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A Test of the Economic Base Hypothesis in the Small Forest Communities of Southeast Alaska

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Abstract

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Recent harvest declines in the Western United States have focused attention on the question of economic impacts at the community level. The impact of changing timber-related economic activity in a given community on other local activity and the general economic health of the community at large has been a persistent and often contentious issue in debates surrounding forest policy decisions. The economic base hypothesis, in which changes in local export-related economic activity are assumed to cause changes in economic activity serving local demand, is a common framework for understanding impacts of forest policy decisions and forms the basis of models commonly used to provide estimates of expected local impacts under different policy options.

This study uses community-specific, time-series employment data to test the economic base hypothesis in the small, semi-isolated communities of southeast Alaska. Estimates were derived for each of 15 communities. Export-related activity was not found to cause changes in economic activity serving local demand for the average community. However, the results indicated statistically significant differences among communities in their response to shocks in export-related activity. The implications of these results for policy, and for the theory and practice of modeling economic impacts at small spatial scales, are explored in the final sections of this study. Specifically, secondary economic impacts cannot be taken as a foregone conclusion in policy analysis, and the fundamental assumptions of static impact modeling approaches deserve greater scrutiny.

Keywords: Economic impacts, economic base, multipliers, community stability.

Summary

This report uses time-series econometric techniques applied to employment data from the small forest communities of southeast Alaska to test what can be called the "economic base hypothesis." The economic base hypothesis holds that changes in export-derived employment and income (termed "basic") are positively linked to changes in other local employment and income serving the demand of residents and nearby firms (termed "nonbasic"). This assumption, in turn, serves as a foundation for the economic base and input-output models commonly used to estimate economic impacts. Often the hypothesis is summarized in the form of a static economic impact multiplier, which purports to measure the change in nonbasic employment that can be expected from a change in basic employment. A classic example is the assumed impact of the opening or closing of a sawmill on other employment in or around the town where the change occurs.

From a theoretical standpoint at least, providing an empirical test of the economic base hypothesis would appear to be a relatively straightforward proposition. Such tests, however, are quite rare, and the results from empirical studies that have been completed in this area are on the whole inconclusive. This absence of empirical validation is especially pronounced at the smaller spatial scales where the economic base hypothesis and its associated multipliers are most commonly applied. The current study seeks to fill this gap.

Forest Policy and Communities

Forest-dependent communities and the policies that may affect them are a central concern of this study. From its inception, the USDA Forest Service has considered community stability as one of its core responsibilities. Traditionally, this has usually meant trying to foster a healthy and sustainable timber base on which proximate communities and mills can depend for timber harvests into perpetuity. More recently, as competing values have come to the fore, the emphasis of forest policy debates has shifted to the conflict between timber development and forest conservation. The expected economic impacts from declining federal timber harvests have figured prominently in these debates. Whether the question is long-term community sustainability or short-term employment impacts, the economic base hypothesis constitutes an important link in the assumed chain of relationships connecting forest policy to timber harvests, local logging and mill employment, and, ultimately, total employment in potentially impacted communities.

An analysis of community-level economic impacts requires a definition for the term "community." The current analysis is specific to "communities of place" (as opposed to, for example, "communities of interest"). Spatial proximity in itself, however, is not enough to define communities of place in an economic sense. Instead, economic interaction between firms and individuals located in the community is the key component of any meaningful economic definition of the term. The economic base hypothesis is one attempt to characterize this interaction.

Economic Models of Local Impact Processes

Economic base models stress exogenous ("outside") demand for locally produced goods and services. The income generated by basic economic activity, whether it is lumber production for export to distant markets or tourism catering to outside visitors, is seen as the driver of the local economy and, specifically, the local support and service industries that compose the nonbasic sectors. Economic base models hypothesize a constant ratio between basic and nonbasic activity. As a result, changes in basic sector activity can be directly linked to changes in nonbasic activity through a

static impact multiplier. For every dollar of income earned in the basic sectors, economic base models assume an additional x (the multiplier) dollars are earned on the nonbasic sectors. The multiplier can then be used to predict changes in total community economic activity based on predicted changes in basic activity.

Input-output models, which have increasingly been used in local economic impact estimation, represent a more complex application of the economic base hypothesis. Although these models treat local economies in a much more complex fashion, disaggregating economic sectors and mapping their interrelationships, the underlying concepts and static relationships remain much the same.

General equilibrium models, which take into account the supply and demand for local goods, services, and productive inputs (capital and labor, for example), provide an alternative approach to local impact modeling. These techniques are more in keeping with neoclassical economic theory, but they are hampered by their complexity and stringent data requirements. Under the assumption of perfect elasticity in input markets (meaning, for example, that firms can hire or fire as many workers as they please without impacting local wage rates), general equilibrium results are theoretically equivalent to those of economic base and input-output models. Thus, the assumption of perfect elasticity in input supply is a key assumption underlying the economic base hypothesis.

Empirical Evidence from Southeast Alaska

On the face of it, conducting an empirical test of the economic base hypothesis would appear to be a fairly obvious and straightforward procedure. Such tests, however, are relatively uncommon, and there is little in the way of definitive empirical evidence. This stems, in part, from the difficulty in obtaining adequate data at the smaller spatial scales at which the economic base hypothesis is thought to be most relevant. Also, the relationships entailed in the hypothesis are believed to occur over time, and various econometric techniques are needed to account for this. This, in turn, increases both the stringency of the data requirements and the complexity of the analysis.

The statistical test in this report uses a unique data set comprising industry-specific (4-digit standard industrial classification code) employment levels recorded quarterly over the 1981–86 period for each of 15 small communities in southeast Alaska. The initial step involved coding employment in export-oriented industries or other occupations earning outside income as basic employment and the remainder as nonbasic. These two time series were then compared, both visually and statistically within a regression model, to see if any relationship is evident between them. No consistent relationship could be found on average for the communities in the sample, and the economic base hypothesis must be rejected in this study.

Anecdotal evidence and visual examination of the data provide an initial indication of this. Mill closures throughout the region, but most notably in Haines and Sitka, have failed to result in commensurate impacts in other sectors of the local economies in question. Positive changes in basic employment likewise failed to correspond with positive increases in nonbasic employment.

A more rigorous statistical test using regression analysis also supported this result. The test involved regressing change in nonbasic employment on change in basic employment for each community. The model accounted for lag effects and autocorrelation by using a fourth-degree polynomial-distributed lag structure in combination with autoregressive and moving average terms (ARMA—see text for details). The results showed that in some communities the relationship between basic and nonbasic employment is positive, in others negative, and that this heterogeneity between communities was highly significant from a statistical standpoint. When averaged across all communities in the sample, however, the relationship was not found to be significantly different from zero. This result yields the two main conclusions of the study: (1) the economic base hypothesis must be rejected as a description of the average behavior of communities in the sample; and (2) communities respond quite differently to changes in basic employment.

The strength of these results relies on the relative simplicity of the test, the agreement between statistical and visual (or anecdotal) evidence, and the richness of the data set employed. There are, however, several additional issues that need to be considered. These include (1) the use of employment rather than income (income is usually the preferred measure); (2) the possibility that compensating income streams offset the negative impacts of mill closures; and (3) the fact that tourism could not be identified and thereby coded as basic for use in the regressions. These issues are addressed through an examination of income streams and the use of first-differenced data (in other words, by using changes in employment rather than the employment levels themselves). Also, the period used in the analysis covers a full business cycle involving both expansion and contraction of basic activity, meaning that both positive and negative impacts are considered.

Discussion

At first glance, the results presented in this study appear to contradict common sense. It seems obvious that mill openings or closures will have a major impact in other sectors in the sorts of small forest communities addressed here. Further, the economic base hypothesis and its associated multipliers are commonly assumed in debates about community-level economic impacts, and they are often hard-wired into the analysis techniques used to gauge these impacts.

There are, however, several possible explanations for why the economic base hypothesis is not valid in the towns of southeast Alaska, and, by extension, small, isolated communities elsewhere. First, an extremely high degree of income leakage in small communities means that impacts from changes in employment and income may appear outside the community in question. Rather than functioning economies, many of these places may be better characterized (at least economically) as production camps where various economic enterprises have little interrelation. The effect of leakage, of course, is theoretically consistent with the economic base hypothesis, but it may not be adequately accounted for in practical implementation. Second, the economic base model's assumption of perfect elasticity in productive inputs, notably labor, may be in error. This would help explain instances where changes in basic employment actually result in opposite changes in employment in other sectors of the local economy, as individuals shift their employment from basic to nonbasic sectors in accord with opportunity.

This suggests a probable area for future research. The fact that different communities exhibit different responses to changes in basic employment indicates a need for study of the community characteristics that underlie this difference, and an examination of local labor markets and their flexibility would be a good place to start. Additionally, labor market adjustments in particular, and economic impacts in general, take time, and a better understanding of the temporal dynamics of impact processes would improve our ability to predict the course of economic impacts and to assess the validity of static techniques such as economic base and input-output modeling.

The economic base hypothesis and its derivative modeling techniques emphasize export industries as the sole determinant of local economic activity. Other approaches have stressed local characteristics such as the pool of labor skills, social cohesion in the face of change, local infrastructure, and overall desirability of the community as a place to live. The results presented here indicate that an emphasis on basic economic activity to the exclusion of all else is unwarranted. Other factors are important, and using changes in basic employment to predict changes in total employment does not work.

Contents

Chapter 1: Introduction

The impact of forest policy on local communities has been a long-standing concern in various forest policy arenas. In the United States, much of this concern has focused on the relation between the provision of timber from public lands and the economic vitality and stability of nearby communities. In the last decade, regional Forest Service planning exercises in Alaska and the Pacific Northwest have highlighted the need for decisionmakers to be sensitive to the potential impacts of policy decisions on the economic well-being of resource-dependent rural communities.[1] Because these plans have entailed sharp reductions in the supply of federal timber, the central issue has been the impact of a reduction of timber-related activity on local economic well-being. At the same time, however, the increasing recognition of the nontimber values associated with the forest (and the economic activities and benefits derived from these values) has increased the emphasis on economic tradeoffs associated with different resource allocations. Many of these nontimber benefits, however, are both spatially diffuse and extremely difficult to quantify. The ill-defined (but no less real) benefits of forest conservation notwithstanding, affected forest communities have emphasized the negative impacts of reduced timber availability on their economic well-being and have demanded that an accurate estimation of these impacts be included in the policy decision process.

At the heart of the issue is the question of the role of wood products production in the economic vitality of small forest communities. It is a common belief that such activities constitute the foundation of local economies and that their reduction in scale or total removal from the local economy will have ramifications extending well beyond the jobs and incomes lost in their specific sectors. Statements to this effect are quite common and carry considerable weight in policy debates. Assumptions about the ways small rural economies operate are often the basis for these beliefs and likewise furnish the foundation for modeling techniques commonly used to estimate economic impacts. Taken together, these assumptions embody what can be called the "economic base hypothesis." The objective of this study is to provide an empirical test of this hypothesis by using the small forest communities of southeast Alaska as a laboratory, and to determine implications for natural resource policy and future research in small-area economics.

Economic base theory constitutes a specific approach to regional economic modeling. As used here, however, the economic base hypothesis extends to cover a more generalized set of assumptions and modeling techniques. Simply stated, this hypothesis claims that changes in economic activities earning outside income for a locality (termed "basic") drive changes in retail, services, and other economic activities that serve local demand ("nonbasic"). Although the magnitude of this relation may vary in accordance with local conditions, it is assumed to be positive in all cases. Additionally, it is assumed that the relation is linear and can thus be described in the form of a

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[1] These planning efforts include the Tongass Land Management Plan in southeast Alaska (USDA Forest Service 1997), the Interior Columbia Basin Ecosystem Management Project (USDA and USDI 1997), and the Forest Ecosystem Management Assessment Team report pertaining to the management of forests in Washington, Oregon, and northern California west of the Cascade crest (FEMAT 1993).

“linear impact multiplier,” which predicts changes in nonbasic activity given changes in basic activity. By using this multiplier, one can calculate the marginal economic impact of the opening or closure of a sawmill, for example, on other sectors in the local economy. Whether this hypothesis is a viable description of local impact processes, however, is an empirical question that remains largely unexplored at smaller spatial scales.

In addition to the central goal of testing the economic base hypothesis, several broader issues also are addressed by this study. First is the relation between the economic base hypothesis and crucial resource policy concerns such as community stability and economic sustainability. A second issue arises from the fact that the consideration of community-level impacts in the planning process assumes a clear understanding of how communities (as opposed to individuals or industrial sectors) may be impacted. This requires both an explicit definition of community and a thorough understanding of the implications of its use as a unit of analysis in the estimation of economic impacts. Finally, we may rightly ask why community impacts should be considered, particularly in relation to national forest policy. After all, it can be argued that the mandate of the Forest Service is to manage the national forests in such a way as to maximize national welfare and that the consideration of community-level variables entails issues related to the distribution of wealth, which are best addressed in other policy forums. Consequently, an explicit rationale for the inclusion of information on community impacts in forest policy decisions is needed, but such a rationale is largely absent both in official policy directives and in the academic literature. These questions will be addressed in chapter 2.

Chapter 2 will provide a setting for the analysis and establish the relevance of the central research question. It will outline the evolution of economic thought from an early focus on community stability to more recent consideration of resiliency, diversity, and resource dependency. Next, the question of how communities might be meaningfully defined in an economic sense will be explored. It will be argued that interactions, and not merely spatial proximity, are paramount. The chapter concludes with a rationale for the inclusion of community-level economic information in policy impact assessments and suggests a limited set of economic variables (essentially employment and income) deemed most important in the estimation of community-level economic impacts.

Chapter 3 considers economic models and approaches that have been used to estimate the impact of an exogenously induced shock on a local or regional economic system. The economic base hypothesis plays a central role in two of these, namely economic base and input-output (I-O) models.[2] Owing, no doubt, to their less stringent data requirements, theoretical simplicity, and the ready availability of computer models such as the Forest Service’s IMPLAN model (Alward et al. 1989), economic base and I-O models have been widely used in regional impact assessments, and the extension of these models to a community setting is certainly an operationally practical option. Another class of model that provides a more flexible approach commonly is specified in the form of a computable-general-equilibrium model (CGE). Although CGE models avoid certain questionable assumptions found in the economic base and I-O models,

[2] I-O models can differ greatly in their design, complexity, and even underlying assumptions. The type of I-O model referenced here is what can be termed a “fixed-price” I-O. This distinction and its relation to the economic base hypothesis will be discussed further in chapter 3.

their data requirements and the overall difficulty in their construction often prohibit their application in policy analysis. The chapter concludes with a discussion of the relation between analytical modeling techniques and the process of empirical testing and validation.

An empirical test of the economic base hypothesis is presented in chapter 4. The initial estimations focus on the relation between manufacturing employment and other employment in each of 15 small, semi-isolated communities in southeast Alaska. In light of their simple economic structure and the relatively large fluctuations in manufacturing employment experienced by these communities, it is argued that they constitute a likely setting for discerning and measuring impact multipliers. The empirical estimates, however, provide strong evidence that no such simple multiplier is uniformly at work within these communities of the sample. Rather, certain communities demonstrate a positive relation between basic and nonbasic employment, others a negative relation, and the majority no significant relation at all.

The final chapter of the study provides summary findings, related policy recommendations, potential avenues for future research, and general concluding remarks. In this chapter, it is argued that community-level impacts resulting from forest policy decisions are more subtle and complex than is commonly assumed. The concept of a local impact multiplier is firmly embedded both in the general policy debate and in the quantitative techniques used in the estimations of impacts that accompany many forest plans. Especially when the analysis focuses solely on employment impacts, the assumption of a local impact multiplier may actually be in error and can easily lead to incorrect expectations about the consequences of changes in resource management policies. This is not to say that secondary impacts from the closure of a mill, for example, are nil, but variables other than employment as well as the possibility of compensating mechanisms need to be considered. And they need to be considered within the broader context of local economic dynamics, a context that is largely ignored in policy debates and by common estimation techniques.

In summary, the objectives of this study are threefold: (1) to empirically test for the existence and magnitude of the relation between timber-related economic activity and other economic activity in small, semi-isolated forest communities; (2) to provide a theoretical foundation for interpreting these empirical results and their relation to common economic impact modeling techniques; and (3) to provide a policy rationale and framework for the inclusion of community-level economic impact analysis in the policy decisionmaking process in general, and to draw policy recommendations from the study's empirical findings in particular. At present, common assumptions about the nature and scope of economic impact processes at smaller spatial scales, and the formal and informal models that underlie these assumptions, are not yet justified by a robust body of empirical research. Likewise, a clear understanding of the policy implications of community-specific economic impact information remains largely undeveloped. The current study is an attempt to shed some light on these issues.

Chapter 2: Forest Policy and Communities

Overview

The issues surrounding the relations among forestry, forest policy, and forest communities have generated a long and diverse history of research and debate. A recent bibliography on stability and change in forest communities, for example, contains over 500 citations (Woods 1996). Add to this the numerous newspaper articles, speeches, and public testimony on the subject, and it is clear that communities and their welfare, however defined, constitute an important and multifaceted aspect of forest management and policy. A comprehensive review of this literature and its underlying issues is beyond the scope of this project. A more limited discussion that seeks to identify key elements of the debate in relation to the economic base hypothesis and the estimation of community-level economic impacts, however, will provide an important foundation for analyzing the efficacy of popular impact estimation techniques and a frame for interpreting the empirical results presented in chapter 4 of this report.

This chapter will provide (1) a review of arguments establishing the importance of community-level impacts in the evolution of forest policy in the United States; (2) a heuristic definition of community; and (3) a rationale for the limited inclusion of community-level economic information in the forest planning process, specifically in the environmental impact statements (EISs) that accompany major planning decisions.

Forest Management and Community Stability

From an economic standpoint, forest management is broadly concerned with two overarching goals. The first is to maximize the “net benefits” flowing from the forest, and the second is to assure a degree of stability in this flow. By allowing the term “net benefits” to encompass the full range of goods and services derived from the forest, questions ranging from the supply of raw materials for industrial production, to the assurance of endangered species viability, to the provision of fuelwood for local consumption can be subsumed within this category. From a theoretical standpoint at least, maximization can be dealt with by using economic concepts such as time discounting and adjustment costs to form a measure of the benefit flow over time. The objective of management would then be to maximize this measure. This technique, however, ignores concerns for the sustainability and stability of the benefit flow over time. A common approach to incorporating these concerns in forest planning has been to use stability conditions as a constraint in the maximization problem. This balance between maximization and stability is evident in the maximum sustained yield and nondeclining even-flow principles used by the Forest Service in the management of the national forests.

The fact that a sustained flow of timber is a binding condition in these management principles indicates the primacy given to the concept of stability. More recently, the focus has shifted from the provision of timber to that of a broad range of forest benefits including species habitat and other environmental amenities. The emphasis on stability still persists, however, as evidenced in the growing attention paid to the sustainability of ecological and, perhaps to a lesser extent, economic conditions in forest regions.

The relation between community stability and the stability of forest outputs has been a major concern in the development of modern forest management. It has been argued, for example, that the relative isolation and economic independence of the political units composing northern Germany in the 18th century provided the impetus for the initial development of sustained-yield management and the idea of the “normal forest,” or, in other words, a forest regulated so as to provide a constant stream of mature timber into perpetuity (Drielsma et al. 1990, Waggener 1977). The relative absence of trade resulted in a direct linkage between local forest conditions and the local consumption of forest products, a linkage that still persists in many developing countries. Similar concerns for the continuity of forest outputs have been cited in the evolution of traditional forest management practices in preindustrial Japan, where local provisions were developed to ensure stable supplies of building materials from softwood stands and, most importantly, supplies of fuelwood and fertilizer from native hardwood stands under coppice management (Totman 1989). Here again, the linkage between forest productivity and the **local** consumption of forest outputs was stressed.

Principles of sustained management developed in Europe provided the core philosophy for the establishment of the National Forest System and its initial management under Bernhard Fernow and later Gifford Pinchot in the early 1900s (Pinchot 1947, Steen 1977). However, the society and economy in which these ideas were implemented differed considerably from those in which they were first conceived and developed. In contrast to the relatively isolated and stable (some might say stagnant) economic environment of 18th-century Europe, late 19th-century America was characterized by economic growth, trade, and an expanding frontier based largely on the extraction and export of raw materials, timber among them. In this environment, the supply of forest products for local consumption was of secondary importance, particularly in the West where the vast size of the forest resource dwarfed the small, but growing, local population. Rather, the ability of forests to supply the growing needs of the Nation was stressed.

Experiences with timber depletion in the Northeast and, lately the upper Midwest, indicated that the vast forests of America were indeed exhaustible when exploited to fuel the demand for building materials in distant urban centers. The fear of an impending “timber famine” was an important piece of the argument for establishing the National Forest System and imposing sustained-yield management thereon (Greeley 1917, Parry et al. 1989). These depletions also highlighted the relation between the supply of timber and the economic fortunes of regions and their constituent communities. Except in this case, the exhaustion of local resources affected the ability of localities to participate in trade with distant markets rather than affecting the local consumption of forest products. Often the reliance of isolated timber communities on export trade and its resultant employment and income was extreme, and, with few other local opportunities to garner export income, the elimination of the timber trade was tantamount to the end of the community (Drielsma et al. 1990). Experience with the boom-and-bust cycles of frontier towns whose economies were based on the extraction and export of natural resources provided a clear example of the linkages among resources, local economic activity, and distant markets. It also provided strong anecdotal evidence for the applicability of the economic base hypothesis in resource-dependent communities.

Elimination of **negative** impacts of migratory timber harvests, however, was not the only concern of those interested in the nexus between forest management and timber communities. Forestry also was seen as presenting **positive** opportunities for economic growth and development, particularly in the sparsely populated West. Nonetheless, the protection of forests and the assurance of sustainability of outputs remained the policy of the Forest Service. Although the promotion of local economic interests may have been the de facto result of many planning decisions, the Forest

Service has historically been quite circumspect about explicit policy statements regarding its role as a promoter of community development (Schallau and Alston 1987). Other entities, notably state and local development agencies as well as groups involved in international development efforts, have been far more explicit in their advocacy of forest management as a means of attaining local and regional economic development. Here again, the ability of the forest to provide a stable supply of timber and thereby foster stable local timber employment is a common thread throughout (Berk et al. 1992, Fortmann et al. 1989). Moreover, the conviction with which this view is still held by many forestry professionals, particularly those in the public sector, suggests that community stability and the general promotion of welfare in forest communities remains a potent ideology in forest management (Wear and Hyde 1992).

Insomuch as they try to constrain forest production and productivity to a constant level over time, classic forest management concepts related to sustained yield and current management principles such as nondeclining even flow are essentially static in nature. In its simplest formulation, stable timber supplies are seen to result in stable wood products production and employment, which in turn result in stable total local employment and thereby stable communities. A number of linkages are assumed here, each of which has received considerable attention in the academic literature and policy debates. Although the linkage between timber employment and other local employment is the focus of this study, the other linkages deserve some explanation.

First is the assumption that a stable supply of available timber will result in stable levels of local wood products production. This assumption ignores the supply and demand interactions that underlie production in a market economy. Additionally, in the case of national forest management in the United States, it ignores the interaction between public and private suppliers. When imposed on a market system characterized by both supply and demand relations, and various private and public actors, sustained-yield management of public forests provides no guarantee of stable production and may serve to exacerbate price fluctuations in stumpage markets—an unintended result that certainly can be a destabilizing influence on local timber economies (Adams 1989, McKetta 1984). Various studies have examined the relation between national forest sustained-yield practices and timber production levels and have found that stable federal timber supply had little bearing on stability in production levels (Burton and Berk 1996, Daniels et al. 1991, MacCleery 1983).[1]

An additional concern is whether or not locally harvested logs will be processed locally, as competition for logs from "outside" mills may undermine the linkage between local harvest and local wood products production. Evidence from the 1970s and 1980s suggests that local mills were unable to wholly monopolize (actually "monopsonize" would be a more accurate term) local timber harvests but that they

[1] Prior to the 1990s, the available supply of stumpage was not a binding constraint in major U.S. timber-producing regions such as the Pacific Northwest. Consequently, demand-driven fluctuations such as the timber recession in the early 1980s were crucial in determining total wood products production levels. With recent harvest restrictions related to the spotted owl (*Strix occidentalis*) and other conservation issues, as well as reduced private timber inventories, this situation has changed considerably in the 1990s. In the Pacific Northwest at least, the reduced supply of federal timber has emerged as a binding constraint on wood products production levels. The periods examined in the studies cited here do not cover these developments.

were nonetheless largely able to secure the raw materials necessary to maintain operations, often through the management of uncut volumes under contract with the USDA Forest Service (Waggener 1983). In any case, the fortunes of individual mills are tied to their competitive advantage vis-à-vis other producers, and, although proximity to local timber may be an important part of this advantage, it is not the only determinant. This, in turn, points to the question of what spatial scale should be used in determining sustained-yield management units and how this relates to the spatial distribution of processors. It also highlights one of the major difficulties in predicting the impact of regional or national forest policy decisions on specific mills and their localities, especially in regions with relatively well-developed transportation networks.

The second linkage in the relation between stable harvest and stable communities is that between local wood products production (including harvest) and local wood products employment. Here again, a static formulation of the linkage ignores important dynamic elements, specifically labor productivity and its relation to relative wages and technology advances. Steady, long-term increases in labor productivity in the wood products sectors are clearly evident in regional employment and production data and have been cited as one cause of declining wood products employment in timber-dependent communities in the Western United States. In this case, local wood products employment and, presumably, local income will decline in spite of steady (or growing) wood products production. It should be noted, however, that increased labor productivity also may result in increased payments to other productive factors as well as to other economic sectors such as business services.

To the extent that these factors and sectors are located in the community in question, the net effect of increasing productivity may be neutral or even positive. Additionally, a shift to increased value-added processing will increase the labor related to a unit of wood input. This has been an important factor in the ability of Washington state to partially offset employment and income reductions resulting from reduced harvests in recent years (Robertson and Lippke 1996). Predicting how these various forces will impact timber employment in a given community is extremely difficult, but it is clear that a stable flow of timber inputs for local processing need not lead to a stable level of wood products employment, even if these inputs are fully utilized.

A final linkage is that between local employment and general well-being. Most discussions and analyses of the economic impact of forest policy on local communities limit themselves to estimating changes in total community employment, income, and other relevant economic variables. There is, however, a large and growing body of literature dedicated to the relation between forestry and community well-being as defined outside of the traditional bounds of economic analysis. Much of this work is in the field of sociology (see Lee et al. 1990 for various views on the sociological aspects of community and forestry). Common threads include the identification and characterization of "timber-dependent" communities (Beckly 1998), the identification and analysis of socioeconomic indicators of well-being (e.g., Horne and Haynes 1999, Kusel and Fortmann 1991), the examination of the relation between timber dependency and socioeconomic indicators such as persistent unemployment or crime rates (Force et al. 1993), and analyses of community response and coping strategies in the face of adverse external shocks (Beckly 1996).

Other studies that are more economic in nature but do not involve modeling local employment or income per se, include studies of local economic diversity and its relation to stability (Onal 1997), and the work of researchers such as Freudenburg (1992) and Johnson and Stallman (1994), which seeks to describe the response of local workers and residents to fluctuating local employment opportunities. Within the context of this report, these latter two studies are of particular interest as this resident response may affect the dynamics of local labor markets. This is an issue that may have an important bearing on the magnitude of secondary impacts resulting from changes in employment in the timber sector.

The foregoing analysis has identified stability as a major and long-standing concern in forest policy and management. As shown in the preceeding paragraphs, the assumption equating a stable timber base with stable communities has been challenged from various angles. In fact, few knowledgeable researchers would expect a complete absence of mitigating factors, which may often muddy these relations. Rather, the linkages among the forest, local wood processing activity, and the economic fortunes of a community as a whole are most commonly emphasized when impending shortages of timber threaten timber employment in a given locality or region. As such, the concern for community stability is usually more aptly characterized as a desire to avoid negative local economic consequences.

Nowhere has this been more evident than in the last decade in the Western United States, where policy decisions have significantly reduced the amount of federal timber sold in the Pacific Northwest and, more recently, southeast Alaska. Losses in timber employment were anticipated by many and were likewise predicted in the impact assessments accompanying the policy decisions (Quigley et al. 1996; USDA Forest Service 1992, 1997). There is clear evidence that sale reductions have indeed resulted in considerable losses of regional employment in the wood products sectors.

From the standpoint of a given timber community facing a regionwide reduction in available timber, particularly one containing processing facilities, the crucial questions are (1) How many timber jobs are likely to be lost as a result of the policy decision? (2) What are the potential secondary impacts resulting from these job losses? and (3) What can the community do about it? These questions are apt to constitute the core concern of potential losers in the policy debate, and they will largely determine the positions and strategies of timber-dependent communities in this debate. Here, the relations inherent in question 2 often will be emphasized. That the local mill constitutes the “lifeblood” of the community, or similarly colorful statements to that effect, are commonly expressed but seldom subjected to critical review. This view is an informal version of the economic base hypothesis, the formal version of which is codified and elaborated in the static models commonly used in economic impact estimations. There is, however, little empirical evidence that this is an apt depiction of small-scale, rural economies as they exist today.

Communities and Economies

Broadly stated, the term “community” can refer to any group that may be delineated by shared characteristics or relationships. Although sociologists have identified various types of communities not dependent on spatial relations, our most common conception of community is that of what can be termed “community of place” and comprises a group of people living in relative proximity. This is the sort of community most often considered in economic studies that examine policy-related impacts. Community-level economic analysis usually collects and analyzes data at very small spatial scales. In rural settings, where population centers are relatively small but distinct, increasingly smaller spatial units of analysis are seen to more accurately reflect actual community economic performance. This is especially true if data are available for the individual municipalities in which population is concentrated.

In themselves, however, local concentrations of residents hardly capture the full meaning of the term "community" as it is commonly used in the analysis of the relation between forests and forest-dependent rural populations. Underlying the conception of communities of place is the assumption that spatial proximity engenders various social and economic relations. Whereas some studies have used these relations to delineate communities in space (e.g., Jakes et al. 1998), most community-level analyses, particularly in the field of economics, use political boundaries or other spatial criteria as a means of identifying communities and have then directed their efforts to characterizing the relations that exist within these areas. Nonetheless, the relations, and not merely the spatial boundaries, constitute the core of what is meant by community.

From the standpoint of economics, the relations that define community of place involve the internal exchange of money for goods and services within the community. These relations, in abstract, will henceforth be refered to as "local endogeneity." In that it encompasses the concepts of leakage (flows of money to public and private entities outside of the local community) and successive rounds of local expenditure, local endogeneity is closely related to economic base theory and standard I-O models. Local endogeneity is, however, a more general concept in that the assumptions underlying these models need not apply.

The internal relations inherent in local endogeneity are a key element in our definition and understanding of community from an economic standpoint. In fact, in the absence of such relations, the term "community" is largely meaningless as an economic concept. If, for example, a given settlement is characterized by a single (or even multiple) production activity for export but little or no retail, service, or other activity catering to local residents or firms, then it is perhaps best characterized as a production camp rather than an economic community. In this situation, endogenous (arising locally) economic impacts flowing from exogenous (originating outside the community) changes in the export sector will be minimal. Thus, in the estimation of policy-induced economic impacts, the impacted sector or firm, rather than the community, becomes the more meaningful unit of analysis. (Alternatively, a regional, or perhaps global perspective in the case of extremely diffuse trading relations, may be called for). Consequently, economic impact assessments, when applied to communities as a unit of analysis, are crucially concerned with local endogeneity and its resultant secondary impacts. This argument is restricted to the field of economics, however, as strong social relationships among local residents may exist in the absence of strong economic relations. Indeed, it is commonly assumed that smaller towns are characterized by tighter social relations, but, owing to their small size, these same towns may exhibit lesser degrees of local endogeneity, as will be argued in subsequent chapters.

