TOWARD A NATIONAL INNOVATION ACCOUNT

Comment Prepared for the
Measuring Innovation in the 21th Century Economy Advisory Committee

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We live in an era of rapid, almost dizzying, innovation in products and processes. These innovations have increased consumer welfare through the introduction of new goods and services, improvements in the quality and lower costs of existing products, and an increase in the amount of information about available products. They have also revolutionized the organization of production, not just in the 'technology' of production as narrowly conceived, but also in the management and global reach of corporations around the world.

While the impact of the revolution in technology is evident 'on the ground,' it has proved surprisingly hard to develop an overall macroeconomic measure of the magnitude of the impact. How much of the recent growth in GDP is due to this revolution? What is the impact on living standards and worker productivity? How does the U.S. compare to other countries? Answers are needed to address the important issue of the sustainability of a high rate of economic growth in the U.S. economy, and a continued rise in living standards.

Unfortunately, a number of observers have questioned the ability of macroeconomic data to capture innovation. In the earlier stages of the IT revolution, Robert Solow (1987) famously quipped that "You see the computer revolution everywhere except in the productivity data." A decade later, William Nordhaus (1997) remarked that official price and output data "miss the most important revolutions in history." Alan Greenspan's remarks on the bias in the CPI and the unreliability of service sector productivity data were motivated by what he saw as the failure of these statistics to provide accurate metrics for what was then called the 'New Economy.' The problem persists. In his 2006 Business Week article, Michael Mandel comments: "Grab your iPod, flip it over, and read the script at the bottom. It says: 'Designed by Apple in California. Assembled in China.' Where the gizmo is made is immaterial to its popularity. It is great design, technical innovation, and savvy marketing that have helped

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Apple Computer sell more than 40 million iPods. Yet the [U.S. national accounts doesn't] count what Apple spends on R&D and brand development, which totaled at least $800 million in 2005."

The iPod problem arises because Apple's accountants value R&D outlays as a current cost, not as an investment in the future of the company. And, R&D is not the only intangible investment treated this way. Firm-specific investments in brand equity, human resource development, and management effectiveness are also treated as current expenses. Recent research by Corrado, Hulten, and Sichel (2005, 2006) for the U.S. Non-farm Business sector suggests that the problem is not unique to Apple. When these other intangible factors are added to a broad conception of R&D, 2003 GDP increases by as much as $800 billion and business intangible capital stock by more than $3 trillion. The inclusion of these intangibles also reveals a higher growth rate of output per worker and explains more than a quarter of the growth rate over the period 1995-2003. To ignore these intangible investments in knowledge and human capital is thus to ignore one of the major sources of innovation and growth.

The Advisory Committee's goal of developing better metrics of technological and business innovation is clearly important and worth pursuing. There are a number of areas where improvements are possible, but there are also a number of important issues that must be considered in the process. One potential pitfall is for the committee to concentrate exclusively on incremental improvements in specific innovation metrics. The incremental approach may make selective progress in areas of importance, but it risks falling short of the overall objective of measuring the contribution of innovation to economic growth and living standards. Answering this larger question requires a comprehensive approach in which new metrics are embedded in a larger statistical framework. The remarks that follow make the case for a National Innovation Account linked to the current U.S. national income accounts and to official statistics on productivity growth. The National Innovation Account would extend the current boundaries of the existing statistical programs to give a more comprehensive account of innovation, but would not disturb the core functions and integrity of these programs.

At What Price Innovation?

In considering ways to improve the nation's official statistics, an old adage applies: be careful what you wish for. The nation's statistics reflect conscious choices made in the past about program objectives and budget levels, and these choices have led to a system that is not organized specifically to show innovation. Both macroeconomic and financial accounting practice tends toward a conservatism that emphasizes accuracy and continuity with the past over approximation and innovation, and the corporate accounting scandals of recent years illustrate the virtue of this emphasis. As a result, accounting practice has traditionally concentrated on market data generated by arms-length transactions and avoided the use of imputed "data" where possible.[2]

[2] There is great value to users when there is a continuity of methods and sources in a statistical program. No macroeconomic time series data will ever be perfectly accurate, but if the data are at least consistent over time, users

Changing accounting practice to make it more "dynamic" cuts against this conservatism, since economic innovation involves new ideas and products whose nature and significance take time to understand, and even more time to incorporate into existing statistical programs at prevailing standards of accuracy. Moreover, innovation often occurs within firms (as with R&D), without market-mediated transactions to provide the dollar metric needed for standard accounting practice.

