluation of the firm's industry activity at the national level.

Data for each question are aggregated into percentages reporting each of the three responses—increase, decrease, and no change.[3] A diffusion index is also calculated for each question. This index is merely the difference between the positive response share (the percentage reporting increases) and the negative response share (the percentage reporting decreases). Numerical values of the diffusion indexes range from minus 100 to positive 100. At the zero value, the percentage reporting increases equals the percentage reporting decreases. While the diffusion indexes are not calculated from specific dollar levels of activity for each respondent, there is a statistical relationship that higher index values are associated with higher growth rates.

Survey questionnaires are mailed out on or near the twenty-fourth of each month. The timing of the mailing allows respondents to provide data that reflect known activity for the reference month, for the most part, rather than estimates based largely on data from the previous month. For the initial release of data for a given reference month, the sample size averages between 115 and 125 respondents; the data received late boost the subsequent month's tally to between 125 and 140 replies. Summary data are released to the public on the second business day after the tenth of the month after the reference month.

*W*hy Seasonally Adjust the Data?

For the past four years, the Survey of Southeastern Manufacturing Conditions has provided useful information and has played a role in the bank's consideration of the proper monetary policy. However, during the first two years of the survey, it became apparent that the data about current activity and expectations have some significant seasonal movements that, at times, overwhelm cyclical movement and add uncertainty to interpretation. For example, each July the share of respondents reporting decreased production output jumps sharply—apparently because of vacation shutdowns and slowdowns. Similarly, output numbers are weakest around December as Christmas production is completed for the most part and there are vacation-related cutbacks in hours of production. Related to the pre-Christmas boost in production and the December slump, data about manufacturers' expectations are generally strongest in December and weakest in June. June expectations data reflect the anticipation of production cutbacks in December (six months after June). See Chart 1 comparing seasonally adjusted and not seasonally adjusted production diffusion indexes.

With these volatile monthly patterns in the data, cyclical movement was often overwhelmed. The question then became, After taking into account these

Table 1
States' Value-Added Manufactures by Industry
As a Percentage of States' Total Value Added by Manufactures

SIC Code	Description	AL	FL	GA	LA	MS	TN	DIST.	U.S.	Survey Distribution By Units[1]
20	Food and kindred products	7.3	14.4	15.7	7.9	11.5	14.0	12.3	11.2	8.51
22	Textile mill products	7.4	D[2]	D	D	D	2.5	1.6	2.1	2.84
23	Apparel and other textile products	7.1	3.5	6.4	0.6	8.0	5.2	4.9	2.6	4.12
24	Lumber and wood products	4.3	2.5	3.2	2.3	8.3	1.5	3.1	2.4	3.09
25	Furniture and fixtures	2.5	1.4	1.5	—	8.1	2.9	2.2	1.6	2.06
26	Paper and allied products	13.3	4.2	11.6	7.9	9.5	5.5	8.3	4.3	8.76
27	Printing and publishing	3.5	11.6	5.8	2.0	D	6.4	5.7	8.1	4.90
28	Chemicals and allied products	11.8	9.3	10.3	40.5	8.9	16.5	16.1	11.8	13.14
29	Petroleum and coal products	D	0.4	D	18.2	D	D	2.8	1.7	—
30	Rubber and misc. plastic products	6.1	3.2	3.9	0.9	5.6	5.8	4.2	4.2	4.12
31	Leather and leather products	D	D	D	D	D	1.0	0.2	0.3	—
32	Stone, clay, and glass products	2.2	3.3	3.5	1.1	2.6	2.3	2.6	2.5	4.64
33	Primary metal industries	7.3	0.7	2.9	0.9	2.7	4.4	3.1	3.7	3.09
34	Fabricated metal products	6.3	4.8	3.5	3.5	5.9	5.8	4.9	6.0	10.57
35	Machinery, except electrical	6.8	4.7	4.9	2.7	7.4	7.3	5.5	9.4	6.70
36	Electric and electronic equipment	5.7	15.7	8.1	1.9	10.4	5.7	8.0	8.7	9.02
37	Transportation equipment	5.6	8.3	14.9	8.8	10.3	8.9	9.7	11.5	9.79
38	Instruments and related products	1.4	10.7	2.6	0.4	0.8	2.4	3.5	6.4	2.58
39	Miscellaneous manufacturing	1.4	1.3	1.1	0.3	D	2.0	1.2	1.6	2.06
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Average for October-December 1995
[2] "D" indicates that census disclosure rules prevent the release of data when there are too few firms in a geographic location for a particular industry.
Source: U.S. Department of Commerce, Census of Manufactures, 1992

