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Evaluation and Improvement of Puerto Rico's National Economic Accounts

BEA
BUREAU OF ECONOMIC ANALYSIS
U.S. DEPARTMENT OF COMMERCE
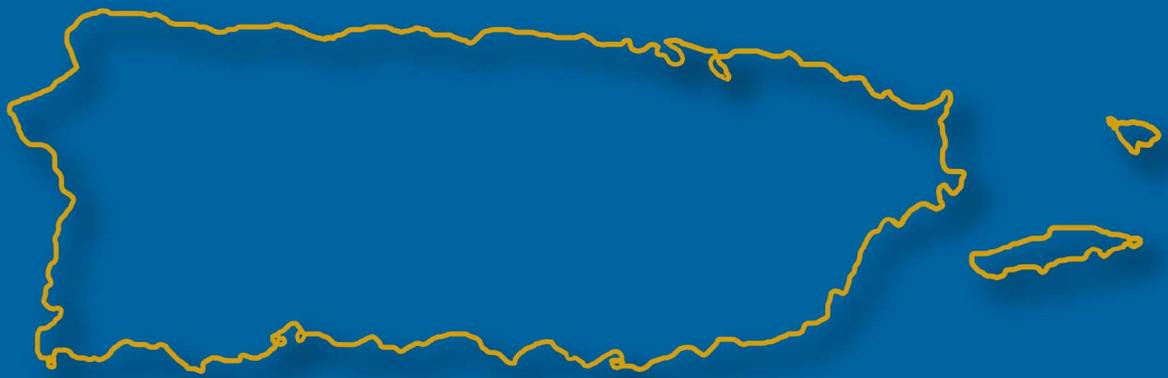
Introduction

In March of 2011, the President's Task Force on Puerto Rico's Status recommended that the U.S. Department of Commerce work with Puerto Rico to assess its national economic accounts and to make recommendations for modernizing Puerto Rico's economic statistics programs. [1] Preceding the recommendation of the President's Task Force, Puerto Rico's Department of Economic Development and Commerce Secretary Pérez-Riera sent a letter to U.S. Commerce Secretary Gary Locke inviting the Bureau of Economic Analysis (BEA) to conduct a comprehensive assessment of the methodologies used to estimate Puerto Rico's gross domestic product (GDP). Secretary Locke accepted Secretary Pérez-Riera's invitation and asked BEA to work with Puerto Rico to begin an assessment of Puerto Rico's GDP statistics. In response, BEA began a collaborative effort with Puerto Rico to identify areas of potential improvement within Puerto Rico's economic statistics programs. [2] As a result of this recommendation, BEA established a team of senior staff to review the Puerto Rico statistics and to work with Puerto Rico to develop a formal set of recommended improvements.

BEA is the agency within the Department of Commerce that produces economic statistics, including GDP, input-output tables, international transactions, and personal income and outlays. Since May 2010, BEA has also been publishing annual GDP estimates for each of the U.S. territories other than Puerto Rico. [3]

Puerto Rico's national economic accounts are produced by the *Junta de Planificación de Puerto Rico*, or Planning Board of Puerto Rico. The Planning Board is part of the Office of the Governor and is responsible for providing guidance on the physical and economic development of the territory. Although the Planning Board provides timely releases of Puerto Rico's economic statistics, the methodologies it uses have not been updated for several years. Therefore, the methodologies used do not follow the latest international guidelines for producing national economic accounts, such as those issued by the *System of National Accounts* (SNA). [4] This has resulted in measures of economic activity that are difficult to compare with estimates for the rest of the United States and many other countries. The absence of accurate information on Puerto Rico's economic output and growth has made it challenging for policymakers and businesses to engage in short- and long-term analysis and planning that is critical for developing Puerto Rico's economy.

In early 2011, a team of senior staff from BEA traveled to Puerto Rico for a week of meetings with staff from the Planning Board. BEA met with each working unit within the Planning Board's Program of

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[1] See *Report by the President's Task Force on Puerto Rico's Status* (Washington, DC: White House, March 2011.)
[2] In November 2009, prior to the official request by the Government of Puerto Rico, BEA hosted a team from Puerto Rico interested in understanding BEA's input-output (I-O) tables and methods used to balance the I-O matrix. BEA provided an overview of how the U.S. I-O accounts are constructed, including source data requirements, industry and commodity relationships, and balancing the I-O matrix.
[3] See Aya Hamano, "GDP for American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands," Survey 91 (September 2011): 41–49.
[4] The SNA was developed by the international community in order to facilitate international comparisons of national economic statistics and to serve as a guide for countries as they develop their economic accounting systems. The latest version was adopted by the United Nations Statistical Commission in 2008. See unstats.un.org/unsd/nationalaccount/sna2008.asp.