Statistical agencies are certainly aware of these problems and have, in fact, made progress in dealing with the tradeoff between accuracy and innovation. The Bureau of Economic Analysis has launched an initiative to capitalize R&D expenditures in the U.S. national accounts, following on their decision to capitalize software expenditures some years earlier. The process of capitalizing of R&D requires substantial imputation, as well as the commitment of substantial budgetary and staff resources, and serves to illustrate the basic reality that bringing innovation into the accounts is not a matter to be taken lightly.

The treatment of product quality is another example of this reality. During the 1980s, data on the price of computers showed a generally rising trend, while at the same time computing power was increasing exponentially. The price of computing power was thus falling, and to estimate this price required a statistical technique known as hedonic price analysis. When BEA made this adjustment in the 1980s, some observers regarded it as controversial, since it increased measured real GDP on the basis of statistical inference and not pure measurement. The BLS also uses this technique to adjust the CPI for changes in the quality of many products. However, a National Research Council panel, established to review the CPI program, gave only a limited endorsement to the hedonic method, recommending "a more cautious integration of hedonically adjusted price change estimates into the CPI (Recommendation 4-3)." When addressing the new goods problem, the same panel concluded that the "Virtual price reductions associated with the introduction of new goods should not be imputed for use in the CPI (Conclusion 5-1)." These virtual price reductions are an important mechanism through which the benefits of product innovation are translated into gains in consumer welfare. The panel's conclusions reflect the fact that the primary objective of the CPI program is not to measure product innovation *per se*, as well as a conservatism about the use of imputations and statistical techniques.

These examples illustrate the tradeoffs facing any effort to increase the "innovation content" of official statistics. Budget considerations also enter the tradeoff picture. U.S. statistical agencies are not generously funded, to put it mildly, and the launch of a new initiative or program within an agency often crowds out improvements in other core areas, and sometime requires cutbacks.

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can interpret them in light of their own experience and needs and use them to inform their actions (Hulten (in press)). Improvements in data methods and sources are obviously needed from time to time, if for no other reason than the structure of the economy changes over time, but the benefits of change must be weighed against the associated costs.

What can be done to make the nation's official statistics better reflect the dynamism of U.S. economy?

Any Advisory Committee recommendations on new innovation metrics will need to recognize the tradeoffs and constraints facing the agencies that would be responsible for implementing the new measures. They will also need to take into account the new programs have been introduced by the statistical agencies, as well as those that the agencies have identified as promising areas for future development. Examples include the BEA R&D satellite account and proposed health-care satellite account, and the new time use surveys at BLS and efforts underway there to improve the treatment of medical-care output. This need applies to other agencies, as well. The U.S. Census Bureau already has a number of programs that measure selected aspects of innovative activity, and is looking at ways to extend their programs (Atrostic (2007)). Much the same is true of the National Science Foundation (NSF (2007)).

These programs, actual and prospective, provide a good starting point for the Advisory Committee's objective of developing "new and improved measures of business innovation." But Atrostic (2007) makes a crucial observation when she writes

"There have been calls for the U.S. to perform an innovation survey similar to those carried out in Canada and many European Union member countries. But neither a formal innovation survey nor more data on innovative activities would fill the critical and long-standing gaps in the core data needed to analyze economic performance—that is, comprehensive coverage of nonmanufacturing industries, including improved measures of output and sales and additional information on inputs such as capital, labor, and purchased materials at the micro (enterprise) level for the same economic unit over time (so the effects can be measured). Without good longitudinal measures of these core data, it is hard to rule out the possibility that a measure of innovative activity merely proxies for something that is omitted from or measured poorly in the core data" (page 3).

