Benchmark Estimates of 2002 Gross Domestic Product

American Samoa

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Executive Summary

In April 2005, the U.S. Department of Interior, Office of Insular Affairs renewed its contract with the International Programs Center (IPC) of the U.S. Census Bureau to evaluate aggregate economic conditions in American Samoa. All parties agreed that the project's objective was to produce estimates of Gross Domestic Product (GDP), and that the scope of work would embrace the essential elements of the research design found in the March 1999 IPC study entitled *"National Income Accounts in the Northern Mariana Islands."* In operational terms, the design ensured that the best practice measurement methods employed by the U.S. Bureau of Economic Analysis (BEA) would be utilized, and that data found in the quinquennial 2002 Economic Census would be the primary source of information for making the economic evaluation.

The following report discusses how IPC molded those Census data into a credible five-year benchmark estimate of GDP. For those unfamiliar with the specialized terminology used in macroeconomics, the figures reported below comprise the base of a triangle of three measurements that are derived collectively from the National Income and Product Accounts (NIPA). In future tasks, we expect to develop the two remaining independent estimates of GDP based upon annual data sets. We expect to implement the income and expenditure methodologies to produce these companion estimates, and coordinate these results with the benchmark so that the NIPA triangle is complete and internally consistent.

On the basis of the information available to us, we estimate that partial GDP for the covered economic census industries is between $262.6 and $422.4 million. The $159 million plus range separating the low and high estimates reflects the absence of complete data, the consequences of using simplifying assumptions, and the choice of measurement methodology. When the $166.4 million in value added originating in the excluded sectors of agriculture and government is accounted for, total GDP rises to an estimated $427.0 to $586.9 million. Based on an estimated population of 61,800 in 2002, this translates into per capita GDP varying between $6,909 and $9,496. Using the "best" (hybrid2) estimate of GDP, $558.8 million, per capita GDP is most likely $9,041. However, given that the bulk of profits generated in the tuna canneries appear to be repatriated to the mainland and do not sustain final expenditure in the local economy, per capita Gross National Income (GNI) is more relevant for determining the standard of living. At an estimated $7,143, this per capita GNI figure is probably twenty percent lower than analogous GDP number, and falls into the middle income category used by the World Bank.

Because these figures are GDP averages, they say nothing about the level of personal disposable income or its distribution. Moreover, these numbers do not distinguish between the living standards of American Samoan born residents, who are U.S. citizens, and foreign guest workers. At this point, firm conclusions about the welfare of individuals cannot be derived. Only future research can properly address this question. Finally, given what has been written about understated cost of goods sold (CGS) and imputed personal consumption expenditures, we refrain from designating this benchmark

value added estimate as the final, definitive measurement. We will reach that stage only when these latest numbers have been calibrated to and reconciled with the updated 2002 annual income and expenditure estimates.

1. Introduction

When the NIPA program began in the Winter of 1998/Spring of 1999, there were significant questions about the adequacy of the available data sets for estimating Gross Domestic Product (GDP). The March 1999 report "National Income Accounts in the Northern Mariana Islands" dispelled that concern. The information found in the 1997 economic census and 1998 income and expenditure survey, coupled with auxiliary data sets, proved to be sufficient to develop a credible benchmark GDP estimate.

It has been more than five years since that original paper was written. With the publication of the latest economic censuses, and financial support from the Department of the Interior, the International Programs Center initiated a research project to produce 2002 benchmark GDP estimates for all four insular areas. Two of the four areas, the Northern Mariana Islands and Guam completed estimates in the Fall 2004. The recent release of the census data for American Samoa and the U.S. Virgin Islands enables us to complete the cycle.

Using procedures similar to those employed in the 1999 paper, estimates of GDP discussed below will continue to be refined and developed in a manner consistent with standard economic accounting definitions. This means essentially implementing two simple algorithms:

1) aggregating value added originating in all sectors of the economy. In this instance, value added is defined as the difference between the dollar value of total output minus the dollar value of intermediate purchases.
2) aggregating value added[1] alternatively defined as the sum of compensation, indirect business taxes and "other value added" (where the latter is basically equal to operating surplus plus depreciation).

With full and proper accounting, both methods will produce identical values. In either case, BEA considers these value added estimates of GDP to be the most complete and reliable of the three methodologies (value added, income, and final expenditure) available for calculating GDP.

This paper will proceed in four sections: data quality assessment, estimation of value added, sensitivity analysis, and final comments.

[1] Or some variant thereof.

2. Initial Data Quality

To begin the analysis of value added, we first examined the microdata, record by record, for completeness and plausibility. Sales and payroll data presented no immediate problems. However, preliminary work on the census done by analysts in the Company Statistics Division (CSD) showed that a significant number of respondents did not fully understand or failed to follow instructions for answering questions on intermediate purchases and cost of good sold (CGS). Simple edit specification programs designed to detect outliers indicated that 203 firms, representing nearly ten percent of respondents on a sales weighted basis, failed to provide any data on intermediate purchases[2]. In our follow-up, we found other instances in which the value of intermediate purchases was implausibly low or high[3]. Likewise, we found 278 records (twenty six percent of all businesses covered in the census) where employers failed to provide any class of customer data.