Economic and Social Planning and received detailed presentations on estimation techniques, source data, and data collection and management techniques used in the production of Puerto Rico's national economic accounts. BEA then met with data providers, such as the Puerto Rico Treasury Department and the U.S. Department of Agriculture, and with users of the Planning Board's statistics, including the Government Development Bank and the Puerto Rico Industrial Development Company. Finally, BEA met with the Puerto Rico Institute of Statistics, which is a new organization formed by the Government of Puerto Rico, that is responsible for ensuring universal and timely access to reliable statistical information on Puerto Rico.

During the visit, BEA also met with consultants from Phidelix Technologies, a private firm that conducted an assessment of Puerto Rico's national accounts in 2009. Phidelix's assessment was funded by the Government Development Bank for Puerto Rico. The current assessment work has been conducted at BEA's own expense.

Following the meetings in Puerto Rico, BEA began developing a set of recommendations to update Puerto Rico's economic accounts. This report summarizes the results of BEA's work and includes the following:

1. Brief descriptions of Puerto Rico's national economic accounts and of Phidelix Technologies' assessment.
2. BEA's recommendations for improving Puerto Rico's economic accounts.
3. How BEA will assist in the implementation of its recommendations.

Summary of Puerto Rico's National Economic Accounts and Previous Assessment Work

Puerto Rico's national accounting framework summarizes the flows of production-related activities and income between sectors of Puerto Rico's economy in five accounts: the net income and gross product account, the personal income and outlay account, the government receipts and expenditures account, the foreign transactions account, and the gross savings and investment account. These accounts are produced by the Puerto Rico Planning Board's Economic and Social Planning Program. In order to produce these accounts, the Economic and Social Planning Program compiles data from a variety of sources, including its own business and public sector surveys, other surveys on construction and tourist expenditures, tax returns from the Puerto Rico Treasury Department, and the quarterly census of employment and wages.

As noted previously, Phidelix Technologies, a private consulting firm, conducted an assessment of Puerto Rico's national accounts in 2009. Phidelix produced a detailed report that reviewed the methods used to measure Puerto Rico's gross national product (GNP), gross domestic product (GDP), net income, and input-output tables. Areas of weakness in the accounts were identified and various improvements were recommended. These recommendations included the following:

1. Calculate alternative estimates of inflation-adjusted (or "real") growth in output and prices using a more recent base period that reflects a more appropriate basket of goods and services being consumed in Puerto Rico. The estimates that are currently available have been calculated using a base period of 1954 and therefore do not provide reliable measures of growth for current periods.
2. Recalculate the consumer price indexes (CPI) for working families from the Department of Labor and Human Resources. These CPIs are used to deflate various components of personal consumption expenditures. According to Phidelix, the procedures used to calculate the CPI are flawed and have produced errors in the index.
3. Use economic census data more extensively. Currently, the national accounts are not benchmarked using economic census data. Puerto Rico's input-output tables should be produced using economic census data, and then used to benchmark the estimates of GDP.
4. Improve and streamline data collection procedures. For example, ensure that different offices within the Planning Board are not collecting the same information using multiple questionnaires and methods. Store data that are used by more than one office in a central database so that the same information does not need to be entered into multiple systems. Devise methods of data collection that minimize manual data entry, such as the electronic transfer of data between the Planning Board and other government agencies.
5. Provide more training for Planning Board staff. For example, survey staff could be provided opportunities to attend Joint Program of Survey Methodology classes.

BEA has reviewed Phidelix's assessment and is in agreement with its primary recommendations.

BEA's Recommendations

The following is a list of BEA's primary recommendations for improving Puerto Rico's national economic accounts. Adopting these recommendations will result in a set of accounts that more accurately portrays Puerto Rico's evolving economy. The accounts will conform more closely to internationally accepted guidelines on national accounting from the *System of National Accounts* (SNA) and will facilitate comparisons between Puerto Rico's economy and other economies worldwide.[5] This list is not meant to be exhaustive, but it does include those areas of primary concern.

1. Change the featured measure of production from gross national product (GNP) to gross domestic product (GDP) to better reflect the actual production taking place in Puerto Rico and to make Puerto Rico's statistics comparable with the rest of the United States and most other countries.
2. Use chain-type Fisher indexes to calculate changes in aggregate output and prices. This will improve the accuracy of the Puerto Rico statistics and make them more useful for short- and long-term economic planning.

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[5] BEA supports the goal of international harmonization of national accounts and has adopted SNA guidelines to the extent feasible. Thus, improving consistency between the Puerto Rican economic accounts and the SNA guidelines should improve consistency between the Puerto Rican accounts and BEA's national income and product accounts.

