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Metro Area Growth from 1976 to 1985: Theory and Evidence

William A. Testa

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William A. Testa*

Over the past 15 years, the process of regional change has been most unfavorable to regions in the Midwest. In particular, the economy of the eastern part of the Midwest--the East North Central Region (encompassing Ohio Indiana, Michigan, Illinois, and Wisconsin) has steadily declined. This region's share of national employment fell from 20 percent to 17 percent between 1972 and 1987. While the West North Central has fared somewhat better, agriculturally-oriented states such as Iowa and Nebraska, have generally paralleled the decline observed in the Midwest's industrial belt.

In response to lagging job opportunities in the Midwest, policymakers have put much effort into development programs intended to ignite robust economic growth in the Midwest or, at least, to maintain the existing job base. This study is intended to help shape these programs by identifying the forces of regional change, thereby suggesting more effective policy levers to stem the region's decline.

Theories of regional change

In identifying potential policy levers, several economic theories explaining regional growth differences have been forwarded. In summary, it is probably safe to say that none of them have proven to be universal in explaining the U.S. experience. However, elements of all of them are consistent with the experiences of particular regions during particular time periods. In brief, the following theoretical frameworks are most prevalent in explaining the U.S. regional experience in recent decades.

Neoclassical Theory: In its most basic form, this set of ideas considers factors of production--especially labor and capital--to be mobile across regions. Labor will move to regions where real wage rates are highest. In

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*The author is Senior Economist at the Federal Reserve Bank of Chicago. The views and findings herein do not necessarily reflect the views of management of the Federal Reserve Bank.
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turn, capital will flow to regions of highest return. Under the most common assumption of one commodity which is produced by the same technology in all regions, differences in factor returns are determined by regional differences in endowments of labor and capital. So long as factor returns such as wages differ across regions, this theory would predict that labor will migrate to high wage regions of capital abundancy while capital would flow to low-wage regions of labor abundancy.[1]

In examining the U.S. growth experience, this neoclassical growth mechanism has been related to the migration of the Southern poor to the factories of the North during the 1950s and 1960s in search of high wages. Also, the strong capital investment observed in the South during the 1950s, 1960s, and 1970s can be partly attributed to low wages in that region. In general, the per capita income convergence observed across U.S. regions in this century has been related to neoclassical mechanisms.

Export-Base Theory recognizes that regions will specialize in certain industry products for reasons which are difficult to specify including historical accident, favorable location with respect to transport, endowment of a unique factor of production, or increasing returns to scale of an industry or group of industries. These industry products or services of specialization form the "economic base" of the region and these goods are traded rather than nontraded. Export base theory posits that a region's growth in employment and income can be best understood in terms of changes in demand for the region's traded goods by the rest of the world and nation or changes in competitive position which influence the quantity demanded. Empirically, divergences in regional growth can often be understood by a region's mix of industries. In recent years, for example, the nation's increasing proclivity for foreign autos and domestic defense expenditure would be key features in explaining the relative decline in Michigan's economy and the relative rise in the coastal economies.

Product Cycle Theory suggests that industries and their attendant products undergo distinct stages or phases of a "life cycle" beginning with an innovative stage. At this initial stage, factor costs are of little relevance. Rather, specialized factor inputs such as entrepreneurial and innovative personnel, specialized business services, access to suppliers, access to emerging technological advances and ideas, and specialized financial services are critical. At the initial innovative stages and later in the early growth phases, the process technology of the industry cannot be transferred to another location. But later, as the process of production becomes standardized, the industry can become mobile in seeking locations where production costs are lowest. Because regions will maintain advantages in different factor costs, production will be spun out to low cost regions or even overseas. Examples from the U.S. experience have been the textile industry's exodus from New England to the South Atlantic states and overseas. More recently, the production segment of the U.S. computer and the semiconductor industry has reportedly moved along the product cycle in such a fashion.

While regions generally share the same fate as their industries, the recent New England experience has shown that a developed region's capacity to innovate is not so permanently and easily eroded by the passing of a single set of industries through a product cycle. The technological legacy of a once-developed region may become the wellspring of a new set of industries. This observation has led others to assert that regions undergo waves or cycles of growth and development.[2]

In other respects, the product cycle theory is not sufficiently developed to be useful as a predictive theory of regional growth. Not all industries proceed through a product cycle (Malecki 1985) and evidence is lacking as to which industries the product cycle applies. Moreover, once a region has experienced decline (as its major industries move out through a product cycle), no guidance is offered on the conditions under which these regions will rejuvenate or if they will do so at all.

Industrial Location Theory suggests that any regional growth theory must be reconciled with the micro decisions of each individual firm. In market economies, firms are thought to maximize their own profits (and minimize costs) in making capital investment decisions, including location alternatives. In turn, firm location and expansion decisions accompany employment opportunities for a mobile labor force.

While it is recognized that different types of firms respond to particular factor costs and conditions, the basic set of locational cost conditions can be generalized to include access to inputs and markets, labor, energy, transport, construction and lease costs, and those myriad services, regulations, and costs which are often influenced by state and local governments. These costs, including tax levels and structure, service provision, environmental regulation, fiscal inducements and financial subsidies, and labor insurance, are often included under the popular rubric of "business climate". Business climate factors are often the focus of state/local officials because these factors can be influenced via the state/local government process or in partnership with the private sector.

