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The Perplexing Literature on Growth and Change^{*}

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Abstract

Even a casual library search clearly indicates that empirical growth studies comprise a significant, and growing, area of interest within the academic literature. In many respects, this strand of literature has been successful in identifying the basic nature of the growth process. By contrast, attempts to provide public policy directions are much less successful. It is this perplexing dichotomy that provides both the justification and point of departure of this volume. In this introductory piece, we identify several unresolved issues in both the public policy arena and economic theory that relate to the individual papers.

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1. INTRODUCTION

Much attention has been focused recently upon the determinants of regional growth and the degree, if any, to which such determinants are amenable to local public policy initiatives. Much of the recent literature has focused upon the “new economy” and its regional components.¹ Assessments of policy efficacy in this area not only have obvious practical significance, but are intellectually intriguing as well.²

Beginning with the classic study of Perloff et al. (1960), investigations of the regional growth process most often have followed one of two avenues of inquiry and in doing so seek answers to two important questions. The first addresses the nature, magnitude, and direction of regional growth to differential socioeconomic conditions across space. The latter and more complex question concerns the effectiveness of this process – namely regional growth – and other market and nonmarket mechanisms in contributing to a more efficient allocation of human resources. Such “allocative efficiency” is likely to be affected to the extent that state and local governments can ultimately influence the geography of industrial location and internal growth mechanisms.³ These questions are of particular interest as state and local communities commit scarce resources to economic development initiatives.

Even a casual library search clearly indicates that empirical growth studies comprise a significant and growing area of interest within the academic literature.⁴ However, this literature reflects two distinct schools of thought relevant to the investigation of regional growth: that which explores the regional growth process in general terms of determinants of growth and that which attempts to specifically suggest public policy that impacts the growth process. The former literature tends to emphasize “traditional” locational determinants such as regional markets and transportation access, with a somewhat cursory treatment of policy implications such as financial incentives and public infrastructure. In many respects, this strand of literature has been successful in identifying the basic nature of the growth process. By contrast, attempts to provide public policy directions are much less successful. It is this perplexing dichotomy that provides both the justification and point of departure of this volume.

There surely is not much necessity for another volume on general determinants of regional economic growth, and this volume isn't one. The papers in this volume represent an attempt to suggest the type of future research on regional growth that will assist us in bridging the gap in our knowledge of public policy efficacy. In our view, the challenge to future research will be to

¹ An excellent discussion of the new economy appears in the set of papers in *Growth and Change* (Fall 2000 and Winter 2000).

² For example, see the recent monograph by Aghion and Howitt (1999) and Nelson (2000). This literature focuses on endogenous growth theory.

³ In truth, the notion of allocative efficiency in regional growth is much more complex than the single dimension of public policy noted here. There are issues of both static and dynamic efficiency as well as optimal versus equilibrium growth paths. As noted by Moomaw, specific regional market structures may result in differential rates of innovation (as in Schumpeter's observations on the static versus dynamic efficiency of perfect competition versus oligopoly). Further, externalities can create a significant divergence between the “optimal” growth rate and the equilibrium growth rate, i.e., too little growth (a point made by Moomaw in the context of Aghion and Howitt [1999, section 2.3] on “business stealing”).

⁴ For example, even by the first edition of the well-known text by Hoover (1971), literally hundreds of regional growth studies could be referenced.

more finely address the efficacy of public policy in the regional growth process and the outcomes of such initiatives on local economic well-being. In this regard, the remainder of our introduction is to present several conceptual issues that have not been fully addressed in research to date. Contributing authors provide important new evidence on future research directions for public policy – local growth interaction as well as the implications of such linkage for research on regional economic development strategy.

2. ORGANIZATION OF THE VOLUME

The remainder of this introduction presents an overview of the volume. The individual contributions examine various dimensions of regional growth, with particular attention to unresolved and emerging issues in research. In addition, each study provides direction to future research dealing with the spatial outcomes of growth.

