REVOLUTIONARY CUBA'S GDP:
A SURVEY OF METHODS AND ESTIMATES

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In the 1990s, Cuba shifted the methodology of compiling its national account statistics from the Material Product System (MPS), used by centrally planned economies (CPEs), to the System of National Accounts (SNA) used by market economies. While there are some questions about how robustly Cuban statistical agencies currently are applying the SNA methodology,[2] unquestionably the shift to SNA has removed a major ill that afflicted revolutionary Cuba's national accounts statistics for nearly three decades, namely the lack of international comparability.

This paper surveys efforts by researchers and organizations to make estimates of Cuban economic performance compatible with those of market economies during the time period—roughly 1960–1990—when Cuban authorities relied on the MPS methodology. The first part of the paper describes the two national accounting methodologies and principal differences. The second part discusses alternative approaches developed by experts to make gross domestic product (GDP)/gross national product (GNP)[3] or GDP/GNP growth rate estimates for CPEs. The third part describes estimates of Cuban GDP/GNP or GDP/GNP growth rates, while the fourth part summarizes the results. The paper touches on some of the challenges in international comparisons of economic performance measures related to conversion to a common currency. Nevertheless, the topic of the appropriate exchange rate to use to convert aggregate economic measures of CPEs is a topic worthy of its own analysis and is not addressed in detail here.

SNA AND MPS

The System of National Accounts (SNA) "consists of an integrated set of macroeconomic accounts, balance sheets and tables based on internationally agreed concepts, definitions, classification, and accounting rules. Together, these principles provide a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision-taking and policy-making."[4]

The SNA standard, first published by the Statistical Office of the United Nations in 1953, has been revised several times, with the most significant revision

2. See, e.g., Jorge Pérez-López and Carmelo Mesa-Lago, "Cuban GDP Statistics Under the Special Period: Discontinuities, Obfuscation, and Puzzles," *Cuba in Transition—Volume 19* (Washington: Association for the Study of the Cuban Economy, 2009) and sources cited therein.

3. GDP is the value of goods and services produced within the borders of a country, regardless of the nationality of those who produce them, while GNP is the value of goods and services produced by the residents of a country, even if they are living abroad. The two measures tend to be very close to each other and are used interchangeably in this paper.

4. http://unstats.un.org/unsd/sna1993/introduction.asp. The rest of this paragraph relies heavily on this same source. The basic document on the SNA is United Nations, Statistical Office, *A System of National Accounts* (New York: United Nations, 1968).

occurring in 1993. Certain key aggregates produced under the SNA, such as the gross domestic product (GDP) or the gross national product (GNP), and GDP or GNP per capita, are widely used by analysts, politicians, the press, the business community and the public at large as summary, global indicators of economic activity and welfare. Movements of such aggregates, and their associated price and volume measures, are used to evaluate the overall performance of the economy and hence to judge the relative success or failure of economic policies pursued by governments and of the economic wellbeing of individuals in those countries.[5]

The Material Product System (MPS) is the system of national accounts used in the former Soviet Union and other CPEs.[6] The MPS uses a different concept of national income than does the SNA—the focus in the MPS is on measuring value added in the production of materials goods and in the provision of the limited group of services directly related to the production or distribution of those goods, generally referred to as "productive services." Sectors of the economy engaged in material production are industry (manufacture and mining), agriculture, and construction; services associated with material production (i.e., productive services) are freight transportation, communications, and wholesale and retail trade. Material production and support services make up what is called the "productive sphere."[7] Aggregate measures of economic activity under the MPS, such as the gross material product (GMP), the

net material product (NMP) or the global social product (GSP), refer exclusively to production by the productive sphere and therefore exclude the contribution to national income of the so-called "non-productive sphere," which is made up of public and private services such as education, health, social insurance pensions and social assistance, culture, housing, passenger transportation, government administration and defense.

In the early 1950s, the Banco Nacional de Cuba (BNC) began to calculate GNP and other SNA aggregates for the Cuban economy. Thus, a GNP series from 1947 to 1958 in national currency (pesos) is available.[8] The BNC also calculated GDP for 1959 and 1960, but it interrupted computation of SNA statistics in 1961 because a five-year plan for 1961–65 was being prepared. With the structural changes to the economy that occurred swiftly in 1959–62—among them the nationalization of private property, the adoption of central planning, a major shift in trading partners—Cuba ceased to publish a wide range of statistics, among them those relating to national accounts. When publication of statistics resumed in the 1960s (the first post-revolutionary yearbook was for 1968), national accounts were now calculated using the MPS, and rather than the familiar GNP/GDP aggregates, the macroeconomic aggregates released by Cuba were GMP, NMP, or GSP. Cuban statistical sources published some historical MPS statistics back to 1962, but no figures for the

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5. The most thorough examination of the problems associated with SNA measures and the challenges of developing alternative measures is contained in the report prepared by the Commission on the Measurement of Economic Development and Social Progress, established by France's President Sarkozy in 2008, with the objective of analyzing the adequacy of current measures of economic performance and how measures of development could take better account of societal wellbeing. The Commission was chaired by prominent economist Joseph Stiglitz; Amartya Sen, another prominent economist, served as principal advisor. The Commission's report, issued in 2009, is available at http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf.

6. United Nations, Statistical Office, *Basic Principles of the System of Balances of the National Economy* (New York: United Nations, 1971). With the exception of North Korea, no country is believed to use the MPS currently.