3. Expand the use of economic census data. Benchmarking the GDP and input-output (I-O) statistics to the economic census will improve the quality and reliability of the Puerto Rico I-O and GDP statistics. It will also ensure that the statistics better reflect structural changes in the Puerto Rico economy.
4. Expand estimates of GDP and related measures from an annual to a quarterly frequency to provide a more timely and complete picture of the economy of Puerto Rico.
5. Expand the level of component detail that is published in order to provide more information to users, particularly on quickly evolving industries in the Puerto Rico economy.
6. Improve the estimates of banking and insurance services to better reflect current international measurement standards and to more accurately reflect the way these industries operate in the economy.
7. Treat expenditures on intangible assets as investment to allow users to understand the role of these intangible assets as drivers of economic growth.
8. Replace the 5 accounts that currently summarize production and income flows with an expanded framework to improve consistency of the Puerto Rico accounts with international standards and to improve comparability of the Puerto Rico accounts with those for the United States and other countries.
9. Improve data collection, storage, and management systems to improve the accuracy of the Puerto Rico statistics and to increase the efficiency of limited staff resources.

Each recommendation is described below in further detail.

Recommendation 1: Change the featured measure of production from GNP to GDP

Although GNP should continue to be published, BEA recommends that the Planning Board highlight GDP as its featured measure of production.

Both GDP and GNP are defined in terms of goods and services produced, but they use different criteria for coverage. GDP is the market value of goods and services produced by labor and property within a country's (or territory's) borders, regardless of nationality. GNP is the market value of goods and services produced by labor and property supplied by resident producer units, regardless of where they are located. For GNP, as long as the labor and property are supplied by Puerto Rican residents, they may be located either in Puerto Rico or abroad.

GDP refers to production taking place in Puerto Rico. It is, therefore, the appropriate measure for much of the short-term monitoring and analysis of the Puerto Rican economy. In particular, GDP is consistent in coverage with indicators such as employment, industry output, and investment in equipment and structures.

In addition, changing the featured measure of Puerto Rico's economic output to GDP would facilitate comparisons of economic activity with the United States, the 50 states and the District of Columbia, other U.S. territories, and most other countries. GDP is the featured measure of production in the SNA

(the set of international guidelines for national economic accounting), and is the primary measure used in the other U.S. territories and in almost all countries.[6]

GNP, however, continues to be a useful concept. Because it refers to the income available to Puerto Rican residents as a result of their contribution to production, it is appropriate for analyses related to sources and uses of income. As noted in a May 2006 Government Accountability Office report on fiscal and economic trends in Puerto Rico, GNP growth is also a more meaningful measure when assessing the changes in economic well-being of Puerto Rican residents, because a large portion of the investment income that is a component of domestic income is paid out to nonresident investors.[7]

Recommendation 2: Use chain-type Fisher indexes to calculate changes in aggregate output and prices

Puerto Rico's measures of aggregate output and prices should be calculated using chain-type Fisher indexes instead of fixed-weighted indexes. Fixed-weighted output and price indexes were designed for a time when changes in the composition of output and relative prices were less rapid. The fixed-weighted approach assumes that the relative price structure of the economy is very similar for the entire period being estimated. It can provide good approximations for real growth over short periods of time, when changes in the relative price structure of the economy are generally small, but it becomes less reliable over longer periods.

When using fixed-weighted indexes, quantity measures that are estimated using a set of prices from a single period in the past tend to increasingly overstate growth as one moves forward from that period. [8] This tendency is referred to as substitution bias and reflects that products for which output grows rapidly are generally those for which relative prices decline (because people tend to buy more of a product if it is cheaper).

Another disadvantage to using fixed-weighted indexes is that growth in output and prices is affected by the choice of a base year. Thus, revisions to growth occur whenever the base year is updated.

Puerto Rico's measures of production are calculated using fixed-weighted indexes and a base period of 1954. In other words, real GDP is calculated by valuing the output of all periods using a set of prices that are several decades old. The use of fixed-weighted indexes and a base period so far in the past is a major weakness in Puerto Rico's estimation methodology.

In order to address the problems associated with using fixed-weighted indexes, BEA adopted the use of chain-type Fisher indexes to measure changes in real GDP and prices for the United States. This change was implemented in 1996 and was consistent with guidelines from the SNA that recommended the

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[6] BEA adopted GDP as its featured measure of U.S. production in the 1990s.

[7] See U.S. General Accounting Office (GAO) *Puerto Rico: Fiscal Relations with the Federal Government and Economic Trends during the Phaseout of the Possessions Tax Credit* Report no. GAO-06-541 (Washington, DC: GAO, May 2006).

[8] For periods prior to the base year, growth in output tends to be understated.

implementation of chained measures of quantities and prices.[9] BEA's annual estimates of real GDP for the other U.S. territories are also derived within a chain-type Fisher index framework.