The articles that follow are organized along five major themes: (1) measurement and theory, (2) agglomeration, (3) modeling, (4) accuracy of forecasts, and (5) the role of “geography.” It is interesting to note that authors, where relevant, have tied their articles to others in the issue.

2.1 Measurement and Theory

In assessing a state’s or area’s economic performance, one is struck by the simple observation that “different” indicators appearing in the literature can provide diverse results. In general, individual studies within the literature have focused on some measure (variant) of total employment (level, change in) or income (per capita, change in).⁵ However, for a given region, we can observe a range of results from favorable to unfavorable. For example, Connecticut had the highest per capita income in 1999 yet had the slowest job growth in the 1990s. With all of the conflicting data, how can researchers effectively assess the relative success of a region? This issue is particularly relevant in understanding the effectiveness of public policy. Fortunately, economic theory does provide ways to objectively assess regional economic performance and to place the conflicting results into context.

For illustrative purposes, suppose that the regional attributes of interest (public program expenditures, special factors, etc.) can be simplified to a single “factor” R . Then what does “region” imply within a model of regional growth? Adapting the Mankiw, Romer, Weil (MRS, 1992) model to include regional factors (capital or otherwise), we have an aggregate Cobb-Douglas production function:

$$(1) \quad Y_{it} = K_{it}^{\alpha} H_{it}^{\beta} R_{it}^{\theta} (A_{it} L_{it})^{1-\alpha-\beta-\theta}$$

where i indexes region; t indexes time; Y is aggregate output; K is physical capital stock; H is human capital stock; R is the regional attribute stock; A allows for labor augmenting technology;

⁵ For an interesting recent study dealing with changes in income inequality, see Madden (2000).

L is labor; and α , β , and θ are aggregate output elasticities with respect to fixed and human capital and regional factors.⁶

Equation (1) is expressed in terms of output per effective labor unit

$$(2) \quad y_{it} = k_{it}^{\alpha} h_{it}^{\beta} reg_{it}^{\theta}$$

where $y = Y/AL$, $k = K/AL$, $h = H/AL$, and $reg = R/AL$ represent quantities per effective labor unit. MRW assume that L and A grow exogenously:

$$(3) \quad L_{it} = L_{io} e^{n_i t}$$

$$(4) \quad A_{it} = A_{io} e^{g t}$$

where n_i is the labor force growth rate in region i and g is the (simplified for exposition) common rate of technological progress.⁷

Regions augment their physical, human and other regional stocks by saving at constant rates s_k , s_{hi} , and s_{reg} . Although an obvious simplification, assume that all stocks depreciate at constant rate δ . Capital accumulation is described by:

$$(5) \quad \dot{k}_{it} = s_{ki} y_{it} - (n_{it} + g + \delta) k_{it}$$

$$(6) \quad \dot{h}_{it} = s_{hi} y_{it} - (n_{it} + g + \delta) h_{it}$$

$$(7) \quad \dot{reg}_{it} = s_{reg} y_{it} - (n_{it} + g + \delta) reg_{it}$$

The corresponding steady state equilibrium values (assuming $\alpha + \beta + \theta < 1$) are:

$$(8) \quad k_i^* = \left(\frac{s_{ki}^{1-\beta-\theta} s_{hi}^{\beta} s_{regi}^{\theta}}{n_i + g + \delta} \right)^{(1/(1-\alpha-\beta-\theta))}$$

$$(9) \quad h_i^* = \left(\frac{s_{ki}^{\alpha} s_{hi}^{1-\alpha-\theta} s_{regi}^{\theta}}{n_i + g + \delta} \right)^{(1/(1-\alpha-\beta-\theta))}$$

⁶ The MRW model is a general construct to investigate variables of interest. For an application to telecommunications (R above replaced by T), see Madden and Savage (2000). We adopt their structure in our exposition.