7. For a description of the MPS see, e.g., Central Intelligence Agency, National Foreign Assessment Center, *USSR: Toward a Reconciliation of Marxist and Western Concepts of National Income* (Washington, 1978).

8. During this period, the Cuban peso was valued at par with the U.S. dollar, and therefore GNP and other aggregates reported in pesos are also in U.S. dollar terms. The parity of the peso with the U.S. dollar ended around 1960.

period 1959–61 and no disaggregated data that would allow bridging the two systems.[9]

Conceptually, national income statistics of CPEs (compiled under the MPS) and of market economies (compiled under the SNA) could be made comparable if full information on the component accounts were available. The Statistical Office of the United Nations has analyzed the two approaches and developed a methodology for converting national income data from one system to the other.[10] In practice, however, MPS/SNA conversions are generally not feasible because the detailed data for CPEs required to estimate GDP or GNP are not available, and Cuba is no exception. As a result, other approaches have been developed for estimating levels of economic activity and growth rates of centrally planned economies that approximate GDP or GNP.

ALTERNATIVE APPROACHES TO ESTIMATE GDP/GNP

In the early 1980s, the World Bank brought together a group of experts to identify and evaluate alternative methods for computing levels and growth rates of the GNPs of CPEs. The project team, led by Professor Paul Marer, consisted of about a dozen academics and practitioners with expertise on methodological issues and/or the specific CPEs within the scope of the project. Carmelo Mesa-Lago was engaged as the country expert on Cuba; I had the privilege of working with him on the assessment and in co-authoring a monograph on Cuban national accounts.[11] Marer's final report on the project was published by the World Bank in 1985.[12]

Marer's report identified and evaluated four alternative approaches employed in the literature to estimate GDP/GNP for CPEs; the first three methods yield estimates in domestic currency, while the fourth directly yields GDP/GNP estimates in a convertible currency (typically U.S. dollars):[13]

1. Building a more or less complete set of national accounts of the CPEs from disaggregated data, computing GNP as the sum of value added generated by all sectors of the economy valued at some sort of market-determined factor cost;

2. Scaling up from the CPE's NMP by adding net value added in the nonmaterial sectors plus depreciation and other adjustments to approximate GNP;[14]

3. Deriving GNP for the CPEs as the sum of the various end uses of the goods and services—consumption, investment, government, and net exports; and

9. The classical review and analysis of socialist Cuba's early statistics is Carmelo Mesa-Lago, "Availability and Reliability of Statistics in Socialist Cuba," *Latin American Research Review*, Pt. 1, 4 (Winter 1969) and Pt. 2, 4 (Summer 1969). See also Mesa-Lago, *Market, Socialist and Mixed Economies: Comparative Policy and Peformance—Chile, Cuba and Costa Rica* (Baltimore: Johns Hopkins University Press, 2000). This section draws on Mesa-Lago's work. An interesting historical essay on Cuban national accounts is Antonio Santamaría García, "Las cuentas nacionales de Cuba, 1890–2005," *Red de Estudios Comparados del Caribe y el Mundo Atlántico* (mayo 2005), http://reccma.es/santamaria.pdf.

10. United Nations, Statistical Office, *Comparison of the System of National Accounts and the System of Balances of the National Economy*, Part I: *Conceptual Relationships* and Part II: *Conversion of Aggregates of SNA to MPS and Viceversa for Selected Countries* (New York: United Nations, 1981).

11. Carmelo Mesa-Lago and Jorge Pérez-López, *A Study of Cuba's Material Product System, Its Conversion to the System of National Accounts, and Estimation of Gross Domestic Product per Capita and Growth Rates*, World Bank Staff Working Papers No. 770 (Washington: World Bank, 1985).

12. Paul Marer, *Dollar GNPs of the U.S.S.R. and Eastern Europe* (Baltimore: The Johns Hopkins University Press for the World Bank, 1985) and Marer, "Alternative Estimates of the Dollar GNP and Growth Rates of the CMEA Countries," in Joint Economic Committee, *East European Economies: Slow Growth in the 1980s* (Washington: U.S. Government Printing Office, 1985). See also, Paul Marer, Janos Arvay, John O'Connor, Martin Schrenk, and Daniel Swanson, *Historically Planned Economies: A Guide to the Data* (Washington: World Bank, 1992).

13. Marer, *Dollar GNPs*, p. 15.

14. Marer, *Dollar GNPs*, p. 15, also described a variation of the "scaling up" method, namely scaling up from NMP to GNP on the basis of the average regression relationship between NMP and GNP for a group of Western countries in a benchmark year. Marer deemed this method to be devoid of a theoretical basis and dismissed it.

4. Estimating GNP in dollars for the CPEs directly through the physical indicators approach.

The team of experts evaluated the feasibility of using each of the approaches to estimate GNP for eight CPEs in 1980. For six of the CPEs (Czechoslovakia, the German Democratic Republic, Hungary, Poland, Romania, and the Soviet Union), scaling up from NMP to GNP was the best practical method identified, while in the case of another (Bulgaria), the best practical method was to estimate GNP by summing up the end uses of all goods and services produced. Neither of these two methods could be used to estimate Cuban GNP for 1980, however, as is discussed below. For purposes of converting GNP in local currencies to a common denominator (i.e., U.S. dollars), the consensus of the project participants was that purchasing power parity (PPP) exchange rates were preferred over other alternatives.