The "core" data are the connective tissue that holds the accounts together and provide a framework for incorporating new metrics. The need for the comprehensive approach applies to all industries, although the need for better core data in the services-producing industries is particularly acute.

A similar view was expressed in a different way at the NSF workshop*, Advancing Measures of Innovation: Knowledge Flows, Business Metrics, and Measurement Strategies, 6–7 June 2006*. A great deal of information on business innovation metrics has already been developed, and these studies were likened (at the workshop) to dots in the information space. While there are undoubtedly benefits from developing more dots, there was a sense that some priority has to be given to the problem of connecting up the existing ones.

Both views point to the need to translate specific surveys and metrics of innovation into a larger macroeconomic framework in order to get at the "bottom line" of technological innovation: how important is technology as a driver of growth and living standards? The constant-dollar GDP in the U.S. has increased five-fold over the last 50 years, and both real per capita disposable income and business sector productivity have tripled. Economists have devoted a substantial body of research to understanding what factors have driven this growth, with particular attention in recent years to how much of this growth is due to improvements in technology and new products. The main research tool for this research is the sources-of-growth method, which is the basis for the productivity statistics published by the BLS Multifactor Productivity program (see Hulten (2001) for a recent survey of this research area).

The BEA's national accounts and the BLS productivity program, which uses the sources-of-growth approach, provide a natural framework for "connecting the dots" developed by individual innovation surveys and programs. Linking new and existing innovation metrics to the macro data framework adds value to each metric (to the extent it contributes to our understanding the bottom line issues), and also adds value to the macro accounts whose capacities are enhanced. This linkage is also helpful for suggesting where new innovation metrics are needed and serves to discipline the process of development, because new metrics must fit into the larger framework. This means that the macro-friendly metrics must satisfy certain criteria: they must be expressible in a dollar metric to be consistent with the national income and productivity accounts; they must be organized to fit into the classification scheme of the accounts; and they must be part of a programmatic effort that generates a consistent data series over time. For their part, these accounts may have to be modified in order to make use of the new data series. One step in this direction would be to accelerate the development of the so-called "capital services" account in the national income accounts and corresponding coordination of effort with the BLS productivity program. Development of an integrated wealth account would also be welcome, particularly one that could be expanded to include human capital and knowledge assets.

Existing "non-innovation" programs at the agencies might also be expanded to support this line of development. For example, the price data of the CPI program are collected regularly from stores and retail outlets. When goods disappear from an outlet, some judgment must be made about finding a comparable substitute to take its place. The people involved are thus in close touch with developments in the market place; while they are currently not charged with the task of spotting new goods when they appear (rather the opposite, since they are supposed to find a close substitute for the item that disappeared), their expertise could be tapped to document the arrival of new and improved goods and evaluate the associated prices. This would involve some programmatic development and substantial budget resources, but it could be very helpful in closing one of the biggest gaps in our current knowledge of the innovation process: the value of product innovation in the market place.

A "National Innovation Account"?

The development of a National Innovation Account that pulls together innovation metrics in a comprehensive accounting framework is an ambitious vision. It would involve a consortium of agencies, and the resulting coordination and budgetary issues are challenging. Moreover, the degree of imputation and approximation required would undoubtedly exceed the comfort levels of the statistical agencies involved. These considerations suggest that a National Innovation Account would have to be a super-satellite account of existing national income and productivity accounts. Satellite status would permit a much higher degree of imputation and experimental statistical development than is usual in the core accounting data, while, at the same time, preserving the linkage to the core accounts.