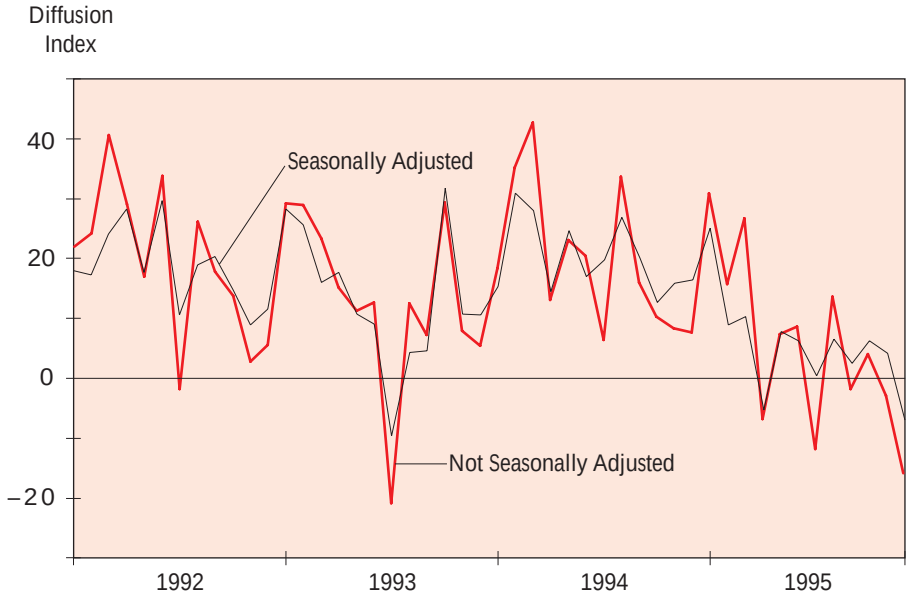
normal seasonal fluctuations, is southeastern manufacturing improving or not? Seasonal adjustment procedures indeed do a relatively good, although not perfect, job of taking these seasonal fluctuations into account. Statistical programs adjust the data for seasonally weak months by raising the data for these months by a typical difference between the unadjusted months' value and an average yearly value such as a thirteen-month centered average.[4] Similarly, data for seasonally strong months are lowered by the typical difference between it and a broader average. As a result, a user can discount normal seasonal influences on the data and focus more closely on data that may suggest changes in underlying economic strength.

The Seasonal Adjustment Process

To seasonally adjust the data, the Atlanta Fed used a standard seasonal adjustment program—the Census Bureau's X11 program. However, before seasonally adjusting the data, standard procedures were implemented to determine whether seasonal adjustment was appropriate. In the preliminary stage of the seasonal adjustment process, the X11 program conducts a statistical test (an F-test) to determine whether the seasonality is "stable"—that is, whether the movement in a data series has a regular intrayear pattern.

Data can be processed through seasonal adjustment programs regardless of whether seasonality is stable. However, doing so for data that do not show a stable seasonal pattern does not improve the user's ability to discern true cyclical movements and may instead distort cyclical patterns. Seasonal adjustment programs compare unadjusted monthly numbers to a yearly moving average and then apply seasonal factors to unadjusted data. If the pattern of the differences from the moving average is not regular (that is, stable), then the seasonal factors that are calculated are simply "averages" of random movements. Under these circumstances seasonally adjusted data merely reflect the addition of random factors (the seasonal factors based on unstable data) to unadjusted data. In short, data series that reveal no sea-

Chart 1
Survey of Southeastern Manufacturing Conditions
Production Diffusion Indexes, Seasonally and Not Seasonally Adjusted



Source: Federal Reserve Bank of Atlanta

sonal patterns should not be run through a seasonal adjustment procedure. Some examples of national data series without clear seasonality are from the U.S. consumer price index report, including the price series for household insurance, household maintenance and repairs, and public transportation costs.