⁷ We would expect that varying rates of innovation would significantly affect the observed spatial pattern of growth. This is indeed the case as explored, for example, in Nijkamp and Poot (1998) and Nijkamp, Poot, and Rouwendal (1991).

$$(10) \quad reg_i^* = \left(\frac{s_{kt}^\alpha s_{hi}^\beta s_{regi}^{1-\alpha-\beta}}{n_i + g + \delta} \right)^{(1/(1-\alpha-\beta-\theta))}$$

where * denotes the steady state value.

Over the interval $[0, t]$ growth in output per worker can be expressed as a function of physical, human, and regional capital accumulation. Substituting equation (4) and equation (8) through equation (10) into equation (2) gives the enhanced MRW model:

$$(11) \quad \ln\left(\frac{Y_{it}}{L_{it}}\right) = \ln A_o + gt + \frac{\alpha}{1-\alpha-\beta-\theta} \ln(s_k)_i + \frac{\beta}{1-\alpha-\beta-\theta} \ln(s_h)_i \\ + \frac{\theta}{1-\alpha-\beta-\theta} \ln(s_{reg})_i - \frac{\alpha+\beta+\theta}{1-\alpha-\beta-\theta} \ln(n_i + g + \delta).$$

Approximating equation (11) around y^* gives the restricted model:

$$(12) \quad \ln\left(\frac{Y}{L}\right)_{it} - \ln\left(\frac{Y}{L}\right)_{i0} = \pi_0 + \frac{\gamma\alpha}{1-\alpha-\beta-\theta} \ln(s_k)_i + \frac{\gamma\beta}{1-\alpha-\beta-\theta} \ln(s_h)_i \\ + \frac{\gamma\theta}{1-\alpha-\beta-\theta} \ln(s_{reg})_i - \frac{\gamma(\alpha+\beta+\theta)}{1-\alpha-\beta-\theta} \ln(n_i + g + \delta) \\ - \gamma \ln\left(\frac{Y}{L}\right)_{i0}$$

where $\lambda = 1 - e^{-\gamma t}$, λ is the convergence rate, and $\pi_0 = \gamma \ln A_o + gt$. Rearranging (12) provides the unrestricted model:

$$(13) \quad \ln\left(\frac{Y}{L}\right)_{it} - \ln\left(\frac{Y}{L}\right)_{i0} = \pi_0 + \frac{\gamma\alpha}{1-\alpha-\beta-\theta} (\ln(s_k)_i - \ln(n_i + g + \delta)) \\ + \frac{\gamma\beta}{1-\alpha-\beta-\theta} (\ln(s_h)_i - \ln(n_i + g + \delta)) \\ + \frac{\gamma\theta}{1-\alpha-\beta-\theta} (\ln(s_{reg})_i - \ln(n_i + g + \delta)) - \gamma \ln\left(\frac{Y}{L}\right)_{i0}.$$

As shown in equations (12) and (13), it is feasible to estimate the impact of specific regional factors on regional productivity and, in addition, their marginal effects. However, what we should utilize as the proper measure of “growth” is not addressed, nor is the proper simultaneous structure that is inherent in so many regional issues addressed.

Two papers in the volume, by Mark D. Partridge and Dan S. Rickman and by Stephen P.A. Brown, Kathy J. Hayes, and Lori L. Taylor, develop this basic modeling concept of regions to explore measurement of performance and public policy efficacy.

In this regard, the first paper by Partridge and Rickman explores the measurement of regional economic performance. They argue that economic development in a region should be equated with utility of its current residents. Absent direct utility measures though, the theoretical framework and analysis of the data suggest that there is no single measure of progress in economic development. The correct indicator of economic development *depends* upon the characteristics of the region.

For high-skilled mobile workers, utility differentials are likely reflected in interregional domestic migration. Whether it is due to higher quality of life or better economic opportunities, higher utility in the region induces domestic in-migration. Yet for migration apparently related to amenities, inverse relationships between domestic migration and per capita income/wage rates are observed for many states. This relationship indicates that average wages and income are incomplete measures of economic development for these states.

