

WOMEN-OWNED SMALL BUSINESSES IN FEDERAL SUBCONTRACTING: MEASURES AND DATA

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Table of Contents

| | |
|--|-----------|
| Executive summary | I |
| 1. Introduction | 1 |
| 2. The disparity ratio and its approximations | 1 |
| 2.1 DEFINITION..... | 1 |
| 2.2 APPROXIMATIONS..... | 3 |
| 3. Some data and results | 6 |
| 3.1 FPDC: SUBCONTRACTING..... | 6 |
| 3.2 SSBF: CAPACITY | 11 |
| 4. A proposal for data collection | 14 |
| 4.1 DATA COLLECTION STRATEGY | 14 |
| 4.2 SAMPLING FRAME AND THE SAMPLE | 15 |
| 4.3 QUESTIONNAIRE DESIGN..... | 19 |
| 5. Appendix | 20 |
| 5.1 THE DATA COLLECTION FORM – VERSION 1 | 20 |
| 5.2. THE DATA COLLECTION FORM – VERSION 2..... | 22 |

Executive Summary

This report contains the results of a research and data development effort on women-owned small businesses (WOSBs) in federal subcontracting. It consists of three core sections. Section 1 presents a conceptual level discussion of disparity measurement and develops the basic measure and a set of approximations. Section 2 provides summary information on two important datasets for disparity measurement and analysis. It also presents some new findings from the data analysis. Section 3 proposes a data collection plan including the selection of sampling frame, determination of the sample size, and stratification. The two versions of a proposed data collection form are in the appendix.

Our discussion in section 1 puts much emphasis on clear definitions of key concepts and variables and precise expressions of the hidden technical relations among those concepts and variables. As a result, the many underlying issues and assumptions are uncovered for the first time as we know but the presentation may appear overly abstract at times.

Our investigation of the key dataset on federal subcontracting from the Federal Procurement Data Center resulted in two main findings.

1. The WOSBs' share in the total subcontracting of all small businesses was around 12% in 1999 and 2000. This share is much higher than the WOSBs' share of less than 5% in total subcontracting.
2. The prime contractors with larger amounts of total subcontracting tend to have smaller shares of that total for WOSBs.

We conducted an extensive data search and analysis on WOSB capacities. Using the 1998 Survey of Small Business Finance conducted by the Federal Reserve, we were able to develop the data for a set of nine measures that we argue are closely correlated with the true capacity of any business concerns. We use both quantitative and qualitative measures and provide a very sensible argument in support of what we discovered for the first time as far as we know. Major findings for 1998 are:

1. WOSBs accounted for about 20% of the total capacity of all small businesses.
2. WOSBs were in a relatively stronger position in the sense that a smaller percentage of WOSB firms experienced problems in labor, cash flow, and technology than other small business firms.

With 12% of the total subcontracting to all small businesses going to WOSBs and assuming no significant changes in WOSB capacity between 1998 and 1999, the purely gender-based disparity ratio for WOSBs is about 0.6. In other words, WOSBs are underrepresented in federal subcontracting according to 1999 and 2000 data.

Data do not allow us to say more. One important dimension, for example, would be detail at an industry level; however, no existing data provide such detail. To overcome the shortcomings, we developed a data collection plan that is ready for implementation.

1. Introduction

Federal subcontracting is a potentially lucrative arena for small businesses, including women-owned small businesses (WOSBs). For example, both the Federal Acquisition Streamlining Act of 1994 and Executive Order 13157 provide that it shall be the policy of the executive branch to establish a participation goal for WOSBs of not less than five percent of the total value of all prime contract awards for each fiscal year and of not less than five percent of the total value of all subcontract awards for each fiscal year. Further, as more prime contracts are consolidated or bundled, WOSBs may find more opportunities with subcontracting. In addition, the subcontracting arena may be a more favorable one for WOSB concerns just starting in federal contracting.

It is of course a different issue whether WOSBs are actually benefiting from such subcontracting opportunities. Many questions need to be answered to get a clear idea about the issue. For example, what are the federal subcontracting opportunities for WOSBs? What are the capacities of WOSBs for the federal subcontracting? Are WOSBs actively pursuing these opportunities? Are executive agencies meeting the subcontracting goals with WOSBs? Often-used summary measures are disparity ratios. A disparity ratio is a ratio between the WOSB share in a well-defined total of subcontracting and the WOSB share in a similarly defined total of capacity. Disparity ratios combine information on utilization and capacity in one number, but both utilization and capacity have to be carefully defined and measured for a disparity ratio to be meaningful. For example, the capacity should be that part of the corporate capability that is ready and willingly offered for government use. In other words, to be counted as part of the available capacity, a business concern should be technically capable, ready for government use, and willing to be used by government.