The chain index is superior to the fixed-weighted index because it allows for changing relative prices and production patterns, and thus provides unbiased comparisons of economic activity over long periods. Chain indexes do not use a set of fixed weights; rather, they use separate sets of weights for each time period that represent the relevant prices or economic conditions for those periods. Because they use up-to-date weights, they provide a more accurate picture of an economy than the traditional fixed-weighted measures by allowing for the effects of changes in relative prices and in the composition of output over time.

Under the chain-type Fisher index framework, a Fisher Ideal index is used to calculate the change in quantities or prices from period *t-1* to period *t*. The Fisher quantity index for calculating real GDP (and other aggregate measures of output and expenditures) in year *t* relative to its value in the previous year *t-1* is

$$Q_t^F = \sqrt{\frac{\Sigma_i(p_{i,t-1}q_{i,t})}{\Sigma_i(p_{i,t-1}q_{i,t-1})} \times \frac{\Sigma_i(p_{i,t}q_{i,t})}{\Sigma_i(p_{i,t}q_{i,t-1})}},$$

where

$p_{i,t}$ is the price of the component *i* in period *t*, and

$q_{i,t}$ is the quantity of the component *i* in period *t*.

Because the first term in the Fisher formula is a Laspeyres quantity index, or

$$Q_t^L = \frac{\Sigma_i(p_{i,t-1}q_{i,t})}{\Sigma_i(p_{i,t-1}q_{i,t-1})},$$

and the second term is a Paasche quantity index, or

$$Q_t^P = \frac{\Sigma_i(p_{i,t}q_{i,t})}{\Sigma_i(p_{i,t}q_{i,t-1})},$$

the Fisher formula can also be expressed for year *t* as the geometric mean of these indexes as follows:

$$Q_t^F = \sqrt{Q_t^L \times Q_t^P}.$$

Similarly, price indexes are calculated using the Fisher formula

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[9] See J. Steven Landefeld and Robert P. Parker, "Preview of the Comprehensive Revision of the National Income and Product Accounts: BEA's New Featured Measures of Output and Prices," Survey 75 (July 1995): 31–38, and "Improved Estimates of the National Income and Product Accounts for 1959–95: Results of the Comprehensive Revision," Survey 76 (January/February 1996): 1–31.

$$P_t^F = \sqrt{\frac{\sum_i(p_{i,t}q_{i,t-1})}{\sum_i(p_{i,t-1}q_{i,t-1})} \times \frac{\sum_i(p_{i,t}q_{i,t})}{\sum_i(p_{i,t-1}q_{i,t})}},$$

which is the geometric mean of a Laspeyres price index and a Paasche price index, or

$$P_t^F = \sqrt{P_t^L \times P_t^P}.$$

The chain-type quantity index value for period t is $I_t^F = I_{t-1}^F \times Q_t^F$, and the chain-type price index is calculated analogously.[10]

Advantages to using chain-type Fisher indexes include:

- The Laspeyres and Paasche indexes exhibit biases in opposite directions; as an average of the Laspeyres index and the Paasche index, the chain-type Fisher index represents a "middle ground" between the two indexes that reduces the biases in the underlying indexes.
- Changes in the chain-type Fisher index are not sensitive to the choice of a reference year, and so updating the reference year does not revise the growth rates of real GDP or prices. (The term "reference year" rather than "base year" is used here because for the chain-type quantity index, period 0 does not affect the weights used in the calculation of relative period-to-period changes and only serves as a point of reference.)
- For business cycle analysis, use of a chain-type index presents a more accurate picture of the strength of expansions and the depth of contractions.
- Use of a chain-type index will provide a more accurate picture not only of overall growth, but also of the growth of the individual components of GDP and their contribution to overall growth.

A major disadvantage of chaining is that the chained-dollar estimates are not additive, particularly for periods that are far from the reference period. For example, the chained-dollar estimate of total GDP is not equal to the sum of the chained-dollar estimates of its components. This makes analyzing each component's contribution to growth more complex. For this reason, BEA provides its users with tables of contributions to percent change in addition to price and quantity indexes, chained-dollar estimates, and percent changes in prices and quantities.

The contributions to percent change in a real aggregate, such as real GDP, provide a measure of the composition of growth in the aggregate that is not affected by the nonadditivity of its components. This property makes contributions to percent change a valuable tool for economic analysis. The contribution to percent change ($C\%\Delta_{i,t}$) in an aggregate in period t that is attributable to the quantity change in component i is defined by the formula

$$C\%\Delta_{i,t} = 100 \times \frac{\left((p_{i,t}/P_t^F) + p_{i,t-1}\right) \times (q_{i,t} - q_{i,t-1})}{\sum_j \left((p_{j,t}/P_t^F) + p_{j,t-1}\right) \times q_{j,t-1}},$$

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[10] Chain-type real output and price indexes are presented with the reference year (b) equal to 100; that is, $I_b = 100$.

where

P_t^F is the Fisher price index for the aggregate in period *t* relative to period *t-1*,

$p_{i,t}$ is the price of the component *i* in period *t*, and

$q_{i,t}$ is the quantity of the component *i* in period *t*.