In addition to cost oriented features, a separate set of growth factors can be included under the rubric business climate. State and local governments have become active in business promotion. Prominent examples of such "demand side" policies are export or trade missions overseas; lobbying the federal government for a more favorable federal funds flow or identifying early procurement contract opportunities for regional industries; and "buy local" programs to increase the home demand for the region's products.

Empirical studies as a framework

Within the body of empirical literature, the econometric specifications of regional growth range from purely *ad hoc* or intuitive empirical equations which are loosely based market frameworks (Plaut & Pluta 1983; Wasylenko 1984; Browne et al 1980; Kieschick 1981; et. al.) to carefully developed foundations based on micro theory of firm location behavior, specific functional forms, and statistical models (Carlton 1979; Hodge 1981; Crihfield 1985; Bartik 1985). Nonetheless, the functional forms that are ultimately used for statistical estimation often end up being very similar. The dependent variable, or what the analyst is trying to explain, is usually measured by either the growth rate in output or the growth rates of the factor inputs of labor and capital across regions.[3] Regional variation in growth rates are then "explained" by such factors as wages, energy costs, state-local taxes, labor climate, access to markets, climate, and an ever-expanding host of measures.

One characteristic of much empirical work has been to assume that regions are slow to equilibrate differences in cost factors. This means that "static" specifications of the empirical models have been generally discarded (i.e., an equation that would explain levels of employment based on concurrent levels of wages and other factors). Rather, one-term changes in the dependent variable are hypothesized to be chiefly determined by beginning period differences in factor costs (Wheat 1973, 1987; Plaut and Pluta 1983; Wasylenko 1984). Beginning-period regional cost differences are represented, for example, by relative wages, unionization levels, taxes, energy costs, and the like. Most studies assume that these cost differences are persistent and fairly constant thoughout the subsequent period of growth. While one can easily imagine that growth would additionally be determined by concurrent changes in factor costs (Plaut & Pluta), such considerations are usually neglected because of a scarcity of data observations.[4]

A recent innovation in this literature recognizes the simultaneous equations bias in those formulations which use "change in employment" as the dependent variable. The theoretical underpinning suggests that these specifications are measuring the regional derived demand for labor and, in turn, the demand for labor depends on relative wages. But if so, then the wage is simultaneously determined with local supply of labor so that inclusion of wages in the single-equation estimation will yield inconsistent parameter estimates.[5] As a result, some studies have used more appropriate statistical techniques such as instrumental variables to correct for simultaneous equations bias (Crihfield 1985; Papke 1984).[6]

Similar to much of the existing literature, we estimate a "disequilibrium" model where economic performance (or growth) across SMSAs (Standard Metropolitan Statistical Areas) can be observed to adjust to initial period relative factor costs. While our empirical specifications are largely ad hoc, (i.e. the equations will not follow directly from a formal model using specific functional forms of a production function), the general form of our equations are similar to those grounded in economic theory (Engle 1974; Crihfield 1985; Papke 1984).

The econometric specification chosen is in linear form; percentage change in employment is a linear function of beginning period levels of input costs (C) and other growth factors (OTH). Each metro area accounts for one observation so that the database can be considered as cross-sectional rather than time-series.

$$PCHEMP_i = a + bC_i + c(OTH_i) + e_i$$

The linear form rather than log-linear is chosen insofar as some observations of employment change are negative, particularly for the manufacturing industry. Accordingly, the logarithm of these observations cannot be calculated. No other functional forms were attempted.

In an alternative specification, output growth substitutes for employment growth as the dependent variable. Output is measured by percentage change in value added in manufacturing—value added measuring the sum of factor payments which is, in practice, roughly equivalent to the value of manufacturing output less purchased inputs. The employment growth equations represent labor demand equations for a region. Theory suggests that we attempt some statistical techniques to account for the simultanity bias in these employment equations. In fact, corrections for these considerations have been made. However, the results reported here are of the ordinary least squares variety. It is noted that our results are robust with respect to estimating methods.[7]

The observations are drawn from the 75 largest SMSAs (Appendix I). SMSAs are economic regions having a common pool of labor, common statewide regulations, and common resources. While these areas have been criticized as economic units due to their proximity to other urban areas with which they are closely entwined, metro areas are more reasonable as economies than either counties, cities, or states—other geographic units for which data for important variables are available.

The analysis was conducted for large industry categories: total employment, manufacturing and nonmanufacturing employment, and also manufacturing output. Owing to regional differences in business cycle timing and severity, a period of some length is required to capture secular growth trend differences. Growth in employment was measured in percentages for the 1976-85 period from *County Business Patterns* data. Unfortunately, manufacturing output for metro areas has not been reported since 1982, so this six-year time period is regrettably short. The 9-year period can be considered sufficient to capture the effects of regional cost differences on regional growth trends. A period that is too long may violate the assumption that observed regional cost differences are constant over the period of study. Some analysts have used longer periods (Crihfield 1984; Wheat 1973, 1986) and others have used shorter periods (Plaut and Pluta 1983 and Wasylenko 1984).