Extensive data with many details are needed to calculate a reliable disparity measure. With such data rarely available, analysts have often had to rely on assumptions and approximations. This report summarizes a special research and data development effort concerning WOSBs in federal subcontracting. Section 1 discusses the conceptual issues in measuring disparity ratios and derives approximations in consideration of data limitations. Section 2 presents the summary results from two relevant data sources, one concerning the WOSB utilization and the other the WOSB capacity. Limited by the original data, we were unable to extract information more detailed than system-level and nationwide aggregates. In consideration of the data limitations, section 3 proposes a data collection plan that can be implemented to gather data with industry level details.

2. The Disparity Ratio and Its Approximations

2.1 Definition

A disparity ratio summarizes the relative utilization of WOSBs in federal subcontracting in comparison with the relative WOSB capacity.

$$(1) \quad D_1 \equiv \frac{x/X}{y/Y} = \frac{x/y}{X/Y} \equiv D_2$$

where

- (1) y is the total available capacity of WOSBs for federal subcontracting;
- (2) Y is the total available capacity of all businesses for federal subcontracting;
- (3) x is the actual utilization of WOSBs in federal subcontracting; and
- (4) X is the total federal subcontracting opportunities.

D_1 is a ratio between the subcontracting of WOSBs relative to the total subcontracting (x/X) and the available capacity of WOSBs relative to the total available capacity (y/Y). $D_1 > 1$ indicates that WOSB share in the federal subcontracting is larger than their share in the total available capacity. D_2 is a ratio between the WOSB subcontracting as a share of their available capacity (x/y) and the total subcontracting as a share of the total available capacity (X/Y). $D_2 > 1$ indicates that a larger percentage of WOSB capacity is utilized for the federal subcontracting than the business sector as a whole. Obviously, D_1 and D_2 imply each other and take exactly the same values. Therefore, the following interpretations apply to both.

$$(2) \quad \begin{cases} D_1, D_2 < 1, & \text{WOSBs underrepresented;} \\ D_1, D_2 = 1, & \text{WOSBs equally represented;} \\ D_1, D_2 > 1, & \text{WOSBs overrepresented.} \end{cases}$$

Data on x , X , y , and Y rarely exist with the needed level of details or timeliness. For example, some information for y may be developed on the basis of the Census data, but the latest Census data are for 1997. The Federal Procurement Data Center (FPDC) collects summary data on subcontracting activities, hence x and X , through standard form 295, but the FPDC data do not provide sufficient characteristics for the subcontractors.

Particularly difficult are the data on the available capacity, y and Y . Determining the total capacity is difficult enough. In this case, the total capacity must be further limited by its availability (ready and willingly offered for government utilization). A General Accounting Office (GAO) study¹ found that many disparity studies under- or over-estimated the representation of disadvantaged businesses in the federal procurement due

¹ GAO-01-586, Disadvantaged Business Enterprise: Critical Information Is Needed to Understand Program Impact, June 2001.

to data limitations on available capacities. There is a problem on the utilization side, too. Because the capacity must be qualified by its readiness, the total contracting or subcontracting opportunities have to be similarly qualified. Specifically, those opportunities outside of the available capacity must be excluded.

Such qualifications may make significant differences. For example, the Small Business Administration (SBA) reported that small businesses received 23 percent of total federal procurement in fiscal year 1998 while SBA's Office of Advocacy reported 21 percent for a similar measure. The difference was caused by the exclusion of several categories of procurements based on the belief that small businesses do not have a reasonable opportunity to compete for them. Specifically, SBA excludes foreign military sales, overseas procurements, procurements from mandatory sources of supplies such as purchases from Federal Prison Industries, Inc., and purchases for specific programs from the Departments of State, Transportation, and the Treasury because (1) foreign government purchases are not subject to SBA requirements, (2) U.S. small businesses are not likely to bid for overseas contracts, and (3) acquisitions from mandatory sources and/or for specific programs are to be awarded non-competitively in accordance with legal requirements.² GAO considers SBA's approach as within its discretion under the statute, although it does not challenge the Office of Advocacy's position that there should not be such exclusions.³ What needs to be pointed out is that the exclusion based on the criteria of capability, readiness, and willingness may not overlap with that carried out by SBA but is likely to be more extensive.

2.2 Approximations

A survey of all businesses, including WOSBs, is needed to determine the available capacity for the overall business sector (Y), particularly with those qualifications. So far nobody has conducted such a survey. Information on the WOSB capacity (y) and the overall capacity (Y) may be used for goal setting by SBA and other federal agencies, but it is largely the information on the WOSB subcontracting amount (x) and the total subcontracting opportunities (X) that is used to evaluate the program and determine the achievement of goals. Assuming the subcontracting goals set for WOSBs by the federal agencies are in rough correspondence with WOSB relative capacity, or

$$(3) \qquad \qquad \qquad \cong \frac{y}{Y}$$

where a is the goal, then D_1 can be approximated as

$$(4) \qquad \qquad \qquad D_1 \cong \tilde{D}_1 \cong \frac{x}{aX}$$

² GAO-01-119, Small Business: Trends in Federal Procurement in the 1990s, January 2001.