Seasonality Tests. For the Atlanta Fed survey, unstable series are monitored on an ongoing basis so that, if they do begin to exhibit a more stable seasonal pattern, they may be seasonally adjusted in the future. Beginning with the initial release of January 1996 data, only three series are not being reported in seasonally adjusted form: (1) prices received for the current month versus the previous month, (2) supplier delivery time for the current month versus the previous month, and (3) new orders for exports for six months from November. These series did not pass a statistical test for stable seasonality.[5] A list of the F-test results for seasonal stability can be found in Table 2 with the top panel indicating the test results for responses in the "this month versus last month" category and the bottom one providing test results for responses in the "six months from now" category.

After F-test results determined which series should be seasonally adjusted, data for each question in the survey were seasonally adjusted by components—that is, the response categories "decrease," "no change," and "increase." A seasonally adjusted diffusion index was created using the seasonally adjusted components.[6]

After the data have been seasonally adjusted but before the survey is published, one final process is necessary. For each month the seasonally adjusted components (decrease, no change, increase) for a given question do not always sum exactly to 100 because of the nature of the seasonal adjustment statistical procedure. The unadjusted responses' percentage shares of course sum to 100. So that the sum of the parts equals the whole, seasonally adjusted components are statistically constrained to sum to 100. As a result, the seasonal factors implied by the difference of published (constrained) adjusted and unadjusted data for a given component are not the same as the factors generated by the unconstrained data. The published seasonally adjusted diffusion indexes are the difference of these constrained seasonally adjusted components.

It is important to note that only four years of data are used to derive the seasonal factors and that revisions could be significant with the inclusion of more data. This past year, seasonal factors were revised from those based on only three years of data, and modest changes were seen in the factors as well as in the test statistics for seasonal stability.

Southeastern Manufacturing: Trends, Current Conditions, and Expectations

Several trends in the southeastern manufacturing data have emerged during the past four years from the responses given by participating manufacturers. Trends have become evident in the proportions reporting increases, decreases, or no change for the various survey questions—such as for production, shipments, and new orders. Changes over the business cycle can also be seen by looking at the diffusion index for a given survey question. While in many situations as the proportion of respondents reporting increases moves up, the share with decreases declines, and vice versa, there are instances when both shares move together with the impact showing up in the no-change category. In these instances, the diffusion index is particularly useful because it reveals the difference between the proportion reporting higher levels of activity and the share reporting lower levels of activity.

During the last four years, the various survey series have shown a manufacturing sector largely in a post-recovery phase of economic expansion. Reports have reflected varying magnitudes of strength for manufacturing output with corroborating data in other series, such as orders and employment. Similarly, price data have followed the strength in output.

The diffusion index for output portrays an almost continually expanding southeastern manufacturing sector from early 1992 until the end of 1995. There were mild softenings in mid-1993 and early 1995. A moderate weakening in output, possibly related to a temporary inventory adjustment, began in December 1995. By early 1995 somewhat more firms than not reported higher inventories for finished goods while series for new orders and backlogs remained soft. In May 1995, for the first time, more plants reported decreases in output than reported increases, beginning an extended period of softness that continued into early 1996.

The survey's employment data suggest that management has been cautious in adding to the manufacturing work force in the Southeast. By February 1992 more manufacturers were adding to the work force than were laying off workers, but the net positive hiring trend took a brief detour in mid-1993, as indicated by the employment diffusion index, which turned negative from May 1993 through August 1993. Thereafter, manufacturers were more inclined to add to their labor force until April 1995, when the employment index again turned negative. Despite mostly favorable hiring trends over the first three years of the survey, the underlying

Table 2
Test for Stable Seasonality

This Month versus Last Month Series

Series	Decrease	No Change	Increase	Diffusion Index
Production	7.114	3.136	8.497	9.645
Shipments	5.701	2.818	5.917	6.346
New orders	2.853	0.547*	3.719	3.308
Backlog of orders	2.978	0.689*	5.562	4.698
Materials inventories	3.156	1.756*	2.835	4.267
Finished goods inventories	3.534	1.120*	4.203	4.674
Number of employees	2.856	5.050	5.027	2.096
Employee workweek	3.187	2.680	5.138	5.899
Prices received	1.972*	3.189	2.399	1.711*
Prices paid for raw materials	0.606*	3.739	3.160	2.026
New orders for exports	0.601*	2.793	3.597	2.358
Supplier delivery time	1.143*	1.718*	1.552*	1.049*
Industry activity nationwide	2.745	1.568*	3.737	2.751

