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SESSION 4: CONFLICTS BETWEEN INNOVATION AND CONTINUITY

THE TENSION BETWEEN CONTINUITY AND RELEVANCE OF ECONOMIC TIME SERIES

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INTRODUCTION

1. Much of the activity of statistical agencies around the world may be described as engaging in a race between modernization and obsolescence. Change seems to be the order of the day. Statistical agencies must engage in this race because businesses and other economic entities have truncated the cycle of change. The faster pace of change, as well as the globalization of business means that the concepts, definitions, and tools used to measure the workings of the economy must also change. Yet change is not a simple matter of getting on with the right thing. Those who produce information to permit study the economic situation find themselves on the slippery slope between usefulness to one group of users and the relevance of their product to others. Statistical agencies are torn by the tension between the continuity

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of the economic time series on the one hand, and the relevance of the information, on the other.

2. This paper explores the parameters of this tension between continuity and relevance in a time in which change is not only accepted but accelerated.

It examines the phenomena of revisions to economic time series, focusing on a current example that is the subject of considerable interest and debate in the United States - the periodic revision to the classification structure for the economic time series.

3. The paper describes statistical techniques for permitting the modernization of the economic time series while meeting the needs of users who require continuity are described using recent examples. Finally, the paper addresses the need for national and international policy that recognizes the need to maintain relevant economic indicators but do so in a manner which permits users to bridge the old and new. A few examples are provided.

The Importance of Continuous Time Series

4. The textbook concept of a time series is quite simple: it is a set of observations of a given variable in sequential order. The essential nature of a time series is that observations are made continuously and (usually) at consistent intervals. Such chronologically-ordered data serve in the most basic capacity as a historical description of some phenomena that can be counted or measured. In addition, a time series has characteristic patterns or components which can be isolated and studied. These components are quite often disaggregated into their component parts: trend, or long-term movement; cyclical change; seasonal fluctuation; and irregular, or residual, movement.

5. Continuous time series that permit identification of the component parts are important to users of economic data. Many statistical agencies and outside analysts depend upon time series data for temporal comparisons for much of economic research and analysis. In addition to being used to analyze and interpret economic events and conditions, another important application of time series is forecasting, where the data are used in specially-designed models to make projections or predictions about economic phenomena. Accurate analyses and forecasts depend upon the consistency of the time series data.

6. In the United States, continuous time series also figure importantly in uses such as the calculation of the leading and coincident indexes, the derivation of seasonal adjustment factors, and the estimation and analysis of the System of National Accounts (SNA). Accuracy is essential for time series analyses and forecasts used for economic decision-making by Congress, the Administration, the Federal Reserve, as well as state and local government entities.

Historical Continuity

7. The term "continuous time series" typically conveys a broader meaning than simply the sequential ordering of observations. It implies that the observations of a series continuous, but also presumes that they are collected using essentially standard methods and definitions over time. This is what is generally understood as "continuity" in a time series. If the

standards for defining and observing the variable are inconsistent, the observations will have little relationship to one another and not constitute a true series. The means of measuring and recording each point in the series must have some similar standard.

8. Breaks in time series continuity impose unwanted restrictions and complications on the analysts who use them. Only if the definitions and methods are stable can the data be confidently applied for analytical deduction and extrapolation (Montgomery, et al., 8). With statistical models, there is some allowance for discrepancies and outliers, but it is important that they appear in a random, not systematic, way.

9. In common practice, a continuous series does not refer to absolute continuity in time or measurement of the data, but only that they were "constructed on a roughly comparable basis over the period concerned" (Kendall, 7). This approach mediates between using an inflexible set of definitions and methods for collecting time series and allowing the observations to incorporate important structural changes that typically occur in an economic variable in the long term.

Preserving Time Series Continuity

10. Numerous events may interrupt the continuity of a time series. Many stem from outside effects and are essentially unmanageable by the statistical agency, among them are changes in laws (particularly tax laws); changes in the organizational structure of business through mergers, breakups, leveraged buyouts, or other forms of business unit regeneration; and exogenous events connected with the calendar, the climate, or other such factors.