³ GAO/GGD-00-82, Small Businesses: Limited Information Available on Contract Bundling's Extent and Effects, March 2000.

where X is assumed to have embodied the necessary exclusions. The interpretation of \tilde{D}_1 remains the same as in equation (2), but the key data requirement is reduced to x and X .

As mentioned above, data on x and X are available at an aggregate level from FPDC. The FPDC uses GSA Standard Form 295 to collect subcontract award data from prime contractors or subcontractors that (a) hold one or more contracts over \$500,000 (over \$1,000,000 for construction of a public facility) and (b) are required to report subcontracts awarded to Small Business, Small Disadvantaged Business (SDB), Women-Owned Small Business, and HUBZone Small Business concerns under a subcontracting plan. For the Department of Defense, the National Aeronautics and Space Administration, and the Coast Guard, this form also collects subcontract award data for Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs). Selected data items in this form are in table 1.

Table 1. Major Data Items in Standard Form 295

| Item Number | Item Description | Preset Values for Selection |
|-------------|--|-----------------------------|
| 1a | Reporting company's name | |
| 4 | Reporting period | |
| 6 | Government agencies | Army, Navy, ... |
| 7 | Reporting company's contractual status | Prime, sub, or both |
| 9 | Reporting company's major products or service | |
| 10a | Cumulative subcontract awards to all small business concerns | |
| 10b | Cumulative subcontract awards to all large business concerns | |
| 11 | Cumulative subcontract awards to SDB concerns | |
| 12 | Cumulative subcontract awards to WOSB concerns | |
| 13 | Cumulative subcontract awards to HBCU/MI | |
| 14 | Cumulative subcontract awards to HUBZone SB concerns | |

Limitations of these data are obvious. First, they cover only those contractors and subcontractors with contracts above \$500,000. Second, they cover only the contracts with a subcontracting plan. Third, they do not provide any details about a WOSB concern such as its industry classification. How much these data under-represent the actual size of subcontracting is hard to know because there is very little information about the subcontracting activities in relation to contract size. However, it seems unlikely that no subcontracting happens for those contracts under \$500,000. Likewise, it is unclear how much of the subcontracting is conducted through formal subcontracting plans even for those contracts above \$500,000, making the possibility of under-coverage even more serious. Therefore, data collected through Standard Form 295 are not ideal for constructing \tilde{D}_1 approximation as in equation (4).

With these limitations in mind, a limited version of \tilde{D}_1 may still be constructed using data in table 1. Let X_i be the combined value of items 10a and 10b for a reporting company i

and x_i the value of item 12 for the same reporting company i ; then the limited version of \tilde{D}_1 (call it \tilde{D}'_1) for WOSBs is as follows.

$$(5) \quad \tilde{D}'_1 \equiv \frac{\sum x_i}{a \sum X_i}$$

where $i = 1, \dots, n$ and n is the number of reporting companies in the FPDC database. Depending on the information available, some or parts of some X_i 's may be excluded based on the previous discussions. A large portion of the SBA's exclusion is already done since, according to instructions of the GSA Standard Form 295, only subcontracts involving performance within the United States, its possessions, Puerto Rico, and the Trust Territory of the Pacific Islands should be included in the report.

\tilde{D}'_1 shows the extent to which the WOSB subcontracting goals were achieved by the reporting companies as a whole. As long as a closely approximates the participating WOSBs' share in the total available capacity for subcontracting, \tilde{D}'_1 can also be used as a disparity ratio for the reporting companies and the participating WOSBs as a whole. Whether or not \tilde{D}'_1 represents the magnitude of the general disparity ratio for the overall federal subcontracting depends on the representativeness of the group of WOSBs and the representativeness of the group of reporting companies in the FPDC database in relation to their respective populations. Since neither of the two groups is selected according to any statistical procedures, the statistical property of \tilde{D}'_1 is impossible to determine. Table 2 summarizes the discussions so far.

Table 2. Three Measures of WOSB Utilization in Federal Subcontracting

| | | |
|----------------|--|---|
| D_1 | Share in subcontracting to share in available capacity for all WOSBs | Measures disparity; comprehensive |
| \tilde{D}_1 | Share in subcontracting to WOSB subcontracting goals for all WOSBs | Measures goal achievement and maybe disparity*; comprehensive |
| \tilde{D}'_1 | Share in subcontracting to WOSB subcontracting goals for some WOSBs | Measures goal achievement and maybe disparity*; not comprehensive |

* Depending on whether the WOSB goal reflects the relative WOSB capacity.