ESTIMATES OF CUBAN GDP/GNP

Several researchers and organizations have applied the approaches listed above—or some variation thereof—to estimate Cuban GDP/GNP or growth rates. This section of the paper describes the general approaches and the results of their application to Cuba. As will be discussed in the next section, it is difficult to compare the estimates as they differ with respect to base year, whether the weighting schemes are based on current prices or are adjusted for inflation, whether the estimates are in domestic currency or in dollars, and the exchange rates that might have been used to calculate GDP/GNP in dollar terms.

Scaling Up from NMP

As discussed earlier, scaling up from NMP was the best practical method identified by the team of experts assembled by the World Bank to estimate GNP for CPEs. Figure 1 presents the relationship among macroeconomic aggregates in Cuba's application of the MPS. The left branch of the figure considers the components of NMP from the product side, while the right branch does the same from the expenditures side.

Recall that the focus of the MPS is on measuring value added in the production of material goods and in the provision of a limited group of services directly related to the production and distribution of material goods.

Figure 1. Components of NMP
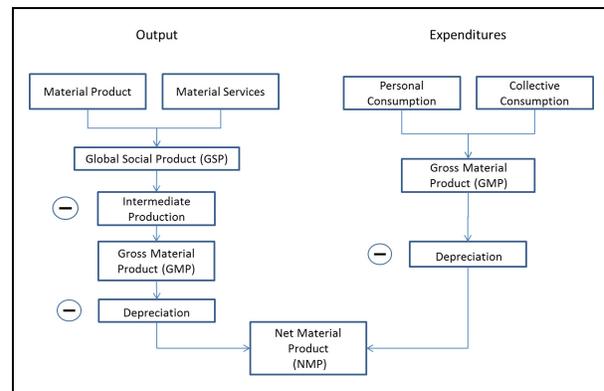
From the production or output side (left branch of Figure 1), sectors of the economy contributing to the **Material Product** are agriculture, fishing, industry (manufacturing, mining, electricity production) and construction. **Material Services**, associated with material production, are freight transportation, communications, and wholesale and retail trade. Material production and supportive material services sectors make up the productive sphere; the **Global Social Product** (GSP) is the indicator of activity in the productive sphere. Subtracting intermediate consumption from GSP yields the **Gross Material Product** (GMP) and further subtracting **Depreciation** obtains **Net Material Product** (NMP).

From the expenditures side (right branch of Figure 1), the **Gross Material Product (GMP)** is the sum of **Personal Consumption**—which refers to expenditures by household units on goods and material services, such as purchases of goods sold in state retail stores and agricultural markets, restaurant purchases, fees paid for public utilities, use of public transport, cost of home repair, and consumption of meals at state workplaces—and **Collective Consuption,** also called social consumption—which refers to consumption by institutions that satisfy collective needs. Subtracting **Depreciation** from GMP yields NMP.

Scaling up to the familiar SNA aggregates GNP or GDP would require adding to NMP the contribution to national income of the so-called non-productive sphere, which is made up of private and public

services such as education, health, social insurance pensions and social assistance, culture, housing, passenger transportation, government administration, and defense.

Mesa-Lago and Pérez-López[15] evaluated the possibility of scaling up from NMP to estimate Cuban GDP for 1980 and found that it was not feasible because of the lack of data. They observed that NMP statistics were not available and neither were consistent GMP statistics. (Beginning in the late 1960s, the only national income indicator regularly published by Cuba was GSP, which includes intermediate consumption.) Moreover, Cuba has not regularly published data on the value of NMS or on the value of individual nonmaterial services that could be aggregated to estimate the value of NMS.

For several years for which official GMP data were available, Mesa-Lago and Pérez-López made rough estimates of the value of Cuban NMS using as proxies expenditures on these sectors from the national budget and scaled up to estimate GDP in pesos. The estimates are given in Table 1. The value of nonmaterial services estimated by Mesa-Lago and Pérez-López ranged from 21.0% to 23.6% of the estimated value of GDP for 1963–1965, while for 1978 it was about 30.0%.

Table 1. Estimates of Cuban GDP Using Scaling Up Procedure
(million pesos)

Year	GMP	NMS	Estimated GDP
1963	3450	1066	4516
1964	4202	1120	5322
1965	4136	1181	5317
1978	10115	4334	14449

Source: Carmelo Mesa-Lago and Jorge Pérez-López, *A Study of Cuba's Material Product System, Its Conversion to the System of National Accounts, and Estimation of Gross Domestic Product per Capita and Growth Rates*, World Bank Staff Working Papers No. 770 (Washington: World Bank, 1985), p. 33.

In 1976, the U.S. Central Intelligence Agency (CIA) estimated Cuban GNP in pesos for 1974 through scaling up: to the official GMP statistics at current prices for 1974 (7414 million pesos), CIA analysts added an estimate of the value of nonmaterial services (such as health, education, and public administration) of 850 million pesos, to obtain an estimated value of GNP of 8264 million pesos.[16]

For the year 1974 only, researchers at Cuba's Comité Estatal de Estadísticas (CEE), the government's statistical office, carried out an exercise of scaling up to GDP from NMP for a seminar on Latin American national income accounts held in 1982. Summary results are given in Table 2. Cuban statisticians reported NMP in 1974 at 7279.6 million pesos. They adjusted NMP by subtracting certain categories of services, losses, and depreciation and adding value added in the nonproductive sphere plus depreciation to obtain GDP. The reported value of GDP in 1974 was 9239.3 million pesos. Note that the estimate of the value of nonmaterial services in 1974 by CEE of 1236 million pesos (13.3% of GNP) is not out of line with the 850 million pesos (10.3% of GNP) estimated by the CIA.