Six Months from Now Series

Series	Decrease	No Change	Increase	Diffusion Index
Production	11.099	2.504	7.891	9.198
Shipments	10.113	2.709	8.064	9.509
New orders	9.175	2.112	8.318	8.986
Backlog of orders	6.962	1.626*	7.633	10.691
Materials inventories	2.877	0.605*	2.037	3.608
Finished goods inventories	3.752	1.374*	2.936	4.810
Number of employees	7.242	1.002*	5.558	7.769
Employee workweek	8.419	0.593*	6.871	14.525
Prices received	4.449	7.202	8.446	6.331
Prices paid for raw materials	0.767*	6.474	5.708	3.434
Capital expenditures	1.556*	1.951	2.910	2.388
New orders for exports	0.687*	1.995	1.869	1.355*
Supplier delivery time	1.563*	1.104*	1.915	2.075
Industry activity nationwide	11.160	3.563	6.544	9.247

Note: The table shows the values of the X-11 F-test for stable seasonality. Seasonal adjustment is done using RATS386-EZ-X11 with graduated extremes. Critical value for the 99 percent level is 2.36. Critical value for the 95 percent level is 1.83. An * indicates those series for which seasonality is not significant at the 95 percent level. The tested series consist of data spanning the period January 1992–December 1995, except for supplier delivery time, which is tested over the March 1992–December 1995 period.

caution of manufacturers should not be overlooked. The percentage of plants reporting no change in their number of employees remained high—never dropping below 55 percent—throughout this period.

The data for the average workweek show a pattern similar to that for the number of employees. Workweek figures have been positive on balance for the 1992-94 period, with the exception of a mildly negative five-month period in mid-1993. Since February 1995 the trend clearly has been for the index to remain mildly negative. Comments from manufacturers give several possible explanations for the fact that only a small portion of plants have boosted either employment or average work hours during the current expansion. These explanations include management's expectation that output gains would be only moderately healthy rather than robust during the expansion, firms' cost of labor being driven up by benefit costs, and foreign and domestic competition's forcing manufacturers to boost productivity and reduce labor costs.

As the string of positive reports on production, shipments, and orders continued into the third year of this expansion, the issue of price pressures became increasingly important. In both 1992 and 1993 the share of respondents reporting an increase in prices for raw materials remained at a relatively constant 20 percent each month. However, by the end of 1994 this figure had surged to over 50 percent, peaking at 59 percent in January 1995. Such figures raised concern that inflation pressure might be building at the manufacturing level and could be passed on to consumers. The share of respondents reporting raising prices for their finished product also rose, although much more slowly. The share reporting increases rose from the 10 percent to the 15 percent range in 1993 to a peak of 34 percent in January 1995. The share reporting increases for either series eased in early 1995 and remained soft into early 1996.

In analyzing the relationship of these numbers, particularly for input prices, to overall inflation trends, several points should be considered. First, the figures do not indicate the size of price increases, merely the proportion of firms reporting those increases. Second, for most firms the number of different raw materials used in their production process exceeds the number of finished products. Hence, reports typically show input prices increasing more often than do finished product prices. Finally, raw materials may be only a small portion of total costs, and manufacturers may temporarily absorb that cost. To some degree, all these factors likely have played a role in constraining reported increases in output prices in 1994 despite the fact that figures for the raw materials price series have been higher.

The Outlook Data

The data respondents report on outlook are difficult to interpret for the Southeast because the survey has not yet been in existence for even a full business cycle. Yet thus far the outlook responses for a number of activities have been consistent with current-month data, but only in a broad cyclical sense. The six-months-out data tend to miss some of the more volatile oscillations in the current-month figures. For example, the outlook data for production peaked early during this expansion, in December 1992, when two-thirds of the respondents anticipated future output gains. This peak was consistent with the later maturing manufacturing sector in the Southeast when output grew more slowly. On the other hand, the noticeable deceleration in mid-1993 was not foreseen by southeastern manufacturers.

In the prices-received and prices-paid series, the six-months anticipation data appear to have been more accurate for peaks and troughs for two or three months ahead than for six months. Also, for the first two years of the survey, manufacturers were significantly more optimistic in terms of expectations of prices received than later data bore out. Only in the spring of 1995 did expectations data for prices, both received and paid, approach the current-month diffusion index levels. During the past four years, only a small percentage of southeastern manufacturers were able to report increases in prices for their own finished products despite significant percentages of respondents indicating higher input prices over the first three years of the survey, especially in 1994.