All the above-presented measures are defined with all business enterprises as the reference group. For example, y is the total available capacity of WOSBs for federal subcontracting, and Y is the total available capacity of all businesses for federal subcontracting. Likewise, x is the federal subcontracting opportunities that went to WOSBs, and X is the total federal subcontracting opportunities that went to all businesses. WOSBs are members of small businesses that are in turn members of all businesses. D_1 can be decomposed to show this connection. Let y^s be the total available capacity of all small businesses for federal subcontracting and x^s the federal

subcontracting opportunities that went to all small businesses; then D_1 can be expressed as the product of two ratios, i.e.,

$$(6) \quad D_1 = \frac{\frac{x/X}{y/Y}}{\frac{x/x^s}{y/y^s}} = \frac{\frac{x/x^s}{y/y^s} \frac{x^s/X}{y^s/Y}}{\frac{x/x^s}{y/y^s}} \equiv D_1^f D_1^s$$

where $D_1^f \equiv (x/x^s)/(y/y^s)$ is a more purely gender-based disparity ratio and $D_1^s \equiv (x^s/X)/(y^s/Y)$ is a more purely size-based disparity ratio.⁴ These two ratios are independently useful indicators. Actually, the more purely gender-based disparity ratio is more appropriate for measuring the possible underlying gender-based disparities. The more purely size-based disparity ratio is nothing but the frequently measured one in many small business disparity studies. Clearly, the ratio for WOSBs with all firms as the reference (D_1) may change because of changes in the ratio for WOSBs with all small firms as the reference (D_1^f) or changes in the ratio for small firms with all firms as the reference (D_1^s) or both. Since changes in D_1^s may have nothing to do with gender, D_1^f is more informative about the true extent of gender disparity. This is so because we limited our domain of analysis to the women-owned small businesses. Additionally, equation (6) indicates other possibilities for using existing data to conduct the estimation. Knowing any two among D_1 , D_1^f , and D_1^s , the other can be determined. Since small businesses are more frequently studied, findings in other studies may be utilized.

3. Some Data and Results

As briefly mentioned before, data that satisfy the exact requirements for implementing measures developed above are not readily available. Data at an industry level, with more or less detail, are even harder to obtain. There are two major datasets that provide aggregate information on WOSB subcontracting and capacity. The FPDC data, presented earlier, is the only source for subcontracting data distinguished by type of businesses. The other dataset is from the Federal Reserve's Survey of Small Business Finance (SSBF). The SSBF data provide some details that facilitate a reasonable approximation of WOSB capacities. The Census Bureau conducts a Survey of Women-Owned Businesses (SWOB) as a part of the economic census but the SWOB data do not provide details for sorting out WOSBs.

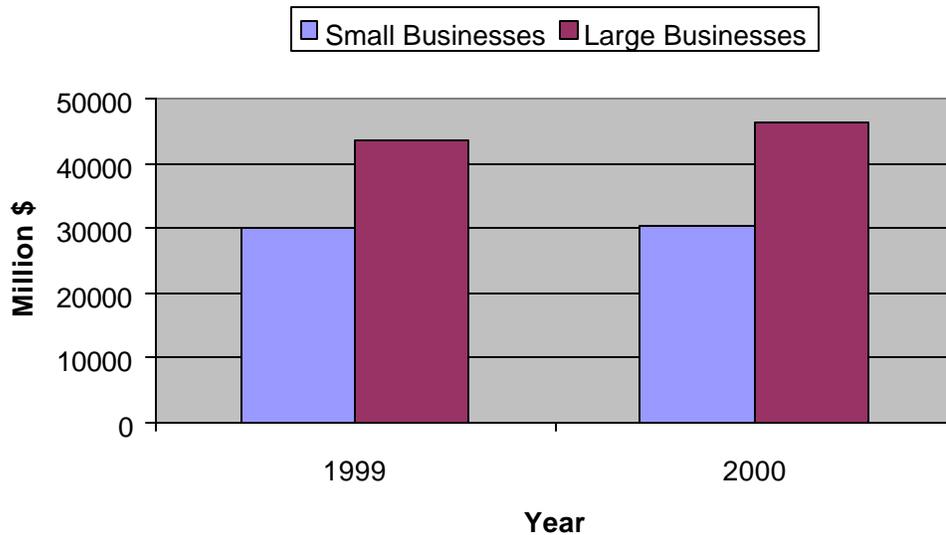
3.1 FPDC: Subcontracting

⁴ Obviously, this is not the only way possible to do the decomposition. For example, if we distinguish between small and socially disadvantaged businesses and other small businesses and consider WOSBs belong to the former, a three-way decomposition will be useful. Next section will indeed present such a decomposition with subcontracting data.

Two years of data were obtained from FPDC for this project. The 1999 dataset contains 3,651 records with information on individual prime contractors' business names, key products, and dollar values of subcontracting with large and small and disadvantaged businesses (SDBs) and with different types of SDBs. The 2000 dataset contains 3,682 records with the same set of information on prime contractors and their subcontracting activities.