11. Other events are quite manageable, indeed, intentional. Changes in methodology, sampling, estimation, and analytical techniques (such as seasonal adjustment) often cause discontinuities in the time series. More important, however, are changes in concepts and definitions, for these sources of change the measure but also change the measuring device.

12. One of the most important of the manageable events are the periodic changes in classification systems. Classification systems assist us in developing a structured view of a system or structure. Whether classifying insects, stamps, occupations, or industries, the decisions about how the congruent parts should be grouped breaks down in to four conceptual tasks (Drayse, Dubinsky, Flaming, and Law, 48):

- identifying the variables by which the system is sorted, clustered, or described;
- defining the observations;
- aggregating the observations into a system of nested hierarchies;
and

- designing the database

13. The decisions that the statistical agency makes with regard to these groupings have the potential of maintaining or disrupting the continuity of a time series.

14. Given the sensitivity of the time series to disruption, it is not surprising that changes in the classification standards used to define economic data have been seen to be among the most devastating of potentially disruptive forces to the smooth continuity of associated time series. Each classification decision incorporates a risk of disrupting the time series, depending on the extent of the classification change and the ultimate uses of the time series. Each decision affects the balance between relevance and continuity.

15. Though these decisions are not to be taken lightly, the balance has often swung toward accepting discontinuity because it has increasingly been understood that economic classification systems cannot remain unchanged indefinitely if they are to define the full scope of constantly changing industrial and business activities. To the economic statistician, the risk of a perceived lack of relevance of the data series on the part of data users has become recognized as a more important factor than continuity of the time series, for if the data series is perceived as being no longer relevant, support will dry up and resources will likewise evaporate. As Peter Struijs has stated, ". . . changes cannot be measured appropriately when the measuring instrument is changing constantly, but not changing it reduces the significance of information on the industrial structure" (14). Thus, statistical agencies increasingly decide in favor of relevance. Most hedge their bets by attempting to minimize the frequency and number of revisions. They also attempt to minimize the affect of the disruption by reconstructing and otherwise linking the time series.

16. The standard approach to preserve continuity after classification revisions is to create linkages where the series break. This is primarily accomplished by producing the data with both the old and new classifications for a given period of transition. With the dual classification of data, the immediate and direct impact of the revision can be assessed. In dual classification procedures, data producers measure the reallocation of the data at aggregate industry levels and develop a concordance between the new and old series for a given point in time. The concordance serves as a crosswalk between the old and new classification systems which quantifies with "coefficients" the reduced or expanded scopes of all relevant industry codes in the classification system. For example, coefficients can denote how much employment was reallocated from one industry group to another due to the revision.

17. Obviously, the concordance coefficients do not constitute a real continuation of a series. They do provide a means to splice or link the break (Beekman, 6). Limited conversion of historical data, however, is possible using a concordance. The coefficients can be applied to data

classified under the old classification system to convert it to the new standard. This provides only an approximation of what the earlier observations may have been and clearly must be applied with caution because a revision of the economic classification system encompasses broad changes to reflect innovations in industrial composition as opposed to small-scale, surgical corrections to micro units. Therefore, full conversion of the earlier series segment to the revised classification system is unsound because of the approximate nature of the concordance. Furthermore, the new classification principles do not necessarily reflect the economic reality of the historical data. While it is arithmetically possible to apply concordance coefficients to fully convert a historical series, in practice it is rarely attempted because of the theoretical implications of the procedure.

18. In spite of efforts to create linkages for a transition from one classification standard to another, the utility of a series still diminishes in application. One of the most critical problems for data users is determining what portion of the historical series may be successfully converted with a concordance. When applied in a forecasting model, it is essential that the recent observations in a time series provide a highly accurate description of the present. Very old observations are of less importance as they probably are not representative of the present (Montgomery, et al., 11). The difficulty lies in evaluating when the conversion coefficients cease to be accurate.