To get a more thorough understanding of these deficiencies, Rubin expanded the CSD search for outliers using a set of special purpose parameters he created based on the ratio of intermediate purchases to final shipments (P/S) found in the 1997 U.S. Input-Output (I-O) table. Rubin first made the assumption that for any given 4-digit North American Industry Classification System (NAICS) industry, the technology underlying production (reflected by input structure) was similar in the U.S. and American Samoa[4]. Moreover, in the absence of rapid technological change and uneven bursts of inflation at the producer price level, this ratio was assumed to be fairly stable over the intracensal period (1997-2002). With this understanding for each 4-digit NAICS record in the census, the observed respondent P/S ratio was then compared to the corresponding parameter range for the relevant 2-digit NAICS industry group in the I-O table[5]. If the observed ratio fell outside

[2] The magnitude of underreporting can be captured by the Intermediate Purchase/Final Sales ratio (P/S). According to our rough estimates, the fraction of firms reporting a "0" P/S was 9.3 percent, where the percent is computed as sales of "0" responders divided by total industry sales of all responders. If the P/S threshold is set at 10 percent, the fraction of industry sales rises to 59 percent.

[3] At the high end, intermediate purchases exceeded final sales. This can occur in the short run if a high fraction of output remains unsold and is entered into inventory. In the long run, it is not sustainable and will cause the firm to go bankrupt.

[4] Finding identical production technique is highly unlikely. If anything, technology is more advanced in the U.S. Nevertheless, technological convergence is promoted by the substantial volume of CNMI machinery and equipment imports from countries like the U.S. and Japan. In addition, CNMI data reflect five years worth of "catch-up" since some of the underlying capital investment decisions captured in the Census figures correspond to machinery of a more recent vintage (2002 "Census" versus 1997 "I-O "). Even if the technology (as measured by capital/labor coefficients) is substantially different, intermediate input structure for homogeneous products should be quite similar. These intermediates are far more important than the level of technique for estimating value added, especially if the focus is on the primary measurement algorithm (see section 3.1 below).

[5] The U.S. Input-Output table reports summary data on final shipments and intermediate purchases at the 4-digit NAICS industry level. There is no detail on variation within any given NAICS industry. Nevertheless, variation in the purchase to shipment ratio can be approximated if one moves to a higher level of aggregation. Specifically, subsets of this data can be assembled to form a 2-digit umbrella industry grouping which corresponds to the macro industries identified in the economic census. The minimum and maximum values of the 4-digit NAICS purchase to shipment ratios contained within this subset determine

the I-O range, the value was considered an outlier. Rubin replaced each outlier value with the mean P/S ratio from the corresponding entry in the I-O table at the 4-digit NAICS.

The assessment of data quality does not end with analyzing intermediate purchases because estimating value added is not the only goal of the benchmark exercise. To produce a fully consistent set of national income and product accounts, it is also necessary to begin the coordination of annual estimates of GDP with the five-year (census) estimates. That coordination is based, in part, on the magnitude and plausibility of the estimate of personal consumption expenditures (PCE).

In the U.S., BEA calculates benchmark PCE from the census data on sales by class of customer. Subsequent estimates of annual PCE are then derived from the benchmark by applying growth rates from the survey data on retail trade and services. To be consistent with BEA methodology, the first step in this exercise begins with the calibration of the American Samoa class of customer data.

As noted earlier, Rubin's review of the class of customer data found that more than 26 percent of respondents provided no disaggregation whatsoever. Moreover, there were instances where the class of customer percentages summed to less than 100. With this much missing information, it was clear that any estimate of PCE derived from the census would be biased downward, so a simple imputation strategy was devised. First, for those records where "0" class of customer data was provided, the mean estimate of the household share from "100" percent responders at the analogous 2-digit NAICS industry level was imputed. Second, in those instances where the class of customer percentages summed to less than 100 and there were no household sales, the residual was assumed to be the household share if it fell within the inter-quartile range for household shares in the analogous 2-digit NAICS industry respondent sample. If the residual fell outside the inter-quartile range, the midpoint of the latter was taken as the preliminary household estimate, and the summation of all class of customer percentage data was then scaled up to equal 100 percent. Third, in those instances where the class of customer percentages summed to less than 100 and there were household sales, that household percentage was scaled up by the reciprocal of the total percentage of reported sales across all classes of customers.

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the range of acceptable values at the 2-digit industry level. Of course, there is an implicit assumption here that *inter-industry* variation at the calculated 2-digit level is greater than or equal to *intra-industry* variation at the 4-digit level. While we cannot prove that this is true, if technology is relatively homogeneous within any given 4-digit industry, then crossing product lines and technologies to move to higher levels of aggregation will create, ipso facto, more variation than would observed in any given compilation of common 4-digit enterprises.

3. Estimation of Value Added

3.1. "Sales minus Purchases" Algorithm (Covered Industries)

The simplest method for calculating value added in the industries covered by the census (all economic agents except those in agriculture and government) is to subtract reported intermediate purchases from final sales[6]. The resulting estimate, raw value added (RVA), serves as the initial estimate and strawman for subsequent work. This initial estimate is juxtaposed against a second estimate (ValueAdded1), where intermediate purchases have been adjusted to correct for the outliers detected in the data quality assessment exercise. We format the presentation of both estimates of value added according to the aggregate industry sectors covered in the 2002 Economic Census with some modification[7]. All figures are reported in thousands of nominal 2002 dollars.

[6] The BEA definition of value added is somewhat more complex. More precisely, one should use shipments and other receipts **plus** changes in finished goods and "work in progress" inventories rather than final sales. The latter information is not contained in the American Samoa economic census, but the needed corrections probably don't alter the end result by more than five percent.

[7] Comparing the official census results to our analysis, the reader should be aware that there are some minor differences in how we assigned individual establishments to their parent industrial sector. This has no impact on the aggregate sales and payroll figures, but does affect the distribution of GDP originating by industrial sector.

