### DISCUSSION

### Introduction

At a meeting of the St. Louis Chapter of the American Statistical Association, Jacob Siegel made the following comments about the present state of the art:

> "It is now generally held by the more prominent and learned members of the fraternity of professional demographers that, with the present knowledge and techniques, it is not possible to forecast the population of small geographic areas accurately."<sup>(1)</sup>

Against the background of these remarks made 15 years ago I wish to discuss the papers by Mr. Kupinsky and Mr. Hollman, since they are, in my opinion, excellent examples of the most recent developments in making population projections.

Mr. Hollman's paper describes the methods by which a service organization, the California Department of Finance, prepares population projections, using time-tested demographic techniques, whose underlying assumptions can be simply stated, whose results can be readily reproduced, and whose reliability is to some extent known on the basis of past applications and tests. In contrast, Mr. Kupinsky's paper describes methods by which a research organization, the National Planning Association, has prepared industry-employment, personal income, and population projections using an "eclectic" and "pragmatic" approach, which projects and imposes consistency on several exogenously determined elements of a very complex system. Achieving this consistency is attained by a number of mechanical iterations and some educated judgements about the "consistency" and "reasonableness" of the results. The methods used by the National Planning Association are in a sense experimental; they have not been extensively tested and evaluated. The underlying assumptions cannot be simply stated, and the results cannot be readily reproduced. Moreover, the extent to which errors associated with the various parameters, such as the "critical ratios" used in the method, can ramify throughout the system is not well-understood.

The California Department of Finance projections represent the application of methods developed during what Hollman would characterize as the second era of population projection history. These are methods that are extensively used by public agencies because their behavior is well-understood, because their data requirements are fairly modest, and because their application is mechanically simple. The National Planning Association projections, in comparison, represent a bold excursion into the frontier of the third era; here, population growth is considered within the broader context of economic change. To my knowledge, no other organization has developed projections of employment, income, and population in such rich geographic detail. I shall discuss how the NPA population projections, based on economic considerations, compare methodologic with the more traditional demographic withods; I shall mention some of the conceptual and practical problems associated with the use of the NPA projection procedures; and I shall speculate on the likelihood that the resulting regional and metropolitan projections are more reliable than those, like Mr. Hollman's, that are generated using standard cohort-survival methods.

### NPA Projections

As indicated by the title of Mr. Kupinsky's paper, the NPA employment and population projections were developed within a national and regional projection framework. First, state industry employment projections were developed by apportioning projected national growth among the states; then metropolitan projections were derived by relating metropolitan growth to projected regional employment change. Regions, according to NPA usage, are those areas defined by state boundaries in which the major economic transactions of the metropolitan area under consideration take place.

Both the state and the metropolitan employment projections are based on techniques that reflect the "export base" theory of economic change. Stated simply, this maintains that economic activities in large regions and smaller geographic areas may be divided into two classes that are different--both with respect to the forces that activate them and with respect to the contributions they make to the particular subnational economy. The first class is composed of "base" or "regional building" activities, which, according to theory, are industries that export goods beyond the boundaries of the area; the second class is composed largely of "service" or "region filling" activities, which are mainly local to the region. The service activities complement the base and react to changes in it. The forces of change, however, according to the theory, develop in the base industries, and, therefore, for purposes of analysis, the base industries are more significant.

There are close parallels in the procedures followed to project industry employment for states and for the metropolitan areas; at both levels of geographic detail, employment in basic industries, predominantly commodity-producing, was projected first relative to the larger geographic area; then employment in predominantly nonexport industries was projected using an export base multiplier. However, it is of great interest that the methodological similarities end when the population projections are developed. To project the population of states (and analytical regions) consistent with the industry

employment projections, NPA developed essentially two independent sets of population projections. the first by expanding the employment projections to population projections. This was done by a straight-forward application of projected laborforce participation rates and employment results to the employment projections. The second set resulted from developing cohort-survival projections for each state. The two series were reconciled mainly by adjusting the net migration component of the cohort-survival projections. The importance of this procedure lies in its "constraining" function to the extent that in this way NPA could determine if the employment projections implied net migration patterns that were reasonably consistent with the past experience of the states under consideration. Net migration, the interface between population and employment at the subnational level, is useful here as a constraint on the system.

For the metropolitan areas, no independent demographic projections were developed. Rather, NPA made population projections by using the extrapolated relationship between employment/ population for the metropolitan area relative to employment/population for the analytical region. These coefficients were applied to employment projections for the metropolitan areas to derive population projections through 1975. Whether the net-migration patterns implicit in the resulting population projections are "reasonable", that is consistent in sign and magnitude with historic experience, is impossible to say. Moreover, for reasons to be discussed later, it is extremely difficult to develop reasonable net-migration estimates that would correspond in a meaningful way with the NPA population projections.