In addition, because they are less mobile, utility differentials are less likely to induce migration of domestic low-skilled workers. Being at the lower end of the income distribution, regional utility differentials are more likely reflected in poverty rate differentials. Changes in poverty rates though were found to be more associated with changes in employment conditions than with changes in average wage rates or per capita income,⁸ again showing that income measures provide an incomplete picture of economic development.

In the second paper, Brown, Hayes, and Taylor develop a theoretical framework to evaluate the efficacy of public capital. This is a general modeling structure that has implications for future research addressing a significant number of public policy issues.

The authors note that the literature is divided into three relatively distinct threads. One thread of literature examines how state and local policy and natural amenities affect regional economic growth or firm location. Another thread emphasizes how differences in state and local policy and natural amenities can lead to persistent regional differences in wage rates. The third thread examines whether the United States has sufficient public capital by examining regional variation in factor inputs.

⁸ In an even more general context, the empirical debate has not been adequately resolved as to the extent to which interregional wage differentials reflect permanent amenity or productivity differentials or (transitional) spatial disequilibrium differentials. This point noted by Moomaw is particularly relevant for urban land use models since land prices would presumably adjust to relocation associated with household utility adjustments.

Their model integrates the three threads of previous inquiry into a general framework of how state and local policy affects factor quantities and, consequently, economic growth. They find that state and local policies, particularly in the provision of public capital, have a more profound influence on the private capital-to-labor ratio in a region than on private output. What is particularly striking about their modeling approach is its adaptability to numerous issues in regional development. Extensions of their approach in future research are certainly warranted.

2.2 Agglomeration

As discussed at length in the early text of Hoover and Giarratani (1975), a critical concept in regional analysis is the concept of agglomeration; that is, firms find a location good (optimal) because of the presence of others. Although external economies as explanations of output variety and market attraction have been characteristic of regional analysis for decades, the reincarnation of agglomeration as “transactions costs” in the broader business and economic literature is striking. For example, Borenstein and Saloner (2001) note the ability of firms to lower transactions costs in electronic commerce “clusters,” while the role of clustered telecommunications firms in lowering costs of information transfer are a central theme in ITU (1999).

Following this theme, an important “reborn” issue for regional analysis is the role of public policy options in lowering regional transactions costs, leading to a decrease in marginal costs for firms and increasing the quality of services, thus stimulating demand across the regional economy.

The effects of transaction costs on regional economic welfare can be demonstrated through a single commodity demand-supply model developed by Madden and Savage (2000). Consider a market with the inverse supply and demand functions:

$$(14) \quad P_s = a + bQ$$

$$(15) \quad P_d = \alpha - \beta Q$$

where P_s is the price received by sellers, Q is the quantity, and P_d is the price paid by buyers. Transaction costs (T) are presumed to be the equilibrium gap between buying and selling prices:

$$(16) \quad T = P_d - P_s.$$

The equilibrium quantity is:

$$(17) \quad Q^* = (\alpha - a - T) / (\beta + b).$$

The derivative $\partial Q^* / \partial T$ suggests that output is lower as transaction costs increase:

$$(18) \quad \partial Q^* / \partial T = -1 / (\beta + b) < 0,$$

which leads to welfare losses in the form of forgone consumer and producer surplus. A further implication of high transaction costs is that no viable market for the commodity will exist when:

$$(19) \quad T^* \geq \alpha - a.$$

Since the welfare of a region increases with market growth (the volume of commodities exchanged), smaller economies with less-developed business infrastructure are limited in their ability to exploit gains from specialization of labor and economies of scale. As such, economy-wide output is lower than that of otherwise comparable economics with lower transaction costs.⁹

The third paper in this volume by Kim, Pickton, and Gerking explores one aspect of the “new” interest in agglomeration. Their paper examines links between types of external scale economies, state promotion expenditures, and the location of *FDI* (foreign direct investment) in new manufacturing plants among U.S. states. One reason for looking at *FDI* in new plants is that such investments could, at least in principle, go to any U.S. state (or anywhere in the world for that matter).