Lessons from Previous Revisions of Time Series

19. The recent international spate of conversions from prior classification systems to the ISIC Ref. 3, NACE, and ANZSIC structures (among others) have provided ample opportunity to test and implement time series revisions in many countries, amidst a wide range of circumstances, and utilizing a variety of conversion and linkage techniques. These experiences and the lessons they teach us are amply documented elsewhere, and will not be discussed in this paper. Nonetheless, an understanding of the national background for entering into a revision cycle is critical to understanding why the country has made the decisions it did, so the historical experience with revisions in the United States is summarized here.

20. Over the past 40 years, the United States has significantly revised its industrial classification system three times (1957, 1972, and 1987). The procedures for achieving the revision matured over the years. The first major revision, in 1957, accompanied changes in the 1945 SIC structure for manufacturing industries and the 1942 Social Security Board system for nonmanufacturing industries. In the process of implementing this new system, the Bureau of Labor Statistics reviewed the coding of all 120,000 units in the monthly employment payroll sample, as well as the 30,000 reports in the labor turnover sample. The recoded data for the in-sample units were retabulated for three and one half years in an operation involving cumulatively about 6 million reports - a daunting workload for that time given the unsophisticated data processing equipment. That revision was

incorporated into the estimates in November 1961. (Wymer, iv.) The revisions in the employment estimates were relatively minor, with no change in the aggregate.

21. Procedures were somewhat refined for conversion to the 1972 SIC revision, though were less successful in terms of timeliness. Again, the individual establishment reports for in-sample units were recoded in accordance with the new industry definitions. This operation took several years to complete. In October 1978, BLS published all estimates retabulated from January 1972 forward, and, for the first time, industry data prior to 1972 to conform to the 1972 SIC. (Buso and Bennett, 8). The publication that introduced the new classification published tables comparing the March 1977 estimate on the old and new SIC basis, and the difference accounted for by the revision at the 2-digit (major) division level. The overall revision was relatively small, accounting for less about 1 percent of employment at the topside, with only a few industries adjusted by more than 5 percent.

22. Although the United States attempted to limit the size of the 1987 revision, the procedures were much more elaborate than the simple recoding of in-sample units that had characterized previous revisions. The idea was to make concordance information available to data users, rather than revise the data series. The cost of converting historical data and the reliability of the process were certainly factors in making this decision. Providing the concordance to data users after the revision allowed the users to make their own determinations about applying the coefficients to the historical series.

23. The 1987 revision to the SIC, while it did not resolve all of the system's acknowledged limitations, certainly did expand its capacity to classify business activities which had evolved in recent years due to changes in technology, regulation, and consumer behavior. On the other hand, these improvements in industry classification were not without costs to those who produce and use SIC-based time series.

24. Producing a time series under two classification systems for however long a time period is not an easy or inexpensive endeavor for the government agencies involved. The total cost for implementing the 1987 revision to the BLS business register was \$9.8 million over a five-year period beginning in fiscal 1987. (MacDonald, 8.) At the time, the register consisted of 5.7 million reporting units, approximately 800,000 of which required labor-intensive analysis to classify under the new system. Some of the major cost factors to BLS for the revision were:

- hiring and training of additional staff,
- computer systems enhancements and programming, including the writing, programming, testing, and documenting of such for installation in BLS and the states,
- design, printing, and distribution of special survey forms, and

- development, printing, and distribution of training and reference materials for staff.

25. The BLS business register is the primary sampling frame for BLS establishment surveys such as the Current Employment Statistics series and, as such, represents the central cost and workload for implementing classification revisions to BLS data. Furthermore, BLS assumes reclassification costs for other agencies. Aggregate employment and wage data from the BLS business register, for example, are provided to BEA as a major component in the estimation of personal income data for the National Income Accounts. For BEA, the 1987 conversion was lengthier and more difficult because of their use of multiple data sources, which did not all convert to the new SIC in the same time period. Dual classification of some data was necessary for an extended period until all input series were converted.

Implications of a Fundamental SIC Revision

26. Historical experience with relatively minor SIC revisions suggests that, if a revision affects the basic framework of the Standard Industrial Classification, linking or reconstructing time series may not be possible, or possible only at great cost. With a distinct new classification structure and coding principles, statistical agencies may not be able to document any type of coherent relationship between the new and old systems nor estimate macro concordance coefficients for data users to make adjustments.