Table 2. Scaling Up from NMP to GDP for 1974 by CEE
(million pesos at current prices)

Net Material Product (NMP)	**7279.6**
Less: Travel Expenses	95.6
Depreciation of Fixed Assets at Reported Prices	88.6
Losses in Fixed Assets	13.3
Nonproductive Services Used by the Productive Sphere	74.5
Plus: Services from Nonproductive Enterprises	116.4
Maintenance of Homes	3.5
Services from Government Units	1116.4
Plus: Depreciation from the Productive Sphere	808.9
Depreciation from the Nonproductive Sphere	186.5
Gross Domestic Product (GDP)	9239.3

Source: Seminario Latinoamericano de Cuentas Nacionales y Balance de la Economía, *Cuba: Conversión de los principals indicadores macroeconómicos del sistema de balances de la economía nacional (SBEN) al sistema de cuentas nacionales (SCN) 1974*, La Habana, Marzo 1982, Table 2.

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15. Mesa-Lago and Pérez-López, *A Study of Cuba's Material Product System*. On the application of the MPS in Cuba and challenges in converting to SNA, see also Andrew Zimbalist and Claes Brundenius, *The Cuban Economy: Measurement and Analysis of Socialist Performance* (Baltimore: The Johns Hopkins University Press, 1989), particularly pp. 9–13.

16. U.S. Central Intelligence Agency, *The Cuban Economy: A Statistical Review*, ER81–10052 (Washington: July 1976).

In the midst of an effort by the Cuban Government to renegotiate with lenders the terms of its foreign debt, in mid-1982 the BNC issued a report in which it presented estimates of GDP in current pesos purportedly calculated using the SNA.[17] The series of estimates for 1971–1980 in the BNC report are given in Table 3. Although said report does not indicate the specific methodology used to make the GDP estimates, a fair assumption is that they were based on the scaling up exercise conducted by CEE (for 1974) mentioned above for two reasons: (1) the CEE exercise and the BNC report were contemporaneous; and (2) the estimated GDP value for 1974 in the CEE exercise (9239 million pesos) and in the BNC report (9240 million pesos) were almost identical.

Table 3. Scaling Up Estimates of Cuban GDP by BNC *(in current pesos)*

Year	GDP
1971	6384
1972	7312
1973	8496
1974	9240
1975	10173
1976	10334
1977	10837
1978	12200
1979	12238
1980	14213

Source: Banco Nacional de Cuba, *Economic Report* (August 1982), p. 30.

Building SNA Accounts from Disaggregated Data

Bergson pioneered a methodology for estimating GDP/GNP growth rates for CPEs that relied on combining changes in non-monetary measures of activity for a large number of economic categories using information on factor cost prices and on value added. [18] This approach, sometimes called the "bottom-up" approach, requires: (1) compiling output or activity indexes for a fairly large number of individual products or services; (2) aggregating the output or activity indexes into branch/sector indexes using a set of base year weights (typically factor cost prices) that reflect the relative importance of each product or service within branches or sectors of the economy; and (3) combining the branch/sector indexes into an overall index of national economic production using base year weights (typically value-added weights) that reflect the contribution of each branch/sector to GDP/GNP.

The earliest application of this methodology to Cuba was by Pérez-López, who used it to construct an industrial production index (covering manufacturing, mining, and electricity production) for pre-revolutionary Cuba (1930–1958).[19] Brundenius expanded Pérez-López's industrial production index, adding the value of agriculture and construction activities, to compute an index of total material production (TMP) and updated it through 1961, that is, through the beginning of the period when Cuba began to apply the MPS.[20]

Separately, Brundenius also made estimates of GDP for the period 1965–1981 (Table 4) that appear to be based at least in part on the bottom up approach. Brundenius states that he used indicators of physical

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17. Banco Nacional de Cuba, *Economic Report* (August 1982), p. 30. A footnote to the table containing the estimates states: "In terms of the UN-National Accounts System."

18. Abram Bergson, "Soviet National Income and Production in 1937," *Quarterly Journal of Economics*, Pt. 1, 65 (May 1950) and Pt. 2, 65 (August 1950). For application to other countries see, e.g., John K. Chang, *Industrial Development in Pre-Communist China* (Chicago: Aldine, 1969); Pong Lee and John M. Montias, "Indices of Romanian Industrial Production," in John M. Montias, editor, *Economic Development in Communist Rumania* (Cambridge: MIT Press, 1967); and George J. Staller, "Czechoslovak Industrial Growth, 1948–1959," *American Economic Review*, 52 (June 1962).

19. Jorge Pérez-López, "An Index of Cuban Industrial Output, 1930–58," in James W. Wilkie and Kenneth Ruddle, *Quantitative Latin American Studies: Methods and Findings* (Los Angeles: UCLA Latin American Center, 1977).