Kim, Pickton, and Gerking examine the independent contribution of both urbanization and localization economies to *FDI* attraction and, in addition, quantify the extent of interaction between promotion expenditures and measures of agglomeration economies. A key finding of their approach is that promotion expenditures can at least partially compensate for a lack of both urbanization and localization economies. This result is good news for states lacking agglomeration advantages because it suggests an economic development policy tool that may be effective in competing with their larger neighbors. In a more general sense, their general approach has merit for related issues.

2.3 Modeling

One of the vexing issues arising from the empirical literature on regional growth is the wide *magnitude* of estimates for the determinants of growth. Estimates for “variables” amenable to public policy often range across studies from elastic to inelastic, significant to insignificant, and positive to negative. Clearly this empirical fact makes it difficult to consistently suggest public policy options. To illustrate these points, consider the nine studies presented in Table 1 for the impact of “education” on growth and those twelve studies shown in Table 2 for the impact of infrastructure investment on growth.¹⁰

As shown in Table 1, the impact of the various measures of education on the various measures of growth is, in general, positive (as anticipated). However, a “back of the envelope” calculation of the marginal impact of education (elasticity) in those studies where sufficient information is shown suggests that the elasticity of “education” can range from highly inelastic

⁹ The discussion above tends to define agglomeration solely as a type of transactions costs. In general, agglomeration as a phenomenon that can be affected by public policy is much broader, namely knowledge spillovers, labor specialization, etc.

¹⁰ We have selected as illustrative education and public infrastructure due to their general interest in the literature. The 21 studies selected in Table 1 and Table 2 are representative examples of the literature. For a more complete discussion of these issues, see Poot (2000a, 2000b).

TABLE 1

The Impact of Education Expenditure on Long-Run Growth

Author	Year	Impact	Analysis	Data/Yr	Data	Dependent Variable	Independent Variable	Notes
Landau	1983	Significantly Positive	Cross-Section Regression	1960-1977	World Bank 104 Countries minus oil exporting countries	Avg. annual percentage Growth rate of per capita GDP (Changes)	Total investment in education (Levels)	Shows education is always significant to growth
Barro	1991	Significantly Positive	Cross-Section Regression	1960-1985	Var. Sources includes 118 1,2,3 rd world countries	Per Capita Growth Changes in (Levels & Changes)	Enrollment Rate: (Levels & Changes)	The enrollment rate may be a proxy for human capital investment
Moomaw & Williams	1991	Significantly Positive	Cross-Section Regression	1954-1976	US Census, from all 50 states	Total Factor Productivity Growth (Levels)	% change in proportion of workers w/12 or more years in education (Levels)	Education Positively effects productivity growth
Hansson & Henrekson	1994	Significantly Positive	Cross-Section Regression	1970-1987	14 industries in 14 OECD countries	Change in total factor productivity (Levels)	Change in government spending on education (Levels)	A lag is used to determine influence of government spending on productivity
Evans & Karras	1994	Significantly Positive	Pooled cross-section/Time-series	1970-1986	48 US states	Change in Gross state product (Changes)	Current educational services (Changes)	Educational services are the only productive current government service
Baffes & Shah	1998	Significantly Positive	Pooled cross-section/Time series	1965-1984	21 Countries w/ low or medium income	GDP (Levels)	Public investment in education (Levels)	Education also includes other human resource development capital stock
Sala-I-Martin	1994	Significantly Positive	Convergence Definitions	1960-1985 1870-1990	WB/IMF & Barro's Data	GDP (Levels)	Educational expenditures (Levels)	Analyzed the Barro and Levine studies
Glomm & Ravikumar	1997	Significantly Positive	Review of Literature	1949-1992	WB/IMF & Barro's Data	GDP (Levels)	Educational expenditures (Levels)	Review of the other literature
Levine & Renelt	1992	Inconclusive	Cross-Section Regression	1960-1989	WB/IMF 119 Countries minus oil exporters	Growth of real per capita GDP / (Changes)	Enrollment Rate: level of education attained (Levels & Changes)	Schooling has a Positive impact, but diff explanatory variables are used in each study thus results inconclusive