Although useful from a conceptual standpoint, local endogeneity needs to be more specifically defined in practical terms before it can be used as a means of delineating economic communities in space. Residential and work patterns are a logical starting point as they provide a spatial linkage between wage earnings and local spending. Here we could draw upon the concept of functional economic areas (FEAs) as developed by Fox and Kumar (1965). An important component of the FEA is the condition that the proportion of resident workers commuting to a central city **within** the FEA exceed the proportion commuting to an alternative city center. An additional condition is that the majority of residents' shopping and service needs are provided by establishments within the FEA. Although this captures the relation between wage income and residents' expenditures, the emphasis on commuting and residential patterns ignores the spending of local exporters on goods and services within the locality. Also, with its emphasis on commuting patterns to local centers, this sort of characterization is more apt for larger, more populous regions than for the small, semi-isolated settlements that are the subject of this study.

One of the defining characteristics of small, timber-dependent communities is that processing facilities (i.e., the mill) are located in or near the town. Where logging is a major employer, however, loggers may find themselves working in various locations often at long distances from their homes. This location will shift over time and can hardly be subsumed under the sort of commuting patterns used to define FEAs. Additionally, the small scale of many settlements may be such that a large proportion of shopping, especially that for big ticket items, will be done in relatively distant regional centers or via mail order. Although this may provide a justification for expanding the boundaries of the FEA to include such regional centers, this course of action would eliminate smaller towns and settlements as legitimate units of economic analysis.

Rather than establish a set of conditions with which to delineate communities in space, an alternative approach would be to work with given spatial delineations, such as municipalities, and ask ourselves whether they exhibit sufficient local endogeneity to be considered meaningful as a unit of economic analysis. Given the availability and organization of data at smaller spatial scales, this method is often far more practical, especially if multiple settlements are to be considered in a time-series setting. This is the approach taken in the empirical analysis presented in chapter 4 of this study. Although taking into account certain anomalies in the data, the communities that form the units of analysis are those given by local government reporting agencies, specifically, the numerous small towns and settlements in southeast Alaska.

For reasons to be discussed later, this is not as arbitrary as it may first seem. Furthermore, from a political and practical standpoint, local municipalities often serve as nodes for formal and informal organizations that seek to voice local residents' interests in the political debate and initiate local coping strategies in the face of negative economic consequences. Economic information specific to their town, especially policy impact assessment, is of central interest to these groups. An important question to be addressed, however, is whether these reporting units do in fact possess the characteristics needed to justify their inclusion as a unit of analysis in economic impact assessment. Consequently, the definition used in this study to delineate communities for empirical investigation is preliminary or heuristic in nature.

Another issue encountered in the use of communities as a unit of analysis is the danger of confounding communities with their constituent individuals. This has been referred to as the "fallacy of people as places" (Alonso 1971), and it has important implications both from a theoretical standpoint and in the practical interpretation of data (Richardson 1978). Theoretical issues include the conflict between the atomistic view of human welfare as the sum of individual acts, which is predominant in neoclassical economics, and a more organic view, common in the field of sociology, which holds that communities are more than the sum of their parts. From a practical standpoint, economic analysts must be aware that measures of community welfare and economic performance do not necessarily reflect individual welfare. Aggregate measures of local income, for example, may not be directly correlated with per capita measures. Furthermore, it is possible that even per capita income is misleading (for example, the out-migration of higher income individuals will register as a drop in community per capita income in spite of stable, or even increasing, incomes of remaining residents).

Depending on the mobility of residents and on gross migration, predictions regarding community-level economic indicators may have a weak relation to the economic prospects of current residents.

Policy and Community-Level Impact Assessment

Although community-level impacts have long been recognized as an important result of forest policy decisions, policy statements regarding how and why these impacts should be considered in forest planning decisions are relatively scarce and decidedly vague. As argued above, during most of this century the debate has centered on the concept of "community stability," although this concept remained poorly defined and was only inferred—not explicitly stated—as a policy objective in congressional legislation and Forest Service directives (Force et al. 1993, Popovich 1976, Waggener 1977). This no doubt allowed considerable leeway to forest managers in addressing the issue of local impacts. In recent years, however, extensive cutbacks in Forest Service timber sales programs have given added urgency to the consideration of the adverse effects of declining timber supplies on forest-dependent communities. At the same time, a more explicit and codified set of forest planning procedures resulting from legislation such as the Forest and Rangeland Renewable Resources Planning Act (RPA 1974), National Forest Management Act (NFMA 1976), and National Environmental Policy Act (NEPA 1969) stipulate a more formal analysis and public accounting for policy decisions than previously existed. The result is that local publics and their representatives have increasingly demanded, through political and legal channels, community-level detail in the forest planning documents (notably the EIS), which are now mandated in the planning process. Meanwhile, although the science of small-area economics has made considerable progress, the definition of policy objectives regarding the presentation and use of this information remains vague.

Much of this vagueness stems from the reluctance of forest managers, politicians, and economists to explicitly grapple with questions of equity and distributional impacts. This reluctance can be traced to two fundamental sources. The first involves the tension between the economic concept of efficiency, on the one hand, and, on the other, distributional impacts, which are the central focus of groups and individuals potentially impacted by employment and income changes (see Alston 1983, Bromley 1990, Clawson 1975, Wear and Hyde 1992 for discussions of the relations among efficiency, distribution, and natural resources). Whereas in the former, forest employment is seen to represent a productive resource that, in the long run at least, could be employed in other activities, the latter sees forest employment as a desirable policy outcome in itself. From an efficiency standpoint, the main concern is an optimum mix of forest uses and an optimum allocation of labor and other inputs among productive activities. Policies that hinder this allocation are discouraged, at least in word if not always in deed. Sectors, regions, or localities facing job losses or gains, in contrast, seldom emphasize the question of whether the labor employed could be better employed in other activities, particularly if those other activities are in distant areas or if high adjustment costs are anticipated by those individuals who are expected to "reallocate" themselves.

It has long been recognized that economically efficient outcomes may impose heavy costs on certain groups and individuals, but the ability of these outcomes to foster economic growth and increased welfare for society as a whole is also a fundamental tenet justifying the maintenance of free market economies. Consequently, the history of national forest policy in the United States is filled with statements voicing concern for the welfare of people who depend on the forests for their livelihood, but there are no laws or policy directives that explicitly outline the circumstances and means by which the Forest Service should seek to protect local forest employment (except, of course, sustained-yield prescriptions, which are currently applied at the forest level and are thus of more regional, than local, import).

Likewise, Krutilla et al. (1983: 212) have argued that the Forest Service should take an essentially passive role in addressing distributional questions by "…being circumspect about plans or programs that may destabilize conditions or create inequitable burdens for some particular group or community." However, they go on to claim that such considerations should be limited only to "large distributional imbalances," and that the main goal of forest policy should be the promotion of the efficient allocation of resources among productive activities. I believe that this stance (including the reluctance to define what is meant by "large") amply characterizes the general opinion of resource economists regarding the tension between efficiency and distributional impacts in forest policy decisions.

The second difficulty in addressing distributional issues arises from the spatial distribution of impacts regardless of the efficiency implications of a given policy. Economic impact statements commonly entail an estimation of regional employment and income effects. By providing greater spatial detail, community-level analysis can provide a more accurate identification of specific winners and losers than that presented in the regional analysis. That this information will improve policy decisions is by no means clear.

There are, in fact, several reasons why such information may be detrimental to the decision process. First, the assertion that greater detail than that provided in the regional analysis is necessary in choosing alternatives assumes that the specific location of impacts is important. This is tantamount to saying that, from the standpoint of the decisionmaker, a job in one community is worth more than a job in another—a tenuous assertion at best.[2] Additionally, within the context of the broader political debate and its overall socioeconomic milieu, the explicit estimation of community-level impacts could prove to be extremely divisive as the conflicting interests of individual settlements are identified and quantified. Added to this is the fact that, especially in small communities, impact assessments may act as self-fulfilling prophesies by affecting the investment and migration decisions of individuals and firms facing an uncertain future. Each of these arguments is further strengthened by the decreased accuracy entailed in community assessments resulting from a lack of necessary data and the absence of the law of averages working at lower levels of aggregation. All these factors add up to a strong argument for omitting community-level estimations in economic impact assessments.

There are, however, several reasons why community-specific information should be included in the impact assessments accompanying planning decisions. The first, and most general, involves the role of economic analysis as one among many sources of information used in the policy decision process. As such, economic criteria are neither the sole nor necessarily the most important criteria in informing public choices. This is certainly true in the political machinations and give-and-take that characterize policy

[2] The possibility that spatial concentrations of economic impacts will in turn affect the magnitude and severity of these impacts may provide a partial justification for emphasizing smaller spatial scales in impact assessments. Common modeling techniques involving linear impact multipliers, however, preclude this possibility.

formulation in the "real world," and where, to the chagrin of more than a few economists, actual policy decisions are often counter to the dictates of economic efficiency analysis (Arrow 1951). Consequently, within the context of a public decision process that seeks to balance various values, economic and otherwise, economic analysis best serves the public interest by providing a clear picture of the various economic tradeoffs among planning alternatives rather than ranking alternatives (Bromley 1990).

This stance allows for a greater breadth and flexibility in the questions economic analysis can properly address in the setting of an impact assessment. For example, rather than grappling head on with the marginal social utility (however defined) of equity-efficiency tradeoffs, the analyst can concentrate on describing these tradeoffs in terms of their relevant economic variables without recourse to vague concepts of utility. Likewise, questions regarding the relative interests of different groups or localities can be sidestepped, along with questions about the federal government's responsibility to communities that have depended on federal timber in the past, or more general concerns about the lagging incomes in many rural areas (President's National Advisory Commission on Rural Poverty 1967; also see Xu 1997 for evidence of the concern of urban populations for the economic welfare of timber workers in the rural Pacific Northwest). This is not to say that economic analysis does not say important things about these questions. It does, but the most useful contributions of economic analysis lie in clarifying issues and, where possible, providing accurate data and analysis, and not in making normative judgments.

The above arguments can be summarized in the statement that community-level economic information is important in policy assessments simply because concerned publics, decisionmakers, and other parties in the policy formation process believe it to be so. In addition to this general argument, there are at least two specific arguments why this information is desirable: (1) the targeting of relief funding requires the identification of affected parties, and (2) the spatial concentration of impacts may affect the total magnitude of these impacts.

Of these two, the targeting of relief funds is of the most direct and practical importance. Recent forest plans involving sharp reductions of harvest have been accompanied by large sums of federal money designed to compensate or facilitate the adjustment of impacted workers and their communities. Often these moneys have been allocated to individual rural municipalities. In southeast Alaska, for example, along with harvest reductions, the latest version of the Tongass Land Management Plan (USDA Forest Service 1997) entailed direct payments of over $100 million to the small communities of the region, with additional funds in the $20 to $30 million range paid to the town of Ketchikan after the closure of its pulp mill in 1997. The distribution of disbursements followed a rather crude decision rule based on the amount of federal land within each municipality's jurisdiction. Given the ostensible aim of these funds to help impacted individuals and communities, a more discriminating means of distributing funds based on expected impacts would seem desirable.

In addition to the question of where relief funds should go, community-level information may have important implications as to how these funds are spent. Along with training and assistance programs targeted for unemployed timber workers, a substantial proportion of the federal money distributed in southeast Alaska was used for general community development projects such as the expansion of public infrastructure. Aside from the efficiency implications of using scarce public funds for capital investments in potentially declining areas, the question remains whether these investments actually help the people they are designed to help. This, in turn, will depend on the dynamics and extent of community-level economic impacts and their relation to individuals. If, for example, it is found that the overall impact of lost timber employment on the community as a whole is small, then using relief funds for general development projects would seem unwarranted. Large local impacts would lead to an opposite conclusion.

The possibility that the spatial concentration of impacts affects their overall severity (reason 2 above) is more difficult to assess as it involves the nature and dynamics of local impact processes—the very question this study seeks to address. Generally speaking, the static sort of economic base or I-O models commonly used in impact assessment preclude this possibility (this will be discussed in further detail in chapter 3). On the other hand, given dynamic model specifications or persistent local disequilibria, it is possible that impacts concentrated in small communities may be associated with relatively larger secondary impacts than if the impact was distributed across multiple communities or occurred in a larger community better positioned to absorb the shock. This result could be obtained, for example, through the accumulation and interdependence of investment and migration decisions, a process tied to the optimism (or pessimism) of local residents and the overall "business climate" of the community. Indeed, various studies, along with countless newspaper articles and other lay forums, have cited this as a key factor in the ability of certain communities to weather adverse shocks (Erickson and Associates 1999). This, in turn, indicates the possibility that the relation between the magnitude of the exogenous shock and endogenous response (i.e., secondary impacts) is nonlinear and even may be characterized by discontinuities and threshold effects. The possibility that impacts are nonlinear represents a violation of the economic base hypothesis. In the course of the current analysis, it will be treated primarily in a qualitative sense.

The foregoing discussion indicates both pros and cons for the inclusion of community-specific economic information in forest planning decisions and their related documentation. There is no single answer as to how to balance these conflicting concerns. Rather, individual policy settings will demand qualitative judgments on the part of analysts depending on the nature and objectives of the policy under consideration, the intensity of political debate, the availability of data and analytical expertise, and the nature of the local economies in question. As a general rule, fully quantified impact assessments should probably be avoided for most small communities—the potential for error and the sensitive nature of the study results are simply too great. At the same time, however, a better understanding of the dynamics of impact processes at small spatial scales could be used to provide a useful array of quantitative measures and qualitative judgments that, although falling short of providing actual quantified estimates of local impacts, would help decisionmakers and potentially affected publics to gauge the expected spatial distribution of impacts under different policy alternatives.

Policy and Community Conclusion

The following chapters will more specifically address the theoretical issues and present empirical evidence of the relation between timber employment and other employment in local communities. A concern for community well-being, it was argued, has been a central and enduring element in forest management and policy, and can be seen as a partial justification for the adoption of sustained-yield management principles for public forests in the United States. This concern has often been coupled with relatively static views of the ways in which small economies work in relation to the local extraction and processing of timber. Conceptions of forest dependence and the strong linkages between timber employment and other local employment have been particularly important themes.

An analysis of the relation between communities and forest policy requires a definition for the term "community." Various possible definitions exist, each of which highlights different dimensions of the ways in which people are interrelated vis-à-vis the forest. The definition proposed in this chapter is specific to the spatial distribution of policy-related economic impacts, and it uses preexisting government reporting units (i.e., municipalities) as a way of identifying and delineating communities in space. Economic relations between local actors, however, also were identified as an important component of an economic definition of community, and this further serves to concentrate our focus on the question of secondary impacts.

Explicit directions and justifications for the use of community-specific economic information in the forest planning process are not well developed in a legal, or even academic, sense. Although acknowledging several important reasons for avoiding overly specific and quantified estimates for individual communities, the third section of this chapter identified two main reasons why a better understanding and description of community-level impacts are needed: (1) the political arena is the proper forum for weighing the various pros and cons of a given policy alternative, and potential economic impacts to small communities have been identified as a concern by various participants in the policy debate; and (2) the provision and use of relief funding in potentially impacted communities requires some knowledge of the expected spatial distribution of impacts along with the ways in which community-level dynamics are related to the welfare of individuals. Although it is only treated qualitatively in this study, the possibility that the spatial concentration of impacts will affect their magnitude is another concern.

Chapter 3: Economic Models of Local Impact Processes

Overview

The assumption of a relation between externally generated (exogenous) demand and locally generated (endogenous) economic activity rests on a set of commonly held beliefs as to how regional and local economies work. These beliefs are often codified in formal economic models. Various such models exist, each representing not only different economic assumptions but also heuristic considerations related to the availability of data and the tractability of model estimation. Three general classes of models are considered: (1) economic base models, which constitute the simplest approach to impact estimation; (2) input-output (I-O) models, which incorporate essentially the same assumptions as economic base models but at a much higher degree of detail and complexity; and (3) general equilibrium models, which avoid certain arguably unrealistic assumptions of the previous two models but which are generally more difficult to parameterize and estimate. Various other approaches to modeling regional economies also exist, but these will not be addressed in this study.

Economic base and I-O models are essentially demand driven, and they embody the economic base hypothesis in their assumption that external demand is the primary determinant of local activity, as well as in their static structures and use of linear impact multipliers.[1] General equilibrium models, on the other hand, can incorporate assumptions that contradict the economic base hypothesis, so their use in impact estimation is not considered here. Nonetheless, equilibrium models provide a useful framework for identifying and analyzing the key assumptions in economic base and I-O models. They also can be used to identify other important parameters in the behavior of local economic systems.

A simple version of a general price equilibrium model applied to an idealized timber community serves to clarify the assumptions underlying each type of model as well as to indicate where the static linkage between exogenous and endogenous activity assumed in economic base and I-O model formulations may break down in a local economy. This foreshadows empirical results presented in chapter 4, which suggest that this linkage is extremely weak for many of the small communities in the study sample.

Models that may be viewed as inferior from a theoretical standpoint will nonetheless be favored in application owing to a lack of sufficient data or other resource constraints. Although commonly asserted as a simple caveat, this consideration is, in fact, central to the whole enterprise of local economic impact modeling. The challenges facing analysts involve tradeoffs between theoretical consistency and practical applicability as well as the verification of model predictions by using actual performance of local economies in a time-series setting.

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[1] Various applications of the I-O method have been developed over the years, including the incorporation of price equilibrium conditions and substitution between inputs. Unless otherwise stated, the term "I-O" is used in this study to refer to the standard, fixed-price variant of I-O models. Although this may misrepresent certain advanced applications of the method, fixed-price I-O models are still the most common type used in practical applications of impact estimation.

Common Issues in Impact Modeling

Export Demand and Factor Supply

The emphasis on the division of local economic activity into basic and nonbasic categories and the assumption that the former is a driver of the latter stress the role of exports in the growth and structural development of local economies. An alternative view stresses the supply of local productive factors and the evolution of internal relations in a local or regional economy. An exchange between North and Tiebout in the early 1950s provides a particularly cogent and often-cited expression of these opposing viewpoints (North 1955, 1956; Tiebout 1956). North, who provided the initial article in the exchange, used the historical experience of the U.S. Pacific Northwest to argue for the primacy of export sectors in determining the growth and prosperity of developing regions in North America. This, he argued, was in contrast to the European experience in which regional economies developed around preexisting population centers through a process of expansion and innovation initially designed to serve local markets and, only later, growing interregional trade. The communities and economies of the American West, on the other hand, were initially founded to supply export markets, evolved to more efficiently service these export markets, and continue to rely heavily on key exports for their livelihood. In his comment on North's article, Tiebout emphasized the various internal elements that allow a region to develop and prosper. These included the ability to attract productive factors (notably labor) and to engage in increasingly diversified production activities to service both local demand and export markets. In this view, the ability of regions to garner the productive resources needed to engage in diversification and import substitution is as important, or maybe more important, than the export of key commodities.

In the subsequent reply by North and rejoinder by Tiebout, it is clear that their differences lie more in the emphasis placed on different forces acting in the regional economy than in a specific theoretical postulate or stance; North emphasizes linkages to exogenous markets, and Tiebout emphasizes endogenous elements in the regional economy. This contrast in emphasis is broadly reflected in the formal models that have been used to describe local and regional economies, although often the sort of nuanced qualitative arguments presented by North and Tiebout are lost in the more rigid model specifications commonly used. By and large, the emphasis on external linkages is most prevalent in actual application to small, resource-dependent economies, particularly as incorporated in key assumptions in popular economic base and I-O modeling approaches. More flexible general equilibrium models have been used to incorporate endogenous elements such as local production in factor markets or the dynamic impact of cumulative investment. These models, however, usually have been confined to the theoretical arena or applications in broader regional or country settings. One of the advantages of general equilibrium models is their ability to isolate and highlight key assumptions, which are often implicit in the other models considered in this study. Hence, as will be shown in the following analysis, a broad equivalence between economic base, I-O, and general equilibrium models can be established by assuming perfect elasticity of factor supply in a general equilibrium framework. A central question for modeling impacts then becomes whether this is a realistic assumption.

New Sources of Outside Income

Until recently, most of the discussion and analysis of the economic base of resource-dependent, rural communities has focused on resource extraction and related manufacturing activities. In the last few decades, however, increasing attention has been given to other sources of outside income and their relation to community-level economic performance. These include tourism (e.g., Archer 1976, Leatherman and Marcouiller 1996, Tooman 1997), "footloose" employment involving telecommuters or other individuals who avail themselves of modern communication and transportation opportunities (e.g., Beyers and Lindahl 1996, Rasker and Glick 1994, Salant et al. 1997), and unearned income sources such as retirement benefits, other transfer payments, dividends, and rents (e.g., Kendall and Piggozi 1994, Nelson and Beyers 1998a, Siegel et al. 1995). In some ways, these income sources can be viewed as simply another export industry or exogenous source of income contributing to the local economic base, and they can easily be incorporated into economic base or I-O frameworks (if income rather than employment is used). At the same time, however, the determinants of location choices on the part of these new income recipients are considerably different than those of people engaged in traditional resource extraction and manufacturing activity. Specifically, local amenities rather than proximity to raw materials or markets, become crucial factors, and the dynamics of local growth and development are affected accordingly. Tourism, a growing industry in many rural communities, relies on local amenities in a similar fashion.

The growth in both tourism and other new income sources has been cited as a cause in the ongoing erosion, or "decoupling," in the relation between traditional resource-based industries and local economic performance. It also indicates the emergence of local amenities as an important element in the prosperity of rural regions and communities (Galston and Baehler 1995, Power 1988). The extent to which this is true no doubt differs considerably across regions and individual communities (Robison et al. 1996), but the growth in nontraditional income sources must be recognized as an important factor throughout the rural West. It is certainly important in many of the southeast Alaska communities examined in the case study of this report, and it is important throughout the theoretical and empirical portions of this and the following chapters.

Variables for Use in Analysis

The number (and variety) of variables that may be used to measure community (or individual) welfare is quite large, even if we limit our view to purely economic matters. At the same time, however, certain variables will be much more important than others and may underlie other measures and thus serve as indicators of overall economic performance. Employment and income stand out as key indicators that have long been the focus of public and professional attention in impact assessments. Although per capita income is central to measuring the welfare of individuals, local aggregate income is the most crucial variable in addressing impacts on communities. Income, both per capita and aggregate, is the most common variable addressed in theoretical work in regional economics and impact modeling.

Owing to the wider availability of employment data, particularly at smaller spatial scales, employment is often a central variable both in empirical studies of local impact processes and in practical impact assessments. Also, employment is often the key economic focus in the political debate surrounding resource policy options (Bolton 1985). The assumption is that local employment is highly correlated with local economic activity and welfare of residents, factors that might be more precisely measured by aggregate and per capita income data if they were available. Both analytical and practical problems with this assumption will be addressed where appropriate in the analysis.

The case study presented in chapter 4 considers both employment and income measures along with the ways in which they may differ. The distinction between income and employment will not be stressed, but data availability allows for a much more detailed analysis of employment. In the theoretical discussion in this chapter, income is ostensibly the measure to be used, and, where appropriate, the two will be subsumed under the general heading of "economic activity." This is true mostly in the case of economic base and I-O models. In the discussions of general equilibrium models, where income flows and price changes are explicitly modeled, income will be the central variable.

Other economic variables that may be important include asset values, particularly in local real estate markets, and local government revenues and expenditures. Population is also a key variable with important economic foundations and implications. In concentrating on employment and income, a central question is whether changes in these variables reflect or foreshadow changes in other variables. In general, one would expect a relatively strong correlation between employment or income measures and the other variables identified above, especially in terms of overall growth trends. The division of local activity into exogenous (basic) and endogenous (nonbasic) sectors, however, does not have the same relevance when looking at, for example, changes in real estate values, as it does in examining the relation between sawmill employment and local service and retail establishments. Consequently, we can imagine a situation where impacts to asset values, government spending, and total population are substantial owing to the direct effect of changes in basic sector employment and income even if the impact of these changes on nonbasic sectors turns out to be insignificant. Although the empirical analysis presented in this study will not directly address these other variables, they should be recognized as important.

General Equilibrium Models

The term general equilibrium model is used here to denote an extremely broad class of economic models that, using Walras' general equilibrium framework (Walras 1954), seek to describe regional or local economic systems via the equilibrium conditions of their constituent markets. Commonly referred to as computable general equilibrium models (CGEs), many of these models have attained a considerable degree of complexity and sophistication. Advances in computer technology and practical solution algorithms have allowed for a marked expansion of theoretical and applied activity in this area in recent years. The following discussion is not a comprehensive review of this work. Rather, I provide only a brief description of the fundamental characteristics of these models as a class and a discussion of their relation to the other models noted in this chapter and to the overall task of economic impact estimation. For reference, Dervis et al. (1982) provide an often-cited review of general equilibrium modeling theory and practice. Kraybill (1993) and Partridge and Rickman (1998) provide recent surveys of general equilibrium modeling in a regional setting.

General equilibrium models comprise a set of equations that describe the behavior of the economic system being modeled. A subset of equations describes production technologies and the supply and demand relations pertaining to various markets for products and factor inputs. These, in turn, yield a set of own-price and cross-price elasticities that specify the response of various elements in the system to exogenous and endogenous price changes. Another equation, or set of equations, describes an income identity relating local expenditure to local income. Additional equations may stipulate constraints on production factor supplies or other contingencies not incorporated in the supply and demand or income identity equations. Under a given set of exogenous variables, these equations can be solved for endogenous variables. In most cases, the number of equations is equal to the number of endogenous variables, and a unique solution is thus likely (but not necessarily assured).

Because any number of equations may be incorporated in the model and the form of these equations is quite open, general equilibrium models possess a degree of flexibility far exceeding that of the other models considered in this chapter. In particular, general equilibrium models, as a class, demand no assumptions about the nature of production technologies or factor markets—different assumptions may be tested under different model specifications. This flexibility also has proven to be a rich ground for the application of innovative techniques in regional modeling (Partridge and Rickman 1998). As will be shown in the next section, by stipulating perfect elasticity of factor supply and homogeneous production functions, one can obtain economic base or I-O type linear multipliers within a general equilibrium framework. These other models can be seen as a limited subset of the broader class of general equilibrium models (see Rose 1995 for further discussion).

The limiting assumption that factor supplies are perfectly elastic is omitted in most general equilibrium modeling applications. Owing perhaps to a paucity of data at smaller spatial scales, however, Leontief technology (i.e., a fixed technology matrix) is commonly assumed as a basis for calculating demand for intermediate inputs. Likewise, Cobb-Douglas or constant-elasticity-of-substitution (CES) production functions with constant returns to scale are commonly used in regard to primary factor inputs in production, resulting in homogeneous production technology (meaning that the shape of the supply curve remains unchanged though its location may shift). In this case, though, substitution of different factors such as capital for labor, or vice versa, is generally allowed.

Although general equilibrium models are generally regarded as superior from a theoretical standpoint, their practical application at small spatial scales is severely hampered by a lack of both data and a generally agreed upon structure and set of procedures. Parameterizing behavioral equations in the absence of sufficient time-series data is a particular problem, and even if accomplished, the parameters chosen may not adequately reflect future behavior. Likewise, in models involving a large number of exogenous variables, each variable must be projected under baseline and alternative scenarios in order to produce impact estimates. Add to this the fact that the specialized knowledge and understanding needed to apply a specific model seldom extend beyond the model developers themselves, and it is easy to see why CGE models are not widely used.

The small-area applications that exist are often tailored to a specific type of problem (e.g., Waters et al. 1997), or are designed to incorporate and examine theoretical innovations. Consequently, replication of study results across diverse study settings is virtually nonexistent. In light of the complex interactions entailed in most CGE models and the absence of comparable studies, the problem of empirical validation remains a pressing issue.

A Simple Equilibrium Model

In order to more clearly demonstrate some of the analytical issues central to this study, this section develops a simple community equilibrium model. The focus of the model is the impact on endogenous sectors of a given community's economy resulting from changes in exogenous activity. A small mill town is perhaps the easiest way to envision the interactions presented in this model. The flow of income for this idealized community is presented in figure 1. The shaded area contains economic actors geographically located in the community, and the arrows denote the direction of money transfers (in many cases, but not all, an opposite flow of physical goods and services is present but not pictured). Two sectors relying solely on exogenous

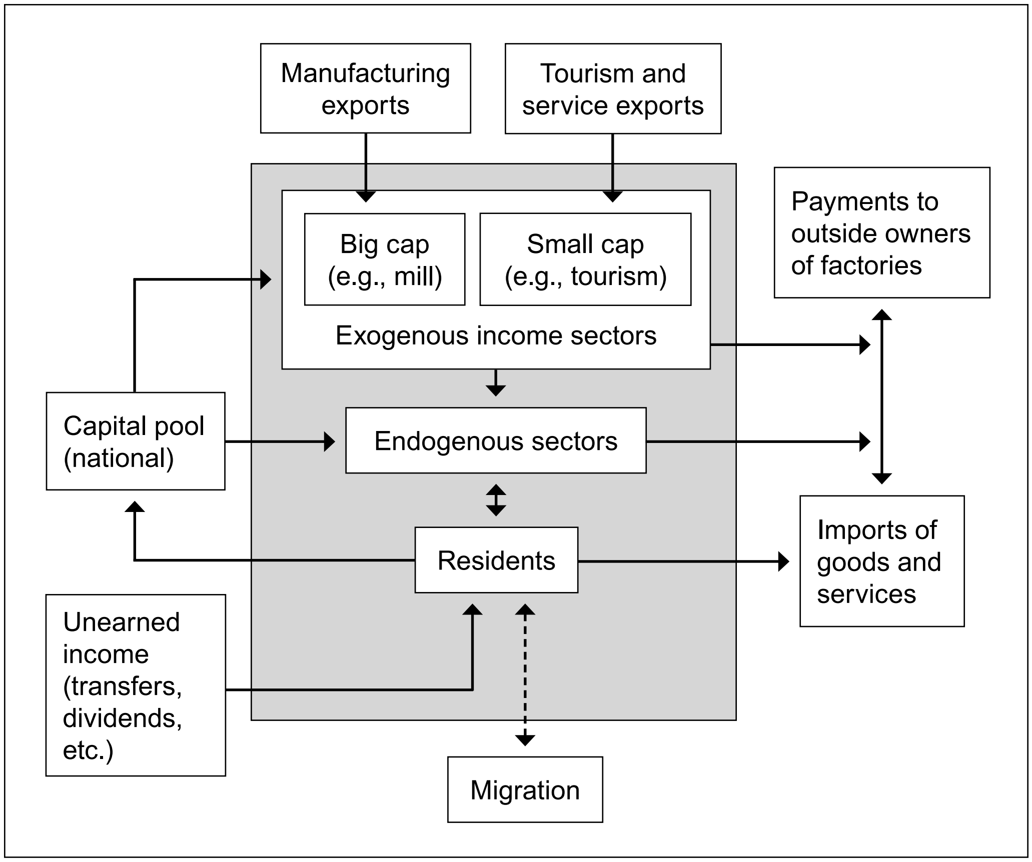

Figure 1— Simplified income flows in a local economy.

sources of income are included in the model: (1) a manufacturing sector, which is assumed to be characterized by large-fixed-capital installations within a single firm or small set of firms; and (2) a small-capital sector characterized by numerous small firms serving tourists, export service markets, etc. In the following analysis, the manufacturing sector is assumed to be wholly exogenous, meaning that it is unaffected by local wages or product demand. The small-capital sector, on the other hand, will be subject to changes in local factor markets and thus endogenous in terms of its supply function but exogenous in terms of product demand.