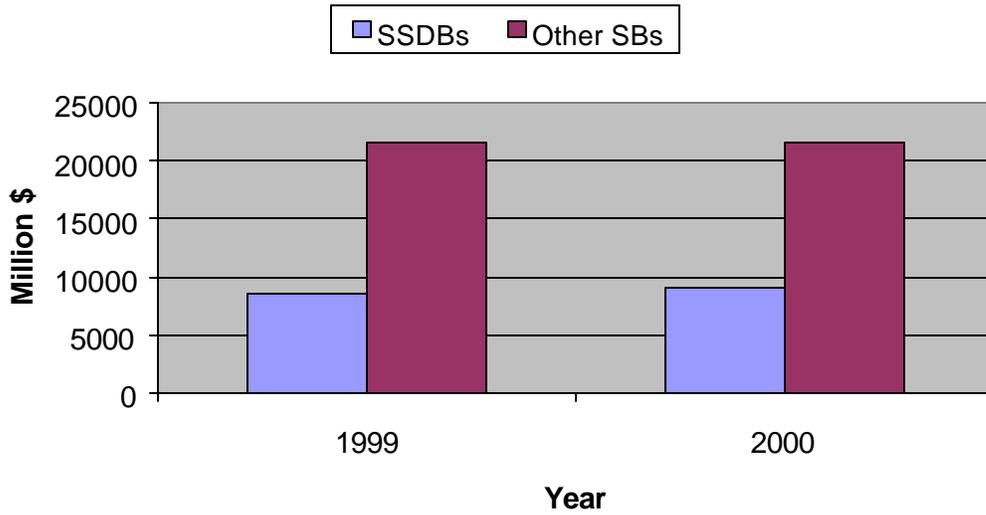
The 3,651 prime contractors contracted out \$73,804 million of their federal business in 1999 and \$76,998 million in 2000. Sixty percent of the total subcontracting dollars went to large business concerns in both years. Less than a third of the remaining 40% went to all types of small and socially disadvantaged businesses (SSDBs) including all 8(a) businesses or small and disadvantaged businesses (SDBs), WOSBs, black colleges, and HUBZone businesses.⁵ Charts 1 and 2 provide the summary information.

Chart 1. Subcontracting to Small and Large Business Concerns



⁵ For the ease of exposition, we group under small and socially disadvantaged businesses (SSDBs) all 8(a) businesses or small and disadvantaged businesses (SDBs), WOSBs, black colleges, and HUBZone businesses. It should be noted that a WOSB firm is not necessarily certified in any of the officially designated disadvantaged status. Excluding WOSBs from SSDBs will result in a much lower share for SSDBs in chart 2. In the following discussion, we look at both cases where WOSBs are treated as part of SSDBs and as part of SBs.

Chart 2. Subcontracting to SSDBs and Other SBs



Among SSDBs, SDBs or 8(a) businesses received more than half and WOSBs received about 40% in both 1999 and 2000. The remaining amount, about 1% in 1999 and 3% in 2000, went to black colleges and HUBZone businesses. While black colleges received 3% less in 2000 than they did in 1999, HUBZone businesses enjoyed a phenomenal increase of more than 400%. Overall, the total subcontracting amount increased 4.3% from 1999 to 2000 and the totals for small and large business concerns went up, respectively, by 1.6% and 6.2%. Charts 3 and 4 provide the summary information.

Chart 3. Distribution of Total SSDB Subcontracting, 1999

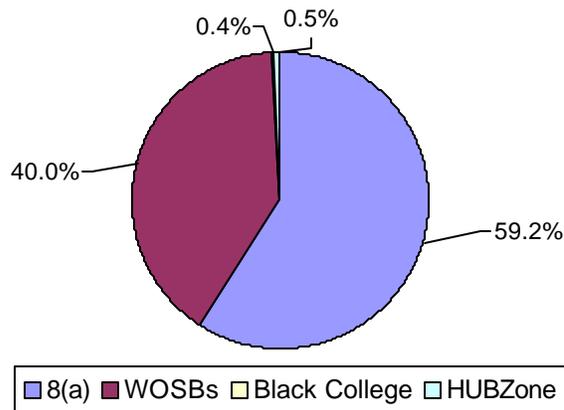
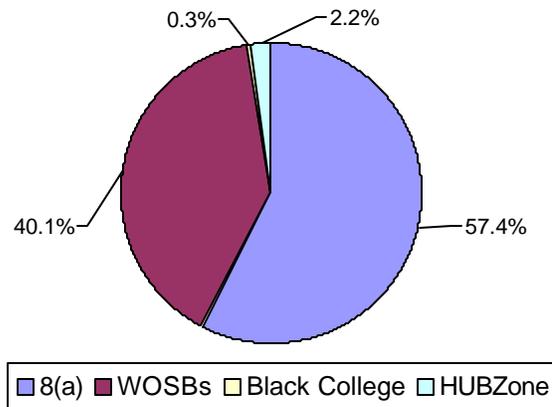


Chart 4. Distribution of Total SSDB Subcontracting, 2000



As previously noted, a WOSB is not necessarily formally designated as socially disadvantaged. Therefore, it is useful to present WOSBs as part of the entire universe of SBs. Not surprisingly, WOSBs accounted for a far smaller share of the total SBs in both 1999 and 2000 (11.3% and 11.8% respectively).

It is straightforward to apply these data to the measures developed in the previous section at the aggregate level. For example, $\sum x_i / \sum X_i$ in equation (5) is a ratio between the total subcontracting with WOSBs and the overall total subcontracting. This ratio and its decomposition similar to that in equation (6) for 1999 and 2000 are in table 3.