20. Claes Brundenius, *Economic Growth, Basic Needs and Income Distribution in Revolutionary Cuba* (Lund, Sweden: Research Policy Institute, University of Lund, 1981). A slightly revised version is Brundenius, *Revolutionary Cuba: The Challenge of Growth with Equity* (Boulder, Colorado: Westview, 1984). Interestingly, the growth rates of TMP that he calculates are 4.3% in 1959, 1.5% in 1960, and 2.8% in 1961, compared to industrial production growth rates of 17% in 1959 and 25% to 29% in 1960 reported by economists favorable toward the Cuban revolutionary process and 13% in 1960 and 6.2% in 1961 given in an official government publication. See Brudenius, *Economic Growth*, p. 42.

Table 4.   Estimated Cuban GDP, 1958–1981, by Brudenius *(million pesos at constant prices of 1965)*

Year	TMP[a]	GMP	NMS	GDP
1958	2116	3480	678	4158
1959	2207	3628	737	4365
1960	2240	3685	742	4427
1961	2303	3787	819	4606
1962	2248	3698	843	4541
1963	2173	3737	880	4617
1964	2397	4075	982	5057
1965	2520	4138	967	5105
1966	2451	3986	1020	5006
1967	2711	4083	1032	5115
1968	2648	4377	1058	5435
1969	2554	4181	1107	5288
1970	2976	4204	1060	5264
1971	3066	4127	1099	5226
1972	3344	4405	1261	5666
1973	3792	4902	1490	6392
1974	4097	5241	1708	6949
1975	4576	5708	1967	7675
1976	4783	5959	2355	8314
1977	4983	6409	2644	9053
1978	5362	6844	2760	9604
1979	5450	6988	2834	9822
1980	5580	7179	2874	10053
1981	6525	8040	2949	10989

Source: Claes Brundenius, *Revolutionary Cuba: The Challenge of Growth with Equity* (Boulder: Westview Press, 1984), p. 39.

a.   At factor cost.

production for a large number of consumer goods and that he aggregated them using official Cuban retail prices for 1965 to obtain activity indexes for the principal goods-producing sectors and for the material product. It is not clear how he aggregated physical production series for capital goods and intermediate products sectors, for which prices were not available; he seems to have used official data on the gross value of output for these sectors. Finally, it appears that he estimated the value of non-material services using as a proxy expenditures on social services in 1965, projecting the latter forward and backward applying the rates of growth of the education and public health sectors.

In the mid-1970s, the U.S. Central Intelligence Agency (CIA) began to publish estimates of Cuban economic performance under the SNA. In a publication on Cuban foreign trade published in 1975,[21] the CIA published the following estimates of Cuban average GNP growth:

1961–1973:	1.8%
1968–1973:	Negligible
1974:	4–6%

In another publication,[22] the CIA calculated a series of index numbers of Cuban GNP growth in pesos for 1968–1975 using the "bottom-up" approach: (1) for goods-producing sectors (agriculture, industry, sugar production), the CIA constructed physical output indexes using production data for key commodities. Official Cuban production data were used in most cases; however, for some agricultural commodities for which official data exclude private sector production, reported *acopio* (government procurement) data were adjusted upward by 10–15%. Individual physical output indices were aggregated to produce sectorial indexes using retail prices for 1957; (2) for productive services sectors (construction, transportation, communications), output indexes were developed based on the behavior of key variables such as apparent consumption of construction materials and freight and passenger traffic, based on official data); (3) the indexes for each sector were aggregated using as weights the contribution of each sector to GNP in 1957.

Table 5 shows the index of Cuban GNP growth developed by the CIA for the period 1968–75. The GNP index is based on 1968=100. The right-most column of Table 4 shows estimates of GNP in pesos for each of the years 1968–75 obtained by applying the estimated GNP growth index to the CIA's estimate of GNP of 8264 million pesos in 1974.[23]

Pérez-López has also constructed estimated growth rates of Cuban GDP for the period 1965–82 using the "bottom-up" approach, that is, from changes in non-monetary measures of activity in a large number

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21. U.S. Central Intelligence Agency, *Cuba Foreign Trade*, A(ER)75–69 (Washington: July 1978), p. 17.

22. U.S. Central Intelligence Agency, *The Cuban Economy*.

Table 5. Growth Rate of Cuban GNP and GNP Estimates, 1968–1975, by CIA *(1968=100 and million pesos at current prices)*

Year	GNP Index	GNP[a]
1968	100.0	7180
1969	101.7	7302
1970	108.0	7754
1971	104.8	7524
1972	105.3	7560
1973	111.8	8027
1974	115.1	8264
1975	118.7	8522

Source: U.S. Central Intelligence Agency, The *Cuban Economy: A Statistical Review*, ER81–10052 (Washington, 1976), p. 2.

a. Jorge Pérez-López, *Measuring Cuban Economic Performance* (Austin: University of Texas Press, 1987), p. 111.

of economic categories aggregated using factor cost prices and value added information.[24] He used approximately 270 non-monetary activity series in the calculations: 185 individual products from the industrial sector, 43 products from the agricultural sector, and 23 and 18 activity series, respectively, for productive services sectors and nonproductive services sectors. As prices of goods and services in socialist Cuba are fixed by the government and deemed not to reflect factor costs, proxy prices from other market economies for 1973–1974 were used to aggregate individual products and services into branches and sectors of the economy. Finally, aggregation across branches and sectors was carried out using value-added weights.