Receipts in the exogenous income sectors are used to purchase intermediate inputs from the endogenous sectors of the community and from outside producers. Firms in the endogenous sector will, in turn, make further purchases of intermediate products from both local and outside producers. Note, however, that internal purchases of intermediate goods within the endogenous sector are not explicitly modeled. Taken together, the impact of purchases by exogenous income sectors of endogenous sector products plus the additional cross purchases in the endogenous sector are conceptually equivalent to the indirect impact (or “type I”) multiplier in the standard I-O model. Both exogenous income sectors and endogenous sectors will purchase local and outside value-added inputs, which are assumed in this model to be limited to labor and capital. Payments for production factor inputs will be distributed between local and outside residents. Local residents will, in turn, make further purchases from the local endogenous sector (as well as making outside purchases), resulting in what are termed “induced impacts” that are incorporated in the “type II multiplier” in the I-O model. The volume of payments originating and terminating within the shaded region is equivalent to the concept of local endogeneity introduced in the previous chapter as a key element in the economic definition of community.

In addition to revenues from the export of goods and services, there are various other outside interactions representing income leakages from and infusions into the local economy. Payments for imports of goods and services, both as intermediate products and final consumption goods, represent a major form of leakage that is generally assumed to be negatively correlated with community size. Payments for outside production inputs are another form of leakage and are assumed to be mostly concentrated in interest payments or other returns to capital, although wages to nonresident employees may be quite important in certain industries. The share of outside capital will vary depending on the structure of the industry in question, with generally higher rates of local ownership in the small capital sectors (McKean et al. 1998, Tooman 1997).

Saving and borrowing by local residents and firms are avenues for both leakage and infusion of money into the local economy. Local savers and borrowers are both assumed to be price takers in capital markets, meaning that their interest rates are determined in national markets beyond their control. Consequently, there is no endogenous feedback relation between income and savings and investment in this model. Nonetheless, the linkage between residents’ savings and investments in the small-capital or endogenous sectors will be considered from a qualitative standpoint in the following discussion. Federal and state transfer payments along with dividends, interest, and other forms of unearned income constitute yet another source of exogenous income, which is paid directly to local residents. For simplicity, other government interactions have been ignored in this model.

For the purposes of this study, this simple model can be used to examine the impact of a change in resource extraction and processing activity on other activity in the economy. The strategy used here is to first concentrate on the income identity, which relates exogenous income to endogenous spending. For the sake of brevity, small-capital exports and unearned income are excluded at this stage of the analysis. The income identity can then be written as follows:

$$PX = \delta \sum_i \gamma_i F_i W_i + Z \ , \qquad (1)$$

where i is capital or labor,

Z is local expenditures based on receipts from the sale of the export good,

X is amount of a composite good representing local production in the endogenous sectors,

P is price of this local good,

F_i is amount of factor i (either capital or labor) used to produce X,

W_i is nominal (unadjusted for inflation) wage for factor i,

γ_i is local share of ownership for factor i, and

δ is share of local income spent on the locally produced good ($1 - \delta$ = the savings rate plus the propensity to import).

Although it does not model intersector purchases, this equation still captures the circular relations inherent in the economic base and I-O model. This is shown by the relation between factor inputs and production of the endogenous good—increases in X will result in increases in F_i resulting in further increases in purchases from the endogenous good and thereby in X. As in the case of the economic base model, and analogous to leakages to savings in the simple Keynesian macroincome model, the leakages summarized in δ and Υ_i result in a finite multiplier. Also, the model includes expressions for factor inputs and wages (in the endogenous sector), thus providing a way to incorporate factor markets into the analysis. Equilibrium conditions in factor markets can be applied here, specifically the profit maximizing condition that the marginal cost of factor inputs equals their marginal value product.

The model does not explicitly model imports of intermediate goods or outside factors in the production of X. These channels, however, can be included in the δ term. Here, δ incorporates both the propensity of consumers to **locally** purchase final consumption goods and firms to **locally** purchase intermediate inputs. Consequently, X measures local value-added content in the endogenous sectors (i.e., net of imports of intermediate goods and factors), and PX measures its value.

An additional point to be noted in the model is the identity between Z, the exogenous income source, and the various channels that constitute leakage of income outside of the community. This identity is obtained by assuming that receipts from the sales of X are exhausted in the payment of productive factors, including those employed in the production of intermediate goods.

$$PX = \sum_i F_i W_i \tag{2}$$

When combined with equation 1, this yields:

$$Z = \sum_i (1 - \delta\Upsilon_i) F_i W_i \ , \tag{3}$$

where the right side is equivalent to total income leakage. Changes in Z will necessarily result in identical changes in total leakage. As will be shown below, this change can either be effected through changes in the physical volume of production of the endogenous composite good, increases in prices and factor wages (local inflation), or a combination of both.

It is useful to express factor prices in real terms. Dividing equation 1 by P yields:

$$X = \delta \sum_i \Upsilon_i F_i w_i + \frac{Z}{P} \ , \tag{4}$$

where the lower case w_i refers to W_i/P. The final goal of this exercise is to derive an expression for dX/dZ, which represents an instantaneous (linear) multiplier mapping an exogenous shock in the export sector into changes in activity in the endogenous sector. Multipliers for employment or income can then be obtained by mapping changes in X into changes in F_i and w_i, and dX/dZ can be obtained by totally differentiating (4) and collecting terms for dX/dZ on the left side:

$$\frac{dX}{dZ} = \frac{1}{P\left[1 + \frac{Z}{P^2}\frac{dP}{dX} - \delta\left(\sum_i \gamma_i w_i \frac{dF_i}{dX} + \sum_i \gamma_i F_i \frac{dw_i}{dX}\right)\right]} \quad . \tag{5}$$

Equation (5) provides a relatively concise way of analyzing the impact multiplier. Specifically, the derivatives for good price, factor inputs, and factor wages in the denominator of the right side allow us to evaluate the impact of factor markets and their respective equilibria on the magnitude of the impact multiplier. Notice the three distinct channels through which the multipliers may be affected by goods and factor markets: (1) the price derivative dP/dX, which enters the denominator positively and will thus negatively impact the multiplier magnitude; (2) the factor employment effect ($w_i dF_i/dX$); and (3) the wage effect, which incorporates the change in the **equilibrium** wage and is denoted by the final term in the denominator. Channels 2 and 3 are simply a linear decomposition of the simultaneous effect of changing factor inputs and wages. They enter the denominator in a negative fashion and are thus positively related to the magnitude of the multiplier.

A crucial assumption of economic base and fixed-price I-O models is that factor supply is infinitely elastic (unlimited). This may be evaluated in the context of equation (5). Under this assumption, both wages and the endogenous good price will be fixed, or, mathematically, $dw_i/dX = dP/dX = 0$. Equation (5) then simplifies to:

$$\frac{dX}{dZ} = \frac{1}{P\left(1 - \delta\sum_i \gamma_i w_i \frac{dF_i}{dX}\right)} \Rightarrow P\frac{dX}{dZ} = \frac{1}{1 - \delta\sum_i \gamma_i w_i \frac{dF_i}{dX}} \quad . \tag{6}$$

As will be shown in the subsequent section on economic base models, this equation is essentially a restatement of the economic base multiplier, which uses the marginal productivity of factors and their real wages. Because prices and wages are constant in this formulation, the equivalence of Z and leakage (assumed in the model) is obtained solely through changes in the volume of production of X. Likewise, changes in employment and in income will be directly proportional, and the two measures will result in identical multipliers.

This result serves to emphasize the central role of the assumption of unlimited factor supply in obtaining the linear multipliers in both the economic base and simple I-O models. El-Hodiri and Nourzad (1988) demonstrate the equivalence of Leontief fixed-coefficient technology and Cobb-Douglas technology under certain restrictive conditions. McGreggor et al. (1996) provide a computational demonstration of the equivalence of I-O and CGE results given a set of key assumptions (see also Kraybill 1993). Equation (6) provides a more generalized statement of the technology needed to guarantee the fixed ratios of productive factors and linear multipliers inherent in the I-O model. Specifically, under the assumption of infinite factor elasticities, any linearly homogeneous production function will yield similar results. The commonly assumed constant-returns-to-scale (CRS) Cobb-Douglas technology is merely a special case of this more general result. Additionally, production technology which is homothetic, but is not CRS, will result in fixed ratios of factors, but the associated impact multiplier will no longer be linear. Production technology of this sort can be used to describe the increasing returns to scale involved in agglomeration economies[2] and processes of technological innovation and application (Krugman 1991, 1995; Malecki and Varaiya 1986).

At the opposite extreme is the assumption that the supply of local factor inputs is wholly constrained and thereby fixed at current levels. This assumption is common in short-term analyses related to country-level models or other relatively closed systems, but it is seldom extended to the relatively open economies thought to characterize the regions and localities of developed nations. Given the assumption of fixed factor inputs available to the local economy and full use of these factors, we know that production of X will be fixed at the current level (once again allowing for the definition of X as the local value-added content of endogenous sector sales), and thus dX/dZ = 0. Because, in perfect competition, receipts from the sale of X will be exhausted in payments to factors, changes in P will only result in proportional changes in W_i and thereby constant w_i. Referring to equation (5), in this case dw_i/dX = 0, and the relative wage channel (channel 3) in the denominator will be eliminated. The factor employment channel (channel 2) will be finite as it is defined by initial wages and the physical productivity of F_i. At the same time, the price channel, dP/dX, which enters the denominator positively, is infinite owing to the perfectly inelastic supply curve (infinite supply) for X. The resulting value for dX/dZ is thus zero.

In this case, the equivalence between Z and leakage in the model is attained wholly through local inflation (or deflation) and the resulting relative values of flows into and out of the community. The inflation resulting from an increase in Z, for example, will wholly absorb the new revenue from that increase. The nominal value of local purchases will increase, but the actual quantity of goods and services consumed will remain unchanged. At the same time, rising nominal wages (W_i) will increase the value of external purchases, or leakage, thus allowing Z and leakage to balance. Note that this takes place under the assumption of fixed leakage parameters (δ and γ_i). If these parameters are sensitive to local goods and factor prices, then the impact of increases in Z on local prices would be partially offset.

The perfect elasticity and constrained factor supply cases presented above represent two extremes in the characterization of local factor markets. Between these extremes lies a spectrum of possible conditions flowing from different assumptions regarding the elasticity of supply for either capital or labor. In general, the more inelastic the factor markets, the more that local inflation, and not increases in local physical activity, will dominate the process. This can be demonstrated by using a standard “short term” specification in which capital is fixed and labor subject to a positive but finite supply

[2] Agglomeration economies can be viewed as spatially defined, interfirm and intrafirm economies of scale in the production of private and public goods and services. The location of new firms or public investments in a community may have a positive effect (or “externality”) on other preexisting firms and help attract new firms and residents to the locality. Growing population and business activity will likewise allow for economies of scale within individual firms and may prompt import substitution as businesses open that would not be viable at the previous, smaller, community size. The various, and potentially quite complex, interactions involved here are often subsumed under the general heading of agglomeration economies.

elasticity. In other words, the supply curve for capital is vertical and that for labor is upward sloping. Given production technology characterized by convex isoquants, a condition common to Cobb-Douglas and CES functions, labor will be subject to decreasing returns to scale in a fixed-capital environment. An increase in Z will result in an increase in demand for the endogenous composite good X and hence an increase in both the price and production levels for that good (note that opposite but symmetrical results will accompany a decrease in Z). Here, increased production will be achieved through an increase in labor inputs with a concomitant increase in the nominal wage W_L, where the subscript L refers to labor. Assuming perfect competition among firms producing X, the first-order conditions for profit maximization stipulate that $dX/dF_L = w_L$. Moreover, given decreasing returns to labor, increases in X will necessarily result in a decrease in the relative wage w_L; changes in P will exceed changes in W_L. The marginal impact on the multiplier via the relative wage channel (channel 3 above) will thus be negative, as will the impact on the multiplier via the price channel (channel 1). The influence of the factor employment channel (channel 2) will remain unaffected by the supply elasticity of labor, and hence, the more inelastic labor supply the lower the resulting multiplier.

The dampening of the multiplier effect as a result of finite factor supply elasticities also will depend on the elasticity of substitution between factors. High substitution elasticities will result in higher multipliers as local firms are able to substitute relatively more abundant factors for relatively scarce ones. For example, in the fixed-capital specification outlined above, high substitution elasticities between labor and capital will serve to lessen the stringency of the capital constraint. The relation between elasticity and impact multiplier estimates, along with the tendency of partial supply constraints in CGE models to yield multiplier results significantly less than impacts estimated by I-O techniques, has been generally noted in various recent studies incorporating sensitivity analysis in a CGE model framework (e.g., Alavalapati et al. 1998, McGreggor et al. 1996, Waters et al. 1997, Zhou et al. 1997).

This discussion highlights another important point. The multiplier expressed in equation (5) is based on instantaneous derivatives. In situations where nonlinearities are present in the production of X, the derivatives shown in equation (5) will not be constant. Consequently, the multiplier estimates given by the equation will diverge from the actual values depending on the magnitude of the exogenous shock. These nonlinearities may occur as the result of (1) non-CRS technology or (2) factor substitution owing to differential supply elasticities between factors. Agglomeration economies provide an example of the former nonlinearity in which actual multipliers will exceed the linear multiplier depending upon the magnitude of the shock. The fixed-capital scenario given in the previous paragraph is an example of the latter nonlinearity where larger changes in Z will dictate an increasing divergence in multiplier estimates as decreasing returns to labor are manifest. Here, the linear multiplier estimate will exceed the actual impact multiplier. In either case, the multiplier given in equation (5) can be viewed as a linear envelope representing the minimum or maximum possible impact multiplier.

From a theoretical standpoint, the two contrasting extremes in assumed factor elasticity presented above have quite different implications for community impact multipliers and the relation to individual welfare. In the perfectly elastic case, I-O and economic base style linear multipliers are maintained, and, as prices and relative wages are constant, employment and income multipliers will be identical.[3] From a community standpoint, income and employment measures will be maximized relative to more inelastic scenarios, but fixed wages will result in fixed real per capita incomes. Under the simple assumptions of this model (and this is an important caveat), perfect elasticity of factor supplies means that community-level multipliers will have no bearing on individual welfare. In the fixed factor supply scenario, on the other hand, both employment levels and wages relative to the local price will be unaffected by changes in exogenous income. If, however, income is deflated by using national prices, or a weighted average of national and local prices, real wages will change, and income multipliers will be positive in spite of a zero employment multiplier. Local prices will rise proportionate to wage increases, but individual purchasing power for imported goods will increase. Consequently, in this case employment and income multipliers will diverge, and zero local employment multipliers will belie actual changes in residents' welfare.

The result that the perfect elasticity assumption in economic base and I-O models precludes increases in individual welfare in a full employment setting, although perhaps unappreciated, is not surprising. This assumption implies that local factor owners are price takers in their respective factor markets, and scarcity plays no part in the wages they receive. Given a positive exogenous income shock, local increases in aggregate income accrue to new migrants, and, given a negative shock, newly unemployed workers are essentially assumed to disappear from local labor markets. Of course, additional assumptions regarding persistent unemployment, adjustment costs, and the overall effect of economic growth or decline on per capita incomes may be used to surmise individual welfare impacts. These assumptions, however, cannot be directly incorporated into a model with perfect factor supply elasticity and, in fact, run counter to the perfect supply elasticity assumption.

In the above model formulation, the exogenous shock manifested in Z has been assumed to affect local equilibria only through its ability to shift local demand for goods and factors. In a resource-dependent community setting, a shock of this nature is analogous to the opening or closure of a mill in which all labor and capital are imported. In this case, the local supply of factors remains unaffected. Although it is perhaps reasonable to assume that a substantial proportion of manufacturing labor is imported in the smallest communities, larger communities will likely supply much of the necessary labor. Similarly, following a mill closure or other reduction in export manufacturing activity, it is likely that some of the newly unemployed labor will seek other employment within the community rather than out-migrating. As a result, changes in Z may act to shift local labor supply, in addition to its influence on demand, resulting in an impact on labor wages in the endogenous sectors (Ghali et al. 1978, Lutrell and Gray 1970).

This impact will vary depending upon the elasticity of the local labor supply and the substitution elasticity between labor and capital. In the perfect elasticity case (for labor), the pecuniary impact will be nil as wages and prices remain unaffected. In a

[3] This equivalence does not hold for simple I-O models in general, as differentials between wages in different sectors will allow for different responses in employment and income figures. When endogenous sectors are aggregated, as is the case in the current model, the potential for discrepancies between the two measures is lost.

labor-constrained economy, however, the inward shift in labor supply resulting from a change in Z will impact the local economy in a complex fashion analogous to that evident in equation (5) above. Specifically, an increase in Z will result in increased wages but, also, decreased employment in the endogenous sectors. The impact on employment in the endogenous sectors will thus be unambiguously negative, but that upon total nominal income in the endogenous sectors will depend upon the **demand** elasticity of labor. Where the absolute elasticity is greater than one, the result will be an increase in nominal income; an elasticity less than one will yield a decrease in nominal income. Note, however, that changes in the nominal wage will affect the price of the good and thereby the relative wage. This local inflation will, in turn, serve to reduce the local multiplier via the price channel discussed above. An important outcome of this model formulation is that, in terms of employment and even income, a negative relation between exogenous and endogenous activity is a distinct possibility in the presence of constrained factor markets.

As an illustration, consider a small, semi-isolated community with a high propensity to import (low δ) and relatively inelastic factor markets. These two factors will combine to yield a relatively low multiplier even in the absence of direct labor market impacts. Additionally, the opening of a new mill in such a community may serve to draw a substantial number of workers away from their current (lower wage) jobs in the local endogenous sectors.[4] The combined result may well be a net reduction of employment and, possibly, income in the endogenous sectors of the economy, even as wage rates rise. Whether this process is symmetrical, and a mill closure would result in increased employment in the endogenous sectors, is perhaps a little more difficult to explain, but if local labor constraints result in significant unmet local economic opportunities, this result is at least a possibility.

Graphic Exposition

The above arguments can be further illustrated with the help of figure 2. The figure shows changes in production and prices for the locally produced and consumed composite good (identified as "X" in the previous mathematical analysis) under different assumptions about the supply elasticity of that good. The first panel of the figure shows the perfect supply elasticity case. As before, the exogenous shock in aggregate community income can be imagined as a mill opening or expansion in which all additional mill employment is imported. Under the assumption of a static propensity to consume locally (constant δ and γ_i), the demand curves will be symmetric to the origin. The initial production level Q^1 is given by the initial level of local demand and the constant per-unit production cost of X. An increase in exogenous income (ΔZ) will increase demand for the endogenous composite good. The first round of expenditure can be depicted as a shift from D^1 to D^2, the second round as a shift from D^2 to D^3, and the total demand impact from infinite rounds as a shift from D^1 to D^*. Note that these shifts will be homothetic and thus will not alter the shape of the demand curve.

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[4] Wages in services and retail, when viewed in aggregate, are generally lower than those in the manufacturing sectors. This discrepancy is particularly noted in rural, resource-dependent communities. In these communities, resource extraction and processing can often offer wages far in excess of those in other sectors of the local economy, especially in occupations requiring education levels comparable to those needed in the resource sectors (Freudenburg and Gramling 1994, Humphrey 1990).

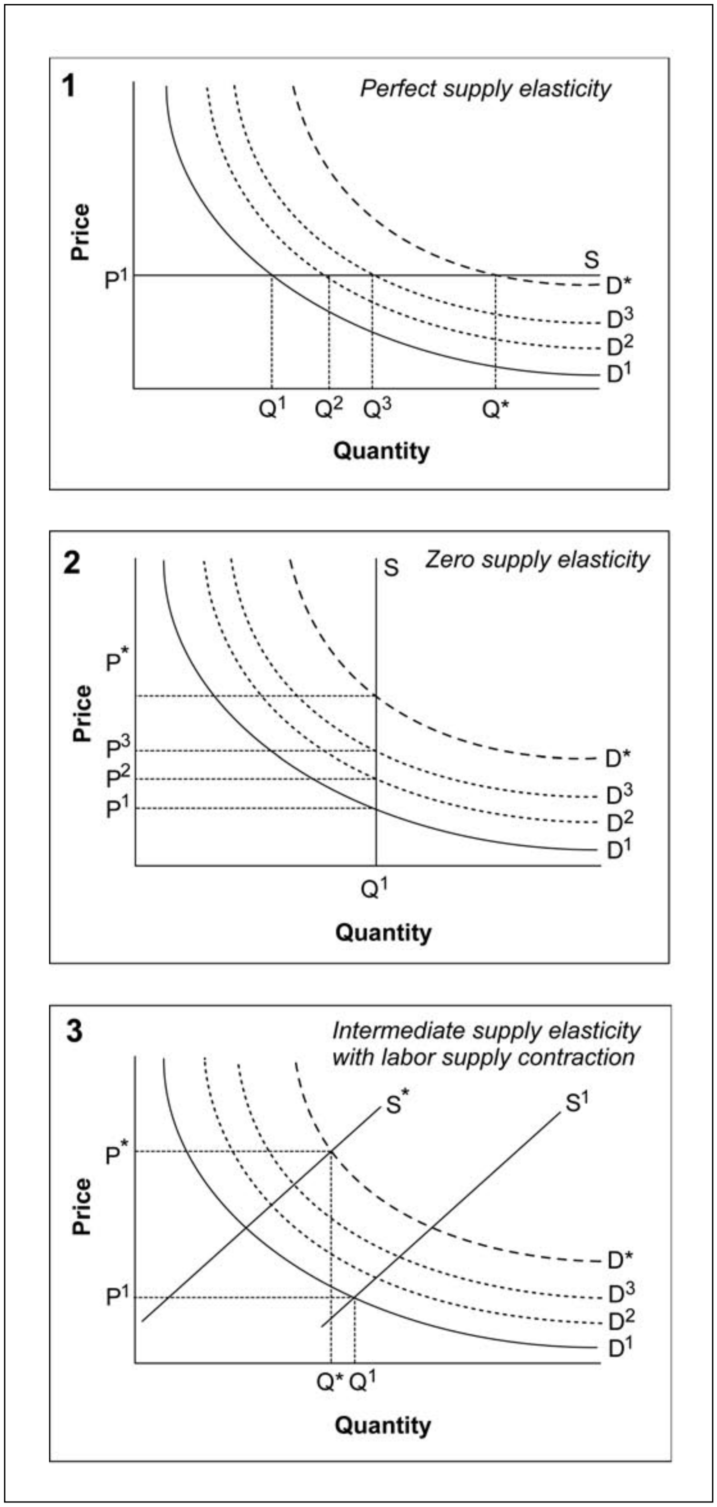

Figure 2—Supply and demand relations for the endogenous (local) composite good.

By eliminating γ_i and letting δ stand for a generalized parameter characterizing the **total** propensity to consume locally, we can describe the changes in the quantity Q of the local good under the perfect supply elasticity case as follows. The production volume increase from Q^1 to Q^2 will be equal to $\Delta Z/P$, that from Q^2 to Q^3 will be $\Delta Z\delta/P$, and subsequent expenditure rounds will entail higher powers of δ. Because $0 < \delta < 1$, the infinite series of expenditure rounds will converge. The total increase is given by:

$$Q^* - Q^1 = \frac{\Delta Z}{P\ (1 - \delta)} \quad . \tag{7}$$

This is analogous to the mathematical expression for dX/dZ under perfect factor supply elasticity given in the mathematical portion of this analysis, except in this case, expressions for the relative wage and marginal factor productivities are omitted. Note that under homogeneous, CRS production technology, the assumption of perfect price elasticity in the supply of the final good is equivalent to the assumption of perfect elasticity in factor supply. A negative exogenous income shock will have an equal but opposite impact on the production of the local good.

The zero supply elasticity case is shown in the second panel of figure 2. This would be consistent with a local economy with full employment of all factor inputs and in which additional factors are unavailable through, for example, inmigration or capital imports. In this case, the shift in demand is identical to that in the perfect elasticity case. Production levels of the local consumption good, however, will be fixed at Q^1 by local factor supply constraints, and the shock will manifest itself wholly in the increase in the price of the local good. Price increases will be symmetric to the production increases in the perfect elasticity case, except Q now replaces P in the denominator (e.g., $\Delta Z/Q$ for the shift from P^1 to P^2).

Because, under perfect competition, revenues will be exhausted in factor payments, changes in wages will be proportional to changes in the price of the consumption good. The purchasing power of residents in terms of the local consumption good will thus remain unaffected, but their purchasing power in terms of outside goods and services will increase.

A final case to be considered is that where the supply elasticity of the local consumption good is nonzero but finite and where the increased activity in the export sector is able to bid workers away from the endogenous sector. This is shown in panel three of figure 2. This case is analogous to the opening or expansion of mill activity where mill wages are significantly higher than wages in local services or retail sectors. The consequent shift of labor to the high-wage export sector results in a contraction in the supply of labor available for the production of the local consumption good from S^1 to S^*. The impact of the exogenous shock to demand is identical to that in the two previous cases. Without the labor supply contraction, the intermediate supply elasticity for the local consumption good yields increases in both quantity and price, but these increases are smaller than those encountered in either of the boundary cases depicted in panels one and two. The degree to which price changes or quantity changes dominate will be directly dependent upon the supply elasticity of the local good. With the incorporation of the labor supply contraction, however, the price response is enhanced and the quantity response dampened. Given relatively inelastic supply and a sufficiently large supply contraction in labor available to the endogenous sector, the change in quantity may in fact be negative, as depicted in the figure. Note that this decrease will be accompanied by a decline in employment in the endogenous sector.

The foregoing discussion highlights the key role played by price elasticities for the supply of productive factors and, thereby, final goods in determining the nature and magnitude of the response in the endogenous sectors to an exogenous income shock. These elasticities will, in turn, be directly related to the supply and cross-substitution elasticities of factor inputs. High factor-supply price elasticities will allow for an elastic response in production quantities, and high substitution elasticities will allow local producers to favor the most elastic factors. In the case of perfect supply elasticity, changes in quantity are wholly determined by changes in demand. Consequently, models that embody this assumption are commonly termed "demand-driven" models. Fixed-price I-O models and economic base models are conventionally of this type.

Extensions of the Model

The discussion of general equilibrium models so far has concentrated on factor markets and their impact on multipliers in an extremely simplified local economic system. The model presented in figure 1 includes various sectors and monetary flows that have not yet been explicitly addressed. Depending on the response of these additional elements to an exogenous change in Z, the magnitude of the multiplier will vary. It is possible that certain relations will serve to mitigate impacts and others will serve to magnify them. These relations will be discussed generally below. It is not the purpose here to develop a thorough analytical exposition of these additional general equilibrium elements but merely to enumerate a set of conceptual and analytical issues that should be considered in impact assessment in general. In particular, these issues will be important in the empirical case study that is developed in chapter 4.

In figure 1, there are two additional sources of exogenous income: unearned income, and exports by the small-capital sector. Both of these may be expected to vary in the face of a change in manufacturing exports. Depending on the income maintenance component of unearned income (i.e., welfare and unemployment insurance), movements in this income category may run counter to those in manufacturing exports. Reductions in resource extraction and processing may result in increased unemployment benefits and related payments, which will mitigate secondary impacts. At the same time, however, to the extent that unearned income is tied to total population (or, more specifically to retirees), the linkage between resource sector activity and this income source may be weakened or even reversed. This is especially true if amenities are a driving force in attracting new residents with nonwage incomes to the community, and if these amenities are subject to negative externalities from resource extraction and processing activities. Additionally, local price changes, particularly lower prices in the real estate markets, may attract new residents who rely on unearned income. This could serve as a countervailing influence to negative shocks in the export sector, which tend to depress local prices.

Activity in the small-capital export sector will be subject to similar influences as well as various dynamics associated with factor markets. Here, this sector is assumed to be composed mostly of tourism-related enterprises or small firms and individuals engaged in the export of services or manufactures of high value-added content. Telecommuters and other individuals producing information products are the quintessential example of this latter category. Natural amenities may be extremely important in attracting both tourism and small firms and individuals engaging in service exports and similar activities (Beyers and Lindahl 1996). Local real estate prices may likewise be important.

Also, where agglomeration economies apply, changes in resource sector activity may be positively correlated with changes in the small-capital export sector by virtue of their impact on total local population and income. Additional impacts to the small-capital sector may result from the changing availability of local factors, especially labor. In a process which is analogous to the so-called “Dutch disease” in the international development literature (Sebastion and Wijnbergen 1989), increases in timber activity, for example, will tend to draw labor away from the small-capital sector, particularly employees engaged in lower wage services in tourism. In fact, Freudenburg (1992) has noted the tendency of residents in resource-dependent communities to use low-wage service sector employment as a partial means of adapting to cyclical employment changes in the resource sector. Changes in the small-capital export sector resulting from a shock to the resource sector will, of course, act to either magnify or mitigate the total impact on the local economy and thus the impact multiplier.

The propensity to spend locally (δ) and the local share of factor ownership (γ_i) also deserve discussion. In the foregoing model, these variables were assumed to be known and constant. In the face of substantial changes in the demand for local goods or factors, however, it is reasonable to assume that these variables also change, thus damping price movements. Consequently, rather than being manifest in price changes, the local income and employment effects of an exogenous shock may be ameliorated through adjustments in imports and savings, or through changes in the local share of factor ownership. Consider, for example, a new mill opening in a small community. In the absence of sufficient local labor supplies, it is likely that the mill will import much of its labor, thus decreasing the share of local factors in the export manufacturing sector. Likewise, increased consumption on the part of previous and new residents will likely be met by an increased share of direct imports of goods and services rather than by local price inflation (although housing markets may constitute an important exception). And finally, increased incomes may result in increased savings rates, especially if local opportunities for spending remain curtailed.

In the face of a mill closure, an opposite process may take effect. An especially important effect, in this case, may be the reduction in the savings rate as residents tap their savings in order to maintain consumption in the face of falling incomes. Here, it is also possible that certain newly unemployed residents will use a portion of their savings to launch new business ventures in either the small-capital export or endogenous sectors. Remodeling one’s home with self-labor and starting a bed and breakfast would be a concrete and perhaps not uncommon example of this.

In the foregoing examples, the effect of changes in the parameter values for δ and γ has been opposite to that of the exogenous shock. The presence of agglomeration economies, however, would allow for a reinforcing effect; an increase in total community employment or income through increased resource-related exports could enhance opportunities in the endogenous sectors. The resulting import substitution would tend to further increase the local multiplier effect via an increase in δ. This is, in fact, the reasoning that underlies the common assumption that larger economies generally exhibit lower propensities to import. The opposite result would pertain in the case of resource sector declines in communities characterized by agglomeration economies, where small retail and service businesses may close resulting in an increased community dependence on imported goods and services.

Factor Markets, Dynamic Adjustments, and Small Communities

Much of the discussion and analysis in this section has focused on the question of the structure and response of factor markets in small communities, and the ramifications of such responses within different modeling contexts. The importance of the assumption of perfect elasticity of factor supply in the economic base and I-O models will be highlighted in subsequent sections, and the results of relaxing this assumption were analyzed in a general equilibrium setting in this section. Both from a theoretical and a common sense standpoint, factor supply elasticities, particularly that for labor, will have an important influence on the economic impact process and its related multiplier, but what evidence is there regarding the nature and magnitude of these elasticities?

Unfortunately, the empirical evidence related to the dynamics of labor supply at small spatial scales is sparse to nonexistent. In most cases, perfect elasticity is assumed a priori as a step to subsequent analysis. This assumption is often justified based on the small size of the region or locality relative to the economy as a whole—smaller units are then seen as price takers unable to affect the large markets in which they sell their goods or obtain their inputs. In regions characterized by relatively developed road networks and population density, initial labor market adjustments can be attained through changes in commuting patterns. The actual labor market may extend well beyond the boundaries of the community under analysis, and an essential element in the local endogeneity used to define economic community, namely the linkage between local employment and local spending, is diluted. In more isolated communities, however, daily commuting becomes less of an option, and the linkage between local residence and employment is enforced (at least for extended stays on the part of workers if not permanently). Labor migration, and not commuting patterns, becomes a key factor in attaining labor market equilibrium in this setting.