TABLE 2

The Impact of Public Infrastructure Expenditure on Long-Run Growth

Author	Year	Impact	Analysis	Data/Yr	Data	Dependent Variable	Independent Variable	Notes
Da Silva Costa, Ellson & Martin	1987	Significantly Positive	Cross-Section Regression	1937-1972	US Dept of commerce for each state	Value Added to each state (Levels)	Ratio of public capital to total investment in capital (Levels)	Notion that public investments will assist poor regions is questionable
Moomaw & Williams	1991	Significantly Positive	Cross-Section Regression	1954-1976	US Census, from all 50 states	Sum of the growth rates of capital and labor (TFP) (Levels)	Density of the state's interstate highway network (Levels)	Evidence for investment in highways is weak when compared to education
Easterly & Rebelo	1993	Significantly Positive	Cross-Section Regression	1970-1988	100 Countries 1, 2, 3 rd world	Real per capita GDP (Changes)	Consolidated Public Investment (Levels & Changes)	Causality runs from infrastructure to growth
Sanchez-Robles	1998	Significantly Positive Non-vector Measurement	Cross-Section Regression	1970-1992	World Bank Low & middle income countries	GDP per capita growth (Changes)	Public capital/GDP Expenditure in infrastructure (Changes)	Explains changes versus levels
Ratner	1983	Significantly Positive	Time-Series Regression	1949-1973	U.S. State info.	Private output (Levels)	Amount of Government owned Capital (Levels)	Private owned capital has a higher elasticity to private production.
Lynde & Richmond	1993	Significantly Positive	Time-Series Regression	1958-1989	US Non-financial corporate sector	Gross output in real terms (Levels)	Public Investment in Capital (Levels)	Lags used. 40% productivity decline explained by fall in public capital-labor ratio
Kocherlakota & Yi	1996	Significantly Positive	Time-Series Regression	1917-1988	United States Data Sources	Annual growth rate of real per capita GNP (Levels)	Ratio of Real Government nonmilitary Structural Capital (Levels)	Lags are used to show the different effects of exogenous vs. endogenous growth policies.
Wylie	1996	Significantly Positive	Time-Series Regression	1947-1991	Canadian Data	GDP (Levels)	Stock in Infrastructure Investment (Levels)	Public Infrastructure Investment allows Canada to compete in goods production
Evans & Karras	1994	Significantly Negative	Pooled	1970-1986	48 US states	Change in gross state product (Changes)	1. net stock of infrastructure capital 2. current infrastructure services (Changes)	Evidence suggests that any infrastructure investment besides education is not going to be productive.
Munnell	1992	Significantly Positive	Specific review of previous literature	1991	US data only	Change in Growth (Levels)	Change in public capital expenditure (Levels)	Lagged growth variable is necessary. More research needed to determine the direction of effects
Glomm & Ravikumar	1997	Significantly Positive	General review of previous literature	1949-1985	WB/IMG & Barro's Data	Growth (Levels)	Congestion on roads (Levels)	Lagged (overlapping generations) variable
Button	1998	Significantly Positive	General review of previous literature	1950-1995	US only National, states, regions	Employment (Levels & Changes)	Infrastructure improvement (Levels & Changes)	Summarizes the accuracy / relevance of other studies infrastructure variables

(say 0.02) to highly elastic (say 1.4).¹¹ What actual policy advice can we provide to those interested in educational issues? In a similar manner, the studies summarized in Table 2 for public infrastructure also exhibit a wide range of impacts. Public investment is more (or less) “productive” than private investment, estimates for infrastructure investment range from somewhat productive to highly productive, etc.