Table 6 presents the growth rates of GDP and other economic aggregates developed by Pérez-López using the bottom-up approach. It is important to note that, consistent with the bottom-up methodology, he did not make estimates of the value of GDP, as this

Table 6. Estimated Output Indicators for Cuba, 1965–1982 *(1974=100)*

Year	Industry	Agriculture	Material Product	GSP	GDP
1965	80	74	76	76	73
1966	83	70	78	80	77
1967	91	79	92	89	86
1968	90	79	85	81	81
1969	91	82	84	79	80
1970	82	96	80	76	77
1971	83	86	78	83	83
1972	88	85	87	88	87
1973	96	90	95	95	95
1974	100	100	100	100	100
1975	108	105	106	104	105
1976	107	111	105	106	108
1977	108	119	111	111	113
1978	115	124	112	114	120
1979	116	127	116	118	123
1980	113	129	111	116	120
1981	120	142	118	122	130
1982	120	141	119	124	133

Source: Jorge Pérez-López, *Measuring Cuban Economic Performance* (Austin: University of Texas Press, 1987), p. 111.

would have required benchmarking, and he estimated only growth rates consistent with the SNA.[25]

The Food and Agriculture Organization (FAO) of the United Nations used a variant of the "bottom up" approach to estimate the value of agricultural production of a large number of member states—among them Cuba—for 1970, 1975 and 1980.[26] For each country in the study, FAO statisticians estimated the value of agricultural production on the basis of physical output of each commodity priced at a common "international price." For Cuba, the FAO estimated the value of agricultural output at 1248 million international dollars in 1970, 1709 million international dollars in 1975, and 2739 million international dollars in 1980. Roy extrapolated from the FAO agricultural production estimates to esti-

23. The CIA estimates of GNP growth rates and of GNP apparently have been used by other U.S. agencies as well. See, for example, the estimates of Cuban GDP in dollars at current and constant prices in several issues for the 1970s of the U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers* (Washington, various years).

24. Jorge Pérez-López, *Measuring Cuban Economic Performance* (Austin: University of Texas Press, 1987).

25. Pérez-López's growth rate estimates are used by Angus Maddison in his compendium of historical economic statistics for estimating Cuban GDP for the relevant period, See Angus Maddison, *The World Economy: Historical Statistics* (Paris: Development Centre, Organization for Economic Cooperation and Development, 2003).

26. Food and Agriculture Organization of the United Nations, *Inter-country comparisons of agricultural production aggregates*, FAO Economic and Social Development Paper 61 (Rome: FAO, 1986).

mate GDP in Cuba (also in North Korea and Vietnam) on the basis of the relationship between the value of agricultural output and GDP in analogue countries for which both statistics were known.[27] Roy used Costa Rica as the analogue for Cuba. Thus, for Costa Rica, agricultural output in 1980 was $780 million and GDP was $7,128 million; therefore, for Cuba, with an estimated agricultural output of $2,739 million, the corresponding GDP level in 1980 would have been $25,030 million or $3,083 per capita.[28] It should be noted that Roy himself acknowledges that this methodology is crude and at best yields tentative estimates of the size of economies.

Physical Indicators

The physical indicators (PI) approach, developed by Janossy and Ehrlich,[29] has been used extensively to estimate GDP/capita for CPEs. In addition to producing measures of GDP/capita for countries that relied on the MPS, the PI approach has the advantage of obviating the problem associated with exchange rate conversion, as estimates are directly produced in a convertible currency (typically dollars).

The conceptual basis for the PI approach is the empirically-observable relationship between levels of physical (that is, nonmonetary) indicators of consumption or production and overall levels of economic output, consumption, or income, both between countries and over time. The method posits that the observed relationship between the level of one or more physical indicators (for example, energy consumption per capita) and the level of economic activity for an economy (for example, GDP/capita) at time t approximates the relationship between these same variables in other economies also at time t. As-

suming that the relationships are stable across countries with different economic systems, the estimated relationship between the level of one or more physical indicators and GDP/capita for a group of reference countries for which both measures are available (for example, countries using the SNA) can be used to estimate GDP/capita for a target country that does not publish such a measure but that does publish data on physical indicators (for example, a country that uses the MPS). If the relationship is estimated for a group of reference countries using GDP/capita in dollars as the dependent variable, then estimates of GDP/capita in dollars can be made for the target country.

Mesa-Lago and Pérez-López estimated Cuban GDP/capita in dollars for 1965, 1970, 1975 and 1977 using the PI approach.[30] They used as reference 28 countries the authors believed were representative of the structure and level of development of the Cuban economy in the 1960s and 1970s. Because of data limitations, they were forced to rely on a set of 24 physical indicators (rather than the 30 or more used by researchers in other country applications); moreover, the set of indicators they used had relatively few measures of consumption (compared to production) and measures for certain activities were missing altogether (e.g., consumption of housing services). In one experiment, the authors took a simple average of the estimated level of Cuban GDP/capita in dollars obtained from each of the 24 univariate regressions; in a second experiment they used multivariate regression, a method in which variables with the most explanatory power are implicitly selected and to some extent the problem of weighting of individual esti-

27. Donald J. Roy, "Real Product and Income in China, Cuba, North Korea and Vietnam," *Development Policy Review*, 8 (1990).