Few would argue that either commuting patterns or, especially, net migration allow for immediate adjustments in labor supply in order to attain perfect elasticity. Rather, these processes are assumed to occur over time. Given a sufficient time lag for adjustment, the assumption of perfect factor supply elasticity becomes much more plausible. In capital markets this idea is commonplace, being addressed through the context of short- and long-run adjustments. In labor markets, demographic adjustment in the form of net migration is the most common vehicle. In both cases, an explicit mechanism for adjustment over time may be specified. Two general approaches are common in the literature.

In the first, price adjustments allow for continuous equilibrium, and these prices then become signals for flows of factor supplies into the local economy. Spatial isolation, which may entail both substantial adjustment costs and information barriers can be summarized in a general parameter termed friction. In labor markets, friction will reduce adjustment rates through both the costs incurred in moving and the fact that potential workers may well be ignorant of opportunities in distant markets. In generalized functional form, this adjustment process can be specified for labor as follows:

$$L_t^S - L_{t-1}^S = \eta f\left(W_{t-1} - W_{t-1}^*\right) \qquad f' > 0; f(0) = 0; 0 < \eta < 1 \quad , \tag{8}$$

where

L^S is local supply of labor,

W is nominal wage,

$W*$ is long-term equilibrium wage, and

η is inverse parameter measuring friction.

Note that when $W = W^*$, net migration is zero. The equilibrium wage, W^*, is the wage rate at which individuals are indifferent between working within the community or outside of it. Consequently, W^* will be closely related to wages prevailing in other regions, although compensating wage differentials may arise owing to disparities in amenities between locations (Greenwood et al. 1991, Mathur et al. 1988). Equation (8) stipulates that the shift in local labor supply from one period to the next will be a positive function of the differential between current and equilibrium wages in the previous period. This function is, in turn, scaled in inverse proportion to the amount of friction, or isolation, prevailing in the community. The lower the value for η (i.e., the higher the amount of friction), the longer it takes for labor markets to reach their long-term equilibrium.

The second approach assumes price stickiness and therefore disequilibrium in factor markets. The difference between actual rates of employment and desired rates of employment, **at the current wage**, becomes the signal driving changes in employment in subsequent periods. Mathematically:

$$L_t - L_{t-1} = \eta f\left(L^*_{t-1} - L_{t-1}\right) \qquad f' > 0; f(0) = 0; 0 < \eta < 1 \quad , \tag{9}$$

where

L is actual labor employed in the endogenous and small-capital export sectors, and

L^* is desired, or optimal, level of employment at the prevalent wage.

Here, shifts in actual employment rather than labor supply are modeled. Although it is probable that the short-term wage and price fluctuations needed to obtain adjustments through equation (8) are active to some degree in small economies, price stickiness and adjustments via equation (9) would seem more likely to dominate.

The form of the adjustment mechanism and the value of the friction parameter will have important implications for both the lag time needed for local multipliers to manifest themselves and, under certain conditions, for the eventual magnitude these multipliers attain. Note that each specification posits local demand as the driving force in changing labor migration; increased labor migration as a result of, for example, local amenity-based attractive factors is largely ignored (although it may be incorporated in W^* in equation [8]).

Given a disequilibrium model of adjustment (equation [9]), continued economic growth in a region or locality will indicate chronic shortages of labor, as unfilled employment opportunities signal migration consecutively over a number of years. Long-term decline will indicate local labor surpluses, which may be measurable in the form of elevated local unemployment levels. The influence of friction on these processes, however, may be asymmetrical, as there is no reason to assume that the ability of firms to attract new workers in a growing economy will mirror their propensity to lay off redundant employees in a shrinking economy. This may be particularly true in the case of smaller firms in the endogenous and small-capital export sectors. These firms may not have the resources to recruit new workers in the face of excess labor demand but will nonetheless be forced to reduce employment in times of economic hardship.

To provide a concrete example of this adjustment process, consider a community experiencing steady increases in exogenous income from nonmanufacturing sources (e.g., unearned income and tourism) and a one-time decrease in manufacturing income from, say, a mill closure. This example foreshadows actual events considered in the case study presented in the next chapter. The increase in nonmanufacturing income will result in a local economy characterized by persistent unmet opportunities for employment in the endogenous and small-capital export sectors. In the absence of the manufacturing shock, local employment and income will demonstrate a steady upward trend whose magnitude depends, subject to equation (8), on the difference between actual and optimal employment in the community and on the friction parameter. Steady increases in L^* will be the driving force behind this increase. The mill closure will result in a decline in exogenous income, and thus a one-time negative impact to L^*. The result will be a temporary departure from the community's prevalent growth trend, the duration of which will depend on η and the functional form of the adjustment function. At the same time, if the labor released from manufacturing is able to avail itself of unmet opportunities in the nonmanufacturing sector, the impact also will have a positive influence on current employment (L) in these sectors and thus result in a further reduction in the excess demand for labor.

Over time, the impact will incrementally approach the difference between L^* and the L^* that would prevail in the absence of the shock. This difference is equal to that which would be obtained under perfect labor supply elasticities and is thus theoretically equivalent to the impacts given by either an economic base or I-O prediction. The adjustment may take considerable time, however, and owing to the possibility of labor mobility between manufacturing and nonmanufacturing sectors, the initial impact of the negative shock in export manufacturing on other sector employment relative to the trend may, in fact, be positive. The backlog of unmet opportunities in the local economy, in effect, provides a buffer that mitigates the initial shock. Friction in the local economy acts to both increase this backlog in a growing economy and to extend the time it takes for the one-time shock in export manufacturing employment to reach its full multiplier impact.

From a theoretical standpoint, this presents no difficulties for models based on perfect factor supply elasticities. Indeed, I-O and economic base model applications are usually at pains to point out that their results indicate an equilibrium impact occurring at some (usually unspecified) time in the future. From an empirical standpoint, however, the effect is to significantly muddy the relation between changes in local manufacturing activity and local activity in other sectors. This is especially true if the economy is subject to additional shocks, both positive and negative, in the intervening years between the initial shock in question and the assumed time of total adjustment. Here, the effect of increased lag time is to reduce the signal-to-noise ratio emanating from the initial shock.

Moreover, with increased lag times for impacts to manifest themselves, the structural parameters used in the initial impact estimation will have a greater tendency to change. Growing localities subject to agglomeration economies, for example, will likely experience a decreasing propensity to import over time. Local shares of factor ownership may likewise change. And finally, a host of factors not incorporated in the models assessed above may be subject to increasing change over time, factors such as the regional investment climate and the perceived attractiveness of local amenities.

All these elements will conspire to reduce the accuracy of impact estimates assumed to obtain in future time periods. From a practical standpoint, estimates become increasingly meaningless with the amount of lag time they are assumed to require, and this is especially true if the time path deviates from a standard path involving larger impacts in initial periods followed by generally declining impacts in subsequent periods. Consequently, in growing economies characterized by short-term labor constraints and relative isolation, impact estimates based on the assumption of perfectly elastic long-term factor supply and stable structural parameters may have little relation to the actual impacts experienced by the community in question. In declining economies where, on the other hand, labor is relatively unconstrained, economic base or I-O impact estimates may better approximate short-term impacts. In this case, however, the reinforcing effect of general investment pessimism may further exacerbate impacts in the instance of a negative shock and dilute positive impacts in the face of a positive shock.

Economic Base and Input-Output Models

Economic base models and fixed-price I-O models have been referred to numerous times in the preceding sections, particularly in reference to the crucial role played by the assumption of perfect elasticity in factor supply. The static and necessarily positive multipliers (actually, greater than 1 in the common total impact multiplier formulation) that result from these models can be viewed as a formal expression of the economic base hypothesis and are thus of central concern to this study. In this section, economic base and I-O models are examined in detail, along with the necessity of the assumption of perfect supply elasticities.

Economic Base Models

One of the oldest and simplest ways of conceptualizing the workings of a regional or local economy is the economic base model. The model has its roots in the field of urban and regional planning and was first explicitly formulated by various analysts in the 1920s (Andrews 1953). Owing, no doubt, to its simplicity, intuitive clarity, and ease of use, the model has survived in certain academic and practical applications in spite of numerous criticisms and acknowledged theoretical shortcomings.

The core of the model involves the division of local economic activity into (1) a "basic" sector, which acquires income from outside sources, and (2) a "nonbasic" sector, in which money received in the basic sector is spent locally in successive rounds of expenditure. The traditional emphasis is on manufacturing for export; for example, a portion of the basic income generated through sales of locally produced lumber to outside markets will be spent by the mill and its employees for other local goods and services. A portion of this income generated in the nonbasic sector will also, in turn, be spent within the local economy, fostering additional nonbasic employment. With each successive round of expenditure, however, a certain amount of income will "leak out" of the economy in the form of savings and imports from other localities. The total ratio of nonbasic to basic activity will thereby be limited to a finite number, which depends on the propensity of local economic actors to save and to directly import outside goods and services. Additionally, local value-added content and the leakage resulting from local firms purchasing outside factor inputs and intermediate goods need to be considered. Taken together, these forms of leakage are analogous to the leakage terms (δ and γ_i) discussed in the context of the general equilibrium model above.

In this fashion, the dependence of the nonbasic sector on the basic sector is established. This dependence is often summarized in the form of an impact multiplier, which measures the total cumulative effect of a change in basic activity on nonbasic activity, and thereby total economic activity. Within the economic base theory, a common way to derive this multiplier is to assume a constant ratio between basic and total employment (termed the "base ratio"). Changes in basic activity will then, by assumption, result in proportional changes in nonbasic activity, and community totals can be calculated accordingly. Mathematically, this can be expressed for employment as follows:

$$r = \frac{B}{T} \quad , \tag{10}$$

where

B is basic employment, and

T is total employment.

The base ratio, r, is assumed to be constant for each region or locality. By partitioning T into its basic and nonbasic (the residual) components and rearranging terms, we obtain:

$$NB = \frac{(1-r)}{r} B = mB \quad . \tag{11}$$

Equation (11) asserts that nonbasic employment (NB) will be a linear function of basic employment according to the impact multiplier m. In this case, m is wholly determined by the base ratio and constitutes a convenient way of summarizing the linkages between endogenous economic activity and exogenous sources of income. Impact multipliers of this sort often will play a key role in estimating total regional or local economic impacts from policy decisions or other exogenous influences.

It is important to note that the multiplier in equation (11) measures the impact on nonbasic activity and not total activity. It is common practice in reporting multipliers to include the **total** impact of the exogenous shock. This multiplier is equivalent to $1 + m$. In the following discussion and in the empirical analysis in the next chapter, it is convenient to report multipliers solely in terms of their impact on the endogenous sectors. To differentiate between the two types of multipliers, where necessary the endogenous sector multiplier (m) will be termed the "partial multiplier," and that for total impact ($1 + m$) will be termed the "total multiplier." In general, however, this terminology will be suppressed, and the reader can assume that partial multipliers are being referenced.

The general equivalence between the economic base formulation and the perfect factor-supply elasticity case for the general equilibrium model presented above now can be evaluated. First note that the general income identity shown in equation (1) implies a constant base ratio in income terms (i.e., the ratio between Z and PX). This is obtained through the identity between Z and leakage in combination with the assumption of fixed leakage parameters (δ and γ_i). In the imperfect factor-supply elasticity case, however, equilibrium will be partially obtained through local inflation depending on the factor input and cross-price elasticities. Consequently, the economic base ratio will be maintained in income, but not in terms of physical production or employment. Additionally, in the presence of sticky prices, the base ratio will change in terms of both income and employment. Depending on the magnitude of the shock, impacts will increasingly diverge from those predicted under the constant base ratio. The linear base multiplier m is thus invalidated as an impact estimator in all but the perfect elasticity case.

Other formulations of the economic base multiplier exist, most of which also assume a constant base ratio and are thus algebraically equivalent to that presented above. Tiebout (1962) presents a somewhat different formulation relying on the propensity of economic actors to consume locally and the local income generated per dollar of local sales (essentially local value added). In difference form:

$$\Delta T = \frac{\Delta B}{1 - (pq)} = m^*\Delta B \, , \tag{12}$$

where

p is propensity to consume locally, and

q is amount of local income generated by a dollar of local sales.

Taken together, p and q measure the leakage in the local economy resulting in each successive spending round. If these variables are constant for a given community, then, in theory at least, $m + 1 = m^*$, and the base ratio of equation (10) becomes simply an empirical description of the behaviors modeled by p and q. Tiebout, however, allows for the possibility that p and q may vary in response to changes in B. Specifically, agglomeration economies and import substitution may allow for increasing values of both p and q with increasing community size. This is in keeping with the common belief that multipliers are higher for larger settlements. Exogenous changes in the demand for goods produced by the basic sector will thus result in changes in the rate of leakage via p and q, and the impact multiplier will no longer be linear. This is obviously a different, and more complex modeling approach than that entailed in the assumption of constant base ratios.

Tiebout uses the economic base formulation in equation (12) to explicitly focus attention on the sources of income leakage, but he offers no advice as to how to measure and incorporate the relation between p, q, and community size in an economic base framework. The fact that multiplier estimates vary with community size is well noted (Olfert and Stabler 1994), but this is seldom used to adjust multiplier estimates for a specific community. Critically, in other studies involving the economic base model, the assumption of a linear multiplier, and thus a constant base ratio, is almost universal (see Mulligan and Vias 1996 for an exception). In fact, the constant base ratio and the linear impact multiplier are essentially synonymous with the economic base model in the minds of many economists.

Given its focus on exports and the base ratio, the split of local economic activity into basic and nonbasic categories becomes a key concern (Gerking and Isserman 1981). Survey techniques, in which the sales of local firms to local and nonlocal customers are directly measured, are commonly regarded as the most desirable, but resource constraints often prohibit their use (Robison et al. 1993). Several nonsurvey techniques exist for delineating basic and nonbasic activity, and their use often extends to other modeling approaches, such as I-O, where exports and local consumption need to be identified.

The simplest technique (and one that cannot be applied to I-O) is the assignment method in which entire economic sectors are assigned to either the basic or nonbasic categories. The most common approach is to broadly designate manufacturing, resource extraction, agricultural production, and federal government expenditures as basic and the remainder as nonbasic, while making allowances for idiosyncrasies in the structure of local production or consumption. Whereas, lumber employment or its related wage income, for example, would be designated basic under the assumption that all local lumber production is sold in outside markets, local barbershops would be designated nonbasic under the assumption that they cater only to local customers.

The possibility that a portion of local production of manufactured goods or other products identified as basic are actually consumed locally is ignored in the assignment technique. Several other approaches have been devised to incorporate this possibility, the location quotient and minimum requirements techniques being chief among them. In the former, a reference economy (usually the entire nation or some broad regional aggregate) is used to gauge the general propensity of the population to consume a given product. This can be measured by the share of a given sector's employment or income relative to the total employment or income of the reference region. If a given subregion or locality demonstrates a higher (or lower) share in a certain sector than the reference region (measured by the "location quotient," or the ratio of the local share to the reference share), then the locality is assumed to export (or import) that sector's products in proportion to the location quotient. The minimum requirements technique uses a similar approach, but the reference becomes the lowest sector share found in a relevant sample of multiple regions or localities.

The location quotient and, to a lesser extent, minimum requirement approaches to delineating export and local activity have been quite popular in relation to the economic base model. They also may be used in I-O model applications to adjust the technology matrix (see explanation below) to account for local and outside purchasing propensities on the part of firms and consumers. There are, however, several serious problems entailed in the use of these techniques. The first is that they are extremely sensitive to the level of sector aggregation used in the analysis. Second, they ignore the existence of cross trade in which localities may simultaneously import and export similar goods and services. This latter problem is particularly pronounced at smaller spatial scales. A timber mill town, for example, will likely export all of its lumber production and rely solely on imports for local consumption. A location quotient approach, however, will assume that, if mill production is sufficiently large, all local consumption is met by local production. Robison and Miller (1988) provide a useful discussion of cross trade in a regional economics setting along with an estimation of the errors associated with common nonsurvey techniques. They conclude that location quotient and similar techniques should not be used for smaller spatial units such as counties or rural municipalities.

Studies comparing location quotient assignment methods with actual survey data have found a tendency on the part of the location quotient method to substantially underestimate the export component of local production, resulting in an overestimation of local impact multipliers when using the economic base model (Gibson and Worden 1981, Tiebout 1962). An additional point, important in the empirical analysis in chapter 4, is the fact that location quotients or similar techniques cannot be used to construct time series variables in order to measure impact multipliers or test for the stability of the relation between basic and nonbasic activity—a point easy to demonstrate mathematically but which has been missed in several previous studies.[5]

Although much of the focus in the development and application of economic base models has been on manufacturing and related industrial production for export, the inclusion of nontraditional income sources in the model presents no theoretical challenges. Tourism income, retirement benefits, etc., can be relegated to basic categories via the assignment method or some other approach, and the multiplier calculated accordingly (Nelson and Beyers 1998b). There are several practical challenges, however. In the first place, sectors associated with nontraditional income sources will seldom be clearly identified. Tourism activity, for example, is spread across a broad range of local retail and service sectors. Secondly, unearned income will, necessarily, be measured in dollar terms rather than jobs—the measure most common in more traditional applications of the economic base model (see Mulligan 1987 for an example of the conversion of transfer payments into employment equivalents for use in an employment economic base model). Lastly, the inclusion of dividends, interest, and rent in the analysis calls into question the spatial distribution of ownership of financial and investment instruments and the methods used to allocate flows in these nonwage income categories to basic and nonbasic divisions.

Perhaps the greatest shortcoming of the economic base model is its lack of a firm theoretical foundation (Nijkamp et al. 1986). The model contains no postulates of market or individual behavior over time that would justify the assumption of a stable base ratio and the assertion that this ratio provides a useful approach to analyzing and predicting behavior in local economic systems. As was shown, a stable base ratio can be obtained in a general equilibrium model under the assumption of perfect elasticity of factor supplies, but the economic base model itself cannot address these issues. In practical application, on the other hand, the economic base model has certain strengths, not the least of these being its simplicity and ease of application to empirical data. Consequently, the model still maintains a persistent presence in the academic literature (e.g., Mulligan and Vias 1996, Nelson and Beyers 1998b, Olfert and Stabler

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[5] A standard location quotient approach uses total local employment times the ratio of national employment in a given industry to total national employment to derive an estimate of local consumption requirements. Mathematically:

$$RE_{iR} = TE_{TR}(E_{iN}/E_{TN}) ,$$

where

RE_{iR} is required employment in industry i in region R,

TE_{TR} is total employment in R, and

E_{iN}/E_{TN} is the ratio between national employment in i and total national employment.

Local employment in i that is in excess of the required employment is then designated as export-oriented, or basic. If local employment is less than the requirement, all employment in that industry is designated nonbasic. This technique introduces an algebraic relation between basic and nonbasic employment that will systematically bias statistical tests based on time-series data. For example, an exogenous reduction in a given basic sector will result in a contemporaneous and compensating change in the basic component of other sectors and a concomitant reduction in the nonbasic component of these sectors.

1994). The shortcomings of the model are often alluded to, but it is claimed that the practical benefits outweigh these shortcomings. In particular, the appropriateness of the model for less developed, sparsely populated regions is often noted (Gibson and Worden 1981, Mulligan 1987). This assertion will be examined in greater detail below.

From a practical standpoint, however, the influence of economic base theory in political debates and general public perceptions of impact processes far exceeds whatever weight the theory may, or may not, carry in academic circles. The economic base model provides a simple but compelling depiction of the workings of a local economy, and discussions of a community's economic base and its associated multiplier are now commonplace. Moreover, the model provides a set of explicit, testable hypotheses that can serve as a starting point for the empirical analysis of local impact processes. In particular, the concept of an impact multiplier and its relative magnitude is a useful concept around which to organize empirical analysis even if the underlying assumptions of the economic base model are found to be invalid.

Input-Output Models

Input-output models constitute another popular method for estimating economic impacts. With recent expansions in computing power and the availability of "canned" computer programs such as the USDA Forest Service's IMPLAN model (Alward et al. 1989, McKean et al. 1998), the application of I-O techniques in settings where limited resources and expertise would have proscribed their use in the past has now become commonplace. Consequently, although the economic base model provides a simple but pervasive conceptual foundation for understanding economic impact processes at the regional and subregional scale, the I-O model has become the most common tool in providing actual estimations of these impacts. Miller and Blair (1985) provide a comprehensive description of I-O models, innovations, and related techniques.

Although arising from a somewhat different economic tradition, I-O models have much in common with economic base models. Precursors of the model can be traced back to the early 18th century (Hewings and Jensen 1986), but it is widely agreed that the work of Leontief around the middle of the 20th century provided both the theoretical foundation and compendium of practical techniques thtat underlie current I-O techniques (Leontief 1951, 1953). As shown below, the similarities between the fixed-price I-O model and the economic base model lie in the implicit assumption of perfect elasticity in factor markets and their resulting linear impact multiplier. The I-O model, however, describes local economic interactions at a much higher degree of disaggregation and complexity (see Billings 1969, Romanoff 1974 for discussion of the mathematical identity of multipliers derived from these two models). Rather than divide the economy into two sectors (i.e., basic and nonbasic), the I-O model can consider multiple sectors, with the availability of data being the primary constraint. As in the economic base model, the core function of an I-O model used in impact estimation is to determine the level of activity generated throughout the economy as a result of a change in final demand in a single sector or related set of sectors. However, now the purchases that constitute each successive round of spending are mapped through a network of inter-industry and resident propensities to consume rather than a simple relation between two sectors. Mathematically, this process can be expressed as follows[6]:

$$X_{ij} = A_{ij} X_j \,, \tag{13}$$

[6] The following exposition closely follows Alavalapati et al. (1998), although similar formulations can be found in most texts describing I-O modeling procedures.

where

X_j is output (usually expressed in dollar terms) in industry j,

A_{ij} is amount of industry i's output required to produce a single unit of X_j, and

X_{ij} is total amount of output purchased from industry i by industry j to produce X_j.

Equation (13) thus provides an expression for specific product pairs entailed in intermediate demand relations. Final demand for the output of each industry (Y_j) is given by:

$$D_j + E_j - M_j = Y_j \ , \qquad (14)$$

where D_j, E_j, and M_j are domestic demand, exports, and imports of j (in practical application a more disaggregated description of demand, including government and investment expenditures, is common). A market clearing condition, which requires output in a given industry to equal final and intermediate demand, is then specified:

$$X_i = \sum_{j=1}^{n} X_{ij} + Y_i \qquad i = 1,2,...,n \ . \qquad (15)$$

By substituting X_{ij} from equation (13) into equation (15) and using matrix notation, we obtain:

$$\mathbf{X = AX + Y} \ . \qquad (16)$$

This can be rearranged as follows:

$$\mathbf{X = (I - A)^{-1} Y} \ , \qquad (17)$$

where **I** is the identity matrix. The matrix **A**, often referred to as the technology matrix, describes the flow of intermediate goods and services in the economy. Each element of the inverse matrix, $\mathbf{(I - A)^{-1}}$, gives the total amount of intermediate inputs of type i directly and indirectly required per unit of delivery to final demand of output in industry j. Column sums of this matrix will yield a total impact multiplier describing the aggregate impact across all sectors i per a unit change in final demand for a specific j. As it stands, however, equation (17) does not explicitly incorporate leakages (via imports), which are important in the small, open economies that characterize rural regions and communities. With the inclusion of a matrix description of import shares in total demand (**U**), the core equation of the I-O model can be written as follows:

$$\mathbf{X = (I - (I - U)A)^{-1} Y} \ , \qquad (18)$$

In the model's standard formulation, the elements of the matrices **A** and **U** are static. Consequently, the inverted matrix $\mathbf{(I - (I - U)A)^{-1}}$ provides a linear transformation of changes in the final demand vector **Y** into changes in the sector output vector **X**. This transformation, in turn, can be viewed as a multivariate analogue of the economic base model's linear impact multiplier (see Romanoff 1974 for a demonstration of the limited equivalence of the two models). An important difference between the two models, however, is that the I-O model does not explicitly differentiate exogenous (basic) and endogenous (nonbasic) sources of income. Rather, the question of exogeneity is addressed in the construction and manipulation of the final demand vector. A standard approach, for example, is to model an exogenous shock generated by export demand as a change in the appropriate element in the vector **Y**, and then recalculate the resulting changes in **X**, the sum of which yields a simple scalar multiplier that estimates the total expected impact of the exogenous shock on the economic system being modeled.

The issue of model closure, or determining which economic elements are incorporated in the inverse matrix and which are relegated to the final demand vector, is an additional factor in I-O models that is not explicitly addressed in economic base theory. In early applications of the model, the elements of the technology matrix were largely restricted to interindustry relations, and the behavior of households, government, and other nonindustrial sectors of the economy was incorporated only in the final demand vector. These models, in other words, "closed" on the industrial sectors and treated the other sectors as exogenous to the model. In these formulations, secondary impacts were limited to the "indirect" impacts resulting solely from the purchases of firms.

There is, however, no theoretical barrier to the incorporation of households or other nonindustrial sectors in the technology matrix. More recently, expanded I-O models that close on households and local government have become increasingly common, yielding income-induced (or simply "induced") impacts in addition to direct and indirect impacts. In fact, the I-O model provides a particularly flexible accounting framework for internalizing various sectors and economic actors, a flexibility that is amply demonstrated in the plethora of extended I-O modeling approaches evident in the literature, which have been broadly labeled as social accounting matrices, or SAMs for short (Pyatt and Round 1985, Robison 1997, Rose et al. 1988). Within the broader SAM framework, nontraditional income sources such as transfer payments and investment income can be easily incorporated into regional or local models (see Robison 1997 for an example).

One of the principal difficulties in applying I-O modeling techniques in a regional setting is directly obtaining all the data necessary to construct the technology and import matrices **A** and **U** (or, as is commonly the case, a single matrix that combines **A** and **U** describing **regional** accounting flows between sectors). Given n sectors, the analyst will have to compile n^2 elements. Although direct surveys are recognized as the most reliable way of constructing regional I-O tables, the cost of such an approach is often prohibitive, particularly in the case of smaller regions or communities.

An alternative approach is to adjust national I-O technology matrices to fit the regional or local economic structure. Various techniques exist for accomplishing this adjustment (see Richardson 1985 for a survey; and Comer and Jackson 1997, Robison and Miller 1988 for a specific application). In general, those techniques that bring the most region-specific information to the problem, including those that use local survey techniques to support and augment adjustments to national coefficients, are deemed superior (Richardson 1985). At the same time, however, the difficulty and the variety of approaches entailed in accurately adjusting all the intersector flows in the model remain important shortcomings. In practice, many of the technical problems and data issues are either approximated or suppressed. Most practical I-O analyses are one-time studies, and many use ad hoc and poorly documented adjustment techniques with no validation or prospect of replication. It is impossible to subject these studies to any sort of rigorous analytical evaluation or critique. This problem is further compounded by the computational complexity of the model (large inverted matrices do not lend themselves to easy interpretation), and the usual absence of other, external reference points such as multiplier estimates obtained through alternative techniques.

The specification of a fixed technology matrix in the fixed-price I-O model implies certain assumptions about "average" production technologies and the availability of productive factors. It is this facet of the model that has come under the greatest criticism. Although certain production technologies have been proposed in order to ensure the fixed proportion of inputs implied by the static technology matrix (Alavalapati et al. 1998, El-Hodiri and Nourzad 1988), it can be shown that fixed proportions are consistent with a number of production technologies as long as the supply of productive factors is perfectly elastic. This results in fixed prices for factor inputs and, under homogenous production technology, a fixed technology matrix.

Another important aspect of the I-O model is its overall static nature. The static technical coefficients discussed in the previous paragraph represent a snapshot in time of the modeled economy. The standard I-O approach then projects this snapshot onto an alternative exogenous framework (i.e., the altered final demand vector) to obtain an impact assessment assumed to be manifest at some indeterminate future date. Actual impact processes, however, are intrinsically dynamic in that they always occur over time. For this reason, the I-O approach represents a fundamental simplification of economic systems. This does not necessarily invalidate the I-O model, but it does highlight the need to carefully consider the ways in which this static model replicates dynamic systems. It also highlights the need to engage in empirical validation to see whether the I-O model faithfully approximates the actual dynamics of regional and local economies (Jensen 1980). Although useful, the common practice of performing sensitivity tests by cross-comparing different scenarios or model formulations is inadequate to this task.

In an important sense, both I-O models and economic base models are essentially noneconomic in nature. Supply and demand relations and their resulting price-quantity equilibria, the foundation of neoclassical economics, are present in neither model. Discussions of factor supply elasticities or production technologies likewise appear more as an afterthought used to justify the static relations found in the models, than as the foundation from which these relations are derived. Note, however, that the generalized formulations presented here depict the traditional impact models in their simplest form. More complex and imaginative applications, particularly of I-O techniques, have incorporated a greater degree of theoretical subtlety and rigor than is evident in the current discussion. The use of I-O model components in conjunction with neoclassical type behavioral equations, which allow for the endogenous adjustment of technical coefficients, for example, is increasingly common (Rey 1998, Rose 1984, Treyz et al. 1992). Additionally, many CGE models make use of an I-O type technology matrix as a central element of the model. Although, these cutting-edge applications address some of the theoretical shortcomings of the I-O model, the sort of practical applications common in forest policy impact assessments inevitably continue to rely on simpler formulations. Also, the problem of empirical verification remains a serious limitation. Indeed, the problem is even more pronounced for the more advanced I-O applications, as these efforts are generally more complex and difficult to replicate, and such "customized" models cannot easily be extended to multiple settings that allow for cross-sectional evaluations.

Empirical Estimations and the Problem of Verification

Of the models reviewed in previous sections of this chapter, economic base models are generally viewed as inferior (Richardson 1985). Given sufficient data and the assumptions needed to sustain an economic base model formulation, a fixed-price I-O or SAM model may be constructed that provides greater sectoral detail and more explicitly identifies and maps important elements and relations in the economy in question. If, on the other hand, price interactions more in keeping with neoclassical economic theory are assumed, a price equilibrium framework incorporated in a CGE model can be used to model relations that are disallowed in both the economic base and fixed-price I-O formulations. However, economic base models have one important advantage that is too often ignored in the academic literature, and this is their ability to generate hypotheses that may be explicitly tested in an empirical setting. Their simplicity allows them to be readily applied across multiple study settings thus allowing for cross-sectional analysis, and the simple division of economic activity into basic and nonbasic sectors allows for a simple and explicit identification of dependent and independent variables to be used in time-series analysis.

In comparison, both I-O and CGE models present substantial barriers to empirical investigation and validation. Much of this springs from their complexity. In the case of I-O models, the number of relations incorporated in model estimations will, depending on the level of disaggregation, be extremely large. If a national technology matrix is adjusted for local conditions, as is usually the case in regional analysis, additional parameters must be added to the model. With the inversion of the adjusted technology matrix, the resulting model and its sector-specific multipliers constitute a considerably daunting black box to all but the most patient and knowledgeable of analysts. The CGE models may involve a smaller number of relations (even though extremely complex models incorporating hundreds of behavioral equations do exist), but the circularity of the models and the process by which equilibrium solutions are obtained is not amenable to discreet analysis. In the case of either model, simple relations that may easily be subject to empirical testing outside the model are not forthcoming. Sensitivity analysis often is used to better understand model behavior, and cross comparisons of different model types are common (McGreggor et al. 1996, Rickman and Schwer 1992), but this does not constitute an empirical test of model accuracy.

