Benchmark Estimates of 2002 Gross Domestic Product in the
U.S. Virgin Islands

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Executive Summary

In February 2005, the U.S. Department of Interior, Office of Insular Affairs awarded a contract to the International Programs Center (IPC) of the U.S. Census Bureau to evaluate aggregate economic conditions in the U.S. Virgin Islands. 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 $1.764 and $2.801 billion. The $1 plus billion 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 $657 million in value added originating in the excluded sectors of agriculture and government is accounted for, total GDP rises to an estimated $2.421 to $3.458 billion. Based on IPC's estimated population of 108,812 in 2002, this translates into per capita GDP varying between $22,249 and $31,780. Using the "best" (hybrid2) estimate of GDP, $2.809 billion, per capita GDP is most likely $25,815. This figure falls between the 2002 thresholds for the upper middle ($9,220) and high ($27,590) income categories 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 USVI 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 conclude that the lower bound estimates are probably closer to the truth. Therefore the reader should exercise caution and err on the low side until the future reconciliation of GDP estimates based on annual income and expenditure data is undertaken and completed.

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.

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

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[1] Or some variant thereof.

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 goods sold (CGS). Simple edit specification programs designed to detect outliers indicated that 1033 firms, representing nearly twenty 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 797 records (thirty 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 USVI[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

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[2] The magnitude of underreporting can be captured by the Raw Intermediate Purchase/Final Sales ratio (P/S). According to our rough estimates, the fraction of firms reporting a "0" P/S was 19.8 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 82.6 percent. These calculations are inclusive of the oil refining industry.

[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 USVI machinery and equipment imports from countries like the U.S. and Japan. In addition, USVI 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 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

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 USVI class of customer data.

As mentioned above, Rubin's review of the class of customer data found that more than 30 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.

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 raw

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aggregation will create, ipso facto, more variation than would observed in any given compilation of common 4-digit enterprises.

intermediate purchases (P) from final sales[6]. The resulting estimate, raw value added (RVA), serves as the initial point of departure and strawman for subsequent work. This first estimate is juxtaposed against a second estimate (ValueAdded1), where raw intermediate purchases have been adjusted by a factor P' that corrects for the outliers detected in the data quality assessment exercise. The revised figure for intermediate purchases is referred to as IP, where IP = P +P'. 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. All figures are reported in thousands of nominal 2002 dollars.

Because of Title 13 non-disclosure issues, the manufacturing sector is reported net of the petroleum refining industry's sales, payroll and purchases. However, respondent confidentiality can be preserved if the focus is limited solely to value added. Thus, the bottom of Table 1 has three entries for value added, two of which include petroleum refining. The first is based on the economic census; the second is derived from the census and USVI administrative records.

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[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 economic census, but the needed corrections probably don't alter the end result by more than five percent.

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

	Total Sales (1)	Total Reported Purchases (2)	Adjusted Purchases (3)	Value Added1	Raw Value Added
Other	3,401	238	771	2,630	3,163
Repair and Maintenance Services	110,602	2,736	42,046	68,556	112,130
Food Services	175,440	447,670	88,398	87,042	-272,230
Accommodations	155,568	48,044	53,777	101,791	107,524
Arts, Entertainment etc.	8,699	584	4,046	4,653	8,115
Health Care and Social Assistance	93,289	55,852	33,541	59,748	37,437
Information, Professional, Business Services etc.	806,505	195,186	281,624	520,653	607,091
Finance, Insurance and Real Estate	391,936	121,984	128,681	263,255	269,952
Rental and Leasing Services	62,687	13,871	23,177	39,510	48,816
Transportation and Storage Services	241,052	46,713	116,751	124,301	194,339
Retail	1,217,466	251,686	477,229	740,237	965,780
Wholesale	262,932	27,876	84,899	178,033	235,056
Construction	264,092	62,661	137,165	126,927	201,431
Manufacturing	167,445	69,626	103,758	63,687	97,819
Total without Petroleum Refining	**3,961,114**	**1,344,727**	**1,575,861**	**2,381,024**	**2,616,423**
Total with Petroleum Refining (Census)				**2,800,668**	**6,412,821**
Total with Petroleum Refining (USVI)				**2,711,356**	

Note: The negative RVA for Food Services is the result of one enterprise recording purchases 750 times greater than sales. This is obviously an erroneous entry, and is corrected in the column labeled "Adjusted Purchases".