28. Expanding on Roy's work, and using historical statistics on Costa Rican GDP from the World Bank Economic Indicators Data Base, Cuban GDP can be estimated at $21,812 million in 1970, $18,986 million in 1975, and $26,741 million in 1980. The reference statistics for Costa Rica are: value of agricultural output (from FAO, *Inter-country comparisons* …), 247 million international dollars in 1970, 521 million international dollars in 1975, and 780 million international dollars in 1980; GDP (from World Bank Economic Indicators Data Base), $4,317 million in 1970, $5,788 million in 1975, and $7,473 million in 1980.

29. Eva Ehrlich, "An Examination of the Inter-relation between Consumption Indicators Expressed in Physical Units and Per Capita National Income," *Czechoslovak Economic Papers*, 7 (1966).

30. Carmelo Mesa-Lago and Jorge Pérez-López, "Estimating Cuban Gross Domestic Product Per Capita in Dollars Using Physical Indicators," *Social Indicators Research*, 16 (1985).

mates to compute an overall average are mooted.[31] Two sets of estimates of Cuban GDP/capita in dollars—from the univariate and from the multivariate experiment—as well as the implied growth rates are presented in Table 7. It is worth noting that the estimates from the two PI approaches are within 3% of each other except for 1975.

Table 7. Estimates of Cuban GDP/Capita in Dollars Using PI Approach

Year	Univariate PI		Multivariate PI	
	Dollars	Growth rate	Dollars	Growth Rate
1965	480	NA	494	NA
1970	616	5.9%	635	5.2%
1975	1127	12.1%	1006	9.6%
1977	1355	9.6%	1317	14.4%

Source: Carmelo Mesa-Lago and Jorge Pérez-López, "Estimating Cuban Gross Domestic Product per Capita in Dollars Using Physical Indicators," *Social Indicators Research,* 16 (1985), pp. 291–295.

Joglekar and Zimbalist also experimented with the PI approach to estimate Cuban GDP/capita in dollars; in addition to replicating the more traditional univariate application of the PI approach, they have also experimented with factor analysis to obviate the weighting/aggregation problem.[32] In their first set of experiments, they estimated Cuban GDP/capita in 1980 using the same reference countries used by Mesa-Lago/Pérez-López and a very similar set of physical indicators (they dropped one indicators because of data problems and added five others). The dependent variable in the experiments was GDP/capita of the reference countries at 1980 prices converted to dollars at (1) market exchange rates; and (2) purchasing power parity exchange rates. Based on market exchange rates, Joglekar and Zimbalist estimated Cuban GDP/capita in 1980 at $2325 and based on purchasing power parity exchange rates at $3385. In the second experiment, using principal components/factor analysis, the estimated Cuban GDP/capita for 1980 using market exchange rates was $2691 and when using purchasing power parity exchange rates it was $3483.

Sánchez and Cahill[33] updated Joglekar and Zimbalist's work by using factor analysis to estimate Cuban GDP/capita for 1990. Sánchez and Cahill used as reference a sample of 20 Latin American countries and 37 variables to make estimates of Cuban GDP/capita in 1990 dollars converted at market exchange rates and also adjusted for terms of trade. The predicted level of GDP/capita for Cuba in 1990 was about $2600; the estimate using 1990 real GDP/capita at 1985 prices adjusted for the terms of trade yielded an estimate of $5420.[34]

SUMMARY OF ESTIMATES

The previous sections have documented efforts by researchers and organizations to make estimates of Cuban GDP/GNP or of growth rates during the time period when Cuban national accounts were compiled under the MPS. As is clear from the discussion, the efforts have been episodic, with no researcher or organization producing estimates using the same methodology for a prolonged period of time.

It is also evident from the previous sections that the estimates that have been made are based on different

31. For an explanation of the methodology see W. Beckerman and R. Bacon, "International Comparisons of Income Levels: A Suggested New Measure," *Economic Journal*, 76 (September 1966).

32. Gitanjali Joglekar and Andrew Zimbalist, "Dollar GDP per Capita in Cuba: Estimates and Observations on the Use of the Physical Indicators Method," *Journal of Comparative Economics*, 13 (1989). See also Chapter 5 in Zimbalist and Brundenius, *The Cuban Economy: Measurement and Analysis of Socialist Performance*.

33. Nicolás Sánchez and Miles Cahill, "The Strenghts and Weaknesses of Factor Analysis in Predicting Cuban GDP," *Cuba in Transition—Volume 18* (Washington: Association for the Study of the Cuban Economy, 1998).

34. Sánchez and Cahill, pp. 281 ff., argue that factor analysis based on the characteristics of market economies, cannot properly estimate the GDP/capita of a command economy such as Cuba for a number of reasons, principally because the proportion of public goods to private goods and the relationship between demographic characteristics and GDP differ significantly between market and command economies and some issues regarding whether GDP/capita in a command economy reflect the true level of economic welfare. For additional concerns about the use of factor analysis as a tool to predict Cuban GDP/capita see Roger Betancourt, "Comments on 'The Strengths and Weaknesses of Factor Analysis in Predicting Cuba's GDP," by Nicolás Sánchez and Miles Cahill," *Cuba in Transition—Volume 18* (Washington: Association for the Study of the Cuban Economy, 1998).

methodologies/approaches and that the estimates themselves are not comparable as in some instances they refer to (1) GDP/GNP aggregates in local currency (pesos) either at current prices or at constant prices; (2) GNP/GDP growth rates in local currency either at current or at constant prices; or (3) GDP/GNP aggregates in dollars calculated on the basis of market exchange rates or PPP exchange rates. With those caveats in mind, in what follows we group together estimates of GDP/GNP or growth rates made by different individuals or organizations that ostensibly refer to the same aggregate as a way to cross check the reasonableness of the estimates and of the approaches on which they were based.