The data requirements of I-O and CGE models also constitute a barrier to empirical testing, and this problem is especially pronounced at smaller spatial scales. Whereas I-O models need to provide an estimate for each of the cross-sector interactions in the technology matrix, CGE models will need to estimate various behavioral parameters by using time-series data. In the absence of sufficient local data, various shortcuts are available, but the resulting models will increasingly reflect these shortcuts rather than actual local economic conditions. When viewed against the actual performance of a local economy, it will be extremely difficult to attribute model deviations to specific parameter estimates, data anomalies, or functional specifications. Congruence with actual events likewise may be the result of a serendipitous combination of factors (if not outright tinkering of model parameters to match expectations based on ex poste experience) rather than correct model specification.

Of course, given a sufficiently rich empirical database, these problems could be partially overcome, but here the complexity and data requirements of the models conspire to limit the development of such a database. The construction of a viable CGE or I-O model for a small economy can be a difficult and expensive undertaking, and such models are extremely rare. Indeed, the smallest CGE models discovered in the course of this research were limited to the state level (e.g., Conway 1990, Hoffman et al. 1996, Waters et al. 1997). Small-scale applications of I-O models are also rare in the academic literature, although the work of Hamilton and Jensen (1983), Robison (1997), and Robison and Miller (1988, 1991) provide notable and valuable exceptions. Practical applications of I-O models at smaller spatial scales are more common, but these often merely use borrowed multipliers. Consequently, rigorous analyses of local economies that use these models are rare and experience with their predictive accuracy correspondingly sparse. Moreover, the models constructed for local economies are usually tailored to specific applications or the exposition of new analytical innovations. The sort of standardized application of a given model across multiple settings needed to develop a cross-sectional framework for empirical analysis is essentially nonexistent, and, in general, rigorous study replication is absent.

The economic base model, on the other hand, generally has not been used as a vehicle for theoretical or technical innovation, and it remains much simpler and more transparent than its more developed counterparts. Theoretical work in the area of economic base modeling has become increasingly scarce as the model has been overshadowed by I-O and CGE techniques. Applications of the economic base model, however, have largely been centered on empirical testing, and they provide perhaps the clearest indication of actual multiplier processes occurring in small-scale, local economies. This research is summarized in chapter 4. The case study of small communities in southeast Alaska also relies on the economic base model with its assumed causal relation between basic and nonbasic employment. Here, the economic base model is used as a framework for testing for the presence of impact multipliers in a cross-sectional, time-series setting.

Models Conclusion

An exogenous shock in resource-related activity affects other economic activity in a given community. The shock could emanate from developments in external markets or, most importantly for the purposes of this study, from policy decisions affecting local firms in the timber and wood products sector.

A major theme has been the dichotomy between purely demand-driven models, such as the economic base and fixed-price I-O models, and general equilibrium models, which incorporate both demand and supply relations. In the demand-driven models, the assumption of perfect elasticity in factor supplies allows for the linear and strictly positive partial impact multipliers (or greater than unity in the case of total multipliers), which are the quantitative expression of the economic base hypothesis. General equilibrium models, on the other hand, allow for more flexible outcomes, including the possibility of negative partial impact multipliers.

The economic base hypothesis in general, and economic base and fixed-price I-O models in particular, are thought to be most applicable at smaller spatial scales. This is due in large part to the greater plausibility of the assumption of perfect elasticity of factor supplies in smaller economies. The adjustment processes necessary to achieve this elasticity, however, take time. This dynamic process and the possibility of persistent disequilibria in local factor markets call into question the perfect elasticity assumption as applied in time scales relevant to impact estimation.

Whether the economic base hypothesis is applicable to small economies and demand-driven models thereby appropriate in impact estimation is an empirical question. Because economic impacts are a dynamic process occurring over time, this question is best addressed in a time-series setting. This is the approach taken in chapter 4.

Chapter 4: Empirical Evidence From Southeast Alaska

Overview

The previous chapters provide a framework for addressing questions associated with the secondary impacts arising from a change in timber-based economic activity in small forest communities. In this chapter, empirical evidence from southeast Alaska is used to analyze the local impacts arising from changes in forest sector activity. Here, the focus will be on employment impacts. Additional evidence developed by using income measures is then used to help explain and qualify results from the employment estimations. The analysis techniques used in this chapter include simple visual observation as well as extensive use of regression analysis in a cross-sectional, time-series setting. The linear regression of nonbasic activity (employment and income) on current and lagged values for basic activity constitutes the fundamental regression model used throughout, and various alternate model specifications conforming to this model are tested and compared. The overarching goal is to provide a robust empirical test for the presence and magnitude of impact multipliers in southeast Alaska and thereby a test of the economic base hypothesis.

Previous Studies

Numerous studies have attempted to measure impact multipliers in an economic base setting by using either time-series data, cross-sectional data, or both (see Krikelas 1992 for an excellent review of this literature). Export-oriented activities, which make up the basic sector, are taken to be exogenous drivers that cause (and are linearly related to) changes in the nonbasic sector. This suggests a linear regression model using nonbasic activity as the dependent variable and basic activity as the independent variable. Impacts in the nonbasic sector, however, will not be instantaneous, and the inclusion of a lagged independent variable has been a common modification to the simple regression model. Sasaki (1963) provides an early and often-cited example of this technique. The study reports a total employment multiplier of 1.28 (or partial multiplier 0.28) when applied to changes in Hawaii's nonbasic sector resulting from fluctuations in basic employment. Additionally, Sasaki found no evidence for any lagged effects. Weiss and Gooding (1968) used a similar technique to test the relation between service employment and changes in three primary export sectors in the Portsmouth, New Hampshire, region. Results indicate a total regional employment multiplier ranging from 1.4 to 1.8, depending on the export sector being tested, and little evidence of lag effects extending beyond 1 year. In contrast, Moody and Puffer (1970) found no indication of a linear short-term employment multiplier in their examination of employment changes in San Diego, California. By using an adjustment model in combination with an assumed equilibrium ratio between nonbasic and basic employment, however, their results indicate a total long-term employment multiplier of 5.45 evolving over several decades. Note, however, that periods of this length hardly coincide with what we commonly consider to be standard input-output (I-O) or economic base relations. Moreover, Gerking and Isserman (1981) showed that the long lag effect may be the artifact of Moody and Puffer's method of assigning employment to basic and nonbasic categories.

Other earlier examples of time-series regression techniques applied to the relation between basic and nonbasic employment (and income where data are available) include Cook (1979), Henry and Nyankori (1981), Lutrell and Gray (1970), and Moriarty (1976). Taken as a whole, results from these studies are rather inconclusive, with several studies finding evidence for significant multipliers (e.g., Henry and Nyankori 1981, Moriarty 1976) and others indicating no significant multiplier.

Cross-sectional data composed of base ratios across spatial units at a given time also have been used to estimate local multipliers. In this case, spatial variation in ratios is used in a regression context to estimate the relation between such factors as community size and the magnitude of local multipliers. By using data from 21 different communities located in the Southwestern United States and ranging in population from approximately 1,000 to 15,000, Mulligan and Gibson (1984) estimated, in their simplest model formulation, a total local multiplier ranging from 1 (no secondary impacts) for communities with approximately 100 employees to 2.2 for towns with 10,000 employees or more. Estimates for median-size communities were relatively high with a multiplier of approximately 1.66 for communities with 500 employees and 1.9 for those with a total of 1,000 employees (see Gibson and Worden 1981, Mulligan 1987, Mulligan and Vias 1996 for similar studies applied to the same data set). Using the data from Saskatchewan, Canada, however, Olfert and Stabler (1994) estimated a total employment multiplier of just 1.26 for “partial shopping centers” with a population of approximately 1,700 and a minimum multiplier of 1.09 for communities of 100 to 200. Much of the discrepancy can be attributed to the incorporation of outshopping (i.e., the propensity of local residents to purchase goods and services outside of their local communities) in Olfert and Stabler’s study. Although they provide a useful description of the spatial distribution of different economic activities, it should be noted that cross-sectional studies cannot provide evidence of the time-based causal linkages assumed to underlie impact processes. Rather, they may simply reflect the fact that larger communities will have more employees in both basic and nonbasic categories.

Another similar but distinct line of analysis involves the application of vector autoregression (VAR) techniques and Granger causality tests to the relation between basic and nonbasic activity occurring over time (see Granger 1969, 1988 for a description of these techniques). Giarratani and McNelis (1980) provide an early example of this approach applied to income at the state level. Their results do not support the hypothesis of a unidirectional causal linkage between basic and nonbasic activity. In more recent years, several studies have replicated and extended this approach. Lesage and Reed (1989) provide an often-cited example of this work. They used Granger causality tests to ascertain the relation between monthly time series for basic and nonbasic employment for each of eight Ohio cities (see also Lesage 1990 for extensions to this approach). Impulse response functions, which use VAR results to estimate the expected time path of response of one variable to an exogenous change in another, also were generated. Although these response functions can be used to derive a VAR estimation of the impact multiplier, Lesage and Reed do not report total multipliers in their study. The Granger causality tests provide strong support for the hypothesis that basic employment drives nonbasic employment, and, although negative responses are evident in two cities, the impulse response functions generally conform with expectations as to the timing and magnitude of impacts. However, like Giarratani and McNelis (1980), Lesage and Reed used location quotients to derive their time series, and this may potentially invalidate their results (cf. chapter 3, footnote 5).

Krikelas (1991) uses similar VAR techniques to test for the relation between basic and nonbasic employment in models specified for the state of Wisconsin. His results, in contrast to those of Lesage and Reed, provide no support for the economic base hypothesis, and he further identifies several difficulties in the application of VAR techniques in this setting (see also Krikelas 1992). Nishiyama (1997) provides a more recent example of this type of analysis applied to quarterly employment data for California, Massachusetts, and Texas. Several alternate methods of dividing employment into basic and nonbasic categories were tested, and the “crude” assignment method, which simply designates only manufacturing employment as basic, generated strong support for the economic base hypothesis (although this simple division in a large state economy does not closely coincide with what is traditionally thought to be an economic base). Other bifurcation techniques, including a location quotient approach, did not yield significant results. Additionally, Nishiyama calculates impulse response functions and provides a battery of advanced statistical diagnostics, but he does not report total multiplier figures derived from this impulse analysis.

A final, and older study to be noted in this context is that of Connaughton et al. (1985), which uses Granger causality in conjunction with the assignment method to test the economic base hypothesis in Flathead County, Montana. Timber-related activity receives explicit emphasis in this study, and the results, once again, do not support a simple, unidirectional causal relation between basic and nonbasic activity.

Although there are no academic studies in this area specific to southeast Alaska, there are several employment multiplier estimates that have been used in the course of practical impact assessments. The 1997 Tongass Land Management Plan (USDA Forest Service 1997) used a 1.72 IMPLAN-derived total employment multiplier (type II) to estimate impacts to the entire region resulting from changes in timber employment. Different multipliers were used for other sectors, but most fell within the 1.5 to 1.9 range. In a 1995 report, the McDowell Group, a Juneau-based economic consultancy, assumed a regional employment multiplier of 2.0 (McDowell Group et al. 1995). Elsewhere in the document, the authors applied the same multiplier to the specific community of Ketchikan. Although the implicit assumption here is that all impacts will be restricted to that community, it should be noted that the authors were not trying to provide a rigorous quantified analysis of secondary impacts. Rather, the multiplier estimates were mentioned merely in passing with no citations or explanations as to their possible foundation. In its comments on the Tongass Land Management Plan environmental impact statement, however, the Ketchikan Gateway Borough adopted the multiplier of 2.0 as a matter of fact, demonstrating how numbers with tentative beginnings often lose their qualifications and caveats in the course of debate. In any case, both the Tongass Land Management Plan and McDowell estimates lie somewhere near the higher end of the estimates cited in the academic studies mentioned above.

The foregoing review demonstrates a long history of empirical analysis related to the economic base hypothesis. Nonetheless, in regard to the empirical verification of the causal linkage between basic and nonbasic employment (much less the estimation of actual impact multipliers), the academic literature is inconclusive at best. The majority of studies cited above examined states or larger metropolitan areas, and none analyzed smaller communities by using time-series data.

A major contribution of the current study is to extend this research to small, forest communities. It has long been argued that economic base theory is most applicable at smaller spatial scales and particularly in the sort of simple, resource-dependent economies found in southeast Alaska (Blumenfeld 1955, Moore 1975, Mulligan and Gibson 1984, Mulligan and Vias 1996). Schallau and Polzin (1983: 3) state: "Most economic growth and changes in small regions can be attributed to events outside the area, and changes in the local, nonexport-producing (service or derivative) industries can be traced to industries producing for markets outside the area (export base)." The analysis presented below will test this assertion.

An additional contribution of this study is derived from the cross-sectional depth of the analysis. Although several of the studies cited above treat multiple spatial units, none provide an explicit cross-sectional comparison and interpretation of time-series results. Such an analysis is an important component of this study, and it is used to draw implications as to the possible causes of the observed empirical results as well as to suggest future areas of research.

Study Setting and Data

The sample communities used in this analysis are located in southeast Alaska, a region bounded by the towns of Yakutat to the north and Ketchikan to the south. The southeast Alaska region is a relatively undeveloped archipelago characterized by extremely rugged terrain, convoluted coastlines, and dense forests in the lower elevations. Most of the 15 [1] communities that constitute the study sample are quite small, with employment levels under 1,000 individuals, and they are usually not integrated into broader road transportation networks. Juneau, Alaska's state capital, Ketchikan, and Sitka to a lesser extent, constitute regional trade centers serving outlying communities, but none of them possess road or rail connections to areas outside the region. On the whole, the communities in the study sample constitute relatively isolated local economies with distinct boundaries where basic economic activity presumably accounts for a high proportion of the total economy, and the economic base model is thought to be most applicable.

Along with government activity centered in Juneau, southeast Alaska's major industries include timber, commercial fishing, seafood processing, and, increasingly, tourism. These activities are not evenly distributed across the communities of the region, and different degrees of local specialization are evident, especially in the smaller communities. The cultural landscape is likewise diverse. Certain of the communities are Native settlements, which, in one form or another, date back to pre-European settlement. These communities maintain a high ratio of Alaska Native population as well as a strong attachment to traditional culture and subsistence activities. Other communities are essentially logging camps that have evolved into permanent settlements but maintain a cultural attachment to the economic activities for which they were first established. And still others are fishing villages with histories dating back to the 19^{th} century and Russian settlement of the region. In most of the communities, a mix of different activities and cultural heritages has evolved over time, but, as a whole, they still demonstrate a degree of social heterogeneity which is perhaps uncommon to the Lower 48 States.

[1] Several communities were omitted owing to their extremely small size or inconsistent data series. Omitted communities account for only 2 percent of total regional employment.

Data

Perhaps the principal barrier to time-series empirical work in estimating local impact multipliers lies in the absence of adequate data. Many of the studies mentioned above were hampered by a lack of sufficient data points (Sasaki 1963, for example, estimated his multiplier by using 9 years of annual observations, leaving only 7 degrees of freedom). In other studies, sufficiently detailed and lengthy time-series data were available but only for a single area, thus precluding cross-sectional analysis across different spatial units—analysis that would substantially add to the credibility of results.

In recent years, the availability of regional economic data has improved somewhat. The U.S. Department of Commerce, Bureau of Economic Analysis data on annual income and employment at the county level for all U.S. counties, for example, are now readily available in digital format (USDC Bureau of Economic Analysis 1998). Additionally, many state governments have amassed growing databases on employment and income by ZIP code or local municipality. Disclosure holds to protect confidentiality may be a problem in the use of certain of these data, however, although the holds may be waived in some cases if the analyst is willing to accept constraints designed to ensure confidentiality. The current study relies extensively on such a database obtained from the Alaska Department of Labor (ADOL).

The data consist of monthly nonagricultural wage and salary (NAWS) employment levels by four-digit Standard Industrial Classification (SIC) groupings for Alaska communities, or small spatial aggregates thereof (Alaska Department of Labor 1998). In some cases the ADOL spatial units are closely aligned with actual municipalities. In others, however, several spatially separated communities are aggregated into a single unit. The coverage includes 1981–96, a period spanning a complete business cycle as well as both positive and negative fluctuations in the region's timber economy. The ADOL data are freely available and not subject to disclosure holds.

Certain important employment categories are excluded from the ADOL data set. Monthly NAWS employment estimates are derived from employers' reported payrolls. Consequently, proprietors and other self-employed individuals are not included. In southeast Alaska, important excluded categories will include commercial fishers, and small proprietors such as vendors, bed and breakfast operators, and others serving the tourist industry. Fishing employment estimated by other means (USDA Forest Service 1997) demonstrates large fluctuations from year to year, but no clear trend is discernible over the period covered by this study. Estimates of the number of individual proprietors available from the U.S. Department of Commerce, Bureau of Economic Analysis, on the other hand, demonstrate strong growth in this category, with increases concentrated in services and retail trade. Issues associated with these discrepancies are further addressed where appropriate in the course of analysis.

The ADOL data also do not make any adjustments for nonresident employment. In certain industries in southeast Alaska, the ratio of nonresident to resident employees can be quite large, approaching 50 percent or more, especially in highly seasonal occupations such as fish processing or timber harvesting (Erickson and Associates 1999). This high proportion will ostensibly increase income leakage as nonresidents spend a substantial portion of their wages in their home communities or states. This will thus reduce the local impact multiplier through the relations described in chapter 3. Correcting for this influence, however, would require survey information on the local distribution of nonresident purchases, information that is not available for this study. Consequently, no attempt was made to adjust for nonresident employment and income. The reader should bear in mind the influence of this fact in the analysis that follows.

In addition to the ADOL community employment data, the study also makes limited use of data available from the U.S. Department of Commerce, Bureau of Economic Analysis Regional Economic Information System (hereafter referred to as the "REIS data"). The REIS data provide annual measures of employment and income for all U.S. counties, including the boroughs and census areas (essentially county equivalents) in southeast Alaska. These data are used primarily to provide estimates of income multipliers in a regression framework similar to that used for employment. Although the temporal span of the REIS data (1969–76) exceeds that of the ADOL employment data, the use of annual reporting units results in fewer degrees of freedom in regression than with the quarterly ADOL data. Likewise the REIS data are at a coarser spatial scale and do not provide the same cross-sectional depth. Nonetheless in certain instances, notably Juneau, Sitka, and Haines, the spatial agreement between the two data sets is relatively tight, and in general the REIS income data provide a valuable and supporting addition to the employment analysis. The REIS data include self-employed proprietors and make adjustments for nonresident income.

Recent Developments in Southeast Alaska's Regional Economy

The economy of southeast Alaska has undergone considerable changes during the period considered in this analysis. These changes constitute an important backdrop for interpreting study results. The most important development has been the steady growth of the regional economy over the last two decades. This growth is clearly evident in figure 3, which shows indexed values for timber harvest, wood products-related employment, and other employment in southeast Alaska. (Note that the magnitudes of the values prior to indexing are considerably different, with timber employment only accounting for slightly more than 10 percent of total employment during its peak year in 1989). Growth in nontimber employment is the result of increases in government activity (primarily state and local) and tourism, as well as presumed increases in local resident services, retail, and related activities resulting from steady and dramatic increases in unearned income to the region's residents (see Allen et al. 1997 for a de-tailed description of recent structural changes in southeast Alaska's regional and local economies). Import substitution resulting from growing population and income also may be a contributing factor to the expansion in service, retail, and related sectors.

At the same time, resource-based extraction and manufacturing activity has failed to keep pace with growth in other employment categories and has even declined in the 1990s. The result has been a marked reduction in the share of traditional export activities in the region's economy, a development that has been noted in other regions of the rural United States and the West in particular (Galston and Baehler 1995, Nelson and Beyers 1998a, Rasker and Glick 1994).

Much of the recent decline in manufacturing in southeast Alaska can be attributed to reductions in wood products-related employment (also shown in index form in fig. 3) including logging, and lumber and pulp manufacturing. Ostensibly, these reductions are the result of forest policy decisions in the 1990s to reduce harvest volumes on the Tongass National Forest.[2] In general, timber harvests and employment have witnessed

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[2] Although recent harvest reductions are undoubtedly partly the result of forest policy decisions, various other factors impinge on the supply of timber to local processors and exporters and their ability to operate profitably. These include private harvests, legal challenges to national forest timber sales, outside market fluctuations, and the high cost of harvesting and processing timber in southeast Alaska relative to other producing regions.

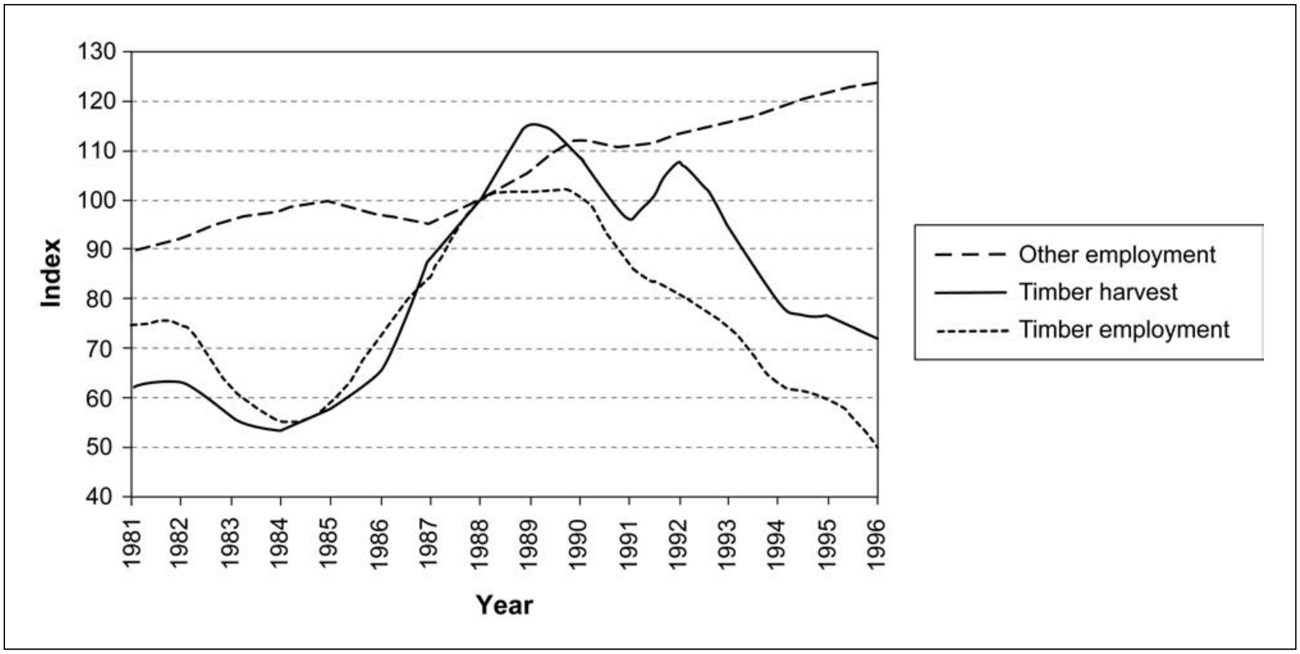

Figure 3—Indexes of timber harvest, timber employment, and other employment. For reference, actual values in 1998 were timber harvest 951 million board feet, timber employment 3,499, and other employment 27,436 (Alaska Department of Labor 1998, USDA Forest Service 1997).

broad fluctuations, including sharp increases in the latter half of the 1980s and equally sharp declines in the 1990s. When viewed at the community level, these fluctuations are even more pronounced, involving large shifts in logging employment and the opening and closure of lumber and pulp manufacturing facilities. Much of the variation in basic employment examined in this study arises from these fluctuations. Of course, fluctuations in other basic categories, notably seafood processing, are also important, but these fluctuations have not approached the absolute and relative magnitude of those in the timber sector nor do they follow the same general trends. Strong increases in timber employment, as well as declines, are included in the study sample. Consequently, the estimation of local impact multipliers includes examples of both positive and negative shocks.

The relative isolation and structural simplicity (owing to their small size) of these communities provide several advantages in the estimation of employment multipliers. These include an enhanced ability to identify and isolate confounding factors, and greater relative variance in basic employment—the key exogenous variable. Likewise, the fact that virtually no local manufacturing output is sold in local markets means that the use of a simple assignment method can more easily be used to distinguish basic from nonbasic employment. When combined with the spatial and temporal detail of the ADOL employment data set, the study setting and data furnish a valuable opportunity to test the economic base hypothesis in a cross-sectional time-series setting. The relatively small size of southeast Alaska's boroughs and census areas allows for the use of REIS county-level data to support and further elaborate results from the analysis of the ADOL community-level statistics. In addition to providing a much needed empirical verification of local multipliers in southeast Alaska, results that are more clearly apparent in the unique environment the region presents may then help shed light on impact processes occurring in small forest communities in the U.S. Pacific Northwest and elsewhere.

Employment

This section contains the empirical analysis and results obtained from the ADOL employment data. After a brief discussion of the methods used to prepare the data for analysis, the resulting data series are examined visually on a community-by-community basis. Next an initial regression model is tested and the results presented. In order to test the sensitivity of these results to different model specifications, several alternative models are subsequently tested and found to be in general agreement with both the initial model and visual observation of the data series. Linear regression, rather than VAR techniques, was chosen in this analysis primarily for the overall ease of interpretation and the ability of this technique to generate multiplier estimates with explicit error bounds.

Data Division and Adjustment

The identification and division of local employment data into basic and nonbasic categories constitutes a major challenge in empirical applications of the economic base theory, and any approach will involve a number of compromises. For several reasons, the simple assignment method in which whole sectors are assigned to basic or nonbasic categories was chosen in this analysis. First, southeast Alaska's major manufacturing sectors such as wood products production and seafood processing produce almost exclusively for export markets; the influence of local product demand on these sectors is essentially nil. Secondly, alternate techniques such as location quotients or minimum requirements may introduce a systematic bias in time-series estimates of local impact multipliers, as has been argued above (see chapter 3 footnote 1).

The assignment method used in this analysis assigns a majority of manufacturing activity along with state and federal government employment to the basic sector and the remainder, primarily trade and services, to the nonbasic sector. In certain instances where manufacturing activity was obviously directed to the local market (e.g., gravel and concrete, or boat building and repair) these categories also were assigned to the nonbasic sector. Tourism, of course, presents problems in that it represents basic activity but is confounded in the employment statistics with retail and services for local consumption. In the statistical estimations presented below, this problem is handled through the inclusion of a trend variable in the regression model (a further discussion of this is provided). When viewing the simple tables and charts discussed in this section, however, it must be remembered that the delineation of basic and nonbasic employment fails to include tourism-related activity in the basic sectors.

Another substantial challenge in using the ADOL community-level employment data involves the problem of seasonality. The communities in the study sample are characterized by extremely high seasonality in employment with differences between reported levels of summer and winter employment sometimes exceeding 50 percent in the smaller settlements. Because fishing, fish processing, and timber (all coded as basic in the current study), as well as tourism (which is confounded with local services and thus coded nonbasic), are all subject to strong seasonal variation, it is essential that this variation is completely stripped from the data before proceeding with the analysis.

This task is complicated by the fact that the magnitude of seasonal fluctuations is seldom constant for any given community over the years. In general, these fluctuations have been decreasing over time, but often the change will reflect a large and discreet shift in local economic structure and can be quite abrupt. Consequently, standard de-seasonalization techniques that may be applicable in larger and more stable systems (e.g., the use of seasonal dummies in a regression context) will not adequately remove seasonality in this study for those years where it is extreme and may actually introduce a reverse seasonality (low summer and high winter employment) in years where it is less pronounced.

As an alternative, after first converting the monthly data to quarterly observations, a four-quarter moving average is used in this study to smooth out seasonal variation for visual observation. This technique also is used for one of the alternative regression models that uses levels data (the term "levels data" will be used throughout this section to refer to data that have not been adjusted through the differencing techniques explained below). All other regression models are applied to "differenced data." Here, quarterly differencing in which the quarter of the previous year is subtracted from that of the current year is used. Both of these methods eliminate all seasonal variation. They also tend to dilute employment shocks and possible responses, spreading them over an entire year. Furthermore, these methods act to introduce additional autocorrelation in the data series and regression residuals, requiring additional autoregressive correction terms in the regression analysis. These issues will be addressed in further detail in the description of the regression analysis.

Base Ratios and Visual Observation

Total 1996 NAWS employment as reported by the ADOL and percentage of change in employment since 1981 are shown for each community in the sample in table 1. Both overall regional employment growth and the heterogeneity in the performance of individual communities are evident. The table also displays information on current and historical base ratios, which were derived by dividing basic employment (identified by using the assignments outlined above) by total employment. As mentioned in the previous chapter, one of the central tenets of economic base theory is that the base ratio will be relatively stable over time and between similar communities.

The communities of southeast Alaska exhibit a high variance in local base ratios in both spatial and temporal dimensions. Not surprisingly, larger communities are correlated with more stable ratios. The ratios for certain medium-size communities such as Hollis, Haines, and Wrangell, however, have relatively high variance between maximum and minimum values. In general, base ratios have been declining for all the communities in the sample. This is a partial result of relative declines in wood products and other manufacturing activity. Tourism employment, however, is not included in the estimates for basic employment, and the general decline in the apparent base ratio, as well as some of the variance across communities, may largely reflect expansion in tourism activity, which is not measured here. Likewise, steady increases in retirement benefits and other transfer payments also may partially underlie the trend. Both of these factors are consistent with economic base theory, and, as a result, it is hard to argue that the observed variance and, especially, the decline in base ratios is an indication that the economic base hypothesis, and its associated multipliers, are inappropriate for the region.

Another, and more direct approach, is to examine changes in basic and nonbasic employment over time to see if a relatively stable relation is evident. Figure 4 displays total employment for the region divided into basic and nonbasic categories. Whereas the two series displayed in the figure show somewhat similar trends through 1990, more recent years show a sharp divergence, with nonbasic employment continuing to make steady gains in spite of declines in the basic sectors. This is no doubt the result

Table 1—Community employment and base ratios, 1981–96

	Employment		Base ratio			
Community	**1996**	**1981–96 change**	**1996**	**Maximum**	**Minimum**	**1981–96 change**
		Percent	- - - - - - - - - - - -	*Percent*	- - - - - - - - - - - -	
All	35,643	31	39	47	39	-15
Juneau	16,127	39	40	46	40	-12
Ketchikan	7,839	40	35	43	35	-8
Sitka	3,848	5	28	40	28	-25
Petersburg	1,452	- 12	48	58	47	-16
Wrangell	832	- 4	45	59	37	-3
Hollis	1,117	87	40	68	38	-35
Haines	876	60	30	64	30	-30
Metlakatla	567	20	81	83	72	-3
Hoonah	447	33	63	80	63	-12
Thorne Bay	352	17	49	88	41	-44
Angoon	336	65	77	77	36	14
Yakutat	428	99	53	57	30	- 6
Kake	324	127	52	81	39	-35
Gustavus	179	23	4	53	1	-92
Hydaburg	75	-26	55	88	44	-15

Source: Alaska Department of Labor nonagricultural wage and salary employment. Self-employment excluded. See text for derivation of base ratio.