Table 1. 2002 Value Added Estimates by Industrial Sector ($000)

	Total Sales	Total Reported Purchases	Adjusted Purchases	Value Added1	Raw Value Added
Repair and Maintenance Services	9,706	4,763	4,139	5,567	4,943
Food Services	20,325	8,001	9,390	10,935	12,324
Accommodations	1,010	389	338	672	621
Health Care and Social Assistance	27,535	506	12,276	15,259	27,029
Information, Professional, Business Services etc.	86,897	32,716	33,131	53,766	54,181
Finance, Insurance and Real Estate	29,593	3,495	10,167	19,426	26,098
Rental and Leasing Services	7,727	1,379	2,334	5,393	6,348
Transportation and Storage Services	22,868	6,032	10,643	12,225	16,836
Retail	154,593	29,148	60,374	94,219	125,445
Wholesale	86,788	9,071	27,916	58,872	77,717
Construction	44,210	17,636	22,976	21,234	26,574
Manufacturing	502,688	25,891	377,826	124,862	476,797
Total	993,940	139,027	571,510	422,430	854,913

Note that the correction for outliers reduces total value added from $ 854.9 million to $422.4 million or by 51 percent. Nevertheless, even the scaled back $422.4 million estimate is probably too high given the large amount of calculated value added originating in retail and wholesale trade. These discrepancies are brought into sharp relief by comparing U.S. ratios for compensation per dollar of value added to the same ratios for the American Samoa. In the U.S. I-O table, compensation accounts for 60 percent of retail trade value added and 56 percent of wholesale trade value added. The corresponding figures from the American Samoa Economic Census are approximately 18[8], and 7 percent respectively. Such figures are not credible because they imply profit

[8] For Retail Trade, the 18 percent figure is based on compensation of $16,654,000 and value added (value added1) of $94,219,000. Given that the suspected inflation of the value added estimate is not a miscalculation, it may have a simple explanation based on patterns of international trade. A large fraction

margins that are improbably high- more than 100[9] percent greater than those in the corresponding U.S. industry. Random noise in the data cannot explain away the problem. Economists know that industrial activity in the trade sectors is largely confined to the re-packaging/re-selling of already produced items. Without significant processing, value added must be dominated by intermediary service type functions whose costs are primarily wage and salary driven. Under these circumstances, further downward adjustment of value added seems warranted.

3.2. Scaled Compensation Algorithm (Covered Industries)

The method discussed below is actually a variant of the factor cost approach (see section 3.3). However for ease of exposition and narrative continuity, it is introduced here.

Prior experience with the 1997 CNMI Economic Census uncovered a similar problem with inflated sectoral estimates. Rubin's 1999 paper concluded that the reporting industries failed to net out the cost of goods resold properly, resulting in understated intermediate purchases and upwardly biased value added. To correct the problem, Rubin refrained from using intermediate purchases altogether, and resorted to the standard fallback position in which estimates of value added are based solely on scaled compensation data[10] [11]. Simple algorithms first converted Census reported payroll to compensation, and then compensation, to value added. Specifically, Rubin used survey data on the value of fringe benefits to scale up payroll to compensation. Likewise, parametric ratios from the U.S. I-O table, representing compensation per dollar of value added, allowed him to complete the conversion from compensation to value added.

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of intermediate purchases in the U.S. purchases (including goods for resale) are from domestic producers. By way of contrast, virtually all of American Samoa's intermediate purchases (including goods for resale) are imported. If cost, insurance and freight (CIF) account for as much as 20 percent of final purchase price, estimates of intermediate purchases in American Samoa will be biased downward by the simple application of U.S. I-O table P/S ratios.

[9] If the estimate of Retail VA1 were accurate, then to preserve the equality of VA1 and VA3 there would have to be an upward adjustment in " OVA" equal to the difference in the initial value added estimates (94,219,000 – 79,050,000 = 15,169,000). With this revision, the sum of operating surplus and depreciation (OVA) would rise from 11.7 percent as a fraction of sales (18,140,000/154,593,000) to 21.5 percent (33,309,000/154,593,000).

[10] Justification for this move is straightforward: most economists consider payroll data to be reliable because tax law mandates accurate collection and reporting. Moreover, research supports the belief in fairly stable empirical relationships between compensation and value added.

[11] Even though U.S. and American Samoa pay rates and benefits are probably quite different, it is still possible to assess how much bias might result from using the US compensation scalars to proxy the American Samoa counterparts in the value added calculation. For the enumerated industries combined, the compensation to total sales (output) ratios are: 29 percent (U.S.) versus an estimated 15-22 percent (American Samoa). Given that sales as a multiple of the CIF-adjusted value added1 is 3.226 (993,940/308,128) in American Samoa and 1.903 (12,825,699/6,644,775) in the U.S., simple arithmetic indicates that the range of the unmeasured ratio of compensation to value added in American Samoa (0.4725 - 0.7233) could be between nineteen percent below and twenty-two percent above the known ratio in the U.S. (.5623), depending upon the choice of estimated compensation in table 2. In turn, this implies that using U.S. compensation to value added ratios to proxy the unknown American Samoa parameters could impart a ten percent downward or twenty-two percent upward bias to the summary estimates of GDP (measured as value added). In our opinion, the upward bias is more likely. See footnote 8 for the assumed CIF markup rate.

With one important qualification, similar techniques are employed to produce the ValueAdded21 and 22 estimates reported in Table 2 below.