For the non-disclosure sample, the correction for outliers reduces total value added from $ 2.616 billion to $2.381 billion or by 9 percent. Nevertheless, even the scaled back $2.381 billion estimate is probably too high given the large amount of calculated value added originating in retail trade, wholesale trade, and information services. 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 USVI. In the U.S. I-O table, compensation accounts for 60 percent of retail trade value added, 56 percent of wholesale trade value added, and almost 60 percent in information and data processing. The corresponding figures from the USVI Economic Census are approximately 19[7], 18, and 28 percent respectively. Such figures are not credible because they imply profit margins that are improbably high- more than 300[8] 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 first 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

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[7] For Retail Trade, the 19 percent figure is based on compensation of $142,534,000 and value added (value added1) of $740,237,000. 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 of intermediate purchases in the U.S. purchases (including goods for resale) are from domestic producers. By way of contrast, virtually all of USVI'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 USVI will be biased downward by the simple application of U.S. I-O table P/S ratios.

[8] 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 $(740,237 – 326,961 = 413,276)$. With this revision, the sum of operating surplus and depreciation (OVA) would rise from 11.7 percent as a fraction of sales $(142,859/1,217,466)$ to 45.7 percent $(556,135/1,217,466)$.

fallback position in which estimates of value added are based solely on scaled compensation data[9] [10]. Simple algorithms first converted Census reported payroll to compensation, and then compensation, to value added. Specifically, Rubin used survey data[11] 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. Analogous techniques are employed to produce the ValueAdded2 estimates reported in Table 2 below.

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[9] 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.

[10] Even though U.S. and USVI pay rates and benefits are known to be different (see footnote 11 below), it is still possible to assess how much bias might result from using the US compensation scalars to proxy the USVI 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 11 percent (USVI). Given that sales as a multiple of the CIF-adjusted value added1 is 3.211 in USVI and 1.903 (12,825,699/6,644,775) in the U.S., simple arithmetic indicates that the unmeasured ratio of compensation to value added in USVI (.3492) is about thirty-eight percent below the known ratio in the U.S. (.5623) In turn, this implies that using U.S. compensation to value added ratios to proxy the unknown USVI parameters will impart a thirty-eight percent downward bias to the summary estimates of GDP (measured as value added). See footnote 7 for the assumed CIF markup rate.

[11] Recent USVI survey data indicate that benefits are worth, on average, 12.4 percent of total compensation, which implies that each payroll dollar has to be inflated by the factor 1.124 to produce the corresponding compensation figure. Without correction, the U.S. benefit scalars corresponding to the distribution of USVI payroll by industry have a mean value of 1.155. To account for this difference, all benefit scalars are revised downward by approximately 3 percent (1.124/1.155).

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

	Payroll (1)	Scalar (2)	Compensation (3) =(1)*(2)	Compensation/Value Added (4)	Value Added2 (5) = (3)/(4)
Other	657	1.1537291	758	0.3695543	2,051
Repair and Maintenance Services	24,441	1.1099791	27,129	0.4890102	55,477
Food Services	41,542	1.1103943	46,128	0.6722439	68,618
Accommodations	50,815	1.1173472	56,778	0.4929557	115,179
Arts, Entertainment etc.	1,952	1.1157787	2,178	0.6075133	3,585
Health Care and Social Assistance	24,428	1.1346406	27,717	0.7681592	36,082
Information, Professional, Business Services etc.	131,024	1.1176731	146,442	0.5062621	289,261
Finance, Insurance and Real Estate	66,330	1.1352782	75,303	0.2217323	339,612
Rental and Leasing Services	10,479	1.1086936	11,618	0.2620622	44,333
Transportation and Storage Services	46,874	1.1363656	53,266	0.6786671	78,486
Retail	128,444	1.1096976	142,534	0.6021732	236,699
Wholesale	27,664	1.1349046	31,396	0.562155	55,849
Construction	88,117	1.1341398	99,937	0.8966211	111,460
Manufacturing	26,219	1.1780388	30,887	0.440976	70,042
Total without Petroleum Refining	**668,986**		**752,071**		**1,506,736**
Total with Petroleum Refining (Census)					**1,763,925**
Total with Petroleum Refining (USVI)					**1,772,249**

Not surprisingly, compensation-based calculations of value added reduce the estimates for Retail Trade, Wholesale Trade and Information by millions of dollars ($503, $122, and $231 million respectively). When the few positive offsets in other industries are

included, the final figure for industry wide value added, net of petroleum refining, falls from $2.381 to $1.507 billion or by an additional 37 percent.