What sort of data might be put into the National Innovation Account? The addition of a broad range of intangible capital is one step that could be taken more or less immediately, given the work of Corrado, Hulten, and Sichel, and the subsequent work using this approach currently underway at various national statistical agencies around the world, as well as in non-governmental organizations like The Conference Board and the Organization for Economic Co-Operation and Development. This framework does make use of extensive imputation in its current formulation, but the rationale for this step is set out on page 56 of the 2007 *Economic Report of The President*:

"Standard measures of capital primarily count physical capital, but businesses expend resources on many other activities that aim to increase the value of future output. Some examples are research and development spending, revamping a business's organization, advertising aimed at improving consumers' perceptions of a business's brand, or developing a secret recipe. These kinds of activities are often called intangible investment because they build up assets that are valuable to firms but are not easily measured."

"Conceptually, these activities qualify as capital investment, but they are not currently included in official capital measures because they are hard to measure. Why does this matter when discussing productivity? Expanding the definition of capital by including intangibles would change the shares of the factors contributing to labor productivity growth, increasing the share attributed to capital deepening and reducing the share attributed to efficiency gains. This shift would not only call into question the finding that IT investment contributed to productivity mainly through efficiency gains, but would also help explain why productivity did not accelerate with early waves of IT investments. Indeed, it is consistent with the hypothesis that for businesses to take full advantage of their IT investments, they needed to develop innovative business practices. Only when they made intangible investments to complement their IT investments did productivity growth really take off."

Product innovation is another area where progress can be made in developing a National Innovation Account, though it is more difficult. The benefits of new goods can

be measured using experimental techniques like those developed in Hausman (1999), and by encouraging greater use of the hedonic price model to get at improvements in product quality. The expertise of the BLS CPI field staff and commodity analysts in identifying productive innovation would also be welcome.

Tapping into the programs at the Census Bureau and the NSF is another important area of development. A National Innovation Account could serve as an organizing framework for aggregating the innovation metrics developed by these agencies.

Human capital is yet another critical area of development. Knowledge often comes "wrapped up in a person" as Paula Stephan has recently observed (Stephan (2006)). Moreover, the growth in output per worker in the U.S. business sector has been strongly influenced by changes in the composition of labor input toward more educated and experienced workers. On the other hand, investment in human capital is largely absent in the national accounts because it occurs within the household sector of the economy and involves imputation about the value of non-market time. New data sets are, however, promising: the BLS time use survey and the Census Longitudinal Employer-Household Dynamics project, which links employees to companies and promises to shed valuable light on the link between worker characteristics and firm productivity. This link is all the more important because recent research by labor economists suggests the demand for worker characteristics is shifting as a result of the computer revolution, toward more conceptual skills (Autor et. al. (2003)). These are critical issues that must be included in a comprehensive innovation account.

Concluding Remarks

The budgetary and programmatic problems are challenging, and a comprehensive National Innovation Account may remain nothing more than an aspiration for many years to come. But aspirations are important, and in the end, a comprehensive solution is the only solution. The endorsement of a clear goal by the Advisory Committee would set the context for the future development of the nation's statistics. In the meantime, creative new approaches and innovation metrics are certainly welcome.

The Advisory Committee might also comment on a related issue. The economist Tjalling Koopmans famously warned against measurement without theory (Koopmans (1947)). Decades later, the late Zvi Griliches issued another warning in his presidential address to the American Economic Association:

" ... it is not reasonable for us to expect the government to produce statistics in areas where concepts are mushy and where there is little professional agreement on what is to be measured and how (page 14)."

“Innovation” is an area where the concept is mushy. It is often defined on an “I know it when I see it” basis. Theoretical work is needed to pin down intuitive ideas surrounding the innovation process in such a way that they can be measured with some degree of precision. Unfortunately, the academic economic profession seemingly does not have the improvement of macroeconomic statistics as a high priority. Griliches goes on to say

“We ourselves [the economics profession] do not put enough emphasis on the value of data and data collection in our training of graduate students and in the reward structure of our profession. It is the preparation skill of the chef that catches the professional eye, not the quality of the materials in the meal, or the effort that went into procuring them page 14).”

This is “theory without measurement,” the reverse of the Koopmans injunction. The Advisory Committee would advance the cause of economic measurement by calling attention to this problem.

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