Table 2. 2002 Value Added Estimates by Industrial Sector ($000)

	Total Payroll	Scalar	Raw Compensation	Estimated Compensation1	Estimated Compensation2	Value Added21	Value Added22
Repair and Maintenance Services	1,440	1.13677	1,637	2,781	1,795	5,670	3,657
Food Services	3,455	1.14091	3,942	6,661	4,084	9,908	6,075
Accommodations	143	1.14797	164	334	204	677	414
Health Care and Social Assistance	13,287	1.16896	15,532	15,365	15,548	15,989	16,195
Information, Professional, Business Services etc.	17,504	1.15053	20,139	22,738	20,479	41,649	37,491
Finance, Insurance and Real Estate	4,304	1.17878	5,073	4,975	5,137	14,601	15,707
Rental and Leasing Services	621	1.13849	707	1,629	1,801	6,971	7,689
Transportation and Storage Services	5,304	1.17318	6,223	8,955	7,559	13,628	11,594
Retail	14,608	1.14009	16,654	53,783	18,059	89,315	29,989
Wholesale	3,630	1.16600	4,233	32,575	4,554	57,947	8,100
Construction	8,456	1.16521	9,853	17,561	9,886	19,969	11,323
Manufacturing	47,800	1.17777	56,297	55,707	56,383	113,197	114,329
Total	**120,552**		**140,454**	**223,065**	**145,490**	**389,523**	**262,563**

Unlike the previous reports on CNMI, Guam and USVI, here we present a range of compensation based value added estimates. Review of the economic census data sets uncovered a high proportion of missing values (zero)[12] for payroll in the economic census data sets, which, if left unadjusted, would produce excessive downward bias in the estimates of value added. To correct the problem, we adopt a dual strategy: in the first instance, ratios for *compensation per dollar of sales* (C/S) are created at the 4 digit NAICS level; inspected for outliers using a 2 digit NAICS range calculated from the U.S.

[12] Many of these missing values can be traced to responders in the "non-employer establishments" category. Essentially, these are businesses that are sole proprietorships with no paid employees.

I-O tables; and replaced as needed with the comparable 4 digit NAICS C/S figure for the U.S. Multiplying the C/S ratio by reported sales produces the "EstimatedCompensation1", which in turn is scaled up to "ValueAdded21. The technique is perfectly analogous to the algorithm for detecting and correcting outliers in the purchase data. In the second instance, a more extreme assumption is adopted where only the "zero" values are considered to be outliers, and all remaining "non-zero" values for compensation are retained as is. Replacement figures for the outliers are generated based upon the average *compensation per dollar of sales* (C'/S) ratios for the "non-zero" responders. This algorithm produces "EstimatedCompensation2" and "ValueAdded22."

Not surprisingly, compensation-based calculations of value added reduce the estimates for Retail and Wholesale Trade. Depending on whether the first or second compensation estimate is used, the reductions could be as high as $64 and $51 million in Retail Trade and Wholesale Trade respectively, or as low as $5 and $1 million. When the positive offsets in other industries are included, the final figure for industry wide value added falls from $422.4 to no more than $389.5 or perhaps as low as $262.6 million.

Thus, the most likely estimate of GDP in the covered sectors of industry would thus appear to lie in the $263 - $422 million range. From a methodological point of view, our strong preference is to use the standard algorithm (final sales minus intermediate purchases) for calculating value added and keep all calculations on a common footing. For ten of the twelve industries, this produces sensible results, and corresponds to $269,340,000 in value added. Nevertheless, the standard algorithm does not produce entirely defensible estimates for Retail Trade and Wholesale Trade. So, to complete the initial picture, we use a hybrid mix of calculations, and replace the questionable numbers with a range of revised-compensation-based estimates of $38,090,000 (VA22) - $147,262,000 (VA21). The end result is GDP totaling between $307,478,000 and $416,602,000. If we focus on the most likely estimate of compensation (corresponding to VA21), the resulting GDP figure ($416.6 million) falls within the range defined by the application of the first two value added algorithms[13]. This estimate is referred to as "hybrid 1."

3.3 Factor Cost Algorithm (Covered Industries)

The second definitive method for calculating value added involves summing compensation, indirect business taxes and "other value added". Information to implement this algorithm is available from Table 2 (compensation), the American Samoa Department of the Treasury reports (indirect business taxes), and the U.S. Input-Output table (other value added scaling factors. See Appendix 1). Application of these methods produces an estimate of value added of $380,580,000, a figure roughly nine percent less than the first hybrid cited above.

[13] This "hybrid 1" estimate is 35.2 percent above the CIF-adjusted value added1estimate ($308.1 million). Refer footnote 11.

Table 3. 2002 Value Added Estimates by Industrial Sector ($000)

	Total Sales	Compensation1	Other Value Added/Sales	Other Value Added	Indirect Business Taxes	Value Added3
Repair and Maintenance Services	9,706	2,781	0.26718	2,593	447	5,821
Food Services	20,325	6,661	0.10224	2,078	937	9,676
Accommodations	1,010	334	0.26057	263	47	643
Health Care and Social Assistance	27,535	15,365	0.01869	515	1,269	17,149
Information, Professional, Business Services etc.	86,897	22,738	0.25229	21,924	4,006	48,668
Finance, Insurance and Real Estate	29,593	4,975	0.36800	10,890	1,364	17,230
Rental and Leasing Services	7,727	1,629	0.49236	3,804	356	5,789
Transportation and Storage Services	22,868	8,955	0.13168	3,011	1,054	13,021
Retail	154,593	53,783	0.11734	18,140	7,127	79,050
Wholesale	86,788	32,575	0.10768	9,345	4,001	45,922
Construction	44,210	17,561	0.04612	2,039	2,038	21,638
Manufacturing	502,688	55,707	0.11749	59,061	1,205	115,973
Total	**993,940**	**223,065**		**133,664**	**23,851**	**380,580**

The use of the factor cost algorithm, in conjunction with the earlier results, suggests yet another possibility for calculating replacement value added in the retail trade and wholesale trade sectors. According to SNA guidelines, the preferred method for calculating value added in these industries is a two-step procedure[14]. Initially, gross margin on sales (GM) is calculated, and then intermediate purchases, exclusive of goods for resale, are netted out. Obviously, the Census does not contain accurate data on cost of goods sold (CGS). However, an approximation to this measure can be calculated as a residual if we accept the VA3 estimate of GDP originating in these sectors as parametric,