The summation with subscript *j* in the denominator includes all the deflation-level components of the aggregate. Contributions of subaggregates (such as personal consumption expenditure goods) to the percent change of the aggregate (say, PCE or GDP) are calculated by summing the contributions of all the deflation-level components contained in the subaggregate.

BEA recommends incorporating chain-type Fisher indexes and the related measures of contributions into the Puerto Rico national accounts. Note that incorporating this recommendation will result in significant revisions to the year-to-year changes in Puerto Rico's real GDP. Growth in real GDP will likely be revised down as a result of the removal of substitution bias, particularly for the most recent years. In other words, when real GDP is recalculated using more relevant price structures for each period, products with strong output growth will generally receive less weight because they tend to be the products that have become (relatively) cheaper. This results in lower growth in the aggregate measure of production.

BEA highly recommends that data users be informed well in advance before the chain-weighted methods are adopted, especially because of the likelihood of large revisions to the growth rates of Puerto Rico's real GDP and the loss of the additive property of the estimates. BEA introduced chain-weighted indexes as alternative measures to fixed-weighted estimates of real GDP and prices in 1992, approximately four years before officially adopting them as its featured measures.[11]

Recommendation 3: Expand the use of economic census data

BEA recommends that the input-output (I-O) statistics incorporate all available information from the Economic Census of Puerto Rico.[12] The Economic Census of Puerto Rico is a mandatory census that provides a detailed portrait of Puerto Rico's economy every 5 years. BEA further recommends that the components of Puerto Rico's GDP be benchmarked to detailed estimates within the Puerto Rican I-O table for years in which economic census data exist.

Using information from the economic census would significantly improve the reliability of the I-O accounts and, consequently, the GDP statistics. As noted in the assessments by Phidelix Technologies and by external consultant Mark Planting, the I-O tables currently do not use economic census data to establish benchmark levels for industry output.[13] Instead, the I-O tables largely rely on data from Planning Board surveys and tax data collected by Planning Board analysts from the Puerto Rico Treasury Department. Unlike the economic censuses, the Planning Board's surveys have very low response rates.

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[11] See Allan H. Young, "Alternative Measures of Change in Real Output and Prices," Survey 72 (April 1992): 32–48.

[12] The economic census is the primary data source for BEA's I-O accounts. Estimates from the I-O accounts are used extensively as benchmarks for many of the U.S. NIPA estimates.

[13] Mark A. Planting is the former chief of the Industry Studies Branch at BEA.

Although responding to the surveys is technically mandatory, compliance is not enforced by the government. Because the response rates are so low, the results must be supplemented with tax data and then adjusted to include the universe of industries based on wage information from the quarterly census of employment and wages (QCEW). Expanding the use of economic census data would greatly reduce the need to use tax data and QCEW data to make such adjustments.

Economic census data could also be used to update ratios that are several decades old and that are still being used in the calculation of various components of Puerto Rico's annual estimates of GDP. For example, class of customer information from the economic census could be used to update ratios that are used to allocate industry output to the consumers of that output (for example, households, businesses, and government). Economic census data could also be used to update the ratios that allocate output between capital goods, intermediate goods, and goods for final consumption.

Due to data limitations, it may not be feasible to fully implement this recommendation in the short term. Complete implementation will require collaboration with the U.S. Census Bureau to ensure that the economic census forms for Puerto Rico collect the necessary information to generate the most accurate I-O tables and GDP statistics. The Planning Board has submitted some modifications to questions on the 2012 Economic Census forms to the Census Bureau, including adding questions on cost of merchandise for resale and on "all other operating expenses."

Recommendation 4: Increase frequency of GDP and related measures from annual to quarterly

Quarterly measures of GDP would provide a more timely and complete picture of the economy of Puerto Rico. They would supplement current quarterly data—such as employment and wages. Quarterly GDP statistics would show a more detailed and precise view of the turning points in the economy. As shown in the recently released BEA briefing on prototype quarterly statistics on U.S. GDP by industry, quarterly statistics can highlight interesting business cycle dynamics that may not be observed when looking at annual statistics.[14]

Quarterly estimates will also allow for the conversion of the currently existing fiscal year estimates to calendar year estimates. This will further facilitate comparisons of economic activity with economic activity in the U.S. and other countries.

Monthly or quarterly indicators are already available for several income and expenditure categories. They include wage and salary employment, proprietors' employment, wages and salaries, exports, imports, the number and value of construction permits, retail sales, net receipts to the general fund of the Government of Puerto Rico, the value of new dwelling units, consumer prices, and some services categories. For categories for which source data are not available to prepare an indicator series, the current estimates would be extrapolated based on trends and on judgment by Planning Board analysts.