Thus, the most likely estimate of GDP in the covered sectors of industry would thus appear to lie in the $1.507 - $2.381 billion range without petroleum and $1.764 - $2.801 billion with. Further analysis validates this view. 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 eleven of the fourteen industries, this produces sensible results, and corresponds to $1,361,744,000 in value added. Nevertheless, the standard algorithm does not produce defensible estimates for Retail Trade, Wholesale Trade, and Information. So, to complete the initial picture, we use a hybrid mix of calculations, and replace the faulty numbers with the revised-compensation-based estimates of $581,810,000. The end result is GDP totaling $1,943,554,000, a figure which falls comfortably inside the range defined by the application of the first two value added algorithms. 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 (IBT) and "other value added" (OVA). Information to implement this algorithm is available from Table 2 (compensation), the VI Bureau of Internal Revenue *Summary of Actual Revenue by Class of Tax* Report (IBT), and the U.S. Input-Output table (OVA scaling factors. See Appendix 1). Application of these methods produces an estimate of value added of $1.880 billion, a figure roughly three percent less than the first hybrid cited above.

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

	Total Sales (1)	Compensation (2)	Other Value Added/Sales (3)	Other Value Added (4) = (1)*(3)	Indirect Business Taxes (5)	Value Added3 (6) = (2)+(4) + (5)
Other	3,401	758	0.386825	1,316	116	2,190
Repair and Maintenance Services	110,602	27,129	0.298328	32,996	3,776	63,901
Food Services	175,440	46,128	0.102245	17,938	5,990	70,056
Accommodations	155,568	56,778	0.260572	40,537	5,312	102,627
Arts, Entertainment etc.	8,699	2,178	0.167933	1,461	297	3,936
Health Care and Social Assistance	93,289	27,717	0.150561	14,046	3,185	44,948
Information, Professional, Business Services etc.	806,505	146,442	0.273796	220,818	27,537	394,797
Finance, Insurance and Real Estate	391,936	75,303	0.371028	145,419	13,382	234,104
Rental and Leasing Services	62,687	11,618	0.328047	20,564	2,140	34,322
Transportation and Storage Services	241,052	53,266	0.127335	30,694	8,230	92,190
Retail	1,217,466	142,534	0.117341	142,859	41,568	326,961
Wholesale	262,932	31,396	0.10768	28,312	8,977	68,685
Construction	264,092	99,937	0.041212	10,884	9,017	119,838
Manufacturing	167,445	30,887	0.165669	27,740	5,717	64,344
Total without Petroleum Refining	**3,961,114**	**752,071**		**735,584**	**135,244**	**1,622,899**
Total with Petroleum Refining (Census)						**1,880,088**
Total with Petroleum Refining (USVI)						**1,888,412**

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[12]. Initially, gross

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

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, 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 CGS: CGS = Total Sales (TS) minus GM. Fidelity to the accounting standard is assured since TS - CGS = GM = IP + VA. For the three industries under consideration, value added (ValueAdded4) following SNA definitions is equal to $790,444,000, while CGS is 652,707,000. When these replacement figures are used, total GDP rises to $2,152,187,000. See previous discussion on p.12, section 3.2. 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)
Information, Professional, Business Services etc.	806,505	130,084	676,421	195,186	86,438	281,624	394,797
Retail	1,217,466	413,276	804,190	251,686	225,543	477,229	326,961
Wholesale	262,932	109,347	153,585	27,876	57,023	84,899	68,686
Total	**2,286,903**	**652,707**	**1,634,196**	**474,748**	**369,004**	**843,752**	**790,444**

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 Census of Agriculture and administrative records from the Department of Finance. Analysis of the agriculture data indicates that this omitted sector is quite small. There are identified sales of $3,018,665 selected purchases of $957,664 and payroll of $853,104. The simple "sales minus purchase" algorithm produces a value added estimate that might be on the order of $2,061,001[13]. Therefore we accept the "$2.1" million figure as the maximum for value added given that purchases are "selected" rather than comprehensive.