Table 3. WOSB Share in Subcontracting and Its Decomposition (%)

| Year | WOSBs in Total | WOSBs in SBs | SBs in Total | SSDBs in SBs | WOSBs in SSDBs |
|------|----------------|--------------|--------------|--------------|----------------|
| 1999 | 4.61 | 11.30 | 40.79 | 28.28 | 39.95 |
| 2000 | 4.68 | 11.77 | 39.74 | 29.38 | 40.06 |

To repeat what has been discussed in the previous section, there are several WOSB disparity ratios, depending on which group firms is used as a reference. One ratio with its numerator equal to the value for “WOSBs in Total” in table 3 uses the entire business world as the reference. The second one with its numerator equal to the value for “WOSBs in SBs” uses the universe of small businesses as the reference. The third one with its numerator equal to the value for “WOSBs in SSDBs” uses all small and socially disadvantaged businesses, as previously defined, as the reference. The first is D_1 , while the second and third, as we argued earlier, are more purely gender-based disparity ratios. Although we cannot draw any conclusions about the level of these three disparity ratios because we do not have the corresponding capacity ratios, the decomposition as presented in equation (6) and table 3 is useful in itself. For example, SSDBs accounted

for a smaller share in total subcontracting for SBs than SBs in total and WOSBs in SSDBs. If SSDB's share had been at a level comparable to that of the other two, WOSBs would have accounted for over 6% of the total subcontracting, other things being equal.

From the public policy's point of view, the decomposition clearly shows that efforts in promoting WOSBs do not necessarily have to be spent in areas directly related to WOSBs. Promoting the small businesses' role in federal subcontracting and raising the presence of SSDBs in the small business community will all indirectly contribute to the presence of WOSBs in the federal subcontracting.

Table 4. WOSB Subcontracting Distribution

| Range of Subcontracting Amount | 1999 | | | 2000 | | |
|---|--------------------------|-------------------------|----------------|--------------------------|-------------------------|----------------|
| | Grand Total (Million \$) | WOSB Total (Million \$) | WOSB Share (%) | Grand Total (Million \$) | WOSB Total (Million \$) | WOSB Share (%) |
| Below \$1 million | 440 | 37 | 8.4 | 421 | 36 | 8.6 |
| At least \$1 million but below \$10 million | 4,522 | 304 | 6.7 | 4,659 | 344 | 7.4 |
| At least \$10 million but below \$100 million | 21,701 | 1,174 | 5.4 | 22,276 | 1,376 | 6.2 |
| At least \$100 million | 47,141 | 1,887 | 4.0 | 49,642 | 1,846 | 3.7 |
| Overall | 73,804 | 3,402 | 4.6 | 76,998 | 3,601 | 4.7 |

The overall share of WOSBs in the total subcontracting hides the underlying variations that may be of interest. As table 4 shows, those prime contractors with smaller amounts of federal subcontracting as a whole tend to have a larger share for WOSBs. For 1999, the firms with the smallest amount of subcontracting as a whole had the largest share of the total going to WOSBs (8.4%), while those with the largest subcontracting amount had the smallest share for WOSBs (4.0%). For 2000, it was 8.6% versus 3.7%. The difference between these two extremes was close to the overall WOSB share of 4.6% in 1999 and was larger than the overall share of 4.7% in 2000. Similar differential patterns hold for intermediate groups for both years.

It is hard to determine what may have contributed to these differences without more detailed data on prime contractors, subcontractors, and the nature of work under each specific contract. One possible factor that has nothing to do with a business concern's social status is the WOSB capacity to handle large subcontracts. Another such factor could be the nature of contract work. If the size of subcontracts has a particular correlation with the nature of the contract work that happens to put WOSBs in a disadvantaged position, what appears to be a negative relationship between the subcontract size and the WOSB share is really a reflection of this underlying mismatch.

There again seem to be useful policy implications in these findings. Specifically, if the negative relationship identified above is due to the difficulty in handling large contracts, WOSBs and their advocates may have to pay more attention to increase WOSB capacity

in this area. If the technical mismatch is the major factor, WOSBs will have to decide whether and how to expand their technical capability to better take advantage of more and larger subcontracting opportunities. If unfavorable treatment is at the root, more attention should then be paid to those firms with larger amounts of subcontracting. No matter which of these factors or their combinations are at work, it is clear that targeting those firms with large amounts of subcontracting will be more likely to increase the WOSB presence in federal subcontracting.⁶

3.2 SSBF: Capacity

Data on WOSB capacity, even at the aggregate level, is not as readily available as the FPDC data on WOSB subcontracting. This is not only due to the fact that the concept and measure of capacity as used here are highly qualified. Qualifications such as “readiness” and “willingness” are indeed hard to control but are secondary in a situation where basic data are not available. Several alternatives were investigated without much attention paid to these qualifications. We believe that the data from the Federal Reserve’s Survey of Small Business Finance (SSBF) is more appropriate than others such as those from the Census Bureau’s Survey of Women-Owned Businesses (SWOB) and Business Research Services Inc.’s National Directory of Woman-Owned Business Firms (NDWOB).