Statistical results

The equations reported in Tables 1 and 2 are ordinary least squares estimates where the dependent variable is expressed in percentage change from the beginning year to the endpoint year. The equations were checked for the common cross-sectional data problems of multicollinearity and heteroskedasticity.[8]

The overall statistical results explain much of the variation in metro area growth over the 1976-85 period. "Explained variations" of between .4 and .5 are reported for the employment equations. These statistics are substantial for cross-sectional type analysis. In comparison, the manufacturing output equation does not perform as well, exhibiting an R^2 slightly under .3. This may be due to the shorter time period for which output data is available. Leonard Wheat (1986) has criticized Plaut and Pluta (1983) and others for using a short time period for this type of model because "cyclical effects, strikes, random spurts, and other short-run anomalies overshadow long-run trends".

The equations reported were arrived at from experimentation and iteration—there is no pretense that these are the outcomes of single "roll of the dice" as set forth from a structural model. A cross-section database was constructed covering many potential factors of importance which were gleaned from existing studies. In the course of this process, considerable care was taken in choosing and constructing variables that were thought to measure the concept that theory would suggest had an influence on regional growth differences. Some variables were ultimately dropped because collinearity between independent variables degraded the estimates of remaining coefficients. (See Table 3 for correlation coefficients of all the retained variables.) In clear cases of bivariate collinearity, the variable that was retained had the greatest economic content and the most straightforward interpretation. For example, unionization variables were dropped in favor of wages.

Table 1

OLS regression equation: Employment and output growth in manufacturing

	Percent change in manufacturing employment (1976 to 1985)	Percent change in manufacturing output (1976 to 1982)
Intercept	1.04**	.95**
	(3.34)	(2.27)
Labor Costs (WM76MFG)	−0.15**	−.18**
	(−2.76)	(−2.45)
Market Maturity (MARKET)	−130.35*	−149.11*
	(−3.72)	(−3.22)
Access to Technology (TECH)	.04	.07
	(1.13)	(1.36)
Defense Spending Per Capita (DOD)	.0001	−.00002
	(1.21)	(−.14)
Educational Expenditure Per Pupil (EDEXP)	.0002*	.0001
	(1.78)	(.60)
Tax Growth Per Capita (CHTX)	−.003**	−.0001
	(−2.06)	(−.07)
Unemployment Insurance (UIMAN)	−21.95	2.88
	(−1.84)	(.18)
Export Orientation (XMFGEMP)	.03**	.03*
	(2.27)	(1.71)
$\bar{R}^2$	.44	.29

*Significant at the 10 percent level.
**Significant at the 5 percent level.

Table 2

OLS regression equation:
Total and nonmanufacturing employment growth 1976 to 1985

	percent change in total employment	percent change in nonmanufacturing employment
Intercept	1.01**	1.03**
	(5.63)	(6.15)
Labor Costs	−0.007**	−0.007**
(WM76MFG)	(−3.71)	(−4.02)
Market Maturity	−91.66**	−52.40**
(MARKET)	(−3.73)	(−2.27)
Access to Technology	0.04	0.03
(TECH)	(1.52)	(1.29)
Defense Spending	0.0002**	0.00002**
Per Capita (DOD)	(2.31)	(2.29)
Educational Expenditure	0.0001*	0.0001*
Per Pupil (EDEXP)	(1.76)	(1.84)
Tax Growth	−0.002**	−0.0001**
Per Capita (CHTX)	(−2.28)	(−2.22)
$\bar{R}^2$	0.48	0.41

*Significant at the 10 percent level.
**Significant at the 5 percent level.

Table 3

Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1. PCTOT	1.00	0.92	0.98	0.68	-0.41	-0.38	-0.11	-0.54	0.43	0.05	0.14	-0.04	0.32
2. PCMFG		1.00	0.85	0.67	-0.35	-0.29	-0.12	-0.51	0.40	0.08	0.14	-0.04	0.33
3. PCNM			1.00	0.65	-0.41	-0.39	-0.13	-0.45	0.41	0.03	0.13	-0.03	0.32
4. PCVA				1.00	-0.34	-0.24	0.01	-0.49	0.25	0.07	0.14	0.08	0.22
5. WM76MFG					1.00	0.73	-0.10	0.40	0.05	0.26	0.33	0.22	0.17
6. UPLTW						1.00	-0.10	0.39	0.01	0.46	0.30	0.47	0.17
7. CHTX							1.00	-0.11	-0.24	0.03	0.00	-0.39	-0.29
8. MARKET								1.00	-0.30	0.02	0.10	0.01	0.04
9. DOD									1.00	0.12	0.39	0.05	0.34
10. EDEXP										1.00	0.27	0.47	0.19
11. TECH											1.00	0.19	0.39
12. UIMAN												1.00	0.17
13. XMFGEMP													1.00

Glossary of variables in regression equations

CHTX — Percent change in per capita state and local taxes from fiscal 1976-77 to fiscal 1984-85

EDEXP — Education expenditure per pupil in A.D.A. 1976-77

DOD — Per capita procurement and payroll by the Department of Defense in 1977

MARKET — Ratio of value added (in $ millions) in manufacturing to population in the metro area

TECH — Total number of scientists and engineers engaged in research and development per 1,000 of the population, 1974

UPLTW — Index of average hourly earnings of unskilled plantworkers, 1975-76

WM76MFG — Average hourly wages, all manufacturing industries, 1976

XMFGEMP — Percent of total manufacturing employment related to exports, 1976

PCMFG — Percent change in manufacturing employment, 1976-1985

PCTOT — Percent change in total employment, 1976-1985

PCNM — Percent change in non-manufacturing employment, 1976-1985

PCVA — Percent change in value added in manufacturing, 1976-1982

UIMAN — Average statewide unemployment insurance rate (as a fraction of total wages) for 1975, 1976, and 1977 in the manufacturing sector

Discussion of findings

An interpretation and discussion of the regression coefficients is presented below.