GDP/GNP Estimates in Local Currency

Under this rubric we group the estimates of Cuban GDP for 1963–1965 and 1978 calculated by Mesa-Lago and Pérez-López using the scaling up methodology (Table 1) as well as the estimate for 1974 by the Comité Estatal de Estadísticas resulting from a full conversion from MPS to SNA conducted by that government agency (Table 2), the BNC series for 1971–1980 (Table 3), and estimate for 1974 by the CIA. A scatter plot of these estimates is given in Figure 2. While the estimates generally line up along a rising trend over time, the sparseness of the data does not permit drawing any inferences.

Figure 2. **Estimates of Cuban GDP**
(in million pesos)
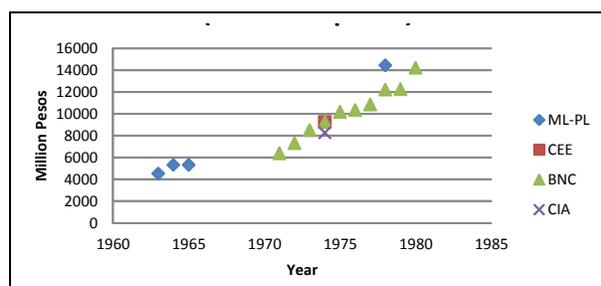
GNP/GDP Growth Rates in Local Currency

The growth rate estimates in this grouping correspond to those made using the "bottom up" methodology by Brundenius (Table 4), the CIA (Table 5), and Pérez-López (Table 6). Because they are based on a vector of prices for a single year, these indexes are estimates of GDP growth at constant prices of the

price base year: 1965 for Brundenius' estimates and 1973–1974 for Pérez-López's, both years within the estimation interval, and 1957 for the CIA's, outside of the estimation interval. The three growth rate index series, rebased to 1974=100 to facilitate comparison, are shown in Figure 3.

Figure 3. **Estimated GDP Growth Indexes**
(in pesos)
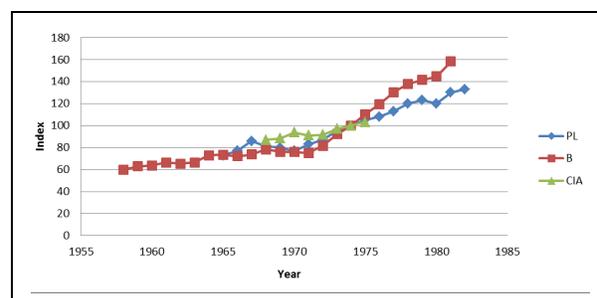
The two longest growth index series—by Brundenius and Pérez-López—tend to track each other quite closely over the time span for which they are both available. Beginning in 1975, however, Brundenius' index series shows a steeper growth rate than the one calculated by Pérez-López. The behavior of the CIA index series is roughly similar to that of the other two for the period for which it is available.

GDP/GNP Aggregates in Dollars

The PI method yields GDP/GNP estimates in dollars (or in whatever currency the GDP/GNP values for the reference countries are specified). Researchers and organizations that have used this methodology typically used GDP/GNP per capita as the dependent variable, and the applications for Cuba have done the same. Figure 4 shows a scatter plot of the GDP/capita in dollars estimates for 1965, 1970, 1975 and 1977 made by Mesa-Lago and Pérez-López and those for 1980 made by Joglekar and Zimbalist. The figure shows two sets of estimates by Mesa-Lago and Pérez-López, the first (ML-PL I) being the results of applying the univariate approach and the second (ML-PL II) the results of applying the multivariate approach. With regard to the estimates by Joglekar and Zimbalist, in addition to an estimate for which GDP per capita of the reference countries was converted from local currency to dollars using market exchange rates (labeled as JZ in Figure 4), a sec-

ond estimate for which the conversion of local currency to dollars was made using purchasing power exchange rates (labeled JZ PPP) is also included. The sparseness of the data does not permit drawing any inferences.

Figure 4. Estimates of Cuban GDP/Capita
(in dollars)
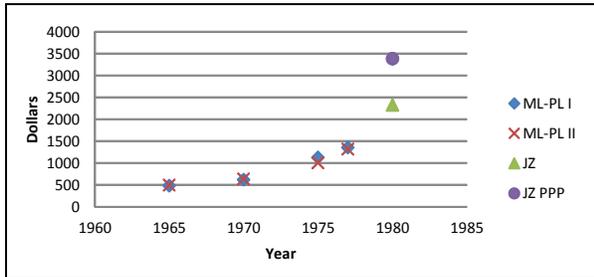
CONCLUDING REMARKS

This paper has surveyed efforts by researchers and organizations to make estimates of Cuban economic performance compatible with those of market economies during the time period—roughly 1960–1990—when Cuban authorities relied on the MPS methodology. Several approaches have been used—scaling up, bottom up, physical indicators—that have yielded several estimates of GDP/GNP in domestic currency (pesos), rates of growth of GNP/GDP, and estimates of GDNP/GDP in dollars. The estimating efforts have been episodic and the sparseness of estimates does not permit a thorough evaluation of the different methodologies and the quality of the estimates.