Summary

In March 1995 the Federal Reserve Bank of Atlanta began publishing data for the Survey of Southeastern Manufacturing Conditions in seasonally adjusted form, thereby significantly improving the data's usefulness in portraying the current status of southeastern manufacturing. Seasonally adjusted data are now available historically back through 1992 for most month-ago and six-months-ahead expectations series. Historical data are available through the Commerce Department's Economic Bulletin Board, on the Internet at

http://www.frbatlanta.org, or through the Atlanta Fed's public affairs department.

The new, seasonally adjusted data portrayed a robust manufacturing sector in the Southeast from 1992 through 1994 with gradually rising price pressures peaking at the first of 1995. The fourth year of the survey, 1995, showed southeastern manufacturing activity rebounding with modest growth following a mild inventory adjustment in the spring of the year. Output in early 1996 weakened after an extended period of declines in backlogs. At the end of 1995, price indexes for prices paid and for prices received were soft compared with 1994.

Notes

1. The Sixth Federal Reserve District encompasses Alabama, Florida, Georgia, and parts of Louisiana, Mississippi, and Tennessee.
2. See R. Mark Rogers, "Tracking Manufacturing: The Survey of Southeastern Manufacturing Conditions," Federal Reserve Bank of Atlanta *Economic Review* 77 (September/October 1992): 26-33.
3. For supplier delivery time the question format was changed in March 1992. The choice of responses was changed from "decrease," "no change," and "increase" to "faster," "no change," and "slower" to clarify intended responses. There had been some doubt as to how respondents were interpreting these questions when the survey first began. For supplier deliveries, "slower" is a positive response because slower deliveries generally indicate a strong economy with increasing shortages of supplies. The diffusion index for supplier delivery time is the percentage of "slower" responses minus the percentage of "faster" responses.
4. Using thirteen months to determine an average gives an equal number of months before and after the "center" of the average.
5. If the results of the F-test do not indicate stable seasonality at the 95 percent confidence level or higher, that particular series is not seasonally adjusted. The 95 percent figure is a typical, high standard for acceptance of the hypothesis (that stable seasonality is present). For a number of types of activity (that is, production, new orders, and so on), one or more of the components of the diffusion indexes did not pass the 95 percent hurdle for stable seasonality. For example, for material goods inventories, the "no change" response has an F-statistic that is well below the 95 percent critical value even though the "decrease" and "increase" components had F-statistics exceeding this value. In these cases, all of the components are seasonally adjusted if one component passed (including, for this test purpose, "no change" as well as the diffusion index [in a test directly on the unadjusted index]). The seasonally adjusted diffusion index is still calculated indirectly from these seasonally adjusted components. For the category "prices received this month versus last month, only the "no change" component series is stable, likely reflecting the fact that most responses fell in that category. The "increase" and "decrease" categories had a high ratio of noise (monthly volatility) to any seasonal movement and did not pass the test for stable seasonality.

   When the survey data were first released in seasonally adjusted form in March 1995, the list of series not available in seasonally adjusted form differed slightly. At that time the series available only in unadjusted form were "prices received for this month versus last month" and "supplier delivery time" (for both time frames). For both the "supplier delivery time" series there were an insufficient number of observations for seasonal adjustment because the format for these series changed in March 1992 (see note 3). A minimum of three years of data is required for the X11 procedure.
6. Direct seasonal adjustment of the diffusion index was also considered. The directly adjusted diffusion indexes were practically identical to those computed using seasonally adjusted components. The directly adjusted indexes usually had marginally less monthly volatility than the indirectly adjusted indexes. The deciding factor in using an indirect seasonal adjustment process for the diffusion indexes was that the seasonally adjusted components are consistent with the indirectly adjusted indexes. In other words, indirectly adjusted diffusion indexes exactly (except for rounding) equal the difference between percentages for positive and negative seasonally adjusted component responses. Directly adjusted indexes do not always equal the difference between positive and negative response shares. Another concern was that with directly adjusted indexes using additive factors it is possible for some seasonally adjusted monthly indexes to take on values greater than 100 or less than –100—possibilities that are not aesthetically or theoretically pleasing.