Labor costs

Labor costs are invariably considered in statistical studies of growth. This is not surprising since labor costs comprise a large share of production costs. For example, manufacturers paid out 48 percent of value added to employee compensation in 1984. This share is possibly higher for service industries which tend to be more labor intensive than manufacturing. Significant regional wage differences have been widely observed by researchers (See ACIR 1980 for a review) even though wages have displayed some convergence over the course of the century. Moreover, a significant body of research finds no real regional wage differences once education and experience of workers is taken into account (Dickie and Gerking 1987).

Opinions remain somewhat divided on the importance of wage differences on regional growth disparities but evidence strongly suggests that wages do matter. The heavy weighting of labor-related costs in business climate rankings indicates that the popular wisdom equates high wage rates with poor business climate. For example, the Grant-Thornton annual *Manufacturing Climates Study* (1988) assigns over 40 percent of its factor weights to labor costs—and this excludes labor productivity and availability indicators. Econometric studies beginning with Victor Fuchs (1962) have implicated wages as affecting manufacturing employment growth across regions. Leonard Wheat's analysis stands out as a well-known study rejecting the importance of wage differences. However, his study does report a state's degree of unionization as highly significant (see also Bartik 1985) and these two variables are highly correlated in his study (rho = .73), as well as in our own study. Roger Schmenner's extensive interview studies of manufacturing branch plant decisions identified labor-related costs as very important (1982).

The estimations in Tables 1-2 report labor costs to be highly significant over the study period. As calculated in elasticity form (at the mean values of observations), employment growth was most responsive to labor costs for both the manufacturing and nonmanufacturing sectors (Table 4). The labor cost measures in the estimating equations represent the costs of hourly workers rather than salaried professionals. This suggests that the attraction of locations in the South for low-cost routinized production operations, such as branch plants and production facilities of mature industries, continues to be a major force in regional growth disparities into the 1980s.

Table 4

Point elasticities of growth factors
(as evaluated at the mean)

	Manufacturing employment		Nonmanufacturing employment
Labor Cost	4.9	Labor Cost	1.4
Educational Spending	4.4	Educational Spending	.5
Markets	1.9	Markets	.3
Tax Growth	1.4	Tax Growth	.3
Unemployment Insurance Tax	1.4	Defense Spending	.1
Export Orientation	1.1	Technology* Access	.1
Technology* Access	.5		
Defense Spending* Per Capita	.3		

*The underlying coefficient is not statistically significant at the 10 percent level using a two-tailed test.

Markets

By market influence, we mean the relative balance in the beginning period between the demand for goods (and services) and the supply (Wheat 1986). Strong demand relative to accessible supply will exert a market pull to attract suppliers to a more proximate location to the metro area.

In Leonard Wheat's recent study, a local market variable is constructed based on a state's ratio of personal income to manufacturing employment (and also on distance to the manufacturing belt) as a proxy for demand to supply imbalance. Unlike the approach of Plaut and Pluta (1983), who weight these two market components of supply and demand by their distance from each and every state, Wheat asserts that it is local demand/supply rather than national market pull that exerts the most influence on growth.

Following Wheat, and after some experimentation with both approaches, we also settle on a variation of the "local market pull", using manufacturing value added per metro area resident as our market measure. Although the point elasticity of the market variable ranks only third among growth factors (Table 4), the market variable enters first in a stepwise regression equation. One cannot decompose the explained variation in the regression attributable to each variable. However, the market variable, when entered alone, accounts for approximately one-half of the explained variance of the overall regression. No other variable (alone) performs in this fashion so that, at an intuitive level, it appears that regional differences in market pull accounted for much of the interregional differences in growth over the sample period.

As a matter of conjecture, the market variable is thought to account for two distinct influences in the equations. First, enhancements in transportation—especially the advent of cheap and fast truck transport over the course of this century—is thought to have magnified the market pull of populous regions such as the South (Chinitz and Vernon 1960). With rail as the dominant mode of shipment, the relative costs of long haul shipments from the core manufacturing belt was fairly low compared with short haul transport. This is because, with rail transport, terminal costs are fairly high. With truck transport, terminal costs are much lower so that short haul transport from factory to market compares more favorably with long haul transport. As a result, the coming of interstate truck transport greatly enhanced the attractiveness of building branch manufacturing plants closer to the markets of final destination. This implies that, regardless of any migration of people to the South and West in this century, strong forces of market pull have been exerted because of changing transport technology and investment in infrastructure (highway).

A second influence behind market pull has been the migration of people to warmer climates which has accompanied the rising incomes of retirees and the attraction of population to the resource-rich Western states. Some studies such as Wheat's have accounted for these two influences separately. In the current study, our sole market variable, value added per capita, is pulling double duty.

It must also be noted that the two influences are simultaneous; growth in supply attracts population growth in search of jobs which, in turn, further enhances market pull. Some analysts have modelled this process as a simultaneous system of job and population growth (Steinnes 1984).