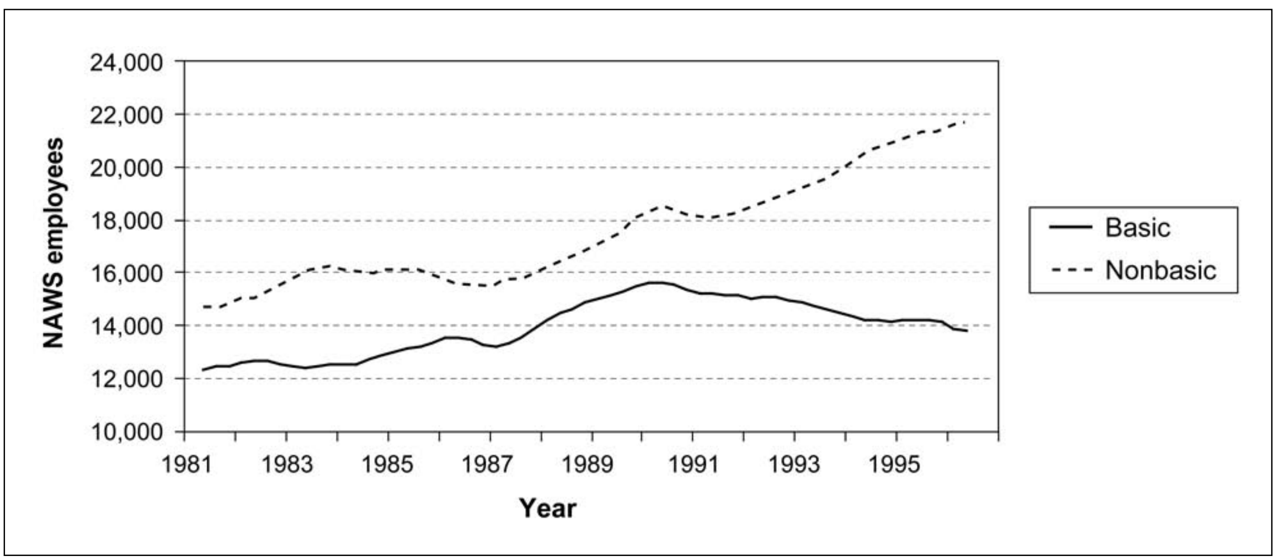

Figure 4—Basic and nonbasic nonagricultural wages and salary (NAWS) employment in southeast Alaska, 1981–96 (Alaska Department of Labor 1998).

of a combination of the expansion in the retail and service sectors (including, but not restricted to, those associated with the tourist industry) and falling employment in the timber sector. The fact that prior to the 1990s the two series are more closely associated with each other may indicate that the region experienced a structural change beginning in 1991 that has weakened the linkage between basic and nonbasic employment. An alternative interpretation, however, is that the apparent association in the 1980s is merely a spurious correlation between trending variables.

When viewed at the community level, fluctuations in both basic and nonbasic employment are much more pronounced than at the regional level. Figure 5 shows quarterly employment in the two categories for the communities of Yakutat, Haines, and Kake. Employment in the Yakutat community appears to confirm the hypothesis that basic and nonbasic employment are positively correlated. In Haines, however, there seems to be no strong connection between the two series, and this is in spite of extremely large fluctuations in basic employment levels. Finally, in Kake, the evidence suggests a strong negative correlation between basic and nonbasic employment.

Although these three communities were chosen as relatively clear examples of divergent relations, this same diversity is evident in the examination of other communities (see app. 1 for charts for each community in the sample). Certain communities evidence a positive relation, others support the hypothesis that no significant relation exists, and still others evidence negative relations. In the case of Yakutat, Haines, and Kake, the statistical estimates presented later in this report closely conform with these visual observations. In addition to its implications for the average magnitude of community-level multipliers, this result also has important implications for the way we study multipliers and local economic impacts in general. Namely, case studies involving individual communities may yield results that are not supported by broader cross-sectional analysis using multiple communities.

In viewing the charts from all the sample communities, it is hard to discern a consistent relation, one way or the other, between basic and nonbasic employment at the individual community level. Certainly, regional multipliers such as those cited in the Tongass Land Management Plan (USDA Forest Service 1997) or the McDowell Group et al. (1995) report (1.7 and 2.0, respectively) are not visually evident here. In some communities, the basic and nonbasic employment series display similar trends, but in others the trends diverge substantially. Likewise, in some cases possible small lag responses in nonbasic employment can be inferred, but in other cases an opposite response also can be inferred. In no instance is a major response in nonbasic employment to an abrupt change in basic employment clearly evident. Admittedly, observing and drawing visually based conclusions from multiple graphs hardly constitutes a definitive analytical test. However, it does provide a simple and relatively direct means to begin to determine whether linear employment impacts are uniformly operating at the community level. The visual evidence suggests that they are not.

Regression Model

The apparent lack of linear impact multipliers can be further tested by using statistical techniques, which are more amenable to summarization and less liable to subjective interpretation than are simple observations. The challenge is to develop a statistical model that is both flexible enough to be uniformly applicable to all communities in the study sample and sensitive enough to register impacts should they exist. The model developed in this study begins with a simple regression model (ordinary least squares) with basic employment as the independent variable and nonbasic employment as the

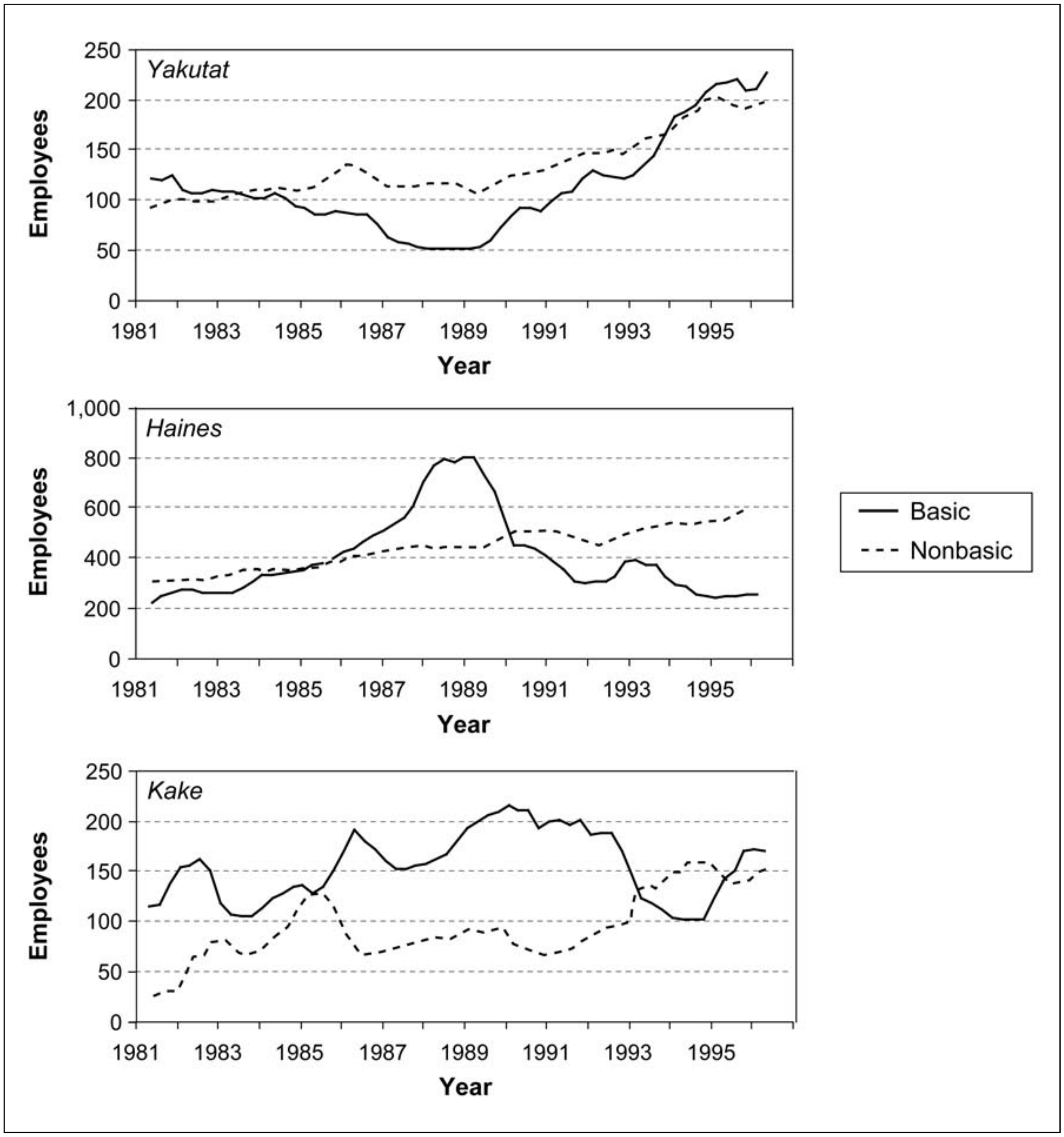

Figure 5—Basic and nonbasic employment for selected southeast Alaska communities.

dependent variable. Following standard statistical procedures, an intercept term is added even though such a term is absent in the simple economic base model discussed in the previous chapter. Several additional modifications are added to handle lagged responses and the presence of other exogenous income sources (primarily unearned income and tourist activity). The following model constitutes a starting point for the statistical estimation of impact multipliers for each of the communities in the study sample:

$$NB_t = \alpha + \sum_{i=0}^{n} \beta_i B_{t-i} + \lambda TR + e_t \quad , \qquad (19)$$

where

NB_t is nonbasic employment in a given community in period t,

B_t is basic employment,

i denotes number of lagged periods, and

TR is a linear trend variable,

α, β_i, and λ are the intercept, the slope coefficients on the lagged independent variables, and the coefficient on the trend variable, and

e is a stochastic error term.

The sum of the β_i terms estimates the total response of nonbasic employment to a shock in basic employment and is thus analogous to an economic base linear impact multiplier (or an input-output- [I-O] derived multiplier). Note that this is a **partial** impact multiplier as defined in the previous chapter. In order to directly compare this estimate with the economic base or I-O **total** impact multipliers mentioned in the review section of this study, 1 must be added to the multiplier estimate (e.g., a regression estimate of 0.5 would equal 1.5 in the standard economic base form). All estimates presented in this portion of the study will be expressed in terms of partial multipliers.

Equation (19) specifies a simple, unconstrained lag structure. However, the estimations use 12 quarters of lagged data, and some additional constraints on the lag structure were imposed in order to handle the high degree of multicolinearity between lagged periods and facilitate interpretation of multiple lag coefficients. A polynomial distributed lag, or **Almon lag**, specification was used for this (see Almon 1965, Greene 1993 for details on this method). This technique assumes that lag responses can be modeled as a polynomial function of lag length. For example, a simple linear decay where a change in basic employment displays its highest impact at lag 0 with uniformly declining impacts thereafter could be modeled as a first-degree polynomial. By increasing the degree of the polynomial lag function, the model can account for more flexible lag responses where, for example, initial impacts are small followed by increasing impacts, which then decline as the community fully adjusts to previous changes in basic employment.

In the current model, the lagged coefficients were constrained to fit a fourth-degree polynomial function of lag length n = 12 quarters with the endpoint (i.e., coefficient of the 12^{th} lagged variable) constrained to be near zero. The 12-quarter lag length was felt to be long enough to register major employment impacts in the community. Likewise, the fourth-degree polynomial is sufficiently flexible to accommodate most reasonable lag structures while still economizing on degrees of freedom.

The trend variable is included as a proxy for tourism employment and for unearned income, which, as elsewhere in the United States, has demonstrated a steady increasing trend as a share of total income over recent decades. Tourism has likewise shown a relatively steady increase over much of the study period. For example, although admittedly an imperfect measure of tourism activity, recreation use on the Tongass National Forest (which constitutes the vast majority of the region's total land area) increased at an annual rate of close to 8 percent in the 1984–95 period with r^2 on both logistic and linear regressions of approximately 0.75 (USDA Forest Service 1997). Other indicators and anecdotal evidence likewise point to a strong and steady increase in tourism-related economic activity. If tourism and other basic employment are correlated (either negatively or positively), the failure of the trend variable to adequately proxy tourism would be a problem. However, the local fluctuations in basic employment examined in this study occur throughout the study period, involve both positive and negative changes, and are often quite abrupt. Whereas it is possible that the impacts of a single mill closure or opening may be obscured by unrelated changes in tourism employment, it is highly unlikely that this would be the case across the entire study sample. Consequently, if the trend variable is an inadequate proxy, the result will be a decreased precision in the multiplier estimates rather than a systematic bias. The same generally holds true for other types of employment omitted in the ADOL data. Commercial fishing is one important omitted category, but other employment estimates for this industry indicate relatively stable levels throughout the study period.

The fact that the undifferenced levels data are generally not stationary for the variables considered in this study constitutes a major problem for the model presented in equation (19). This allows for the possibility of spurious correlation between trend variables as well as statistical problems when dealing with variables with infinite variance (as is the case with nonstationary variables). The inclusion of the trend variable is a possible technique for handling some of these problems, but a more satisfactory technique is to use first-differenced data (or higher order differencing) in order to obtain stationary variables for use in regression. Given the high degree of seasonality in the current data, a four-quarter differencing scheme was used in which the same quarter of the previous year was subtracted from the current quarter. Note that this is equivalent to first differencing a four-quarter moving average series (the smoothing technique used to handle the data in the graphical presentation shown above).[3] By using an adjusted Dickey-Fuller test, the four-quarter differenced series for basic and nonbasic employment were found to be stationary at the 95-percent significance level for all but two cases, and these two were found to be stationary at the 90-percent level of significance. The explicit model is as follows:

$$NB_t - NB_{t-4} = \alpha + \sum_{i=0}^{n} \beta_i \left(B_{t-i} - \beta_{t-i-4}\right) + e_t - e_{t-4} \quad . \tag{20}$$

The trend variable is now subsumed in the intercept term. The same lag structure, namely a fourth-degree polynomial on a 12-period lag, is used. The error term in this model is a linear combination of the current and previous year's error from the model using levels data, and thus a fourth-order moving average (MA(4)) error correction term is appropriate. The use of this term is further suggested by the relation between quarterly differencing and first differencing a four-quarter moving average. In almost every community the MA(4) term constituted an important (and statistically highly significant) addition to the model. Additionally, a first-order autoregressive correction term (AR(1)) was used to absorb remaining autocorrelation in the residuals. By using this model (equation 20), we can formulate a test of the economic base hypothesis:

$$H_1\colon \Sigma\beta_i > 0$$

$$H_0\colon \Sigma\beta_i \leq 0$$

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[3]The first differencing of the 4-quarter moving average is identical to quarterly differencing except that the former operation introduces the scalar 1/4:

$$\frac{\sum_{n=0}^{3} X_{t-n}}{4} - \frac{\sum_{n=1}^{4} X_{t-n}}{4} = \frac{X_t - X_{t-4}}{4}$$

Table 2—Regression results for original model

	Multiplier ($\Sigma\beta$)			Diagnostic statistics[a]			
Community	**Value**	**Std. dev.**	**t-value**	**AR(1)**	**MA(4)**	**Adj. R^2**	**DW**
Angoon	0.29	0.08	3.55**	0.65	0	0.35	2.36
Gustavus	-.79	.44	-1.79**	.24	0	.25	2.01
Haines	.04	.10	.42	0	.04	.27	1.95
Hollis	-.50	.16	-3.12**	.19	.01	.51	1.68
Hoonah	-.22	.14	-1.61*	0	0	.48	2.02
Hydaburg	.07	.04	1.57*	.35	0	.50	1.95
Juneau	-.08	1.21	-.07	0	0	.61	2.05
Kake	-.56	.19	-2.87**	.18	0	.56	1.91
Ketchikan	.10	.26	.39	0	0	.45	1.81
Metlakatla	.28	.88	.32	0	0	.53	1.99
Petersburg	-.35	.41	-.85	0	0	.63	1.79
Sitka	.20	.30	.68	0	0	.55	1.71
Thorne Bay	-.09	.24	-.37	0	.30	.53	2.02
Wrangell	.20	.11	1.80**	0	0	.56	2.06
Yakutat	.48	.07	6.42**	.16	0	.64	1.94
Average	-.06	.09[b]	1.72[c]	.12	.02	.50	1.95

Note: ** = 95-percent significance level, * = 90-percent significance level.

[a] AR(1) and MA(4) are probability scores for accepting the null hypothesis of a zero coefficient on the autocorrelation and moving average error terms. Adj. R^2 and DW are the adjusted R^2 value and Durbin-Watson statistic.

[b] Standard deviation for the sample average of community multiplier scores.

[c] Average for the absolute value of community multiplier t-values.

The regression results for this model are given in table 2, and, for visual confirmation, the differenced data series for selected communities are shown in figure 6.

The Durbin-Watson statistics show a general absence of autocorrelation in the error terms. Although the adjusted R^2 values are relatively high for first-differenced data of this sort, they probably largely reflect the significance of the ARMA terms. In six of the communities, the AR(1) term is insignificant, indicating the possibility of improving individual community regressions by omitting this term. Nonetheless, these improvements were forgone in order to avoid the potential problems of data mining associated with optimizing regressions for separate communities. The same argument applies to the use of different lag structures for individual communities.

The $\Sigma\beta$ term is the central focus of this analysis. The average score for all communities is -0.06, and, assuming the community estimates are independent, the standard deviation for this estimate of the community sample mean is 0.09. On the basis of this evidence, we cannot reject the null hypothesis of no relation (i.e., H_0: $\Sigma\beta \leq 0$) between basic and nonbasic employment in southeast Alaska communities. When combined with the sensitivity analysis of alternative models (see below), this provides robust evidence for the rejection of the economic base hypothesis as a viable description of the **average** employment response of southeast Alaska communities to an employment shock in local basic sectors. This constitutes the central result of the analysis, a

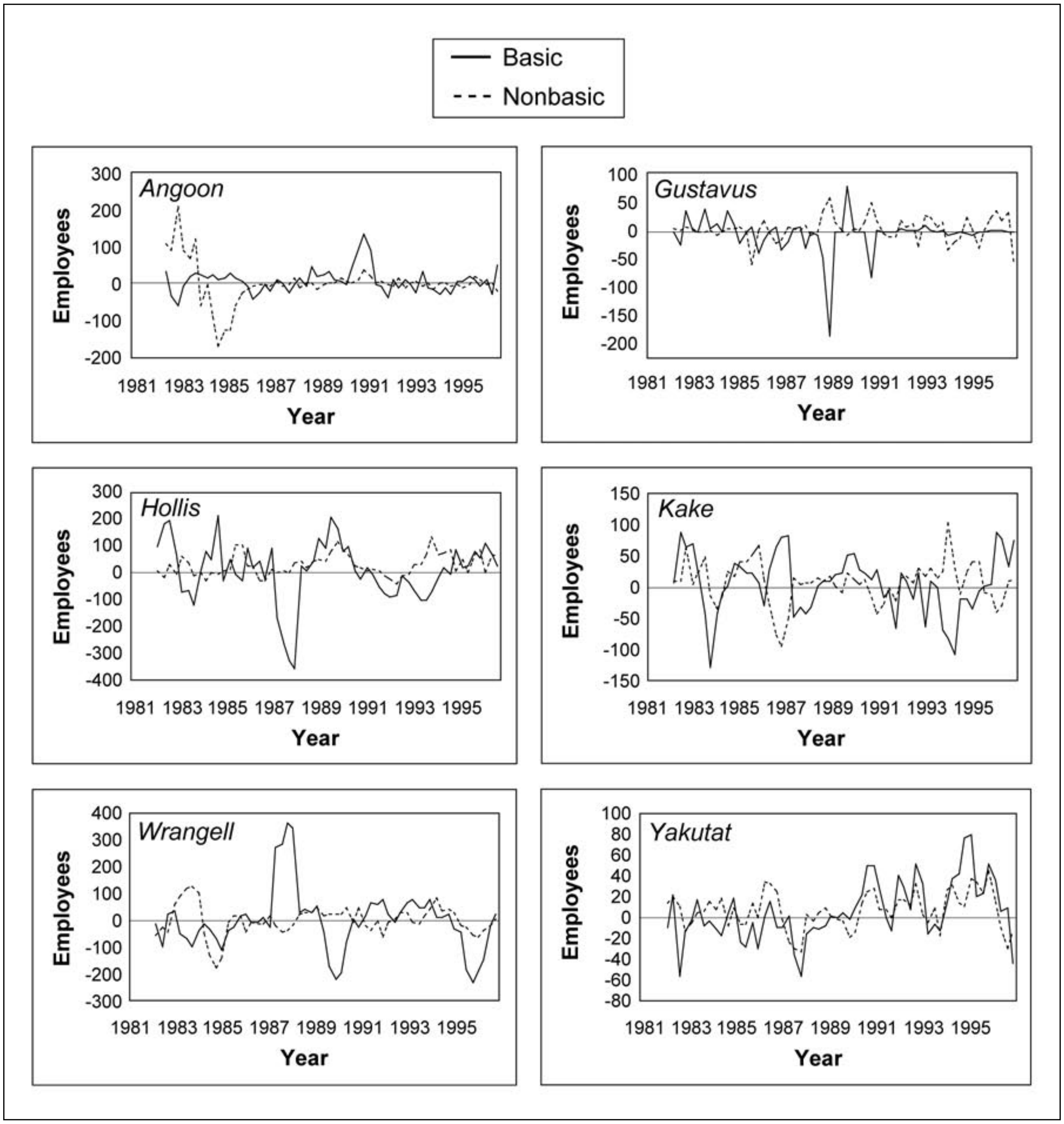

Figure 6—Change in basic and nonbasic employment in selected communities (difference from same quarter of previous year).

result that is all the more significant given the common assumption that the communities examined in this study are precisely the sort of place where the economic base hypothesis is most applicable.

The above analysis does not constitute a test of the hypothesis that all of the coefficient estimates are insignificant. In contrast to the average result, certain of the individual community multiplier estimates demonstrate a high degree of significance, as evidenced by the t-values shown in table 2. This suggests the need for a more thorough examination of the distribution of estimates for specific communities. These estimates, ranked in descending order are shown in figure 7. The bars represent ± two

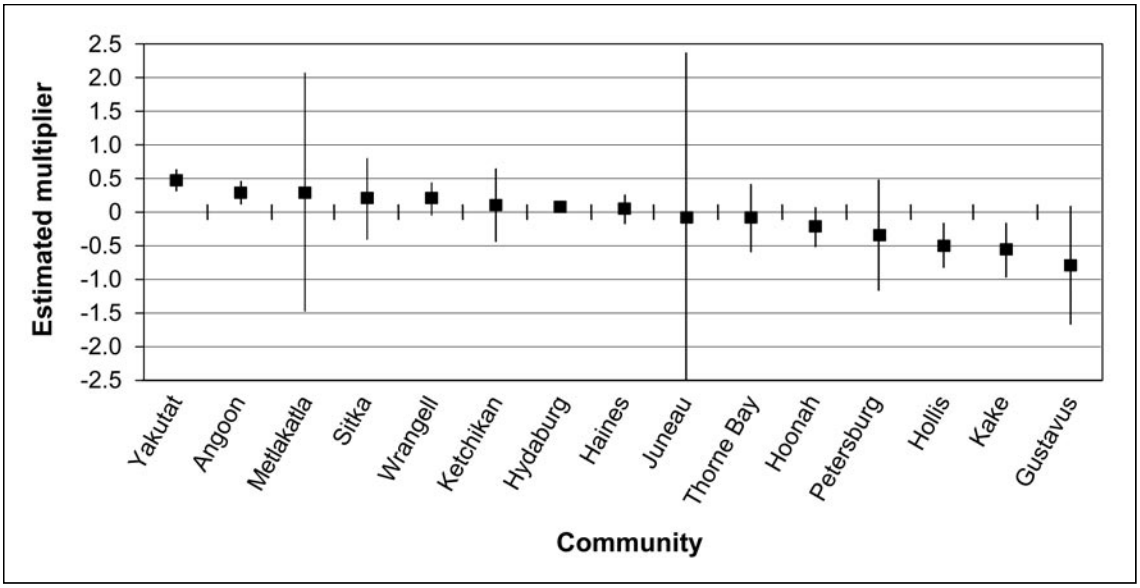

Figure 7—Community multiplier estimates with ±2 standard deviations (ranked in descending order of estimate value).

standard deviations and are roughly equivalent to a 95-percent confidence interval. The first thing to notice in the figure is that the estimates are approximately evenly distributed around zero, with eight communities demonstrating positive estimates and seven communities demonstrating negative estimates. Of the positive estimates, three are significant at the 95-percent (one-tailed) level, and three of the negative estimates are likewise significant (see table 2). The data series shown in figure 6 generally conform to these estimates. Given the symmetrical nature of the distribution, however, it is tempting to conclude that these significant estimates are merely random variations around what is essentially a zero mean.

Whether this is the case can be readily tested statistically. The question to be answered is, How likely are we to find a distribution such as that shown here under the null hypothesis of no relation in all communities? If each community estimate is taken as an independent sample from a uniform process, then, **under the null**, there will be a 10-percent chance of obtaining a significant score at the one-tailed 95-percent level (5-percent chance for a significantly positive estimate and 5 percent for a negative estimate). The chance of obtaining **at least** 6 significant results out of a sample of 15, as is the case in the above analysis, is a combinatorial problem of the following form:

$$\sum_{k=k^*}^{n} \binom{n}{k} \times \left(P\left(|t| \geq t^*\right)^k \times \left[1 - P\left(|t| \geq t^*\right)\right]^{n-k} \right), \tag{21}$$

where

n is the sample size (in this case 15),

k^* is the number of significant scores (here 6),

t is the t-value associated with a specific coefficient estimate, and

t^* is the 95-percent one-tailed confidence bound for the t-value given the degrees of freedom available for the regression in question.

The first term in the summation is the total number of possible permutations with k significant scores. The second term is the probability of any single permutation with k significant scores. The product of these terms gives the probability of obtaining **exactly** k^* significant scores, and the summation gives the probability of obtaining **at least** k^* significant scores.

The probability of obtaining at least six significant scores under the null hypothesis is approximately 0.2 percent. For reference, the probability of obtaining five and four significant scores is approximately 1 percent and 6 percent, respectively. Consequently, although the mean estimate across all communities does not allow us to reject the null hypothesis of no relation, the distribution of community-specific estimates indicates the rejection of the null for every individual community at the 99-percent confidence level. In other words, the average impact response is essentially zero, but the communities of the sample demonstrate highly significant heterogeneity in their response. Certain communities demonstrate significant positive impact responses, others demonstrate negative responses, and it is unlikely that this is the result of simple random variation in the communities in the sample. This result is consistent with the visual observation of levels data in figure 5 and the differenced data in figure 6. This constitutes the second major empirical result of the current study, one that provides an important qualification to the first result and carries with it important implications for future research.

Sensitivity Analysis

To assess the robustness of this analysis, a sensitivity analysis was conducted comparing the above model (hereafter termed the "original model") to several alternative model formulations. The first of these alternatives uses the basic and nonbasic employment data in levels form, as opposed to the difference form in the original model. In line with the discussion presented above, a linear trend variable is used as a proxy for trends in income sources. This is the model expressed in equation (19) above and will be termed the "levels model." The same polynomial lag structure is used (i.e., a fourth-degree polynomial applied to a 12-period lag), and seasonality is eliminated by the use of a four-quarter moving average on both the dependent and independent variables. Once again, this introduces an MA(4) moving average structure to the error term. Consequently, as in the original model, AR(1) and MA(4) error correction terms were used to eliminate serial autocorrelation. The second alternative model, which will be termed the "freelag model," uses the same quarterly differenced variables as in the original model, but in this case the lag structure is unconstrained. As opposed to the polynomial distributed lag approach, which estimates the polynomial coefficients, this model directly estimates the coefficients on each lagged variable. Once again, AR(1) and MA(4) error correction terms are used in the regressions.

Results from the two alternative models are summarized in table 3 along with summary results from the original model (see app. 2 for complete results for alternative models). The table shows the mean multiplier score ($\Sigma\beta$) across all communities and the standard deviation associated with this mean score. Average values for the adjusted R^2 and Durbin-Watson statistics also are reported. The next two columns of the table give the rank correlation and simple correlation of multiplier scores between the original and alternative models when ordered by communities. These latter measures give an indication of the stability of community-specific multiplier estimates across different model specifications. The final columns tally the number of significant positive and negative multiplier estimates under a 95-percent one-tailed t-test (this test was not available for the freelag model).

Table 3—Comparison of results from original and alternative models

	Multiplier estimates		Diagnostics		Correlation		Sig. scores	
Model type	**Average**	**Std. dev.**	**Adj. R^2**	**DW**	**Rank**	**Simple**	**Pos.**	**Neg.**
Original model	-0.06	0.09	0.50	1.95	1.00	1.00	3	3
Levels model	-.05	.08	.96	1.35	.75	.77	2	3
Freelag model	-.19	.12	.53	1.94	.69	.71	—	—

Note: The average multiplier estimates are the mean $\Sigma\beta$ scores across communities for each model. Std. dev. is the standard deviation for this mean score. Adj. R^2 and DW are the adjusted R^2 value and Durbin-Watson statistic. Correlation scores represent the rank and simple correlation of the $\Sigma\beta$ estimates for communities referenced to the original model. Sig. scores is the number of significant multiplier scores under a 95-percent one-tailed t-test.

In the average multiplier estimates, we find that all models result in negative estimates, but, in light of the magnitude of their standard deviations, none of these are significantly different from zero. In terms of adjusted R^2 and Durbin-Watson statistics, the original and freelag models are in close agreement. Not surprisingly, the levels model demonstrates much higher R^2 values, but the Durbin-Watson statistic indicates the presence of significant serial autocorrelation in the error terms. Remember that the levels data are not generally stationary and that a trend variable was included in this model. Correlation scores indicate a reasonable, but by no means perfect, agreement between the original and alternative models in terms of community-specific multiplier scores and their rankings. In general, it is clear that the use of either of these alternative models would not substantially alter the fundamental conclusions of the analysis.

The choice of lag length also may substantially affect model results, and to test this an additional sensitivity analysis using alternative lag lengths in combination with the original model specification was performed. Note that in addition to changing the amount of lagged variables in the regression, changing the lag length also will change the range of the sample available for analysis. At lag lengths of 8 and 16 quarters, the alternative specifications bracket the original model's 12-quarter lag. Summary results are presented in table 4 with the same format as in table 3. Once again, none of the mean multiplier scores are significantly different from zero, but it does appear that this estimate is negatively correlated with lag length. The diagnostic statistics are virtually identical for all models. Rank correlation between the alternative lags and the 12-quarter lag is quite close, but the simple correlation is less so. In contrast to the original model's six significant scores, the 8- and 16-quarter lags both demonstrate only four significant scores—equivalent to a 94-percent probability criterion under the assumption that these estimates are independent. Consequently, the choice of alternative lag lengths would not substantially alter the conclusion relative to mean multiplier values, but it could reduce the significance of the heterogeneity result.

Income

Although public policy debates often focus on employment as the most salient aspect of economic impact, income has long been recognized by economists as a more comprehensive measure. Income and its resulting expenditure are, after all, the media through which economic impacts propagate through a local economy. Most academic studies that use employment to gauge economic impacts explicitly recognize this fact, claiming that employment merely acts as a proxy for income, a proxy necessitated by a lack of adequate income data. This same rationale applies to the current study.

Table 4—Comparison of results from 12-period lag and alternative lag models

Lag length (quarters)	Multiplier estimates		Diagnostics		Correlation		Sig. scores	
	Average	Std. dev.	Adj. R^2	DW	Rank	Simple	Pos.	Neg.
8	0.02	0.08	0.53	1.98	0.83	0.74	1	3
12	-.06	.09	.50	1.95	1.00	1.00	3	3
16	-.18	.13	.52	1.94	.85	.57	2	2

Note: The average multiplier estimates are the mean $\Sigma\beta$ scores across communities for each model. Std. dev. is the standard deviation for this mean score. Adj. R^2 and DW are the adjusted R^2 value and Durbin-Watson statistic. Correlation scores represent the rank and simple correlation of the $\Sigma\beta$ estimates for communities referenced to the original model. Sig. scores is the number of significant multiplier scores under a 95-percent one-tailed t-test.