#### Conceptual and Practical Problems

The NPA metropolitan-area projections are unquestionably a monumental and important work. They present for the first time a consistent set of industry-employment, personal income, and population projections for 224 metropolitan areas through 1975. However, I think that their pedagogical value may be at least as important as their value to policy planners who need "hard" projections as an element in the decision-making process. By pedagogical I mean that they can serve as a valuable teaching device to demographers, who for so many years have been secure with component-projection methods but who also have recognized the need for making and understanding the social and economic assumptions that underlie purely demographic techniques. The NPA projection reports demonstrate that the economicdemographic linkage can be effected at the national and subnational levels; Mr. Kupinsky's paper clearly describes how these projections were made. However, I am disappointed that neither the NPA reports in their well-documented methodological sections nor the presentation this morning discussed some of the serious conceptual and practical problems associated with this undertaking. I say this because demographers and planners for some time to come are likely to view the NPA projections as the "authoritative" source

of internally consistent demographic and economic projections at the subnational level.

I will discuss some of these problems as they relate specifically to NPA's work and more generally to the problems of developing regional projections. These problems include (1) the definition of analytical regions, (2) the validity of export base theory for projection purposes, (3) the relationship between migration and employment, and (4) geographic-boundary problems in small area projections.

I want also to discuss very briefly the promise I see for more complex economic models, such as social accounts and input-output analysis, in relation to population projections; the importance of evaluative studies; and the direction that I hope future work in this area will take.

# Defining Analytical Regions

Because the NPA projections are carried out within a national and regional framework, the research has had to face squarely the difficult problem of determining the relationship between the metropolis and its hinterland. This was done on the basis of several very general criteria relating mainly to the economic transactions between the metropolitan area and the region from which it draws its resources and which consumes its products. Kupinsky states that the projections are very sensitive to the geographic boundaries that establish the economic region to which the metropolitan area is related. In reviewing the text of the NPA projections publications, I see no mention of this problem. I feel that it would be well to develop in detail how the boundaries were actually established, how the economic functions played by the metropolitan centers relate to the analytical region, and--if the projections are highly sensitive to the definition of the relevant analytical region--, the extent to which confidence can be placed on the boundaries of the analytical regions.

### Validity of Export Theory

The NPA projection methodology relies heavily on economic-base theory, as stated by Kupinsky, "The level of economic activity and of population growth in an area depends on the area's level of activity in certain 'basic industries' and the export component of localized industries". During the 1950's the validity of the economic-base theory was frequently, and I might add, effectively challenged. One study, for example, found no significant relationship between basic activity and population growth for selected areas. In fact, tests suggested that in the dual classification (basic and service industries) of economic activity, the service component might be a more important indicator of growth potential than the basic component. (2) In another study it was contended that the applicability of the basic-nonbasic concept tends to

decrease with increasing size of a metropolitan area, and that large metropolitan areas exist, survive, and grow because their highly developed business and consumer services enable them to substitute new export industries for those that decline; it was argued that nonbasic industries are the permanent and constant element, in fact, the truly basic element of the metropolitan area economy, while the export activities were the more variable element, subject to continual change and replacement.<sup>(3)</sup> So far, Wilbur Thompson has had the last word on the problem on export-base theory; he maintains that in the short run, the primacy of the demand export products in effecting economic change in an urban area is uncontestable, but that, over the long term, the service sector becomes increasingly important.(4)

Two other points worth mentioning in this regard relate to classifying industries as export or residentiary and to the export multiplier. Studies have shown that the manner in which the classification of industry employment into the basic and nonbasic categories can have a significant effect on the employment projections, particularly if the "misclassified" industry has a predicted growth that is different from the predicted growth rate for the total primary, or basic, sector. <sup>(5)</sup> In addition, the base multiplier, which expresses the relationship between export- and nonexport-industry employment has been found to be unstable for some large metropolitan areas; this instability again can have a telling impact on the magnitude of employment projections that developed using this approach.<sup>(6)</sup>

I raise these questions about export-base theory not because I challenge its usefulness as an analytical tool, but because I feel that the validity of this method for making employment and population projections--despite its widespread acceptance and increasing use in regional studies--is still seriously open to question; these considerations should be brought to the attention of the users of the NPA projections.