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[14] See Nicole M. Mayerhauser and Erich H. Strassner, "BEA Briefing: Prototype Quarterly Statistics on U.S. Gross Domestic Product by Industry," Survey 91 (July 2011): 32–43.

Recommendation 5: Expand the level of component detail that is published

Estimates should be published in greater detail in order to provide users with more information, particularly on quickly evolving components of the Puerto Rican economy.

Today, a larger share of investment in machinery and equipment is composed of products in which there has been rapid innovation and frequent changes in pricing. As reported in the May 2006 Government Accountability Office report on fiscal and economic trends in Puerto Rico, over 10 percent of manufacturing shipments in Puerto Rico in 2002 were shipments by computer and electronics manufacturers and medical equipment manufacturers.[15] Despite the importance of these types of capital goods, there is no detail published for investment in machinery and equipment in Puerto Rico's income and product accounts tables other than a distribution between enterprises and government.[16] BEA recommends that the Planning Board publish estimates of investment in machinery and equipment that highlight more high-tech equipment, such as computers, electronics, and medical equipment, as well as communications and photocopy equipment. Purchases of software by businesses and governments should also be treated as investment and be separately shown as a component of investment. This will be explained in further detail under Recommendation 7.

The presentation of personal consumption expenditures should also be modernized to reflect changes that have occurred in consumer buying patterns since the currently used classifications were developed. The Planning Board should provide a more detailed presentation of spending on services, which have increased greatly in importance since the Puerto Rico national accounts were first developed. BEA recommends that the following new categories be introduced: financial services and insurance, communication services, and food services and accommodations. The category of food services and accommodations should be separately identified because of its importance in analyzing tourism spending, which is a significant component of the Puerto Rican economy. Motor vehicle services should also be highlighted under the existing category of transportation services.

Recommendation 6: Improve the estimates of banking and insurance services

The methodology for estimating banking services in the Puerto Rico national accounts should be updated to recognize that borrowers and depositors both receive implicit services from banks. Currently, the imputation that is made for services that banks provide without an explicit charge is allocated entirely to depositors.

The view that all the implicit services of banks go to depositors is based on the notion that depositors are the ultimate lenders and that the net interest belongs to them. This view, however, does not adequately account for the implicit services of commercial banks to borrowers in their role as financial intermediaries. In that role, banks transform deposits into earning assets by providing many financial services. In particular, banks provide services related to the provision of credit that overcome problems of asymmetric information and that transfer risk to the bank. Banks devote staff time and other

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[15] See Report no. GAO-06-541, 162–163.
[16] See "Table 3: Gross Product in Constant 1954 Dollars" of Puerto Rico's income and product tables. www.jp.gobierno.pr

resources both to activities that serve depositors, such as clearing checks, and to activities that serve borrowers, such as making loan-underwriting decisions. Accordingly, a measure of bank output should reflect borrower services along with depositor services. [17]

The SNA proposes an approach in which the implicit financial services provided by banks are allocated between borrowers and depositors using a "reference rate" of interest that represents the opportunity cost of borrowing or lending funds. Under this approach, the difference between the interest received by depositors and the interest they would have received had they been paid the reference rate is the value of the implicit services to depositors. Similarly, the difference between the interest paid by borrowers and the interest they would have paid had they borrowed at the reference rate is the value of the implicit services to borrowers.

Incorporating this recommendation will reduce Puerto Rico's GDP. A significant source of the reduction in GDP will be the reallocation of implicit services from final expenditures to intermediate purchases because a larger share of borrowed funds than deposited funds is attributable to business.

In addition to updating the methodology for estimating banking services in the Puerto Rico national accounts, the methodology for estimating property and casualty insurance services should be modified. Under the existing methodology, the value of services provided by insurance companies to their policyholders is estimated as the premiums received by insurance carriers less the actual losses incurred.[18]

Insurance companies provide financial protection to policyholders through the pooling of risk, and they provide financial intermediation services through the investment of reserves that are held to help cover extraordinary losses. After accounting for investment income, insurance companies set premiums to cover the expected costs of providing the services, of settling claims, of maintaining reserves against future claims, and of purchasing reinsurance.

Therefore, services of the property-casualty insurance industry should be measured as direct premiums earned plus premium supplements—that is, the expected investment income earned from the investment of reserves that are directly attributable to policyholders because of prepayment of premiums or accrual of benefits minus normal losses incurred and dividends paid to policyholders. The normal losses should be calculated on the basis of historical experience. This approach is consistent with SNA guidelines.

Because of the use of normal losses rather than actual losses, incorporating this recommendation will result in less volatile estimates of insurance services when disasters occur, such as hurricanes.