There are several reasons to suspect that changes in employment may not always be precisely reflected in changes in income. An often-cited discrepancy is that employment numbers do not take into account differential wages and salaries both across different employment categories and within these categories. Changes in wages resulting from changing local demand for labor are an additional source of possible deviation between employment and income figures. A related issue is the fact that reported employment levels do not necessarily measure actual labor inputs in terms of hours worked or the intensity of work. In smaller rural communities, a possible response of residents and employers to changes in local employment opportunities may be to adjust the amount of hours worked (e.g., by moving to part-time employment) and engage in various forms of informal work activities, which generally are not registered in the employment statistics. Similarly, in small establishments, labor may constitute a "lumpy" input. In this case, recorded employment may not change although the work required of and accomplished by employees may change considerably.

Another, and extremely important point is that income from unearned income sources such as government transfers or investments is not accounted for in employment measures. Much of this income can be classified as basic and thus may constitute an important force in the economic development of many forest communities. In addition to providing external income via retirement benefits, investment dividends, etc., unearned income includes unemployment benefits and related income maintenance payments, payments which may be negatively correlated with changes in local employment and thus automatically provide a compensating income flow. Income measures will more adequately reflect all these factors.

In this section of the study, annual (REIS) income data published by the U.S. Department of Commerce, (1998) covering the 1969–96 period for southeast Alaska boroughs and census areas (the Alaska equivalent of counties) are examined in a linear regression context similar to that of the employment analysis above. Before presenting the regression model and results, however, a brief examination of the data and some implications is in order. The 1996 income levels and growth rates are shown for five southeast Alaska boroughs in table 5.[4] Growth estimates measure annual percentage of growth and were obtained by fitting the data to a simple logistic growth function.

[4] Owing to data omissions resulting from disclosure holds and changing jurisdictional boundaries, some boroughs were omitted from the analysis. These include Prince of Wales-Outer Ketchikan census area, Skagway-Hoonah-Angoon census area, and Yakutat Borough.

Table 5—Income summary for southeast Alaska boroughs

	Haines		Juneau		Ketchikan-Gateway		Sitka		Wrangell-Petersburg	
	1996	Growth	1996	Growth	1996	Growth	1996	Growth	1996	Growth
	Dollars[a]	*Percent*	*Dollars*[a]	*Percent*	*Dollars*[a]	*Percent*	*Dollars*[a]	*Percent*	*Dollars*[a]	*Percent*
Personal income[b]	62	4	839	3	428	3	207	2	161	2
Personal income:[c]	60	4	902	3	470	3	232	1	168	2
Unearned income	23	6	259	6	126	5	78	6	57	5
Share (percent)	(39)	2	(29)	3	(27)	2	(34)	4	(34)	3
Earned income	37	3	643	3	343	2	154	0	111	1
Share (percent)	(61)	-1	(71)	-1	(73)	-1	(66)	-1	(66)	-1
Earned income by sector:										
Manufacturing	6	3	14	7	62	1	11	-5	18	1
Share (percent)	(16)	0	(2)	5	(18)	-1	(7)	-5	(16)	0
Retail and services	13	4	167	4	97	4	54	4	18	0
Share (percent)	(36)	1	(26)	2	(28)	2	(35)	3	(16)	-1
Government	6	1	310	2	78	2	47	1	33	3
Share (percent)	(16)	-3	(48)	-1	(23)	0	(31)	1	(29)	1
TCPU:[d]	4	2	43	2	30	2	11	1	7	-1
Share (percent)	(11)	-1	(7)	-1	(9)	0	(7)	1	(7)	-2
Other	8	5	109	2	76	2	29	1	35	1
Share (percent)	(21)	2	(17)	0	(22)	0	(19)	1	(32)	0

Note: Growth estimated by using growth function fitted to 1969–96 data.
[a] Million 1995 dollars.
[b] Personal income is adjusted for residency.
[c] Personal income is unadjusted.
[d] TCPU = transportation, communications, and public utilities.
Source: Regional Economic Information System (USDC BEA 1998).

The first row of the table shows total personal income after adjustments made by the Bureau of Economic Affairs to account for "personal contributions to social insurance," and for nonresident income. Because wage and salary income for individual sectors is not adjusted, an additional, unadjusted personal income measure is shown in the second row of table 5. Unearned and earned income shares are derived from this second total personal income category. For the purposes of this study, the most important point to be noticed in the upper half of the table is that growth in unearned income[5] was at least twice that of earned income in each of the boroughs. Unearned income now accounts for a substantial proportion of total income in the region. This highlights the recent emphasis placed on unearned income in recent economic base studies and more general studies of growth and change in rural economies (see for example, Galston and Baehler 1995, Mulligan 1987, Nelson and Beyers 1998b).

[5] In most boroughs, unearned income is about evenly divided between transfer payments and investment income. For the boroughs examined in this study, retirement benefits, medical payments and "other payments to individuals" (primarily disbursements from the Alaska permanent fund) accounted for approximately 85 percent of total transfers. Income maintenance and unemployment benefits accounted for most of the remainder.

Earned income by major employment sector is shown in the bottom half of table 5. Except in the case of Juneau and the Wrangell-Petersburg Borough, the share of manufacturing in total earned income has been stable or falling, and that for retail and services has been increasing. Other sectors display a high degree of heterogeneity across communities in terms of both current shares and performance over time. Increases in the retail and services sectors can largely be explained by the growing tourism trade and increased purchases by residents flowing from growth in unearned income. Import substitution resulting from increasing agglomeration economies in a growing regional economy also may be a factor.

Statistical Evidence

To test the validity of the economic base hypothesis, the REIS income data were first divided into basic and nonbasic categories. Once again, an assignment method was used, with unearned income, manufacturing income, and earnings by federal employees being coded basic, and the remainder being coded nonbasic. Recreation and tourism are not identified separately in the REIS data, and income from employment in these categories is distributed primarily in the nonbasic sectors. The same techniques used in the employment analysis (a trend variable in the levels model and simple intercept in the first-differenced model) are used here, and the same sorts of issues also apply.

Unfortunately, the REIS data do not differentiate between state and local government income in the study region prior to 1979. Consequently, state government activity could not be singled out in the analysis, and this could significantly alter statistical results, particularly in Juneau. To investigate this possibility, an alternate assignment scheme was tested in which income to state and local government employees was also coded as basic. The results of this analysis were in general agreement with those of the tests presented below, and they are not reported here.

When plotted against time (see charts in app. 3), the basic and nonbasic income series for the sample boroughs reveal a somewhat different evolution than that apparent in the community-level employment series. Owing in large part to the inclusion of unearned income, basic income matches or exceeds nonbasic income in four of the five boroughs. Juneau, with its high levels of state-government activity, is the only exception. Likewise, given strong and continued growth in unearned income, a readily discernible upward trend is evident in basic income as well as in nonbasic income. And finally, the relative variance over time of the basic income series is substantially reduced relative to that for the community employment series, thus reducing the signal-to-noise ratios in statistical tests of the relation between basic and nonbasic variables. Haines and Wrangell-Petersburg Boroughs are the only areas exhibiting the same sort of sharp swings in basic activity as were evident in the community employment data.

A regression model similar to that used in the employment analysis was used to gauge the impact of current and lagged levels of basic income on current levels of nonbasic income. A linear trend and an autoregressive correction term were included in the regression model. Owing to the use of annual data, the number of lag terms was reduced to three (a 3-year lag) and modeled by using a simple, unrestricted lag structure. A second model involving first-differenced variables also was tested, although in this case both the linear trend and the autoregressive term were dropped. The two model specifications are as follows:

Levels model:

$$NB_t = \alpha + \sum_{i=0}^{n} \beta_i B_{t-i} + \gamma TR + e_t \qquad n = 3 \ . \tag{22}$$

Difference model:

$$\Delta NB_t = \sum_{i=0}^{n} \beta_i \Delta B_{t-i} + e_t \qquad n = 3 \ . \tag{23}$$

Results from these two models are shown, respectively, in the upper and lower halves of table 6. In general, the model results are inconclusive. The levels model demonstrates significant estimates for the trend variable along with reasonably high R^2 values—an unsurprising result given the prevalent growth trend in the region. However, only one borough (Juneau) demonstrates significant coefficients on the basic income variables, and in this case the signs on the coefficients are opposite from that predicted by the economic base model. Regarding the first-differenced model, the inability of the model to explain changes in nonbasic income is clearly evident in the low R^2 values and insignificant F statistics. Significant coefficient estimates for the lagged basic income variables include, once again, negative coefficients for Juneau, and one positive estimate for Wrangell-Petersburg Borough at a 3-year lag. (Note that these results were rendered insignificant for Juneau when the alternate assignment scheme described above was used, although the signs were not reversed.) This estimate for Wrangell-Petersburg constitutes the only support for the economic base hypothesis in the current (income) analysis, and it is accompanied by negative coefficient estimates for the other lagged variables, particularly at lag 1 where the t-value is nearly as large as that for the lag-3 coefficient.

Given these weak results, a further test using Granger causality was undertaken to verify the lack of a unidirectional causal relation from basic income to nonbasic income. By regressing current values of a given variable (Y) on its own past values and past values of another variable (X), Granger causality represents a vector autoregression (VAR) technique that tests whether the inclusion of the lagged values for X helps to predict Y. If so, Y is said to be "Granger-caused" by X, a qualified statement that need not imply a strict causal relation (see Granger 1969, Greene 1993 for details). As noted above, this is a technique used by Connaughton et al. (1985), Lesage and Reed (1989), Nishiyama (1997), and others to test, with varying results, for the relation between basic and nonbasic activity. The advantage of this approach lies primarily in the lack of a priori restrictions placed on the relation in question. Diagnostic statistics, however, are not as developed, and the interpretation of results is more problematic.

As in other VAR techniques, it is necessary to assure stationarity in the variables before proceeding. By using an augmented Dickey-Fuller unit root test, first-differenced series for basic and nonbasic income were found to be stationary at the 5-percent significance level for all the boroughs. The Granger causality test proceeds by considering two paired hypotheses: X => Y, and Y => X, where "=>" is used as shorthand for "Granger causes." Under the economic base hypothesis, we would expect to reject the hypothesis that nonbasic income => basic income, and accept the opposite hypothesis that basic income => nonbasic income (Nishiyama 1997). Results from this test conducted for different lag lengths are presented in table 7. In all but one instance, the null hypothesis that basic income **does not** Granger cause nonbasic income cannot be rejected. Wrangell-Petersburg Borough, at lag 3, is the only exception, and this corresponds with the results from the regression model presented above. In the Ketchikan-Gateway Borough (referenced here as "Ketchikan"), the alternate hypothesis that

Table 6— Regression results for levels and first-differenced income models (nonbasic income as dependent variable)

Model type and location	B[a]	B(-1)	B(-2)	B(-3)	Trend	AR(1)[b]	Adj. R^2	DW
Levels model								
Haines	0.04	0.03	0.04	0.02	447	0.66	0.89	1.83
	.6	.4	.3	2.7**	3.4**			
Juneau	-.48	-.94	-.76	-.49	26,847	.81	.89	1.52
	-1.1	-2.2**	-1.8*	2.4**	6.8**			
Ketchikan	-.08	-.06	-.10	.10	3,876	.29	.93	2.21
	-.5	-.5	-.8	.8	4.0**	1.2		
Sitka	.10	-.34	0	.31	1,413	.55	.72	1.84
	.3	-1.2	0	1.1	2.5**	2.5**		
Wrangell-Petersburg	-.06	-.22	-.20	.22	103	.54	.52	2.08
	-.5	-1.7	-1.5	1.6	.1	2.6**		
First-differenced model								
Haines	.01	.02	.04	0	—	—	-.16	2.12
	.24	.33	.59	.03	—	—		
Juneau	-.48	-.97	-.83	-.50	—	—	.14	1.39
	-1.1	-2.2**	-1.9*	-1.2	—	—		
Ketchikan	.15	-.01	-.03	-.02	—	—	-.09	2.03
	1.2	-.1	-.2	-.1				
Sitka	.20	-.30	-.02	.23			-.05	2.19
	.8	-1.2	-.1	.9				
Wrangell-Petersburg	-.06	-.21	-.19	.22			.13	2.53
	-.5	-1.7	-1.5	1.7*				

Note: t-values are immediately below coefficient estimates. ** indicates significance at the 5-percent level, * at the 10-percent level.

[a] B () refers to current and lagged basic income.

[b] AR(1) refers to the autoregressive correction term. An intercept term was included in the regressions but not reported here. See text for variable definitions.

nonbasic income Granger causes basic income cannot be rejected. This result is similar to that of Connaughton et al. (1985) who found, in the case of Flathead County, Montana, qualified support for the assertion that the commonly assumed direction of causality between basic and nonbasic activity may indeed be reversed. However, the fact that the other boroughs in the current analysis do not demonstrate similar results (with the exception of Wrangell-Petersburg at lag 1) would argue against the general adoption of this result for all communities. Moreover, an examination of the impulse response function (not included here) indicates that the significant relation measured for Ketchikan in the Granger causality test is, in fact, negative—a result not considered in the Connaughton study.

The analysis presented in this section is somewhat less satisfying than that for the employment data. In general, the lack of spatial detail and cross-sectional dimension limits the information available from the analysis as a whole, and the scarcity of data points resulting from the annual (as opposed to quarterly) data reduces the precision of the individual estimates. At the higher levels of spatial aggregation in the REIS data

Table 7—Granger causality tests on first-differenced income data

Location and probability of accepting the null hypothesis 1	Lags			
	2	3	4	
Haines:				
Nonbasic => basic	0.15	0.24	0.39	0.55
Basic => nonbasic	.60	.81	.78	.72
Juneau:				
Nonbasic => basic	.87	.26	.42	.61
Basic => nonbasic	.20	.33	.48	.25
Ketchikan:				
Nonbasic => basic	.08	.02	.01	0
Basic => nonbasic	.80	.71	.78	.62
Sitka:				
Nonbasic => basic	.60	.83	.84	.74
Basic => nonbasic	.37	.57	.38	.56
Wrangell-Petersburg:				
Nonbasic => basic	.05	.16	.21	.58
Basic => nonbasic	.22	.26	.05	.20

Note: X => Y indicates hypothesis that X "Granger causes" Y.

set, much of the community-specific variation is lost. Given an income data set comparable in spatial and temporal detail to the ADOL employment data, results conforming to those in the employment analysis, in terms of significant estimates for individual communities, may be possible. However, such a result is by no means assured.

The lack of a significant positive relation between basic and nonbasic income may provide an indication of the absence of significant income impacts, a fact not registered in the employment data. This conclusion is bolstered by the results from Sitka and Haines Boroughs. Each borough roughly corresponds with the community as delineated in the ADOL data, variation in manufacturing and total basic income is relatively high (especially in Haines), and the results from the employment estimates were insignificant. In any case, the analysis in this section provides no indication of significant positive impacts not apparent in the employment analysis.

Unemployment Benefits

A final issue to be considered here is the role of unemployment benefits and income maintenance programs (Supplemental Security Income [SSI], Aid to Families with Dependent Children [AFDC], food stamps, etc.) in mitigating impacts from changes in the basic sectors. The central question here is whether increases (decreases) in these income sources sufficiently offset decreases (increases) in basic income to account for the absence of significant impacts on the nonbasic sectors.

Summary statistics for unemployment and income maintenance are shown in table 8 both in terms of dollars and in their share of total personal income. In relation to total income, these income sources are relatively small, ranging from a combined mean share (measured over the study period) of 1.2 percent for Juneau to 2.8 percent for Haines. Certain boroughs demonstrate a relatively high temporal variance in unemployment benefits, especially Haines Borough where, in 1977, maximum benefits

Table 8—Summary measures for unearned income in selected southeast Alaska boroughs, 1969–96

Location and measure	Mean	Maximum	Minimum	Std. dev.
Haines:				
Welfare[a]	473	855	222	184
Share[b] (percent)	1.1	2.4	.6	.5
Unemployment[a]	707	2,050	282	468
Share[b] (percent)	1.8	6.4	.3	1.5
Ketchikan:				
Welfare[a]	3,832	6,185	2,570	1,114
Share[b] (percent)	1.0	1.5	.7	.2
Unemployment[a]	3,392	7,681	1,287	1,724
Share[b] (percent)	1.0	2.2	.3	.6
Wrangell-Petersburg:				
Welfare[a]	1,439	2,410	827	499
Share[b] (percent)	.9	1.4	.5	.3
Unemployment[a]	2,060	4,467	705	1,116
Share[b] (percent)	1.4	3.1	.3	.8
Juneau:				
Welfare[a]	4,183	8,311	2,254	1,877
Share[b] (percent)	.6	.9	.3	.2
Unemployment[a]	4,392	7,850	2,621	1,446
Share[b] (percent)	.6	1.2	.3	.2
Sitka:				
Welfare[a]	1,105	2,078	560	493
Share[b] (percent)	.5	.9	.2	.2
Unemployment[a]	1,867	3,904	938	740
Share[b] (percent)	.9	1.8	.4	.3

[a] Welfare and unemployment are both expressed in thousand 1995 dollars.
[b] Share refers to share of total personal income.
Source: Regional Economic Information System (USDC BEA 1998).

attained a level of 6.4 percent of total income. The magnitude of changes in unemployment benefits relative to that for basic income is, nonetheless, quite small. This can be shown by examining the ratio between the standard deviation for changes in unemployment benefits (i.e., the first-differenced series) and that for basic income. These values range from 0.06 for Haines to 0.09 for Juneau (the fact that Haines demonstrates the lowest score in spite of high variance in unemployment benefits is a result of the even higher relative variance in basic income in that borough). In other words, changes in unemployment benefits generally range between 6 and 9 percent of changes in basic income. Consequently, although unemployment benefits and income maintenance may serve to partially mitigate employment and income impacts on nonbasic sectors, their influence will be quite limited. They certainly cannot be cited as a major factor underlying the absence of a significant impact multiplier in many of the communities and boroughs examined in this study.

Discussion of Results

No one model or approach presented here is definitive in itself, but when viewed as a whole, the evidence presented in this chapter provides strong and robust support for the rejection of the assumption of a positive impact multiplier uniformly at work in the communities of southeast Alaska. In certain communities, a significant positive relation between basic and nonbasic employment exists, but in other instances a negative relation is significant, and the average response across all communities is essentially zero. Visual observation and statistical results were consistent with each other, and the statistical results were generally replicated across several model formulations. In addition, the analysis of income provided no evidence of a major discrepancy between income and employment measures of impact. Consequently, the empirical results presented in this study indicate a rejection of the economic base hypothesis, or, more accurately, a failure to reject the null hypothesis.

Of course, it may be argued that the economic base hypothesis postulates impacts in a ceteris paribus ("all other things equal") environment in which other exogenous variables do not change, and that the current analysis does not account for this fact. It must be remembered, however, that the estimation results presented here are based on deviations from trend. Hence, trending violations of the *ceteris paribus* assumption are accounted for in the regression analysis. Other violations can generally be assumed to be uncorrelated with the independent variable, basic activity. Their influence on the analysis will be to reduce the precision of the multiplier estimates but not to systematically bias these estimates in one direction or another. This will be a problem in any study that seeks to measure economic base relations. In the current study, it has been argued that the high relative variance in the dependent variable in combination with the relatively simple economic structure of the sample communities allows for a viable test of the economic base hypothesis, a test that cuts through the noise associated with ceteris paribus violations.

Endogenous responses to external shocks in the basic sectors that mitigate response in nonbasic activity are another possible reason underlying the failure to reject the null hypothesis. Unemployment benefits and other income maintenance programs were identified as likely mitigating responses, but the magnitude and variation of these income sources are quite small relative to changes in basic income. Reduced or negative aggregate savings is another possibility, but one that cannot be directly addressed in this study. In either case, it should be remembered that the impacts examined here include both positive and negative shocks in the basic sectors and that the compensating mechanisms mentioned above are asymmetrical relative to the direction of the shock. Additional endogenous responses may be anticipated, but, as in the case with factor market adjustments, many violate the economic base hypothesis itself.

Yet another argument can be made that the measures used in this analysis are not sensitive enough to register secondary impacts even though these impacts may be positive and substantial. Employment measures, in particular, may not closely track actual labor inputs in terms of either hours or effort. Given long enough lag times, however, it seems likely that the relation between employment measures and actual labor inputs will return to its preshock condition. Otherwise, structural or behavioral changes in labor markets must be assumed. This is a possibility, but one that cannot be addressed within the scope of the current analysis. In any case, the income analysis also failed to provide evidence for the rejection of the null hypothesis. Also, the employment and income measures used in this analysis are precisely the same kinds of measures that are commonly used in applied impact analyses. Consequently, if these variables are not sufficiently sensitive to register impacts, then a majority of applied impact analyses, and not just the current study results, are called into question.

Although the average estimate is close to zero, an important result from the employment analysis is that individual communities demonstrate significant heterogeneity in their response to exogenous shocks. This may help explain the inconclusiveness of the overall history of empirical research into the economic base relation. Much of this research was conducted at larger spatial scales and generally with less cross-sectional information. The choice of study area and time period, rather than estimation, could underlie positive results in some cases and insignificant results in others. As a result, analyses of single spatial units should be viewed as individual case studies rather than statistical tests of a generalized hypothesis.

One important difference, however, between this study's results and those of preceding studies is the presence of significant negative estimates. The only other negative results reported in the research reviewed for this report are the negative impulse response functions reported by Lesage and Reed (1989) for two of the eight Ohio cities examined in their report. In both cases (Canton and Cincinnati), the impulse response is unambiguously negative, but, although noting this result, the authors do not address it in their analysis or conclusions. Also, it should be remembered that Granger causality tests will not, by themselves, identify the sign of the relation. Hence, studies such as Connaughton et al. (1985) that report Granger test statistics but do not examine impulse response functions may actually be measuring negative relations.

The discussion of local economic processes in chapter 3 provides some indication why partial impact multipliers may be absent in the communities examined in this study. Two general reasons can be identified: (1) high leakage (as reflected in low values for the leakage terms δ and γ) effectively reduces multipliers to statistically undetectable levels; and (2) constrained factor supplies, particularly for labor, reduce or even reverse the relation between basic and nonbasic sectors.

A high amount of income leakage is no doubt increasingly important at smaller spatial scales. This is especially true in regions like southeast Alaska where nonresident employment is substantial. Factor supply constraints are difficult to measure, particularly in the presence of sticky wages. They are commonly assumed to be absent in economic base and fixed-price I-O applications to local economies, but this assumption is seldom justified in the literature by actual empirical evidence. In the small semi-isolated communities examined in the current study it seems likely that factor constraints would be present to some extent—the spatial and cultural barriers to information transfer and migration are too large for it to be otherwise.

The significant negative estimates for certain of the communities in the study sample indicate the possibility of local factor supply constraints. At the same time, significant positive estimates in other communities provide a counterindication. On the whole, the heterogeneity of study results indicates the need for further study. Factor markets, particularly those for labor, constitute a likely starting point.

When viewed in combination, the effects of high leakage and constrained factor supplies in a growing regional economy provide a plausible explanation for the zero average multiplier estimate and even the negative estimates in some communities. If, for example, a given community experiences high income leakage, its static impact multiplier in an economic base context may already be quite low. Certain I-O studies of small communities, although rare, indicate that this may indeed be the case.[6] As noted in chapter 3, the result of economic growth in the presence of factor constraints will be locally unmet opportunities for factor employment. These will include, in the case of southeast Alaska, opportunities for import substitution and expansion of tourist-related activity, both concentrated primarily in the services and retail sectors. Increases (decreases) in timber sector employment, in this environment, will have a limited multiplier even under the assumption of perfect factor supply elasticity, and will further act to absorb (release) inputs from other sectors in a factor-constrained economy. Here an insignificant or even negative relation between basic and nonbasic employment is a distinct possibility, particularly if tourist-related activity is coded as nonbasic.

In considering factor constraints, labor has been the key focus, but capital markets also may be important. In the case of large installations, such as lumber mills or major hotels, it is reasonable to assume that capital is obtained from outside sources. In many smaller retail and service establishments, however, large-scale investors cannot be expected to respond to local opportunities, and residents may provide much of the capital needed to open and sustain these businesses. Consequently, the investment behavior of local residents, and not just the expected return on investment viewed from an impartial perspective, will be important. A certain proportion of newly unemployed workers, for example, may use their savings to create alternative jobs for themselves within the community, even if better opportunities for investment are found elsewhere. Such activity will serve to further reduce multiplier estimates.

The importance of this, as well as that of the labor shifts between basic and nonbasic sectors, will crucially depend on the flexibility and initiative of local residents, factors that are not commonly incorporated in traditional economic analyses. An additional factor that is not readily amenable to quantification is the general investment climate of a region or locality. The rational (and not so rational) expectations of residents and investors may in fact eclipse the importance of a single production facility or sector. Once again, regional growth and opportunity will play a central role in both bolstering confidence and in allowing the individual investment and migration decisions based on this confidence to actually bear fruit over time.

Regional growth is, in fact, a crucial element in this overall argument. In a shrinking economy, excess labor supply as well as excess capacity in the nonbasic sectors is likely, and the linear impact multipliers hypothesized by economic base and I-O models may be more applicable than in growing regions where factor supplies are more binding. Additionally, pessimism on the part of residents and investors in a declining region may further exacerbate the impacts of negative exogenous shocks and mitigate those of positive shocks.

The statistical results presented here should not be extended to a general explanation of the cause of growth or decline in small communities. Specifically, a zero average (partial) multiplier estimate cannot be used to argue that outside income plays no role

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[6] Hamilton and Jensen (1983), for example, estimated a **total** local multiplier of just 1.1 for the smallest level of their trade hierarchy (Toowoomba City, Queensland, Australia) and 1.54 for the next level (Moreton Region including Brisbane, Australia—a regional center), implying that over 85 percent of impacts resulting from shocks to local basic employment will occur elsewhere in the region (see also Hamilton et al. 1994). These results, and others like them, will be highly sensitive to the techniques and data used to adjust the technology matrix for local leakage.

in local economic development. In the case of southeast Alaska, for example, it would be foolish to claim that growth in tourism, unearned income, or state government activity has played no role in economic growth in the region and its constituent localities. What the results do indicate, however, is that the impact of specific basic activities on local economies is neither additive or linear in the fashion assumed by economic base or standard I-O models.

In light of the above arguments and the inconclusive nature of the research history in this area, the results of this study are perhaps not so surprising. Nonetheless, the casual assumption of a positive relation between basic and nonbasic activity is a particularly durable one, especially when applied to the sort of small communities examined here. Indeed, the economic base hypothesis underlies a broad spectrum of applied academic research, applied impact estimation, and public policy, all directed to the question of local economies and their likely prosperity in the face of economic change. The implications of its rejection, therefore, are extreme and far reaching. These implications will be the general topic of chapter 5.

Chapter 5: Policy Implications and Future Research

Empirical evidence in the preceding chapter indicates (1) a failure to reject the null hypothesis of no relation between basic and nonbasic economic activity **on average** for the forest communities of southeast Alaska and (2) significant heterogeneity in the responses of the nonbasic sectors of specific communities to shocks in the basic sector. This chapter discusses the implications for policy and potential avenues of future research flowing from these results.

Policy Implications

The implications of these results for resource and rural development policy can, for the purposes of this study, be divided into two main areas. The first is related to the distribution of funds and other policy measures designed to alleviate negative policy impacts. The second is related to the analytical techniques commonly used in impact assessment.

Relief Funding and Community Development

A major implication of this study is that "community" may not be a particularly important unit of analysis in attempting to understand and address economic impacts. If it cannot be demonstrated that a mill closure or similar economic shock will have significant economic ramifications in other sectors in the local economy, then the direct employment and income losses in the directly impacted sector become a more appropriate subject of focus in impact assessment. In this context, it is meaningless to speak of "community impacts" as something other than simply the local portion of the direct impacts of the closure, and the focus on community may serve to divert resources from those individuals who need help the most. As a result, relief funding should be targeted to help directly impacted individuals in the sector receiving the exogenous shock rather than broader development projects aimed to bolster the economic prospects of the community at large.

Of course, there are numerous ways in which community and individual aid might be distributed. Some of these could involve "joint production possibilities" in which community goals as well as aid to directly impacted individuals are combined. Also, it is possible that the economic and psychological welfare of directly impacted individuals may be best addressed in a community setting. Thus, community could remain an important concept in organizing relief efforts and seeing them through to a successful conclusion. Nevertheless, the results here suggest that directly affected workers and their families, rather than hypothetical secondary impacts to other workers in the community, should be the focus of relief funding attached to specific resource policy decisions.

The heterogeneity of results for specific communities as well as the overall growth occurring in the study region over the sample period constitute an important caveat to the above recommendations. It is possible, and perhaps likely, that certain communities will demonstrate significant secondary impacts, especially in a stagnant or declining regional economic environment. In the absence of reliable estimates of expected secondary impacts for specific communities, perhaps the best policy option is to maintain an emphasis on directly impacted individuals but also to include monitoring programs in areas where secondary impacts are deemed probable.

Policies related to the general encouragement of local economic development and welfare are beyond the scope of this study, but the study results do indicate that the promotion of a specific export industry may not yield the full range of linked impacts often envisioned. The opening of export manufacturing facilities, for example, may not significantly alter aggregate employment trends net of the new facility. Once again, however, the qualifications resulting from community-specific heterogeneity and the overall regional economic environment apply.

Impact Assessment

The underlying hypothesis that the economic prospects of a given locality are directly tied to the performance of certain key export industries is a persistent argument in many resource policy debates. Conflicting assertions as to the nature and magnitude of this relation often result in conflicting impact estimates and general public confusion. Given the emphasis on export industries, the economic base of a given locality often becomes the central focus of impact assessments. Studies that seek to describe, measure, and project the performance of basic sectors are commonplace. Often, basic sectors are viewed as independent components of the local economy whose levels and trends, and their associated multipliers, can be added or subtracted in a linear fashion. The results of the current study suggest that this approach is largely unfounded.

Although the economic base ratio is now less frequently used to generate specific multipliers, the fixed-price input-output (I-O) models that have taken on this role can arguably be viewed as an extension of an underlying economic base theory. Certainly, I-O models can accommodate a much greater degree of detail and complexity, and they do not involve the splitting of local activity into two simple aggregates. The underlying assumptions of standard I-O models are, nevertheless, essentially the same as those in economic base theory. As argued in chapter 3 of this study, the fundamental assumption in both approaches is that local factor supply is perfectly elastic. This assumption, when combined with additional (but perhaps less problematic) assumptions about local production technologies, allows for a static view of local economies in which prices and price equilibria play no part. Exogenous demand becomes the sole determinant of local economic structure and change. This unidirectional causal relation is summarized in the form of a linear impact multiplier.

A standard procedure in impact assessment is to use I-O derived multipliers in conjunction with projections of basic employment or income to estimate total economic impacts. In academic studies, considerable attention may be devoted to the actual derivation of these multipliers (although attention to the underlying assumptions of the model often may be limited). In many practical impact assessments, however, the derivation of the impact multiplier and its associated caveats are omitted. As such, the impact multiplier exists as an unquestioned, but often crucial, assumption buried in the analysis. Results from the current study indicate that a great deal more scrutiny should be given to these multipliers and their resulting impact assessments. The same perhaps can be said for multipliers derived from more elaborate modeling approaches if the lack of data or other resources prevents the proper parameterization and specification of the model for actual conditions in the locality being modeled.

It is important to remember, however, that this critique most directly concerns relatively simple modeling applications applied in settings similar to those encountered in this study (namely, small, semi-isolated forest communities in a growing regional economy). A more generalized critique of I-O methodology is not directly forthcoming from this analysis. The results of this study, however, do represent an example in which the fundamental postulates of I-O and economic base theory are apparently not validated. To be fair, many I-O applications, fixed-price and otherwise, entail various innovations that substantially differentiate themselves from the simplified characterization presented in the current analysis. Consequently, the challenge to I-O and economic base methods inherent in the study results should not be uniformly applied to all models of this type; the relevance of these results to specific models must be judged on a case-by-case basis. Nevertheless, the evidence presented here would seem to indicate the need to engage in a more thorough empirical validation of static, demand-driven modeling approaches as a general class. Unfortunately, the complexity and sometimes ad hoc nature of many innovations constitute barriers to validation.