#### Migration and Employment

It is generally recognized that there is a strong relationship between employment and population size on the subnational level and that the most important equating variable between the demand for labor and its supply is migration to and from the region. Other important variables are the labor-force participation rate, which expresses the net relationship between the labor force and population size; the unemployment rate which expresses the net relationship between the number of unemployed and the labor force; and the natural increase of the resident labor force. Studies on the magnitude and the timing of these linked relationships--while of considerable importance for making regional employment and population projections--have been extremely few in number. To my knowledge their findings have not been incorporated into any projection methodology in current use. Rather, a one-way nexus, expressed as a simple ratio, has usually been

assumed between employment and population. Implicit migration effects are assumed to be treated as a residual following from the posited employment/population relationship.

I am in no position to evaluate the NPA projections in this regard--nor am I aware that evaluations of alternative methods, including the simple ratio assumption, have <u>ever</u> been made. The relevant points are that a model of population change can be developed in which migration is jointly and explicitly determined with employment change and that the resulting demographic projections may be more realistic than those developed from existing models.

Ira Lowry's recent study is extremely important in this respect.<sup>(7)</sup> Lowry examined the relationship between net migration and several other variables for 52 SMSA's between 1950 and 1960. He found that net migration was related: (1) negatively to natural increase in the resident labor force, (2) positively to changes in the number of resident military personnel, (3) positively to changes in the number of school enrollees 14-29 years, (4) negatively to changes in the median income of families, and (5) positively to changes in employment. The most impressive statistic was that 98 percent of the variance in migration could be explained by changes in employment, and that the model accounted for almost all the variation in net migration during the period. His model suggests that, on the average, an increment of 100 jobs is associated, ceteris paribus, with a net in-migration of 143 persons of labor-force age; while an increment of 100 residents of labor-force age would reduce the influx of migrations by 65 persons, rather than displacing it altogether. The importance of Lowry's monograph is in demonstrating, for metropolitan areas, the quantitative relationship between net-migration changes in the labor market expressed in terms of employment. Lowry shows how this approach can be adapted to projecting population, and presents a substantial argument for using this strategy rather than a ratio method, which lumps net migration, labor-force participation, employment status, and population into one coefficient whose magnitude has no structural meaning.

#### Geographic Boundaries

The considerations above are not specifically related to the NPA projections but bear more generally on the problems of making regional economic and population projections. The following comments relate directly to the NPA metropolitan projections. Kupinsky has stated that the NPA projections do not follow the practice of using constant SMSA boundaries:

> "Although metropolitan areas' statistical series for historical years readjusted to current boundary definitions may have many uses, we believe that such a series is inappropriate for a study of factors underlying

metropolitan area economic growth, since an extension of geographic boundaries is itself a means for accommodating such growth".

As a consequence of this procedure, the projected employment and population figures relate to an amorphous geographic area. This area presumably includes those counties defined as metropolitan at the benchmark date, but it may include additional counties by 1975. Given the NPA practice, there is no way to determine if the boundaries have changed during the projection period. I cannot see how this practice is consistent with defining economic regions (one or more states) by administrative boundaries, since surely the spatial characteristics of regional economic growth are the characteristics of metropolitan areas writ large. This is not to say that one can argue on this basis for flexible state boundaries but, rather, that fixed geographic boundaries are the constant about which we must build our analyses and projections--be they for states, regions, metropolitan areas or even cities. This is particularly true if, at some time in the future, net migration is to be treated explicitly, since migration has no meaning apart from explicit geographic boundaries.

In my opinion, the usefulness of the NPA metropolitan projections is seriously impaired by this procedure. Because area studies are usually carried out for well-delineated administrative units, with boundaries held constant during the study period, the regional analyst -demographer or economist--is constrained to work within fixed boundaries. The effects of the NPA "boundary problem" are reflected in the NPA projections, where, for a number of metropolitan areas. erratic population changes can be observed during the projection period. According to the projection report this can be explained as follows: "when a county is added to a metropolitan area (during the projection period), it usually means a proportionately greater increase in population than employment. This is because much of the work force in the county would have been employed in the metropolitan area prior to annexation."<sup>(9)</sup>

# Other Projection Models

A number of other regional-growth models are in development or operation, but none, to my knowledge, has been used to generate data in such geographic detail as the NPA procedures. With the exception of one, all of these models -whether couched in terms of the interregional input-output framework or in terms of regional accounts--develop population using the employmentto-population ratio or some simple variant thereof. The one exception, worth mentioning here, is a model developed by Stanislaw Czamanski for projecting employment and population in the Baltimore SMSA.<sup>(10)</sup> Czamanski attempts to incorporate into his model interaction effects between population and employment in a timelagged model. In this model, the employment of certain basic industries is projected exogenously, the employment of complementary industries is related to the basic industries functionally (lagged relationship), and employment in industries whose main locational factors depend on the existence of the central city is related functionally to population (lagged); total population is a lagged function of employment in all industries combined.