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[17] See Dennis J. Fixler, Marshall B. Reinsdorf, and George M. Smith, "Measuring the Services of Commercial Banks in the NIPAs," Survey 89 (September 2003): 33-44.

[18] See Baoline Chen and Dennis J. Fixler, "Measuring the Services of Property-Casualty Insurance in the NIPAs," Survey 83 (October 2003): 10-26.

Recommendation 7: Treat expenditures on intangible assets as investment

Puerto Rico's national accounts do not treat expenditures on intangible assets as investment, even though they contribute to future production just as expenditures on tangible assets do (for example, equipment and structures). Therefore, the accounts are missing an important component of the modern economy. Developing measures of these intangible assets and incorporating them into the national accounting framework for Puerto Rico will allow users to understand the role of intangible assets as drivers of economic growth.

BEA recommends that expenditures on the following intangible assets be treated as investment when the required source data become available. These categories are identified as capital assets in the latest SNA guidelines.

- Computer software
- Research and development (R&D)
- Entertainment, literary, or artistic originals[19]

Computer software should be treated as investment regardless of whether it is sold in the market (such as prepackaged or custom software) or developed in-house by private enterprises or government units for their own use (referred to as "own-account" software). Assuming software purchases are currently treated as intermediate purchases by businesses, reclassifying software as investment would increase GDP by the purchases of software and the own-account production of software by businesses, and by the depreciation on purchases and own-account production of software by general government units and by nonprofit institutions serving households (NPISHs).[20]

R&D is defined in the SNA as "creative work undertaken on a systematic basis to increase the stock of knowledge, and use this stock of knowledge for the purpose of discovering or developing new products, including improved versions or qualities of existing products, or discovering or developing new or more efficient processes of production."[21] Reclassifying R&D expenditures of business from intermediate purchases to investment will increase GDP by the value of R&D investment. Reclassifying R&D expenditures of general governments and of NPISHs from consumption expenditures to investment will increase GDP by the value of depreciation generated by R&D investment. Given the large role of pharmaceutical manufacturing in the economy of Puerto Rico, capitalizing R&D expenditures is likely to have a significant effect on measures of production.[22] According to the latest estimates from BEA's R&D satellite account, the largest contribution from an R&D-intensive industry to average real GDP growth in

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[19] The SNA also includes expenditures for mineral exploration as investment. However, mineral exploration is assumed to be a very small component of the economy of Puerto Rico and is not addressed here.

[20] See Robert Parker and Bruce Grimm, "Recognition of Business and Government Expenditures for Software as Investment: Methodology and Quantitative Impacts, 1959-98," www.bea.gov/papers/pdfs/software.pdf

[21] See SNA 2008, paragraph 6.207.

[22] According to "Table 10: Gross Product and Gross Domestic Product by Industrial Sector" of Puerto Rico's income and product tables, *pharmaceutical and medicine manufacturing* accounted for approximately 27 percent of GDP in current-dollar terms. www.jp.gobierno.pr

the U.S. (excluding the territories) from 1995 to 2007 would have been from the pharmaceutical and medicine manufacturing industry.[23]

The category of entertainment, literary, or artistic originals includes spending to create musical scores, films, musical recordings, and artistic images. The primary issue with including this category of intangibles in the economic accounts for any country or region is measurement. One problem for intangible assets is that they are rarely sold in an open market (except for prepackaged and custom software), so it is difficult to observe prices. A common solution to this problem is to estimate the value of investment based on the costs of production. This is the approach used by BEA in measuring own-account software and R&D. However, in the case of entertainment, literary, or artistic originals, even direct data on production costs may not be available, so other alternative methods must be developed.[24] BEA has not yet incorporated artistic originals or R&D as investment into its core accounts but plans to do so around 2013.

Recommendation 8: Replace the existing five summary account framework with an expanded framework

As stated previously, Puerto Rico's national accounting framework currently consists of five accounts: the net income and gross product account, the personal income and outlay account, the government receipts and expenditures account, the foreign transactions account, and the gross savings and investment account.

The U.S. national income and product accounts previously consisted of a similar five-account framework. However, in 2003, BEA expanded its framework to include seven accounts in order to improve consistency with the SNA and provide users with more information.[25] For example, the SNA recommends that current foreign transactions—such as exports, imports, income receipts and payments, and current transfer receipts and payments—should be shown in a separate account from capital transactions, such as capital transfers. BEA implemented this recommendation by splitting the previously existing foreign transactions account into two accounts—the foreign transactions current account and the foreign transactions capital account. BEA also added a private enterprise income account in order to provide more detailed information on the components of private income.

Recommendation 9: Improve data collection, storage, and management systems

BEA recommends that data collection and processing of estimates be automated in order to maximize the efficiency of the limited staff available for measuring these statistics. This is especially critical given the resource demands imposed by updating the economic accounts as recommended above.