Unemployment insurance taxes

State-by-state differences in unemployment insurance systems greatly concern many business groups and state chambers of commerce. This is especially so for those industry groups, such as construction and manufacturing, which tend to pay higher-than-average UI rates. The employment volatility of these industries is usually reflected in higher tax rates because state tax rates are "experience rated"—based on the unemployment history of individual firms. Accordingly, UI tax rates will often comprise a higher fraction of wage costs for firms in manufacturing and other plant-type industries.

Concern over unemployment insurance costs are expressed by manufacturers in the Grant-Thornton annual study of manufacturing climates. Input into this business climate ranking is provided by 36 associations representing manufacturers around the country. In the 1988 edition of the study, average benefits per covered worker are given a weight of 5.1 percent of the overall index and the net worth of the state unemployment insurance trust fund is weighted at 4.6 percent.

Few statistical studies of regional growth differences consider UI tax rates. A statistical study by Roger W. Schmenner (1987) and others' using an hierarchical or two-stage sequential approach, examines the plant location decisions of 114 branch plant openings by Fortune 500 manufacturing firms during the 1970s. In the model, the unemployment insurance tax rate is measured by average unemployment compensation benefits paid per employed worker. This is a fairly cost-relevent measure reflecting current plus expected UI system liabilities to employers. However, little evidence is found in the Schmenner study that UI costs are influential in the decision to open branch manufacturing plants.

Using employment data from 1973 to 1980, a study by Michael Wasylenko investigates the factors surrounding differences in growth among the 48 states on the U.S. mainland (1984). Major industry sectors under consideration include manufacturing, transportation, administrative and auxiliary employment, wholesale trade, retail trade, services, finance-insurance-real-estate, and total (employment). The measure of unemployment insurance is reported to be dropped from inclusion in the final results with no explanation. Presumably, the variable displayed a perverse sign or collinearity with another variable(s). It should be noted that the particular measure of unemployment burden on employers, which is the average benefit paid to a worker receiving benefits, is not well chosen. A state with very generous benefits could burden firms very slightly if that state is experiencing high growth and low unemployment. This would tend to lessen the population of unemployed workers and hence concomitant tax rates.

A 1985 study by Timothy Bartik examines how corporate location decisions for new branch plants (using the same database as Roger Schmenner) are influenced by unionization, taxes, and other characteristics of states. The study results show no detrimental impact of high state UI tax rates on plant location. In fact, the sign of the UI variable is unexpectedly positive for one of the reported estimating equations.

In contrast to these existing studies, our results indicate that UI taxes negatively influence employment growth over the 1976-85 period. These findings hold true for the manufacturing sector where, because the tax rates are often higher, one would most expect that high tax rates deter employment expansion.

Unlike those measures used in the previous studies, our measure of the UI tax burden is industry-specific and mirrors the employer's cost perspective. Still, this variable merits further investigation in that it is probably susceptible to simultaneous bias. Slow growth causes high UI tax rates. While we account for this by choosing beginning period values of UI tax, the causation we measure could be reversed to the extent that growth in a region is serially correlated from one period to the next (i.e. slow growth in the prior period accounts for high initial values of UI tax rates which, in turn, are correlated with slow growth over the subsequent period of study).

Orientation to manufactured exports

Throughout the 1970s, and peaking in 1980, the international trade share of U.S. output climbed steadily upward--imports and exports alike (Hervey 1986). Subsequently, merchandise exports fell off rapidly under the weight of a rising dollar and significant import penetration. As a percent of

GNP-output, merchandise exports had fallen to roughly the same level by 1984 as they had been in 1976.

In addition to their importance to the nation's economy, manufacturing exports have been demonstrated to greatly effect job generation in state economies. At least two studies have documented a significant relationship between a state economy's export orientation and economic growth (Crihfield 1985; Manrique 1987).

It is not surprising, then, that state policies have placed greater resources in recent years into stimulating state exports abroad. For example, one analyst reports that between 1976 and 1980 alone, the number of overseas offices maintained by state governments tripled (Posner 1981). At least one study has uncovered a link between state export promotion activity and actual state export activity (Coughlin and Cartwright 1987). In our model, metro area export orientation is measured by the percent of an area's manufacturing employment directly related to exports in 1976. The coefficient on this variable is found to be statistically significant in both the manufacturing employment equation and in the manufacturing output equation. Consequently, the role of exports in state economic growth merits some attention as a factor that can be influenced by state and local policy.

Access to technology

The high tech boom of the late 1970s and early 1980s furthered public awareness of the importance of technology to regional development. Those flourishing regional economies which we know so well in California and Massachusetts serve as a frequent reminder that a region's technological base (and institutions) are important to economic growth—even to the extent that new industries can arise from the infrastructure legacy of long-departed manufacturing industries. Technological factors are now recognized in business climate studies. The recent Ameritrust/SRI "Indicators of Economic Activity" lists nine measures of regional technological capacity. The importance of technology in regional economic revival has even been noted overseas: "Places in America where modern manufacturing has taken root and grown fastest tend to have three things in common: a handful of firms strong in one particular field; technical expertise on tap at a nearby engineering school or big government laboratory; and imaginative local bankers and investors".[9]

To date, the importance of technology access to regional growth remains anecdotal rather than statistical (Markusen and Hall 1985; Sirbu et al 1976; Office of Technology Assessment 1984). However, the strength of the recent regional growth success stories, along with the well-documented histories of the importance of technology in their success, suggests that metro area accessibility to technology through joint ventures with universities and government labs, private consulting with university faculty, and interaction among industrial R&D facilities should possibly be included in future statistical studies.