This is not the place to evaluate the various methods for making regional employment and population projections. The great value of the more complex models, it seems to me, has been in elucidating relationships and in demonstrating the critical parameters and possible sources of error in the more aggregative models. In a sense, the complex economic models are to simple models as the component-projection methods for projecting population are to the logistic curve or other simple extrapolative methods. The component model enables demographers to view and control the interaction of births, deaths, and net migration; input-output analyses enable economists to view and constrain flows of goods among sectors of an economy where aggregate models would completely obscure these important relationships.

Whether the more complex methods will become practicable for making extensive regional economic projections is not clear at present. There are a number of conceptual and practical problems that may limit their use. These relate partly to data availability, partly to establishing future demand levels that are inputs to such models, partly to projecting critical coefficients in the models, and partly to constraining the models so that the internal relationships, as they are generated within the model, retain a semblance to the real world. Linking the complex economic models to population growth is a subject that can be considered independently; I feel that this linkage is of sufficient importance in regional studies to warrant considerable study.

### Evaluative Studies

It is clear that, to use Mr. Hollman's colorful phrase, the "promised land of econometric models" is not near at hand, at least as far as small-area population projections are concerned. For the demographer in pursuit of a "best" method for making small area projections, there are still no guidelines. A paucity of evaluation studies on various projection methods has not been remedied during the 15 years since Siegel called it to our attention. His own work on evaluating projections for small areas(11) and that of Helen White on evaluating the accuracy of various methods for making state projections (12) still stand alone. Their results were not very comforting, but they show that, on the average, cohort-survival projections are better than other methods. In this regard, Ira Lowry has made a contribution by showing that an objective function linking net migration and employment yield more reasonable projections of net migration than the usual assumptions of

constant net migration, used in short-term cohort-survival methods, if the employment projections are "good".

## <u>Conclusion</u>

I have discussed Mr. Kupinsky's paper at length because I think that, as Mr. Hollman suggests, the NPA projections represent the beginning of a new period in history of demographic techniques. That demographic projections cannot be made <u>in vacuo</u> is beginning to be appreciated by demographers; the NPA reports represent a first major attempt to blend economic and demographic projections into a coherent and internally consistent whole. I consider their work very important in this respect, although I feel strongly about some of the shortcomings of their projections, particularly the problem of geographic boundaries.

Mr. Hollman's work is also important for it illustrates how the present state of the demographic art can be fruitfully applied at the county level. My hope and perhaps his is that the U.S. Bureau of the Census will soon undertake the task of making county projections using the cohort-survival method, with several assumptions about net migration, similar to the procedures they use in making state projections. If we are to progress in the small-area-projection field in the immediate future, I feel that evaluative studies are a first order of business. Perhaps the Bureau of the Census and the National Planning Association will train their extensive capabilities in this area.

 Siegel, Jacob, "Forecasting the Population of Small Areas", <u>Land Economics</u>, 29 (1953), 72-88.

- (2) Pfouts, Ralph W., "An Empirical Testing of the Economic Base Theory", <u>Journal of the</u> <u>American Institute of Planners</u>, 23 (1957), 64-69.
- (3) Blumenfeld, Hans, "The Economic Base of the Metropolis", <u>Journal of the American</u> <u>Institute of Planners</u>, 21 (1955), 114-132.
- (4) Thompson, Wilbur R., <u>A Preface to Urban</u> <u>Economics</u>, Wiley, Baltimore (1965), 30.
- (5) Gillies, James and Grigsby, William,
  "Classification Errors in Base Ratio Analysis", <u>Journal of the American Institute</u> of Planners, 22 (1956), 17-23.
- (6) <u>Ibid.</u>, Isard, Walter, <u>Methods of Regional</u> <u>Analysis</u>, Wiley, New York (1960), 200.
- (7) Lowry, Ira S., <u>Migration and Metropolitan</u> <u>Growth: Two Analytical Models</u>, Chandler, San Francisco (1956).
- (8) Parenthesis inserted.
- (9) National Planning Association, <u>Economic and</u> <u>Demographic Projections for Two Hundred and</u> <u>Twenty-Four Metropolitan Areas</u>, Regional Economic Projection Series, Report No. 67-R-1, National Planning Association, Washington (1967), 39.
- (10) Czamanski, Stanislaw, "A Method of Forecasting Metropolitan Growth by Means of Distributed Lag Analysis", <u>Journal of</u> <u>Regional Science</u>, 6 (1965), 35-49.
- (11) Siegel, op. cit.
- (12) White, Helen R., "Empirical Study of the Accuracy of Selected Methods of Projecting State Population", <u>Journal of the American</u> <u>Statistical Association</u>, 49 (1954) 480-498.