Whereas the average result of no relation between basic and nonbasic activity suggests the possible insignificance of linear impact multipliers, the heterogeneity of community-specific estimates provides a somewhat counter indication. Here, the analyst must weigh the risk of accepting the null hypothesis of no relation when a significant relation does in fact exist—an example of a type I error—against the risk of erroneously rejecting the null—a type II error. The difficulty in balancing these risks is further compounded by the possibility of a negative relation between basic and nonbasic activity in certain communities. Although the analysts involved in the impact assessment may have certain preferences, the political imperatives and social concerns surrounding the broader policy debate will no doubt partially dictate the way these risks should be handled. In some circumstances, the assumption of positive secondary impacts may be indicated. If such is the case, then care should be taken to include proper (and explicit) caveats and qualifications to the analysis.

On a more general level, the variance in community-specific estimates as well as the hypothesized importance of the economic performance of the study region at large indicate the need to consider the broader local and regional contexts. Such factors as overall regional and local growth trends, the magnitude and nature of alternative sources of outside income, the size and structure of local economies, the spatial distribution of income expenditures, and the spatial and cultural isolation of communities will play an important role in determining the secondary impacts resulting from a shock to the timber or other export sectors. In the first instance, secondary impacts may be quite different in declining regions than in growing regions. In the second, alternative outside income sources may vary considerably in their ability to absorb or release labor and capital resources resulting from changes in other sectors. In the third, the size and overall structure of local economies will have important implications for the resiliency and ability of communities to adjust as well as for more narrow questions focused on income leakage and local endogeneity. And in the last case, the degree of isolation in a given community will affect the mobility of labor and other resources.

All these factors, as well as others not enumerated here, are potentially important in assessing policy-related impacts. Unfortunately, current understanding of how they individually and collectively affect local impact processes is extremely limited, especially in the context of multiple and ongoing exogenous changes. The current analysis provides little indication of the relative importance of each factor or of the nature of their mutual interaction. It does indicate, however, that the assumption and application of a positive sector-specific impact multiplier is not a viable analytical approach to impact estimation in small communities. This, in turn, points to the need for further research into the dynamics of small-area economic impacts as they actually occur over time in specific localities.

Avenues for Future Research

In that the core results of this study indicate the rejection of the economic base hypothesis for small communities, the need to develop other ways of understanding and predicting small-area economic impacts comes to the fore. Rather than build more complex models under the assumption that knowledge gaps will be filled in with time, I believe that empirical investigation into the basic relations we use to build these models is the most pressing research agenda in this area. There are multiple possible avenues for investigation, and two distinct lines of inquiry are clearly implied in the current analysis: (1) further investigation of the relation between exogenous and endogenous income sources in different settings and (2) factor markets and labor response to employment shocks in small rural communities.

Testing the Relation Between Exogenous and Endogenous Activity in Different Settings

Although the results of this study and certain of the other studies cited above indicate the rejection of the economic base hypothesis, they do not provide a clear analytical or empirical explanation of why this is the case. Low levels of local economic endogeneity and concomitant high income leakage were identified as a possible cause in the current study, a cause that does not violate economic base or I-O assumptions but that may nonetheless reduce multipliers in small communities to statistically insignificant levels. Studies that seek to accurately describe and measure the flow of money into, out of, and within rural communities could test this hypothesis. Input-output models could prove quite useful in such an investigation, but it is essential that they be properly parameterized with respect to business expenditure and personal income leakages. In this case, location quotients or other nonsurvey methods for identifying exports, imports, and local activity are not sufficient in themselves. Local surveys or more involved manipulation and analysis of preexisting community data will be necessary. Moreover, results from this approach must be viewed in the context of sensitivity analysis and not as empirical multiplier estimations, unless independent empirical verification is available. It is questionable, however, whether the rewards from this work will justify the considerable effort needed in data collection and analysis.

The significant heterogeneity in community-specific estimates in this study remains an important but unexplained result. This indicates another and perhaps more promising line of research. If the sort of variance found here is replicated in other small-community settings, particularly those involving a greater number of cross-sectional units, then it would perhaps be possible to explain why communities (or other spatial units) exhibit different impact responses. One potential approach would be to combine time-series analysis (as used in this study) with an expanded set of conditioning variables describing, for example, spatial characteristics or regional and local aggregate economic performance. If successful, research in this area could result in the partial resurrection of the economic base hypothesis under those specific circumstances where empirical evidence shows it to be significant. Here, the impact multiplier would act as one determinant among many driving local economic change.

Given its immense cross-sectional reach, relatively long timespan, variety of income and other variables, and ready availability, the REIS data set is an obvious starting point for this suggested research. The data's county-level resolution, however, may prove to be too coarse to pick up the sort of impacts examined in the current study. The REIS data, nonetheless, constitute a potentially fertile ground for investigations of the causal relations between sectors. Additionally, it could be useful in identifying the factors underlying growth and change in specific areas, such as the various components of unearned income or activity in the services and retail sectors. For finer spatial resolution, state data sources comparable to the ADOL could be useful, although considerable effort in data acquisition and manipulation will be necessary.

Factor Markets and Labor Response

Locally constrained factor supply, particularly that for labor, provides a ready and economically consistent explanation for many of the results presented in this study, especially the negative relations found in certain communities. As was shown in chapter 3, the assumption of an infinite supply of factor inputs is key in both economic base and standard I-O models. Where this assumption is violated, then the determinants of factor supply, as well as those for factor demand, must be considered in modeling impacts and local growth processes in general. Economic base and I-O practitioners have often argued that, owing to their small size, rural communities are essentially price takers in factor markets, but this argument has ignored the role of isolation in constraining factor supplies. The results from this study indicate that the possibility of local supply constraints should be taken seriously.

This suggests a research agenda to identify causal elements underlying factor supply. Labor could be the primary focus of this research, and a fundamental question would be the magnitude and timing of net migration responses to changes in local labor demand. Lags in adjustment and the possibility of persistent disequilibria in local labor markets would have to be considered. A possible approach is to examine the relation between wages and migration rates in a time-series setting. But given wage stickiness this may not be successful. Alternative approaches that use unemployment or other measures as proxies for local employment opportunity could be more promising, but considerable imagination in study design will be required. In either approach, the role of rational income maximization versus noneconomic motivations would be a central concern.

Longitudinal studies following the job and migration history of individuals over time are another possibility. The employment history of former mill workers, for example, could help answer the question of whether these individuals obtain alternative employment locally or migrate in search of other job opportunities more in line with their employment experience. In the former case, the hypothesis that shifts in local labor supply act to mitigate negative shocks would be maintained. The latter case would provide a counterindication. An additional benefit from such research would be an increased understanding of the nature and magnitude of economic hardship, including losses in lifetime income, experienced by workers facing job losses in the timber or other sectors.

Another potential area of research into the economics of local factor markets would be an investigation of the role of local investment in the development of different economic sectors. A central question here is to what extent local residents use their savings in combination with their labor to create local employment for themselves, and whether this propensity is sensitive to changes in employment opportunities in the commodities export sectors. Once again, an example of this would be an unemployed timber worker opening a bed and breakfast or similar establishment. Such activity will depend on a variety of economic and social factors including the presence of local opportunities and the initiative of local residents. Of course, whether this sort of development is actually common enough to be important in the broader setting of impact analysis is an empirical question. The ability of different sectors and activities to accommodate these investments is also an interesting and important question. Ostensibly, small business activity related to tourism or import substitution would seem most amenable to this kind of activity, but other opportunities including specialty wood products manufacture (toys, furniture, and the like) are also possibilities.

Conclusion

The prominent regional economist Harry W. Richardson, writing for the *Journal of Regional Science* in 1985 in his review of the then current history of research within the economic base paradigm, concluded that "[t]he literature would have to be much more convincing than it has been hitherto for a disinterested observer to resist the conclusion that economic base models should be buried, and without prospects for resurrection" (Richardson 1985: 646). Broad-scale investigation and application of the economic base theory have, nonetheless, continued. Although this work has been fueled, in part, by the introduction of new time-series techniques (Krikelas 1992) as well as the expansion of computational ability computers afford, perhaps the most important factor in the survival of economic base theory has been the simplicity and practical applicability of the concepts involved. Consequently, and in spite of the warnings of Richardson and others, the economic base concept with its associated multipliers remains a standard and widely (mis)used tool in practical regional economic analysis.

The strongest defense of I-O and economic base techniques has been their presumed applicability at smaller spatial scales. The results from the current study, however, imply that even in small communities where shifts in basic employment may be quite extreme, the economic base hypothesis is not supported by the empirical evidence. Linear impact multipliers derived from economic base or fixed-price I-O models are, therefore, not applicable in this setting. Both in the more narrow arena of impact assessment and the broader area of rural development at large, this conclusion has important policy implications. Chief among these is the fact that, within the general debate surrounding natural resource policy decisions, the presence of significant secondary impacts resulting from changes in resource-based economic activity cannot be taken as a matter of fact.

This is not to imply that outside income sources are not important in the economic development of rural communities. Common sense, as well as a long history of theoretical development and empirical analysis, provides a strong indication that outside income sources and locally endogenous activity are indeed integrated, meaning that they generally move in tandem over time. By itself, however, this integration does not justify the assumption that basic sectors can be viewed as independent components of a local economy, that the marginal impact of changes in a single sector can be modeled in a linear fashion, and that these impacts can be summed to provide a total impact estimate.

A more dynamic view of small-area economic interactions is called for, one that takes into account local factor supply as well as exogenous demand and that more accurately describes the magnitude and behavior of parameters measuring small-community income sources as well as leakage. The findings of this study suggest that, within this more dynamic context, the secondary impacts of changes in basic activity in many small forest communities may in fact be quite small or even, in some cases, negative.

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Appendix 1: Basic and Nonbasic Employment by Alaska Department of Labor Community

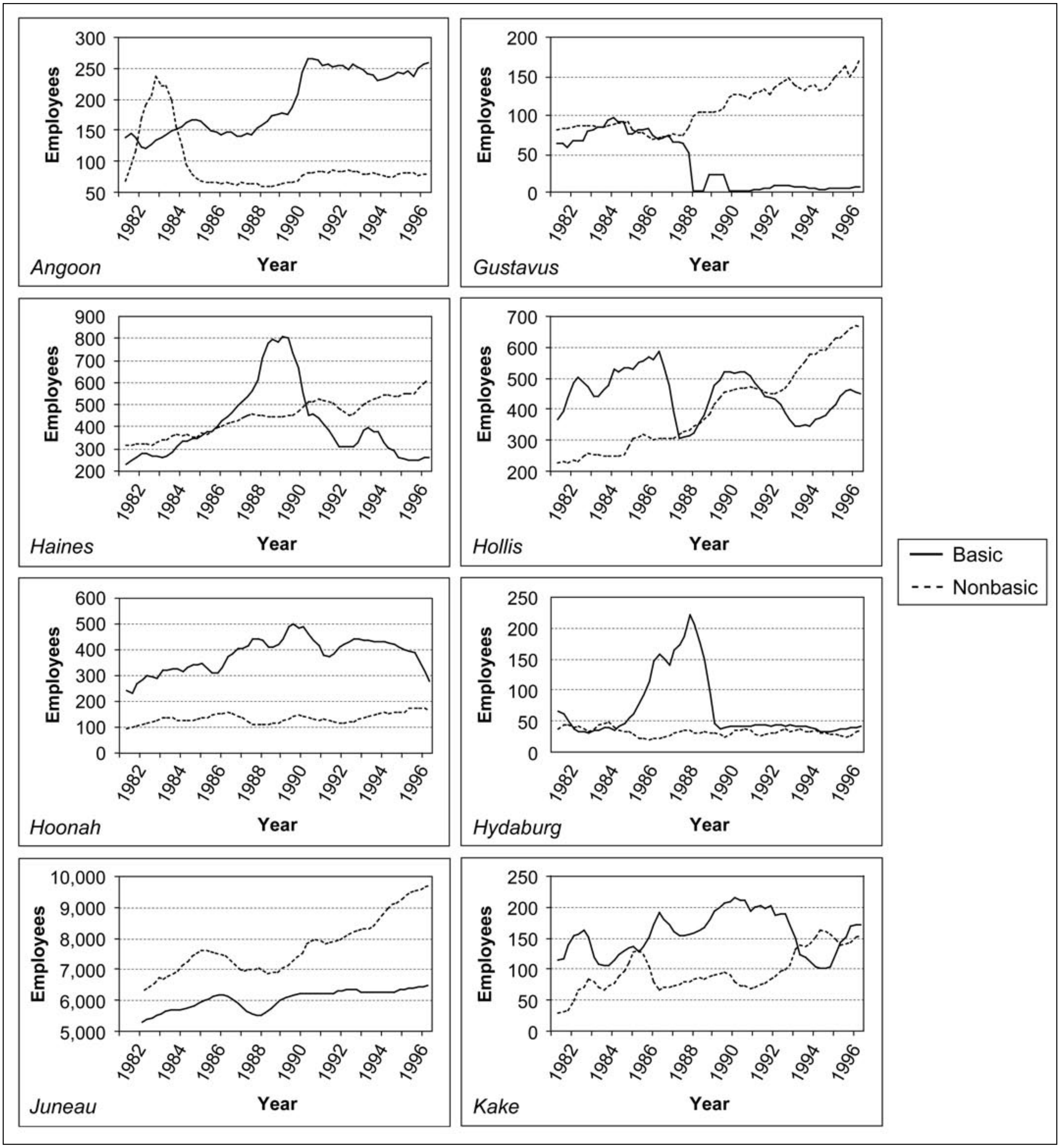

Figure 8—Employment figures for nonagricultural wage and salary employment (Alaska Department of Labor 1998). To obtain charts, monthly data were averaged for each quarter, and then a 4-quarter moving average was applied to eliminate seasonality. Basic and nonbasic categories were derived by using assignment method descibed in chapter 4 of the text.

Appendix 2: Results From Alternative Models

Table 9—Results from levels model (see text for model specification)

	Multiplier estimates			Trend		Diagnostic statistics			
Community	Value	Std. dev.	t-value	Value	Prob.	AR(1)	MA(4)	Adj. R^2	DW
Angoon	0.25	0.04	6.68**	-0.23	0.07	0	0	0.96	1.96
Gustavus	-.45	.22	-2.03**	1.30	.02	0	0	.97	2.00
Haines	0	.07	-.05	4.36	0	0	0	.97	1.12
Hollis	-.49	.13	-3.77**	7.61	0	0	0	1.00	1.53
Hoonah	.13	.19	.69	5.81	.34	0	0	.94	1.29
Hydaburg	.06	.04	1.29`	.22	.15	0	0	.81	1.59
Juneau	-.13	.37	-.35	119.56	0	0	0	1.00	1.35
Kake	-.53	.08	-6.19**	1.27	0	0	0	.97	1.56
Ketchikan	.00	.09	.00	40.62	0	0	0	.99	1.24
Metlakatla	-.38	.79	-.47	-3.09	.34	0	0	.93	.86
Petersburg	-.15	.16	-.98	2.97	0	0	0	.97	1.18
Sitka	.21	.18	1.15	22.48	0	0	0	.99	.75
Thorne Bay	-.12	.15	-.80	-.23	.85	0	0	.96	1.14
Wrangell	.31	.00	0	1.19	.03	0	0	.96	1.22
Yakutat	.57	.02	23.51**	.14	.38	0	0	.99	1.52
Average	-.05	.08[a]	3.19[b]	13.60	.15	0	0	.96	1.35

Note: Trend shows coefficient estimate on the trend variable and the 1-tailed probability that the estimate is zero. AR(1) and MA(4) are probability scores for accepting the null hypothesis of a zero coefficient on the autocorrelation and moving average error correction terms. Adj. R^2 and DW are the adjusted R^2 value and Durbin-Watson statistic.

** = 95-percent significance level.

[a] Standard deviation for the sample average of community multiplier scores.

[b] Average for the absolute value of community multiplier t-values.

Table 10—Results from freelag model (see text for model specification)

	Multiplier estimates		Diagnostic statistics			
Community	Value	Std. dev.	AR(1)	MA(4)	Adj. R^2	DW
Angoon	0.25	—	0.21	0	0.54	2.07
Gustavus	-1.23	—	.70	0	.32	1.84
Haines	.07	—	0	.23	.29	1.97
Hollis	-.43	—	.30	.08	.45	1.81
Hoonah	-.26	—	0	0	.59	1.69
Hydaburg	.06	—	.33	0	.43	1.95
Juneau	-.56	—	0	0	.79	2.00
Kake	-.57	—	.09	0	.58	1.95
Ketchikan	0	—	.02	0	.41	1.81
Metlakatla	-.89	—	0	0	.53	2.01
Petersburg	-.27	—	0	0	.68	2.02
Sitka	.31	—	0	0	.52	1.69
Thorne Bay	.03	—	0	.68	.63	2.22
Wrangell	.22	—	0	0	.53	2.05
Yakutat	.46	—	.08	0	.67	2.02
Average	-.19	.12[a]	.12	.07	.53	1.94

Note: AR(1) and MA(4) are probability scores for accepting the null hypothesis of a zero coefficient on the autocorrelation and moving average error correction terms. Adj. R^2 and DW are the adjusted R^2 value and Durbin-Watson statistic. T-values not available for the total multiplier estimate.

[a] Standard deviation for the sample average of community multiplier scores.

Table 11—Results from alternative lag models (see text for model specification)

Community	Multiplier estimates			Diagnostic statistics			
	Value	Std. dev.	t-value	AR(1)	MA(4)	Adj. R^2	DW
			8-period lag				
Angoon	0.19	0.12	1.56	0	0	0.89	2.40
Gustavus	-.30	.34	-.90	.90	0	.15	1.95
Haines	.06	.08	.73	0	.02	.29	1.94
Hollis	-.19	.11	-1.77**	.10	.01	.42	1.75
Hoonah	-.14	.12	-1.22	0	0	.48	2.02
Hydaburg	0	.04	-.05	.20	0	.44	1.93
Juneau	.65	.98	.67	0	0	.62	1.94
Kake	-.69	.18	-3.80**	.03	0	.51	1.91
Ketchikan	.14	.22	.64	0	0	.53	1.76
Metlakatla	.26	.38	.69	0	0	.56	1.98
Petersburg	-.36	.30	-1.20	0	0	.59	2.25
Sitka	.19	.24	.78	0	0	.59	1.72
Thorne Bay	.06	.18	.33	0	.11	.50	2.06
Wrangell	.06	.08	.74	0	0	.76	2.09
Yakutat	.38	.06	5.97**	.04	0	.62	1.96
Average	.02[a]	.08[b]	1.40	.09	.01	.53	1.98
			16-period lag				
Angoon	0.24	0.10	2.40**	0.13	0	0.35	2.10
Gustavus	-.32	.63	-.52	.96	.01	.09	1.93
Haines	-.06	.10	-.61	.02	.04	.35	1.94
Hollis	-.73	.23	-3.15**	.39	.13	.53	1.79
Hoonah	-.23	.16	-1.46	0	0	.52	2.21
Hydaburg	.05	.07	.71	.47	0	.42	1.95
Juneau	-1.52	1.25	-1.22	0	0	.65	1.86
Kake	-.42	.31	-1.36	.08	0	.42	1.89
Ketchikan	-.24	.16	-1.53	.55	.02	.55	1.86
Metlakatla	.37	.59	.62	.01	0	.69	1.94
Petersburg	-.25	.42	-.60	0	0	.66	1.91
Sitka	.11	.53	.20	0	0	.59	1.64
Thorne Bay	-.36	.09	-3.90**	.95	.08	.64	1.96
Wrangell	.18	.13	1.35	0	0	.58	2.09
Yakutat	.51	.08	6.72**	.57	0	.69	2.00
Average	-.18	.13[a]	1.76[b]	.28	.02	.52	1.94

Note: AR(1) and MA(4) are probability scores for accepting the null hypothesis of a zero coefficient on the autocorrelation and moving average error correction terms. Adj. R^2 and DW are the adjusted R^2 value and Durbin-Watson statistic.

[a] Standard deviation for the sample average of community multiplier scores.

[b] Average for the absolute value of community multiplier t-values.

** = 95-percent significance level.

Appendix 3: Basic and Nonbasic Income for Selected Boroughs

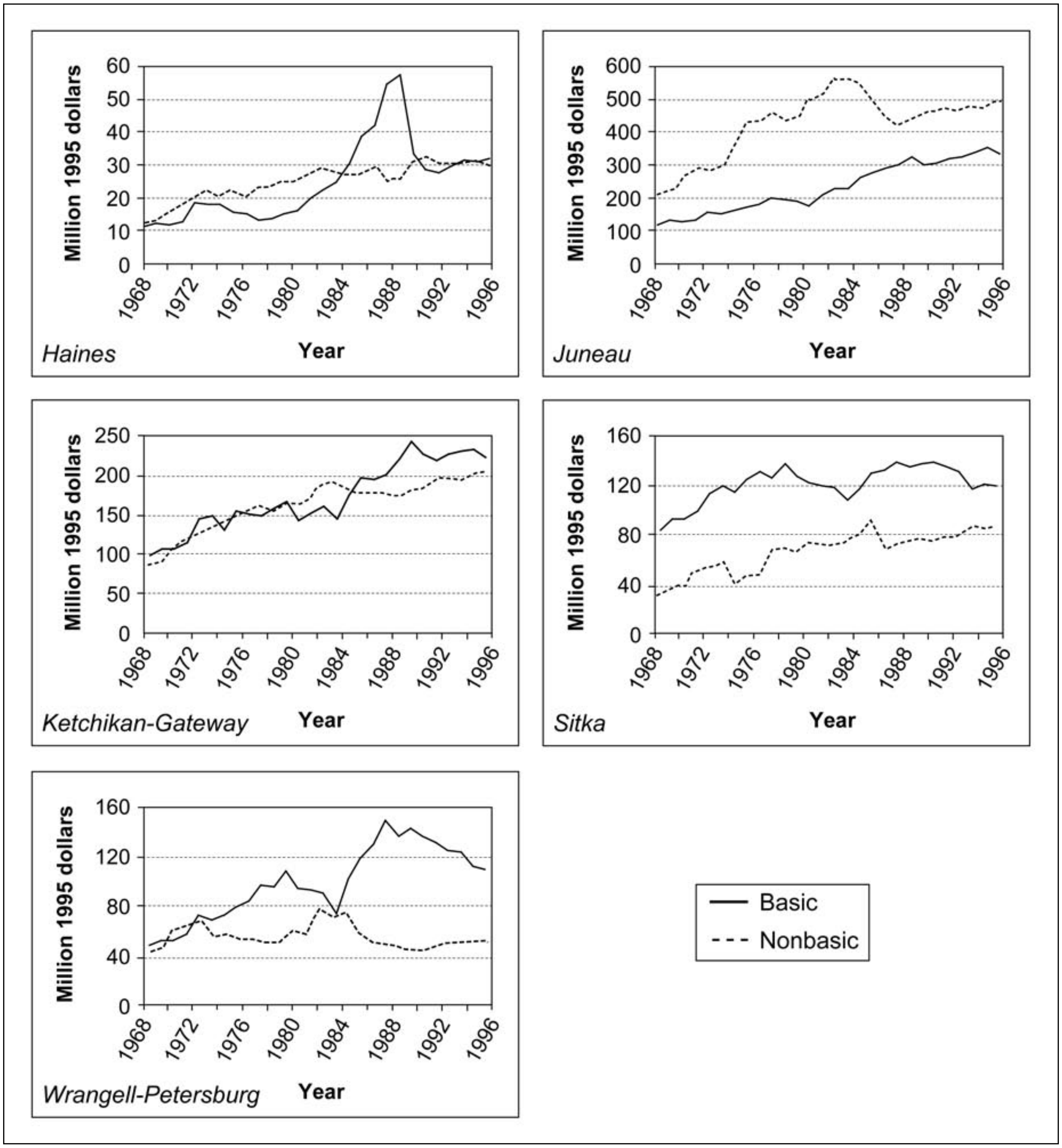

Figure 9—Basic and nonbasic income from Regional Economic Information System (USDC BEA 1998). See Chapter 4 of text for details on derivation of basic and nonbasic income categories.

Glossary

agglomeration economy—A reduction in production cost that results when related firms locate near one another.

base ratio—The ratio of export-derived (“basic”) employment or income to total employment or income for a given geographical unit.

behavioral equations—Equations specifying the behavior of an economic system for use in economic modeling such as computer-generated equilibrium models.

Cobb-Douglas technology—A production function linking inputs of capital and labor to a specified level of output. Cobb-Douglas production functions have the form $Q = L^a \times K^b$, where Q is the quantity produced, L is labor, K is capital, and a and b are adjustable parameters.

conditioning variable—A variable included in a regression model that helps clarify the relationship between the dependent variable and main independent variable of interest.

constant returns to scale—A production technology where the ratio of inputs to outputs is constant. A doubling of productive inputs under constant returns to scale, for example, will result in a doubling of product output.

convex isoquant—An isoquant is a curve describing the quantities of two productive inputs (in the two-dimensional case) needed to produce a fixed amount of product output. A convex isoquant is convex to the origin.

cross-price elasticity—Refers to the impact of a change of price of one good on the quantity consumed of another good. An increase in the price of apples leading more people to purchase oranges would be an example of a positive cross-price elasticity.

differenced data—Time-series data where the previous time period is subtracted from the next period. An example would be yearly employment levels that, when first differenced, are converted to a data series showing yearly changes in employment. Note that data can be differenced repeatedly.

economic base multiplier—A multiplier relating total employment to basic employment in a given unit of analysis. An economic base multiplier of 2, for example, would imply that every basic job would entail an additional support job, resulting in a total of two jobs. Economic base multipliers are commonly developed by dividing total local employment by basic employment.

elasticity—The impact of changes in price on the quantity of a given good that is produced or consumed. Goods whose consumption is sensitive to price are said to be highly elastic. Many luxury goods are thought to fall into this category. Goods whose consumption shows little response to price changes (tobacco, for example), are termed “inelastic.”

equilibrium wage—The wage received by a given productive input in the absence of market distortions and when long-run market equilibrium has been reached.

externalities—An effect of one economic agent’s actions on another, such that one agent’s decisions make another better or worse off by changing their utility or costs. Beneficial effects are positive externalities; harmful ones are negative externalities.

factor—An input used in the production of a given good. Capital and labor are the most commonly considered productive factors.

first differencing—See definition of “differenced data” above.

fixed-capital environment—A situation where, for the purposes of modeling, it is assumed that the level of capital used in the production process is fixed.

friction—Barriers that impede market adjustment. Labor markets, for example, are often characterized by friction, because people cannot be expected to instantaneously move to take advantage of new employment opportunities.

Granger causality—Granger causality refers to a statistical relationship between two variables in which changes in one variable occur prior to and are systematically related to changes in another variable. Although this relationship may provide evidence that changes in the first variable “cause” changes in the second, it is not proof.

homogenous production technology—Homogenous production technology stipulates a power relationship between productive inputs and product outputs. Mathematically, a production function is homogeneous of degree X if: $F(\lambda V) = \lambda^X F(V)$. For example, if the quantities of all productive inputs in a production process are increased by 100 percent and product output also increases by 100 percent, then the production technology is said to be “homogeneous of degree 1” (the term “linearly homogenous” may also be used). Higher or lower degrees of homogeneity are also possible.

homothetic—Stipulates that the shape of a given function’s curve will remain constant as it shifts inward or outward from the origin. For production functions, this implies that productive inputs will be used in fixed proportions at all levels of production as long as the prices of these inputs remain constant.

infinitely elastic—see perfect elasticity.

inward shift—A shift of the demand or supply function inward toward the origin and thereby denoting a contraction. Reductions in total personal income, for example, will result in an inward shift in the demand for consumer goods.

leakage—The process by which money leaves a local economy. Leakage may occur through any of a number of different channels, including imports of goods and services, payment of state and national taxes, and investment of local savings in outside capital markets.

Leontief fixed-coefficient technology—Production functions that are commonly used in input-output models and assume that productive inputs will be used in fixed proportions at all levels of production, and further that the ratio of inputs to outputs will also be fixed.

levels data—Time-series data displaying actual values (levels) as opposed to rates of change or other derived measures. The yearly number of employees in an industry over a given time period would be an example of levels data. The yearly number of jobs gained or lost (obtained through first differencing) would not.

linear decomposition—The technique of breaking a complex matrix into a set of linear equations that are more easily solved.

linearly homogenous—See definition of homogenous production technology above.

location quotient—The ratio of the share of a given industry's employment or income in the local economy to the share of that industry in some reference economy, often the state or Nation. If, for example, peanut butter manufacturing made up 10 percent of local employment and only 5 percent of national employment, the location quotient with regard to these two economies would be 2.

market-clearing condition—A condition that must be met in order for market equilibrium to be established.

minimum requirements technique—A means of determining the amount of export-related activity in a given local industry based on the minimum requirements of the locality for that industry's product. Minimum requirements are often determined through reference to other localities where the industry in question is minimally represented on a per capita basis.

nominal income—Income not adjusted for inflation.

nonstationary variable—A nonstationary variable is one whose average value tends to wander over time. This is in contrast to stationary variables (see definition below).

outward shift—A shift of the demand or supply function outward from the origin and thereby denoting an expansion. Increases in total personal income, for example, will result in an outward shift in the demand for consumer goods.

own-price elasticity—Own-price elasticity measures the impact of a change in price of a given good on the amount of that good purchased. For example, if a 1-percent price increase results in a 1-percent decline in purchases, then the good is said to have an own-price elasticity of negative 1.

perfect elasticity—Perfect elasticity is equivalent to infinite elasticity, meaning that quantities have an infinite response to changes in price. This report has focused on the supply elasticity of labor and other productive inputs. In this case, perfect elasticity means that firms can obtain an infinite supply of labor and other inputs at the prevailing wage.

price stickiness—A term denoting the failure of prices to instantaneously adjust to new market conditions. Prices are commonly thought to be sticky in the downward direction, meaning that firms and labor are more reluctant to lower their prices and wages than to raise them.

price taker—Price takers are economic agents who cannot influence the prices they pay or receive in the market place. Individual consumers, for example, cannot by themselves impact the prices they pay for most consumer goods, and they are thus price takers.

production technology—The means whereby productive inputs are converted into product outputs. In the abstract, "production technology" may refer to the production functions assumed in economic modeling.

quarterly differencing—A data manipulation in which the number from one quarter is subtracted from that of the same quarter of the following year. The result is a data series describing yearly change on a quarterly basis. (See definition of first differencing for additional information).

relative wage—Relative wages measure wage of one productive input relative to that of another. For example, if the price of both capital and labor increase by the same factor, then their relative wages remain unchanged.

returns to scale—Refers to the relationship between changes in productive inputs used and the level of outputs produced. Industries exhibiting increasing returns to scale enjoy greater efficiency as they become larger and thus need less input in order to produce a unit of output. Decreasing returns to scale implies growing inefficiencies and rising costs on per unit basis.

scarcity rents—The value accruing to a given good or productive input by virtue of its scarcity. Scarcity rents are most common in the case of nonrenewable resources. The value of gold in the ground, for example, is one common example of scarcity rents, as is the price of land.

stationary—A stationary variable is one that tends to return to some average value over time. Economic growth is commonly viewed as an example of a stationary process, where some years may exhibit higher or lower (or even negative) growth, but long-term averages appear to be relatively stable.

substitution elasticity—See cross-price elasticity.

time-series data—Data made up of periodic measurements, such as yearly income levels or quarterly unemployment rates.

trend variable—A variable used in regression to measure the trend component of a data series. Trend variables are often of the form $1, 2, \ldots n$, where n is the total number of observations in the data series.

vector autoregression—A regression technique in time-series econometrics in which each of two or more variables is regressed against past values of all the variables being considered (including themselves).

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