27. It is also important to note that merely establishing a means to link time series from before and after a substantial revision may not be sufficient for data users. Concordances for linking a series coded under two distinct classification systems may be too complex and costly for practical use and less likely to be useful for any historical conversion. The overall effect of major definitional changes, reclassification, and potential changes in reporting procedures resulting from comprehensive classification revision may likely leave some time series unsuitable for use in forecasting models and other analyses. The linked or reconstructed series may still contain inconsistencies which introduce bias or distortions into time series analysis and forecasting models.

28. Disruptions to historical continuity, when combined with revised seasonal adjustment factors, may introduce even more distortion for the user. Data users, primarily forecasters, have indicated when interviewed in the past that such changes in variable definitions and classifications, despite some overlap in the series, have caused serious problems with the output of their models and the related analysis (Bishop and Werbos, 2). There is substantial cost to data users in testing revised data in models and evaluating the output for reliability. Additional costs may be incurred if there is a need to develop alternative models and/or data.

Need for a Policy on Revisions

29. The tradeoffs between time series continuity and modernization of the economic classification system must be considered during the development of a classification system. The importance of time series data in economic analysis and policy-making requires some provision for continuity, but the statistical agency(s) have little to guide them as they make the important decisions on whether continuity should be a primary consideration or guiding principle in the development of a new classification system.

30. In the United States, the official policy on revisions covers all types of revisions (benchmarking, updating of seasonal factors, and replacement of preliminary figures) as well as the more systemic types accompanying classification changes, and, thus, is quite broad. The official standard, set forth in Office of Management and Budget Statistical Policy Directive No.3, advises U.S. agencies to use the following guidelines when issuing revisions:

- agencies should clearly identify figures as revised;
- agencies should only release routine revisions of a principal economic indicator as part of the regular reporting schedule;
- if the revisions show signs of a consistent bias, the agency should take steps to correct this bias;
- revisions occurring for more than one routine reason, such as benchmarking or updating of seasonal factors, should be consolidated and released simultaneously; and
- revisions occurring for other than routine reasons (such as SIC revision) should be full explained and released as soon as corrections can be completed.

31. In an attempt to make these guidelines more useful, the U.S. Federal Committee on Statistical Methodology set up a Subcommittee on Guidelines for Making and Publishing Revisions and Corrections to Time-Series in 1981. The subcommittee reviewed agency policies and determined if user needs were being met by the broad guidelines in Statistical Policy Directive No .3. The subcommittee recommended that agencies publish standard errors of revisions for published series, set fixed schedules for data revisions, and publish revised time series when historic publications are printed. (Bishop and Werbos, 5.)

32. A similar relative lack of guidance at the international level has recently been remedied by the International Monetary Fund (IMF). In May, 1996, the IMF issued its publication, Guide to the Data Dissemination Standards," a set of voluntary standards to which all subscribing member countries commit to observe. In subscribing countries, the statistical offices play an important role in the fulfillment of the standard.

33. The Special Data Dissemination Standard (SDDS) identifies four dimensions of data dissemination: coverage, periodicity, and timeliness of the data; access to the public; integrity of the disseminated data; and quality of the disseminated data. In this scheme, revisions to the data and changes in methodology are portrayed as issues of integrity, and countries are urged to fully describe the revisions. Included in the list of suggested information about the revisions is a catalogue of reasons for revisions and a discussion of the need to discuss the size and bias in previous revisions. These guidelines are important additions to our understanding of good statistical practice. Unfortunately, they do not inform us as to the appropriate balance between constancy and relevance.

34. In an attempt to lay out some principles for release of data into the public domain, this author reviewed the national practices of member countries of the Organization of Economic Cooperation and Development with regard to labor force statistics in 1992. Noting that labor force survey data are liable to revisions extending over long historical periods, the paper recommended that, as a general rule, the frequency of revisions should be minimized. When necessary, significant revisions to previously-published data should be provided to users in a timely manner, and attempts should be made to link the old and new data series. (Plewes, XIII.)

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