The SSBF data is better than the SWOB data because the former relates directly to WOSBs rather than the larger universe of women-owned businesses. Also, the SWOB data of the latest census year 1997 are not consistent with the data from the most recent previous survey because the Census Bureau redefined the WOBs to include only those with at least 51% ownership belonging to women while the previous definition used 50% as the cut-off. The NDWOB data use 51% in the definition of WOBs. Additionally, it associates each WOB with a four-digit SIC code. For most firms included, data on sales, employment, or both are provided so that the size of a WOB can be determined according to the Small Business Administration’s size standards. The biggest disadvantage for NDWOB data is that there is no basis to assess the data coverage and representativeness because the dataset is to be developed from a membership directory that is compiled on a basis of voluntary participation. Since the SSBF data is developed from a statistically determined random sample, it overcomes this problem. The SSBF data provide a large set of variables that make a multidimensional picture possible. Furthermore, the rich dataset offers some possibility to control for qualifications such “readiness” and “willingness” for federal subcontracting.

The 1998 SSBF data, the latest available, provide information about a nationally representative sample of small businesses in the United States. The target population is the population of all for-profit, non-financial, non-farm, and non-subsidiary business

⁶ It is worth noting that collecting more detailed micro datasets and conducting a behavioral analysis of subcontracting decisions by prime contractors will prove extremely useful to confirm or refute some of the conjectures that were spelt out in our discussion. Findings from such analysis should be valuable inputs for related public discussion and policy making.

enterprises that had fewer than 500 employees and were in operation as of year-end 1998. For the 1998 survey, employment was defined as the number of employees and owners working in the firm (whether or not the employees were full or part time). The public use dataset contains 3,561 firms. These firms represent 5.3 million small businesses. The public dataset contains weights that are required to estimate population statistics for the types of businesses included in the survey. The sampling procedures used for the 1998 SSBF satisfy the requirement for relative capacity measurement because what is needed for this purpose is exactly a representative sample of all small businesses. Since the SSBF data only cover small businesses, the relative WOSB capacity based on this dataset is a more purely gender-based measure. As discussed in section 1, this measure is not only useful for disparity measurement within the universe of small businesses but also easy to be composed with other disparity measures to derive a WOSB disparity ratio with the entire business sector as the reference. Actually, a single measure of relative capacity for small businesses with the whole business sector as the reference is sufficient.

The remaining problem is what should be used to measure the capacity of a business concern. Based on a careful examination of the SSBF questionnaire and dataset, we developed a set of measures so that a relatively comprehensive picture can be presented. Usual candidates such as the numbers of firms and employees should always be included. They do not exactly measure the true capacity but do provide some general idea of how large the whole sector is. Annual sales measure capacity more accurately, particularly when data for multiple years exist. Larger and growing sales generally indicate larger and growing capacity. A common problem with these measures, however, is that they largely show the capacity in existence or in the past, which is even worse. An ideal measure is one that measures the potential capacity. Such a measure, if it exists, also provides a better control for “readiness” and “willingness.”

The SSBF data provide some useful information that can be used to approximate such an ideal measure. Specifically, we identified a set of variables that directly bear on the efficient operation of all business concerns and their general health. Cash on hand is such a variable. These variables and the ones discussed in the previous paragraph are in table 5.

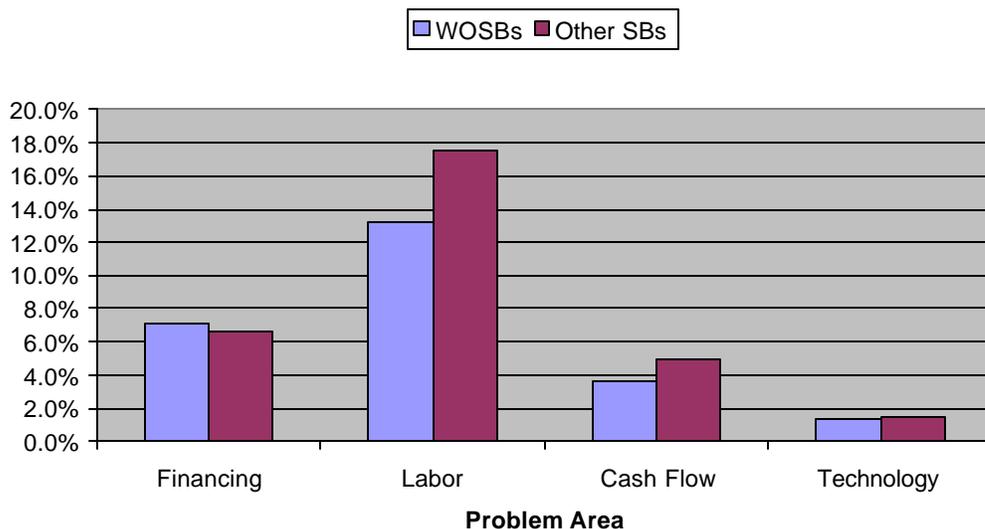
Table 5. Measures of Relative WOSB Capacity