[14] SNA is an acronym for the United Nations *System of National Accounts.*

and then work through a series of accounting definitions. First note that GM = IP + VA (VA3). Data for the right hand side of the equation come from Tables 1 and 3. Next, apply the residual formula for calculating : = Total Sales (TS) minus GM. Fidelity to the accounting standard is assured since TS - = GM = IP + VA. For the two industries under consideration, value added (ValueAdded4) following SNA definitions is equal to $124,972,000, while CGS is 28,119,000[15]. When these replacement figures are used, total GDP rises to $394,312,000. This estimate is referred to as "hybrid 2".

Table 4. 2002 Value Added Estimates for Selected Service Sectors ($000)

	Total Sales (TS) (1)	Cost of Goods Sold (CGS) (2) = (1) - (3)	Gross Margin (GM) (3) = (6) + (7)	Raw Intermediate Purchases (P) (4)	Purchase Adjustment (P') (5)	Intermediate Purchases (IP) (6) = (4) +(5)	Value Added 4 (7)
Retail	154,593	15,169	139,424	29,148	31,226	60,374	79,050
Wholesale	86,788	12,950	73,838	9,071	18,845	27,916	45,922
Total	**241,381**	**28,119**	**213,262**	**38,219**	**50,071**	**88,290**	**124,972**

3.4 Estimates of Value Added in Non-covered Industries

The economic census does not cover GDP originating in agriculture or government. To account for value added in these missing sectors, two additional data sets are employed: the 2003 Census of Agriculture and administrative records from the Department of Finance. Our analysis of the agriculture data indicates that this omitted sector is substantial. There could be sales of as much as $22,216,318; selected purchases of $3,877,175; and payroll of $730,900. The simple "sales minus purchase" algorithm produces a value added estimate that might be on the order of $18,339,143. To this, it is necessary to add in perhaps $35,980,514 in subsistence consumption which brings total value added to $54,309,568.[16] However, since the census is for 2003, not 2002, further correction for price changes and real growth (time trend) needs to be made. [17] With these

[15] Our preliminary analysis of the Census questionnaire and the individual data records in the industrial sectors under review strongly suggests that these "raw intermediate purchase" numbers are the operating expenses on materials, utilities, warehousing etc. The sum of these reported purchases (P) along with the unknown cost of goods sold (CGS) conceptually equals the summary category intermediate purchases (IP) used in the first value added algorithm. By definition, value added estimated from sales and intermediate purchases must equal value added estimated from factor costs. Thus S-IP = C + OVA + IBT. Substituting P + for IP implies that unknown = S – P – C – OVA – IBT. By this line of reasoning, CGS is $78,190,000, roughly $50 million more than the SNA estimate. While this produces a more reasonable estimate of gross margin, the loss of theoretical and definitional consistency is unacceptable, so P' is not stripped out of IP.

[16] Subsistence consumption includes all foodstuffs produced but not sold, i.e. vegetables, fruits, poultry, swine, dairy, seafood etc. These own consumed items are valued at the going market price just as if they had been offered for sale.

[17] During the intercensal period (1998-2003), food prices as measured by the CPI, rose from 101.3 to 112.3. Thus, 2003 value added, measured in constant 1998$, was really $48,998,943. Because 1998 value added was $69,526,356, real negative growth occurred at –5.9% per annum. Factoring in this time trend, and

adjustments, the estimate falls to $53,733,500. This "$53.7" million figure is the maximum for value added given that purchases are "selected" rather than comprehensive.

Finally, government payroll and fringe benefits in American Samoa are known to be approximately $95,287,546 at the territorial level in CY2002. If the American Samoa compensation to value added scalars are identical to those in the U.S, then value added in this combined government sector equals $110,710,169[18] and value added in all non-covered industries totals $164,443,669.

3.5 Class of Customer Imputation and Calibration of the Range of GDP Estimates

Based on the group average imputation methods discussed at the end of section 2, there could be as much as $187,429,000 in household personal consumption expenditures (PCE) resulting from sales by firms and enterprises represented in the economic census. When subsistence consumption is added in, the figure rises to $223,409,514.While this figure is somewhat speculative, it does have testable implications.

If American Samoa GDP for the economic census industries is between $262.6 and $422.4 million, and if value added in agriculture and government is $164.4 million, then total GDP is in the range of $427.0 to $586.9 million. If we use our best estimate, the "hybrid 2" figure of $558.8 million ($394.31 + $164.44), then PCE is 40 percent of GDP. Based upon what we know about typical island economies, PCE as a fraction of Gross National Income (GNI)[19] is rarely below 60 percent or above 70 percent. Clearly, this estimate is not consistent with the stylized fact about the known structure of final expenditures in the insular areas. Moreover, the percentages corresponding to the high and low GDP estimates, 38.1 and 52.3 percent respectively, are likewise outside of the tolerance limits.

For reasons that are not yet completely understood, the imputation procedure for estimating PCE worked well in the other three insular areas but produced unusually low numbers[20] in American Samoa. We suspect that some of the problem occurs because GNI is substantially less than GDP in the American Samoa experience (see footnotes 19 and

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rebasing from 1998$ to 2002$ (CPI 2002 = 102.5) to account for inflation, raises the 2002 estimate to $53,733,500.