In attempting to measure a metro area's access to technology, comprehensive and condensable measures are not plentiful. A special survey conducted by the National Science Foundation for 1974 reported on the number of scientists and engineers who are actually engaged in research and development activity by metro area. The coefficient of this measure proved to be quite robust over the course of alternative estimating equations. While the coefficients are not significant as reported in Tables 1-2, the coefficient sign remains consistently positive across industry sectors.

However, while the presence of R&D activities can be measured, individual program initiatives that attempt to accelerate technological transfer from lab to market are not accounted for in these measures. Measurement refinements which account for public policy influence may yield more (or less) significant results.

State-local taxes and spending

"...relative growth in manufacturing employment from 1939 to 1953 has not been highest where per capita state and local tax collections are lowest...

...relative growth in manufacturing employment from 1939 to 1953 has not been highest where increases in per capita state and local tax collections have been held lowest..." Clark C. Bloom—1956

"...an inverse relationship exists between changes in state relative tax burdens and state relative economic growth..." Robert J. Genetski—1983

"...economic growth varies inversely with the burden of state and local government taxes; the fastest growing states, by and large, are states with relatively low tax rates....Even more important, changes in tax burden are strongly inversely related to economic growth..." Richard K. Vedder—1981

The above passages exemplify the long-standing debate over the role of state-local taxes (and spending) in economic growth. Evidence and argument are as diametrically opposed today as 30 years ago. It would not be difficult to unearth one hundred or more statistical studies with the evidence weighing significantly on either side.

Despite the apparent conflict in the literature, we know more than the body of conclusions from these studies suggests. A look at the problems inherent in answering the question "do taxes matter?" helps to understand the conflicting results which have emerged.

Many statistical studies, such as the ones cited above, perform only simple, one-by-one correlations between tax levels and economic growth. Because there are many influences on differential regional growth (and more important ones as well), the impact, if any, of tax levels or tax growth on regional economic growth will be seriously distorted by such methods. However, it is not only statistical technique that has given rise to the conflicting evidence in the literature, but also the complexity of the question and the fact that taxes are not the primary determinant of regional growth differences. State and local taxes are usually a small fraction of total costs. Estimates of 3-4 percent of total costs are common. For this reason, some major research efforts have felt justified in neglecting taxation altogether in statistical studies (Fuchs 1962).

However, some researchers have recently argued that, while taxes are indeed a small part of total costs, differences in taxes are larger relative to profits and thus they do influence relative rates of return to capital (and profit) by location (Papke 1984). Measurements of "business taxes relative to business income" (Wheaton 1983) have also been shown to be larger than the taxes-to-total-cost measurements which were often cited in earlier studies (Cornia, Testa, Stocker 1978). Subsequently, researchers have carefully measured tax rates as they influence the price of capital and they have entered them into statistical forms intended to explain location of capital investment. At least one study found that, in using this careful measure (and correcting for simultaneous equation bias), location of investment expenditures is significantly related to the after-tax return on a marginal investment (Papke 1984).

A second reason why tax levels are not thought to be important, and where statistical studies err, is that higher levels of taxation are frequently associated with higher levels of spending for services which, in turn, benefit businesses directly (e.g. highways and sanitation) or indirectly by enhancing quality of life (e.g. education and recreation) and thereby lower the level of wages necessary to compensate the workforce (Hoehn, Berger, and Blomquist 1987). As a result, it is not surprising to find some studies reporting that tax levels enhance economic growth rather than exert a fiscal drag (Romans and Subrahmanyam 1979; Plaut and Pluta 1983).

In considering that public services can have value, one would also expect businesses to value certain types of services more than others. This has been accounted for in empirical studies by including variables to measure the composition of state-local government expenditures (Plaut & Pluta 1983; Newman 1983; Romans and Subrahmanyan 1979; Wasylenko 1984; Helms 1985). The idea here is that highway and education and infrastructure spending will more significantly benefit business than welfare spending and recreation. By accounting for these spending patterns in the estimating equation, the influence of tax levels can presumably be measured more accurately.

A third reason for the conflicting evidence on the tax-growth relation, and one which has gained recent popularity in tandem with federal tax reform, is that state and local tax structures are important rather than simply tax levels. Accordingly, studies focusing on tax levels alone will tend to be mis-specified. Some analysts contend that these differences in tax structure differ by region so as to cause differences in economic growth across regions (Vedder 1981; Wasylenko 1984). Tax structure differences must then be accounted for in statistical studies which have, in fact, included variables such as the marginal corporate income tax rate (Kieschnick 1981) and the percentage of revenue raised from individual income taxes (Waslyenko 1984).

The statistical results reported in Table 1-2 show that tax growth is significantly related to regional growth. One interpretation is that those metro areas that were not able to hold their initial tax burdens in check ultimately paid a price in terms of lower subsequent growth.

This result is very close to those results reported by others who have correlated personal income growth by state along with the growth in "taxes per $1000 of personal income" (Genetski 1982; Vedder 1981). The latter studies have found strong negative correlations between personal income growth and measured growth in tax burden. However, such results have been strongly criticized as displaying reverse casualty. Over relatively short time periods, such as the length of a business cycle or less, one would find that slow-growing regions might necessarily experience increasing tax effort. As income falls, public expenditure needs fall less rapidly, driving up the tax rate. But such an observation hardly implies a direction of causality from tax burden to growth.