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[23] See Jennifer Lee and Andrew G. Schmidt, "Research and Development Satellite Account Update: Estimates for 1959–2007," Survey 90 (December 2010): 16–27.

[24] A method for measuring investment in entertainment, literary, or artistic originals was proposed by Rachel H. Soloveichik in "Research Spotlight: Artistic Originals as Capital Assets," Survey 91 (June 2011): 43–51.

[25] See Nicole Mayerhauser, Shelly Smith, and David F. Sullivan, "Preview of the 2003 Comprehensive Revision of the National Income and Product Accounts: New and Redesigned Tables," Survey 83 (August 2003): 7–31.

Source data should be imported electronically whenever possible, rather than hand-entered. This would reduce the amount of time needed to collect data, the labor needed to enter data, and the number of data entry errors. It would also increase the amount of data collected. In some cases, information may be available but is not entered into a database due to time constraints. In particular, automation would improve the process of collecting tax data from the Treasury Department. Currently, Planning Board analysts tabulate tax data from the Treasury Department by hand.

Certain types of calculations should be performed only using database-oriented programming languages rather than spreadsheets. For example, estimating GDP within a chain-type Fisher index framework requires far more calculations than the fixed-weighted Laspeyres approach. The computation of the indexes is more complex; in addition, tables of contributions to growth in prices and in real GDP need to be generated because the chained-dollar estimates are not additive. Such calculations are extremely prone to error in a spreadsheet. Furthermore, automating these calculations would allow staff to dedicate more time to analytical work rather than to processing issues.

BEA uses a processing system for GDP that was developed using a relational database system. BEA uses Microsoft SQL Server, but other relational database systems could be used. The system performs the calculation of chain-type Fisher indexes, chained dollars, and the contributions to percent change. BEA staff submit current-dollar series and price indexes to the system, called STATS, and then retrieve and analyze the output. STATS is able to complete the calculation of all of the chain-type Fisher index calculations that are required for the quarterly estimates of U.S. GDP in less than 1 minute.

BEA's input-output (I-O) accounts, including the benchmark I-O accounts, are also prepared using a relational database system. BEA uses Microsoft SQL server with balancing procedures developed using custom software programmed at BEA. These procedures automate many of the calculations required to produce the accounts. This processing system imposes the I-O framework to harmonize and reconcile various administrative, survey, and economic census data that are available in the U.S. statistical system. The process ensures that various economic accounting identities hold; for example, GDP measured through the final expenditures, gross domestic income, and production approach are all equivalent. For economic census years, the statistics on final expenditures generated by this system are essential to the benchmarking of official U.S. GDP statistics. A major benefit of this system has been the development of an annual feedback loop to the U.S. national economic accounts in which detailed information on imbalances in data on income, expenditure, industry value added, intermediate inputs and gross output is shared and can be incorporated into the national economic accounts expeditiously.

Overall, BEA's work to modernize its processing systems for GDP and the I-O accounts has allowed for the development of more accurate economic statistics because staff can devote more time to analysis rather than data entry, manipulation, and other lower value-added activities. The computational system currently used at BEA has taken considerable effort and resources to develop. We hope that the Planning Board can benefit from leveraging this accumulated knowledge and adapting it to the specific needs of Puerto Rico's economic accounts.

Future steps

Improving the quality of Puerto Rico's national accounts is critical to the Island's economic development but will require funding. Unfortunately, governments at every level, including the federal government, are facing major budget constraints. In this difficult budget climate, BEA can provide only limited technical support to begin implementing improvements to Puerto Rico's national economic accounts.

As part of this limited assistance, BEA will conduct a series of training sessions on national accounting in Puerto Rico. The training sessions are currently scheduled to be held in mid-October of 2011 and will be open to staff from the Planning Board's Program of Economic and Social Planning and the Puerto Rico Institute of Statistics. The sessions will provide:

1. Detailed discussions of methods for estimating GDP statistics and I-O accounts
2. Discussions on how source data are used and modified to fit national accounting concepts
3. Detailed discussions on data collection, storage, and management and discussions on how BEA developed its central data processing systems to estimate U.S. GDP and I-O accounts
4. Opportunities for Planning Board and Institute of Statistics staff to interact with BEA staff and learn "best practices" techniques for working with data

To the extent possible, BEA will also lend its own staff resources and expertise to assist Puerto Rico in solving specific national economic accounting measurement concerns. For example, BEA has offered to review Puerto Rico's foreign direct investment statistics that have been calculated by the Planning Board but have not been published. Earlier this year, BEA provided the algorithm and documentation for calculating Fisher chain-weighted quantity and price indexes to the Puerto Rico Planning Board and the Institute of Statistics.

BEA looks forward to working with staff of the Planning Board and the Institute of Statistics to improve and expand Puerto Rico's economic accounts.