[18] US data for 2001 indicates that GDP originating in Federal Government was $396.2 billion, while State and Local Government produced $885.1 billion. Given that compensation in these sectors was $300.3 and $761.8 billion respectively, compensation as a percent of GDP is 0.76 for the federal government and 0.86 for the state and local components. See: Survey of Current Business December 2002, appendix pages D-31, D-34 Tables B.3 and B.7.

[19] We are assuming that GDP and GNI are identical in magnitude. In fact, GNI could be as much as twenty-one percent less than GDP. If foreign owned companies repatriate the vast bulk of their profits, as is the case in American Samoa, then this would suggest PCE shares ranging from 48.2 to 66.2 percent of GNI.

[20] Based upon extrapolations of the 1994 HIES, we estimated that 2002 PCE, net of subsistence agriculture and imputed rent, was $273,489,404 ($1999 = 100). Alternatively, using data on personal income, taxes, and savings, we produced an estimate for PCE of $257,508,784 ($1999 = 100). These competing numbers suggest that the economic census estimate is low by at least $70 million. See: *Interim Trip Report on the First Phase of the American Samoa NIPA Project pp. 44 and 50.*

22). There are probably other leakages from the income and expenditure streams which affect the estimates that have yet to be identified and quantified. For the time being, we refrain from drawing strong conclusions; the issue of calibration will be revisited when the diary results from the 2005 HIES (household income and expenditure survey) become available.

Table 5. 2002 Estimated Personal Consumption Expenditures ($000)

Number of Establishments	Sales & Receipts	Value of sales to HH customers	NAICS 4-digit industry code
1,061	993,940	187,429	0000 American Samoa Total
		899	01 Health care and social assistance
		3,807	02 Repair and maintenance services
		203	03 Accommodations
		16,633	04 Food services
		29,136	05 Information/professional/business services
		7,730	06 Transportation and storage services
		103,534	07 Retail
		7,633	08 Wholesale trade
		1,656	09 Manufacturing
		997	10 Construction
		12,402	11 Finance, insurance, real estate
		2,799	12 Rental and leasing services [not real estate]

4. Sensitivity Analysis and Other Qualifications

The above analyses are somewhat speculative. They contain synthetic estimates of intermediate purchases and compensation which are not based entirely on information contained within the 2002 Economic Census. Both situations are remediable since there are additional data sets which could further substantiate the assumptions used in the analysis. Data extracted from tax records could potentially allow us to replace the synthetic numbers with company reported figures on purchases, cost of goods sold and payroll as a fraction of total compensation. Unfortunately, as of this writing, queries of the tax base have not been made.

Finally, to make our analysis more consistent with BEA practice, we address the issue of reconciling the Census and BEA definitions of value added. The former focuses solely on final shipments and intermediate purchases, while the latter is more inclusive and includes an entry for inventory change. Currently we have no information on beginning and ending inventories. However, based upon previous analyses of the CNMI data and the 1997 Puerto Rico Economic Census, we believe that inventory change is less than 3

percent of final shipments and could be as low as 0.4%[21]. In our opinion, this correction factor is within the "noise" in the data and can therefore be ignored.

5. Summary GDP Measurement and Concluding Observations

On the basis of the information available to us, we estimate that partial GDP for the covered economic census industries is between $262.6 and $422.4 million. The $159 million plus range separating the low and high estimates reflects the absence of complete data, the consequences of using simplifying assumptions, and the choice of measurement methodology. When the $166.4 million in value added originating in the excluded sectors of agriculture and government is accounted for, total GDP rises to an estimated $427.0 to $586.9 million. Based on an estimated population of 61,800 in 2002, this translates into per capita GDP varying between $6,909 and $9,496. Using the "best" (hybrid2) estimate of GDP, $558.8 million, per capita GDP is most likely $9,041. However, given that the bulk of profits generated in the tuna canneries[22] appear to be repatriated to the mainland and do not sustain final expenditure in the local economy, per capita Gross National Income (GNI) is more relevant for determining the standard of living. At an estimated $7,143, this per capita GNI figure is probably twenty percent lower than analogous GDP number, and falls into the middle income category used by the World Bank.

Because these figures are GDP averages, they say nothing about the level of personal disposable income or its distribution. Moreover, these numbers do not distinguish between the living standards of American Samoan born residents, who are U.S. citizens, and foreign guest workers. At this point, firm conclusions about the welfare of individuals cannot be derived. Only future research can properly address this question. Finally, given what has been written about understated CGS and imputed personal consumption expenditures, we refrain from designating this benchmark value added estimate as the final, definitive measurement. We will reach that stage only when these latest numbers have been calibrated to and reconciled with the updated 2002 annual income and expenditure estimates.

[21] See: *Benchmark Estimates of 2002 Gross Domestic Product in the Commonwealth of the Northern Mariana Islands. p.16.*

[22] Estimated operating surplus in the canneries ($120,439,871) exceeds reported corporate profits for the entire economy by over $100 million in 2002. See: *Interim Trip Report on the First Phase of the American Samoa NIPA Project p. 89.*