Part of this quandary stems from empirical models that are not related to theoretical considerations as discussed in the first papers in this volume. However, in our view, a fundamental modeling issue has been “lost” in many recent studies, namely the interesting work by Bartik (1985, 1989) regarding should “changes in” or “levels of” a region’s characteristics be seen as affecting regional growth. The relevant issue is as follows.

Suppose business activity (measured by capital, employment, or value added) in area i at time t , A_{it} , only partially adjusts to its long-run optimal level, A_{it}^* , from its previous level, A_{it-1} , or

$$(20) \quad A_{it} = \lambda A_{it}^* + (1 - \lambda) A_{it-1} + \mu_{it},$$

where μ_{it} is a random disturbance. This partial adjustment reflects capital’s durability. Suppose long-run optimal business activity depends on this period’s level of observed variables X_{it} , or

$$(21) \quad A_{it}^* = B' X_{it} + E_{it},$$

where E_{it} is a disturbance. Substitution yields

$$(22) \quad A_{it} = \lambda B' X_{it} + (1 - \lambda) A_{it-1} + e_{it},$$

where $e_{it} = \lambda E_{it} + \mu_{it}$. “Levels/levels” models of this sort have been used in prior work (see references in Bartik [1985, 1989]).

Subtraction of A_{it} from both sides of equation (22) yields

$$(23) \quad A_{it} - A_{it-1} = \lambda B' X_{it} - \lambda A_{it-1} + e_{it}.$$

Equation (23) rationalizes researchers’ modeling some component of an area’s change in business activity (e.g., new branch plants, new firms, relocating firms) as depending on the levels of area characteristics and past business activity (a “levels” model as used by Bartik 1985, 1989). The coefficient on lagged business activity may deviate from the speed of adjustment parameter λ if lagged business activity also proxies for the area’s agglomeration economies (i.e., if A_{it-1} is also an element of X_{it}). Because equations (22) and (23) are minimizing the same prediction

¹¹ Although these figures are meant to be illustrative only, there has been an increasing use of meta-analysis to compare estimates across studies. See the Phillips and Goss (1995) study on state and local taxes and Button (1998) on infrastructure. The Button study also raises interesting research questions on the “productive” role of the public sector.

error term, estimation of either equation using aggregate business activity measure will yield identical estimates.

Subtracting the previous period's version of equation (22) from equation (22) yields

$$(24) \quad A_{it} - A_{it-1} = \lambda B'(X_{it} - X_{it-1}) + (1 - \lambda)(A_{it-1} - A_{it-2}) + e_{it} - e_{it-1}.$$

Business location studies that model growth as a function of changes (the “changes” model) have not always recognized that the lagged change in business activity, $A_{it-1} - A_{it-2}$, should be included as control variable. This is seen in several studies cited above in the tables.

A model equivalent to equation (24) can be derived by subtracting the previous period's version of equation (23) from equation (23) to obtain

$$(25) \quad (A_{it} - A_{it-1}) - (A_{it-1} - A_{it-2}) = \lambda B'(X_{it} - X_{it-1}) - \lambda(A_{it-1} - A_{it-2}) + e_{it} - e_{it-1}.$$

A model of this type has been estimated using microdata by Bartik (1989). Estimation of equation (24) or equation (25) using aggregate business activity data will yield identical estimates, as the same prediction error is minimized.

However, as pointed out in Bartik's work as cited above, models involving changes in area characteristics have statistical properties different from models involving the levels of area characteristics. First-differencing area characteristics will eliminate the possibility of omitted-variable bias from unobserved fixed-area characteristics. But first-differencing will also increase the ratio of measurement error “noise” to true variation in the independent variables, biasing many coefficients toward zero.