In deference to these criticisms of the existing tax growth literature, state-local taxes were measured on a per capita basis in the estimations presented here. A region experiencing economic decline would not experience the dramatic short term drop in population (so much as income) so that there would not tend to be an automatic increase in tax burden in response to lagging growth. For this reason, we believe our results to be more meaningful than those others, such as Wasylenko (1984), which have measured tax burden using income-type measures in the denominator. In alternative and unreported specifications, the best available measures of tax burden levels were also entered into the empirical work—including ACIR's measure of tax burden and William Wheaton's careful measurements of business tax/business income. That tax levels did not turn out to be a significant variable in our estimations is a bit difficult to explain, (although Michael Wasylenko reports a similar result in his recent examination of state economic growth). The most straightforward explanation is that differences in taxes reflect monies needed to pay for regional differences in demand for local public goods. If so, variables reflecting regional differences in taste would need to be included if tax levels were to display significant coefficients.

Other studies have found that the composition of public spending also affects economic growth. For example, Romans and Subrahmanyam report that transfer payments per dollar of state income are negatively related to growth. Michael Wasylenko reports education spending as a fraction of state income to be positively correlated with growth. We part slightly with Waslyenko by specifying the educational spending (elementary and secondary) variable more closely to service output—i.e. educational spending per pupil. Similar to Wasylenko's recent analysis of state economic growth, we find that the education coefficient has been positive and significant in accounting for metro area growth.[10]

Federal spending

The search for explanations of differential rates of regional growth frequently leads to the uneven geographic incidence of federal spending across the U.S. landscape. An extensive study by the Advisory Commission on Intergovernmental Relations (1980) documents the markedly changing incidence of federal spending away from Midwest and toward the South and West over the period from 1952 up through the mid-1970s. Coupled with a strong growth in the level of federal spending in the post-WW II era, the federal government is often accredited or blamed for an implicit industrial targeting that favors the Sunbelt (Markusen 1986).

Among major categories of federal spending, defense spending grew most rapidly during the period of study; the defense budget growth has outstripped GNP growth in every year from 1978 to 1986. Moreover, defense outlays occupied almost 28 percent of federal government outlays in 1986. For these reasons, we chose per capita outlays by the Dept. of Defense as an important measure of federal spending incidence in metro areas.

This component of the federal budget was found to exert a positive and significant impact on employment growth over the 1976 to 1985 period. Whether or not such job gains were offset or augmented by other federal spending and regulatory programs cannot be answered with our limited data set.

Conclusions and policy implications

Using metro area economies as observations, a cross-sectional study of growth over the 1976 to 1985 period is able to identify several key elements that account for regional growth differences in recent years. Regional differences in wages and education exert strong hypothetical point impacts on metro area growth. Meanwhile, in terms of actual impacts on growth over the 1976-85 period, regional differences in market pull were highly influential.

Among policy variables that can be manipulated by state and local officials; unemployment insurance, tax growth, educational spending, a state's propensity to exports overseas, and technology can be listed as potentially important. However, several significant influences, including wages and the market pull of developing regions, will be more difficult for slow-growing regions to manipulate. These factors can possibly be maneuvered by tighter reins on alternative policy instruments. For example, educational improvement can potentially improve labor productivity, thereby offsetting labor cost disadvantages in some regions.

Footnotes

[1] Results of the theorem are modified under differing assumptions about factor mobility, transport costs, differences in technology, and multifactor production.

[2] See Douglas E. Booth, "Regional Long Waves and Urban Policy," *Urban Studies*. Vol. 24 No. 6, December 1987, pp. 447-459.

[3] In the bibliography, see references to Crihfield, Steinnes, Fuchs, Borts and Stein, Papke, Wasylenko, Kieschnick, Plaut and Pluta, Wheat, ACIR, Kahley, Newman, and Browne. One exception remains—the work of Carlton who formulates a statistical model using conditional logit analysis on the probability of firm birth and expansion in any given region (Carlton 1979). Similarly, other studies have borrowed this basic framework and have estimated it using more refined statistical specifications (Bartik 1985).

[4] One exception is Crihfield (1985) who had a sufficient number of data observations to include both the initial period level of relative costs along with changing relative costs.

[5] It is more accurate to say that most empirical work purportedly measures shifts over time in demand for labor and supply of output.

Equations explaining output per se do not suffer from this simultaneous equations bias because the price of output (i.e. demand for output facing a single small region) can be assumed to be fixed for a small region selling to a national or international market.

[6] Using the instrumental variables approach, John Crihfield used six to seven variables to identify labor demand (i.e. to shift the supply of labor), depending on the specification chosen. The variables included state income taxes as a fraction of state personal income, local prices as reflected in housing rents, local government expenditures as a fraction of local personal income, state government expenditures as a fraction of state personal income, nominal social security payment in the locality, the local unemployment rate, and local real wages in 1960. Leslie Papke chose the unemployment rate and the percent of workforce unionized to create an instrument for wages in that study (1984).

[7] Instruments for wages were constructed using tax effort, unionization, unemployment insurance system generosity, and unemployment rate (see Appendix II).

[8] In such cases, like the present, where the size of the observations varies markedly, there may be reason to suspect some heteroskedascity in the error terms. Accordingly, the residuals were plotted against the population of the SMSA in 1976. No heteroskedasticity was evident. Bartlett's test was performed over the top and bottom one-third of this ranked sample. The hypothesis that the error variances were equal could not be rejected at the 5 percent significance level.