6. Appendix 1: Critical Economic Ratios Derived from U.S. Input-Output Accounts and Other Official U.S. Statistics

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
1110	Crop products	1.171251495	0.1914919	0.5125279	0.3750688
1120	Animal products	1.171251495	0.3708193	0.8509767	0.0763318
1130	Forestry and logging products	1.119961373	0.2044177	0.4990055	0.3687654
1140	Fish and other non-farm animals	1.119961373	0.1532087	0.447338	0.409838
1150	Agriculture and forestry support services	1.119961373	0.9172788	0.4595745	0.0230549
2110	Oil and gas	1.163378408	0.1830656	0.5994245	0.2517028
2121	Coal	1.189054726	0.4954605	0.5379911	0.1335135
2122	Metal ores	1.212925852	0.5294009	0.5670794	0.1565155
2123	Nonmetallic minerals	1.171833299	0.4761356	0.4543849	0.2577472
2130	Mining support services	1.170872237	0.6743442	0.5756449	0.084972
2211	Electric power	1.193114814	0.2033462	0.3754867	0.3890399
2212	Natural gas distribution	1.193114814	0.3038349	0.6714919	0.1272735
2213	Water and sewage treatment	1.193114814	0.3355574	0.3500855	0.3964294
2301	New residential construction	1.165206872	0.7546677	0.6323585	0.0825979
2302	New nonresidential construction	1.165206872	0.8975616	0.5163929	0.0408427
2303	Maintenance and repair construction	1.165206872	0.8577883	0.6017215	0.0473191
3110	Food products	1.17762435	0.4823521	0.7585239	0.1178935
3121	Beverage products	1.17762435	0.233352	0.6156313	0.1786777
3122	Tobacco products	1.270292208	0.0877838	0.4482253	0.3596247
3130	Yarn, fabrics, and other textile mill products	1.17305218	0.8260566	0.7438856	0.0377674
3140	Non-apparel textile products	1.184439686	0.6007447	0.6713745	0.1259711
3150	Apparel	1.184439686	0.6374208	0.6509395	0.1223638
3160	Leather and allied products	1.175091193	0.6519795	0.6951636	0.1006966
3210	Wood products	1.177399406	0.6906114	0.7146356	0.0743245
3221	Pulp, paper, and paperboard	1.169359502	0.4983126	0.6560709	0.1644889
3222	Converted paper products	1.169359502	0.6574777	0.6979449	0.0933626
3230	Printed products	1.169359502	0.7174159	0.570011	0.1127035
3240	Petroleum and coal products	1.220271733	0.3463597	0.8895674	0.061855
3251	Basic chemicals	1.205944103	0.4197562	0.7338329	0.1379247

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
3252	Resins, rubber, and artificial fibers	1.190686389	0.4159569	0.7417698	0.1348933
3253	Agricultural chemicals	1.205944103	0.222071	0.6780095	0.2340952
3254	Pharmaceuticals and medicines	1.193134638	0.2745384	0.6142272	0.2602751
3255	Paints, coatings, and adhesives	1.193134638	0.4036489	0.6844475	0.1712114
3256	Soaps, cleaning compounds, and toiletries	1.193134638	0.1852337	0.5906615	0.3190926
3259	Other chemical products	1.205944103	0.4494844	0.644962	0.1840128
3260	Plastics and rubber products	1.190686389	0.6229667	0.6214377	0.1345773
3270	Nonmetallic mineral products	1.192499127	0.5210948	0.5425182	0.2076444
331A	Primary ferrous metal products	1.218746802	0.7018621	0.7466756	0.066702
331B	Primary nonferrous metal products	1.218746802	0.7886668	0.8294275	0.0268541
3315	Foundry products	1.196572993	0.8347816	0.5970295	0.0576246
3321	Forgings and stampings	1.196572993	0.6559157	0.5728948	0.1405804
3322	Cutlery and hand tools	1.196572993	0.5506777	0.4961614	0.2194913
3323	Architectural and structural metal products	1.196572993	0.6064477	0.5574596	0.1675696
3324	Boilers, tanks, and shipping containers	1.196572993	0.6406962	0.6820695	0.1077916
332A	Ordnance and accessories	1.196572993	0.6336928	0.4696823	0.1646407
332B	Other fabricated metal products	1.196572993	0.6402092	0.5068607	0.1703987
3331	Agriculture, construction, and mining machinery	1.166165215	0.58189	0.679293	0.1269978
3332	Industrial machinery	1.166165215	0.6661386	0.6207785	0.1197645
3333	Commercial and service industry machinery	1.166165215	0.6930836	0.6663159	0.0956688
3334	HVAC and commercial refrigeration equipment	1.166165215	0.666493	0.6673024	0.1029242
3335	Metalworking machinery	1.166165215	0.8054476	0.5092158	0.0873188
3336	Turbine and power transmission equipment	1.166165215	0.5298862	0.6225982	0.1725252
3339	Other general purpose machinery	1.166165215	0.6589121	0.5912471	0.1310743
3341	Computer and peripheral equipment	1.181523039	0.7219024	0.8394994	0.035959

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
334A	Audio, video, and communications equipment	1.181523039	0.520275	0.6362625	0.1669876
3344	Semiconductors and electronic components	1.181523039	0.4012167	0.514061	0.2834121
3345	Electronic instruments	1.181523039	0.7198607	0.5515421	0.1183562
3346	Magnetic media products	1.181523039	0.5591392	0.5810228	0.1787626
3351	Electric lighting equipment	1.181523039	0.58159	0.6251259	0.1491654
3352	Household appliances	1.181523039	0.6344796	0.7134098	0.0970661
3353	Electrical equipment	1.181523039	0.6554614	0.6271797	0.1208034
3359	Other electrical equipment and components	1.181523039	0.552385	0.6216681	0.1613415
3361	Motor vehicles	1.276135009	0.528298	0.8438382	0.0685525
336A	Motor vehicle bodies, trailers, and parts	1.276135009	0.8264697	0.7254636	0.0422484
3364	Aerospace products and parts	1.203714318	0.7639638	0.6521786	0.0771443
336B	Other transportation equipment	1.203714318	0.7576037	0.6499214	0.0802297
3370	Furniture and related products	1.179597433	0.6694649	0.5760372	0.1342077
3391	Medical equipment and supplies	1.166690816	0.5432352	0.4941897	0.2235625
3399	Other miscellaneous manufactured products	1.193134638	0.6367094	0.6164057	0.1279211
4200	Wholesale trade	1.165999361	0.5621609	0.3306932	0.1076797
4A00	Retail trade	1.140091194	0.6021739	0.3930115	0.117341
4810	Air transportation	1.213903255	0.8095548	0.6333568	0.0209804
4820	Rail transportation	1.353387709	0.6683403	0.4460505	0.166297
4830	Water transportation	1.196734986	0.5476973	0.7554239	0.0846802
4840	Truck transportation	1.209858997	0.5914051	0.5193631	0.1877114
4850	Transit and ground passenger transportation	1.175449473	0.6155399	0.3541367	0.204639
4860	Pipeline transportation	1.180540541	0.4526318	0.691465	0.1262567
48A0	Sightseeing transportation and transportation support	1.170221305	0.736129	0.5121239	0.102912
4920	Courier and messenger services	1.170221305	0.6710513	0.3410448	0.213436
4930	Warehousing and storage	1.209858997	0.7448205	0.3170207	0.1448189
5111	Newspapers, books, and directories	1.163857996	0.4265843	0.4288924	0.3184626
5112	Software	1.139017614	0.4625512	0.3339335	0.3471143
5120	Motion pictures and sound recordings	1.172372248	0.4332018	0.5824925	0.2112663