The issue above is particularly relevant in single-equation models of regional growth where regressors are often implicitly endogenous. The fourth paper in the volume by Riddel and Schwer augments both the empirical literature and our comments above by exploring estimation in dynamic (endogenous) models of the growth process. The authors explore the simultaneous or systems approach to regional growth rather than relying on single equation models.

The Riddel and Schwer paper takes as its starting point the innovative capacity of an economy supported by an educated and skilled work force and the stock of current knowledge. As the stock of new ideas grows, new innovations become more likely because a wider foundation for development exists. Idea workers comprise an integral part of the high-tech work force. These workers are fueled by increased innovative capacity, but they also fuel further technological advances. Melding these two concepts – endogeneity between high-tech industry and growth in innovative capacity and between ideas production and a growing frontier of knowledge – provides a dynamic model of the relationship between innovation and high-tech industry growth.

The authors extend models for endogenous growth in innovative capacity to account for endogeneity between technological innovation and high-tech employment. In this regard their model is estimated using a generalized least squares, instrumental variables, random-effects

estimator that explicitly accounts for endogeneity. Clearly future research on the determinants of regional growth should follow along these lines.

2.4 Accuracy of Forecasts

For policy makers, “erratic” forecasts from regional models are of little use. In many respects, regional forecasts provide the primary bridge between the academic literature and public policy. Even with the extensive literature available on regional forecasting, there is no “obvious” manner in which to assess accuracy. As a researcher on the forefront of this issue, West addresses the fundamental concept of “accuracy” in the fifth paper of the volume.

First, West briefly reviews the regional forecasting accuracy literature. She then considers the question of “When is a forecast accurate?” and, finally, addresses the issue of how the accuracy analysis can be used to improve forecast precision. Her final section discusses avenues for future research.

West’s analysis is generally restricted to studies of the accuracy of true *ex ante* regional forecasts, a literature much smaller than that examining accuracy of “post sample tests.” It is the former in which we are ultimately interested, and true *ex ante* implies complete lack of knowledge about the future. In addition, often the available data used at the time of forecast is preliminary and hence may contain considerable misinformation about the actual state of the economy than revised or final data. Structural models based on final data that truncate the period of estimation and reserve the most recent for the post sample test violate both these conditions – the start point for the test uses final data and inevitably knowledge of the post sample period has had some influence on specification.

2.5 The Role of Geography

The papers in this volume represent an attempt to suggest the type of future research on regional growth that will assist us in bridging the gap in our knowledge of public policy efficacy. Contributing authors provide important new evidence on future research directions for public policy – local growth interaction as well as the implications of such linkage for research on regional economic development strategy.

As noted by Hoover (1971, p. 5), “To sum up, an understanding of spatial and regional economic problems can be built on three facts of life: (1) natural resource advantages, (2) economies of concentration, and (3) costs of transport. In more technical language, these foundation stones can be identified as (1) imperfect factor mobility, (2) imperfect divisibility, and (3) imperfect mobility of goods and services.” In a word, geography matters.

In a philosophical essay that forms the final paper in the volume, Plane summarizes the implications of the topic at hand for the “role” of geography in future research. In many respects, the recent literature on the “new economy” tends to downplay the spatial aspect of economic activity. In this regard, does “place” matter except for political (fiscal) jurisdictions? All of the papers in this volume would positively support the concept of “region,” and Plane develops the theme of geography in future research. What is required in the future is to more

fully integrate broad concepts of endogenous growth and transactions costs with specific regional factors (such as natural amenities).

As Plane notes, much of the research on regional growth rates, particularly for differentials in metropolitan and non-metropolitan growth rates, only provides a partial picture of the growth process. Although the individual studies can explain different aspects of the regional development process, its complexity can only really be explained by the whole geographical milieu in which development takes place. In this regard, Plane reasserts Hoover's notion that geography matters. Pursuing this issue, Plane provides an overview of the research methodology that the U.S. Bureau of the Census is utilizing to more finely report spatial interactions in the Census data.

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