Finally, government payroll and fringe benefits in USVI are known to be approximately $486.1 million at the territorial level and $68.1 million at the federal level in CY2002. If the USVI compensation to value added scalars are identical to those in the U.S, then

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[13] Data disclosure (Title 13) issues made it impossible to estimate value added from scaled compensation.

value added in this combined government sector equals $654,600,000[14] and value added in all non-covered industries totals $657,000,000 in round numbers.

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 $1.759 billion in household personal consumption expenditures (PCE) resulting from sales by firms and enterprises represented in the economic census. While this figure is somewhat speculative, it does have testable implications.

If USVI GDP for the economic census industries is between $1.764 and $2.801 billion, and if value added in agriculture and government is $657 million, then total GDP is in the range of $2.421 to $3.458 billion. If we use our best estimate, the "hybrid 2" figure of $2.809 billion ($2.152 + $0.657), then PCE is 62.6 percent of GDP. Based upon what we know about typical island economies, PCE as a fraction of Gross National Income (GNI)[15] is rarely below 60 percent or above 70 percent. Clearly, this estimate is consistent with the stylized fact about the known structure of final expenditures in the insular areas. On the other hand, the percentages corresponding to the high and low GDP estimates, 50.9 and 72.6 percent respectively, are outside of the tolerance limits

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

Number of Establishments	Sales & Receipts	Value of Sales to household customers	NAICS 2-digit Industry Code
2,615	3,961,114	1,758,612	0 Virgin Island Total
203	93,289	82,702	1 Health care and social assistance
59	110,602	94,685	2 Repair and maintenance services
50	155,568	8,275	3 Accommodations
263	175,440	107,124	4 Food services
570	806,505	335,472	5 Information/professional/business services
162	241,052	113,217	6 Transportation and storage services
680	1,217,466	676,428	7 Retail
74	262,932	4,066	8 Wholesale trade
60	167,445	9,908	9 Manufacturing
183	267,805	78,003	10 Construction
221	391,936	225,910	11 Finance, insurance, real estate
74	58,974	19,160	12 Rental and leasing services [not real estate]
5	3,401	691	13 Other kinds of business or activity
11	8,699	2,971	14 Arts

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[14] 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.

[15] We are assuming that GDP and GNI are identical in magnitude. In fact, GNI could be as much as five 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 53.5 to 76.4 percent of GNI.

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 database and labor survey data have not produced usable results.

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%[16]. In our opinion, this correction factor is within the "noise" in the data and can therefore be ignored.

5. Final Comments

On the basis of the information available to us, we estimate that partial GDP for the covered economic census industries is between $1.764 and $2.801 billion. The $1 plus billion 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 $657 million in value added originating in the excluded sectors of agriculture and government is accounted for, total GDP rises to an estimated $2.421 to $3.458 billion. Based on IPC's estimated population of 108,812 in 2002, this translates into per capita GDP varying between $22,249 and $31,780. Using the "best" (hybrid2) estimate of GDP, $2.809 billion, per capita GDP is most likely $25,815. This figure falls between the 2002 thresholds for the upper middle ($9,220) and high ($27,590) income categories 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 USVI 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 conclude that the lower bound estimates are probably closer to the truth. Therefore the reader should exercise caution and err on the low side until the future reconciliation of GDP estimates based on annual income and expenditure data is undertaken and completed.

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

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
3251	Basic chemicals	1.205944103	0.4197562	0.7338329	0.1379247
3252	Resins, rubber, and artificial fibers	1.190686389	0.4159569	0.7417698	0.1348933

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
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
334A	Audio, video, and communications	1.181523039	0.520275	0.6362625	0.1669876

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
	equipment				
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
5131	Radio and television	1.172372248	0.8235473	0.6654608	0.0523236

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
	broadcasting				
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
5615	Travel arrangement	1.139017614	0.7007657	0.4618873	0.1451232

NAICS	Industry	Compensation (Benefits) Scale Factor	Compensation/Value Added	Intermediate Purchases/Final Shipments	Other Value Added/Final Shipments
	and reservation services				
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

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