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
5131	Radio and television broadcasting	1.172372248	0.8235473	0.6654608	0.0523236
5132	Cable networks and program distribution	1.172372248	0.3335077	0.530328	0.2816567
5133	Telecommunications	1.192934172	0.3430455	0.4418455	0.2660133
5141	Information services	1.192934172	0.5734303	0.403023	0.2376237
5142	Data processing services	1.192934172	0.5890563	0.3421489	0.2596896
52A0	Monetary oversight and credit intermediation	1.184085116	0.3490832	0.291006	0.4360915
5230	Securities, commodity contracts, investments	1.118434935	0.7613362	0.4455803	0.1075615
5240	Insurance carriers and related services	1.177468547	0.6394297	0.498527	0.142226
5250	Funds, trusts, and other financial vehicles	1.149142622	0.6326954	0.9280793	0.0110404
5310	Real estate	1.156334606	0.0961274	0.3042988	0.5046845
5321	Automotive equipment rental and leasing	1.139017614	0.2266818	0.3012713	0.4916939
532A	Consumer goods and general rentals	1.139017614	0.4013199	0.3080004	0.3741862
5324	Machinery and equipment rental and leasing	1.139017614	0.2631157	0.2437209	0.5256531
5330	Rights to non-financial intangible assets	1.139017614	0.0122868	0.0357013	0.8657313
5411	Legal services	1.135718758	0.5650606	0.2777899	0.3085856
5412	Accounting and bookkeeping services	1.139017614	0.6281311	0.2681958	0.2660694
5413	Architectural and engineering services	1.139017614	0.6168493	0.2943357	0.2641494
5414	Specialized design services	1.139017614	0.4543283	0.3532254	0.3361163
5415	Computer systems design and related services	1.139017614	0.784348	0.3547105	0.1295346
5416	Management and technical consulting services	1.139017614	0.5119754	0.2878363	0.3419917
5417	Scientific research and development services	1.139017614	0.8860754	0.3569982	0.066885
5418	Advertising and related services	1.139017614	0.5335697	0.3573892	0.2890181
5419	Other professional and technical services	1.139017614	0.2064875	0.3173924	0.5229651
5500	Management of companies and enterprises	1.139017614	0.8682304	0.2960229	0.0740314
5613	Employment services	1.139017614	0.8692275	0.0920309	0.1142502

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
5615	Travel arrangement and reservation services	1.139017614	0.7007657	0.4618873	0.1451232
561A	All other administrative and support services	1.139017614	0.5794556	0.3201325	0.2711463
5620	Waste management and remediation services	1.139017614	0.4943694	0.4738822	0.2218259
6100	Educational services	1.153614193	0.8913795	0.4193278	0.0604877
6210	Ambulatory health care services	1.169380993	0.7087345	0.3138793	0.1944022
6220	Hospital care	1.169380993	0.9714039	0.4497268	0.012356
6230	Nursing and residential care	1.169380993	0.8679594	0.3735079	0.0752124
6240	Social assistance	1.154444748	0.8302508	0.4508546	0.0866164
71A0	Performing arts, spectator sports, and museums	1.146269242	0.6074772	0.4650702	0.1679325
7130	Amusements, gambling, and recreation	1.146269242	0.4854634	0.3222725	0.298187
7210	Accommodations	1.14795755	0.4929594	0.3299977	0.2605724
7220	Food and beverage services to customer order	1.140905329	0.6723027	0.5125204	0.1022446
8111	Automotive repair and maintenance	1.134672599	0.4923747	0.4712431	0.2293621
811A	Electronic, commercial, and household goods repair	1.140766116	0.488792	0.3739577	0.3024712
8120	Personal and laundry services	1.124811819	0.441397	0.3915163	0.315125
813A	Religious, grant-making, and social advocacy	1.098823141	0.9995842	0.3366344	0
813B	Civic, social, professional and similar organizations	1.098823141	0.9961645	0.5326934	0
S001	Federal Government enterprise services	1.52319617	0.9032248	0.2052129	0.0769157
S002	State and local government enterprise services	1.24181173	0.6471111	0.5146917	0.1627786

Table sources:

Compensation Benefits Scale Factor: author's calculation from data in: U.S. Bureau of Economic Analysis.2004 *Table B.7. Compensation and Wage and Salary Accruals by Industry*, www.bea.gov/bea/ARTICLES/2002/12December/D-pages/1202Dpg, accessed July 22, 2004.

For all other critical ratios, the source is the author's calculations from data in:
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