As in all cross-sectional samples, multicollinearity lowers the efficiency of the parameter estimates. As seen by the correlation coefficients of the independent variables, bivariate collinearity does not appear to be a severe problem. In addition, analysis of the type practiced by Belsley-Kuh-Welsch suggested that severe collinearity was not present in the reported equations.

[9] Automation Alley: "Rust bowls can regain their shine by playing to their industrial strengths," *Economist*, April 11-17, 1987.

[10] The educational spending per pupil variable has been criticized as measuring a single input among many in the production of education rather than an output of education. Unfortunately, output variables are difficult to measure. In this study, the percent of the adult population with at least a high school education was attempted as a replacement for educational spending. These latter results were consistent with the results reported herein.

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Appendix I

Metropolitan areas included in the statistical analysis (ranked by 1976 SMSA population)

	1976 SMSA Population		1976 SMSA Population
New York	9,605,000	Rochester	978,700
Chicago	7,003,800	Sacramento	902,960
Los Angeles	6,981,500	Louisville	895,300
Philadelphia	4,784,500	Fort Lauderdale	886,300
Detroit	4,414,500	Memphis	880,500
Boston	3,930,400	Providence	862,500
Oakland (w/S.F.)	3,156,400	Dayton	835,200
San Francisco (w/Oak.)	3,156,400	Salt Lake City	802,500
Washington, D.C.	3,056,500	Birmingham	802,300
Dallas (w/Ft. Worth)	2,603,400	Albany	799,700
Fort Worth (w/Dallas)	2,603,400	Norfolk	787,300
Houston	2,389,900	Toledo	782,100
St. Louis	2,367,300	Greensboro	776,200
Pittsburgh	2,313,800	Oklahoma City	772,900
Baltimore	2,144,100	Nashville	769,700
Minneapolis	2,042,300	Jacksonville	716,100
Newark	1,990,000	Akron	663,900
Cleveland	1,955,200	Syracuse	648,000
Atlanta	1,849,300	Scranton	643,600
Columbus	1,806,600	Gary-Hammond	635,900
Anaheim	1,776,000	Allentown	627,500
San Diego	1,655,900	Charlotte	605,800
Miami	1,465,400	Orlando	601,400
Denver	1,442,400	Tulsa	596,300
Seattle	1,431,500	Richmond	596,100
Milwaukee	1,428,500	Omaha	579,800
Tampa-St. Petersburg	1,427,100	Jersey City	579,700
Cincinnati	1,379,100	Grand Rapids	567,000
Buffalo	1,322,400	Greenville	534,700
Kansas City	1,290,300	Raleigh-Durham	483,700
Riverside	1,262,900	West Palm Beach	480,500
Phoenix	1,257,300	Tucson	467,300
San Jose	1,210,100	Fresno	460,800
Indianapolis	1,156,800	Oxnard-Ventura	459,500
New Orleans	1,117,000	Knoxville	443,200
Portland	1,103,600	Harrisburg	432,600
Hartford	1,059,900	Austin	410,800
San Antonio	993,600		

Appendix II

Instrumental variables regression equation: Employment and output growth in manufacturing

	Percent change in manufacturing employment (1976 to 1985)	Percent change in manufacturing output (1976 to 1982)
Intercept	1.12**	1.26**
	(2.94)	(2.46)
Labor costs	−.17**	− .24**
(WM76MFG)	(2.10)	(2.03)
Market maturity	137.7**	−153.4**
(MARKET)	(3.88)	(3.26)
Access to technology	.04	.07
(TECH)	(.91)	(1.30)
Defense spending	.0002	.00001
per capita (DOD)	(1.34)	(.07)
Educational expenditure	.0002	.0005
per pupil (EDEXP)	(1.37)	(.28)
Tax growth	−.002	.0007
per capita (CHTX)	(1.43)	(.44)
Unemployment	−14.9	11.16
insurance (UIMAN)	(−1.84)	(.67)
Export	.03**	.03
orientation (XMFGEMP)	(2.14)	(1.51)
$\bar{R}^2$	.41	.28

*Significant at the 10 percent level.
**Significant at the 5 percent level.

Appendix II (cont'd)

Instrumental variables regression equation:
Total and nonmanufacturing employment growth 1976 to 1985

	Percent change in total employment	Percent change in nonmanufacturing employment
Intercept	1.10**	1.10**
	(5.67)	(5.97)
Labor costs	−0.008**	−0.007**
(WM76MFG)	(−3.63)	(−3.48)
Market maturity	−97.81**	−62.92**
(MARKET)	(−4.05)	(−2.75)
Access to technology	0.04	0.03
(TECH)	(1.59)	(1.33)
Defense spending	0.0002**	0.00002**
per capita (DOD)	(2.36)	(2.37)
Educational expenditure	0.0002*	0.0001*
per pupil (EDEXP)	(1.81)	(1.84)
Tax growth	−0.001*	−0.0001*
per capita (CHTX)	(−1.75)	(−1.64)
$\bar{R}^2$	0.47	0.38

*Significant at the 10 percent level.
**Significant at the 5 percent level.
NOTE: The wage variable is created as an instrument by regressing unemployment rate, tax burden, UI generosity, and unionization on the wage index, UPLTW and WM76MF6.