| | WOSBs | Other SBs | All SBs | WOSBs in Total (%) |
|--------------------------------------|-----------|------------|------------|--------------------|
| Number of Firms | 1,286,596 | 4,004,650 | 5,291,246 | 24 |
| Number of Employees | 7,907,527 | 37,463,974 | 45,371,501 | 17 |
| FY 1998 Sales (Million \$) | 705,963 | 4,501,145 | 5,207,108 | 14 |
| FY 1997 Sales (Million \$) | 724,157 | 4,012,786 | 4,736,943 | 15 |
| Cash on Hand (Million \$) | 43,590 | 175,751 | 219,341 | 20 |
| No. of Firms with Nationwide Sales | 101,403 | 400,840 | 502,244 | 20 |
| No. of Firms with Financing Problem | 91,768 | 266,426 | 358,194 | 26 |
| No. of Firms with Labor Problem | 169,867 | 701,449 | 871,316 | 19 |
| No. of Firms with Cash Flow Problem | 47,268 | 197,389 | 244,657 | 19 |
| No. of Firms with Technology Problem | 17,405 | 59,475 | 76,880 | 23 |

The data in table 5 are national aggregates developed from the 1998 SSBF sample data, using the final sample weights in the 1998 SSBF public use dataset. The first six measures indicate that the WOSB capacity is 14% to 24% of the total small business capacity in 1998. It can be argued that the true value is probably closer to 20% than 14% or 24%. While the number of firms does not reflect any firm's capacity and annual sales may decline due to demand rather than capacity, the number of employees (17%) and cash on hand (20%) both directly influence what a firm can do. Furthermore, the WOSB firms with nationwide sales account for 20% of all small business firms with such sales. This last measure is particularly indicative since a firm active in the national market may have (1) better information and expertise in the area of federal procurement; (2) more frequent contacts with large federal prime contractors; and (3) wider name recognition for its services, quality, and prices. Although it takes far more to have a capable business, it seems intuitively very clear that a large proportion of any business success must have a lot to do with cash, people, and the market.

The next four measures show how many of those firms facing the four identified business problems are WOSBs. For example, WOSBs account for 23% of the small business firms that experienced technology difficulties in 1998. Other problems are in areas of financing and interest rate, cost, availability, and quality of labor, and cash flow. These variables again represent crucial aspects of any business operations. A firm that has sufficient cash flow and has no difficulties in technologies or in obtaining additional financing and hiring more quality employees at a competitive salary should be considered qualified for federal contract work. Except for financing problems, WOSBs as a group were in a relatively better situation than other small business firms. To show this more clearly, we express the number of firms with a problem as a share of the total number of firms for both WOSBs and other small businesses. Results are in chart 5.

Chart 5. Relative Experience in Business Difficulties



In words, a smaller percentage of WOSB firms experienced problems in labor, cash flow, and technology than other small business firms.

4. A Proposal for Data Collection

4.1 Data Collection Strategy

Since a comprehensive survey needed for implementing D_1 is beyond the limit of the available resources⁷, data collection efforts are targeted at \tilde{D}_1 and \tilde{D}_1^l . As already discussed, data for \tilde{D}_1^l already exist. Therefore, the following discussion focuses on the data for \tilde{D}_1 , the WOSB share in subcontracting. In other words, data on total subcontracting and on WOSB subcontracting are to be collected. As discussed above, the FPDC data provide such information at an aggregate level. This proposed data collection plan aims at collecting similar data at the two-digit SIC major industry group level.

Based on investigations, it is almost certain that government procurement agencies do not have the data on how much of their procurement dollars are spent by their prime contractors for subcontracting with different types of businesses including WOSBs. On the other hand, it seems likely that prime contractors keep records of how much and to whom they have awarded subcontracts. It should be relatively easy for them to pull out of their records such information on a contract-by-contract basis. Existing data show that large prime contractors with a large amount of subcontracting activities accounted for a predominant portion of the total subcontracting. By regulation, such subcontracting

⁷ Some approximations may still be possible using data from other sources such as the Census Bureau. Further discussions will be in the analytical sections.

activities must have been conducted through detailed subcontracting plans or at least have been well documented through subcontracting agreements. As a rule, subcontracting plans and subcontracting agreements record subcontractor identities, business types, SIC or NAICS codes relevant to the subcontracted work, the subcontracting amount, etc. Therefore, prime contractor-based data collection seems to be the most promising solution.⁸

Two immediate difficulties must be faced. First, who are the prime contractors? How many of them exist? In other words, a complete list of prime contractors is needed. Second, how will the prime contractors respond to the data collection effort? If it is perceived as part of the program assessment effort, as it is most likely to be so perceived, will a prime contractor respond to a private entity's request for information? It appears unlikely. These two difficulties may be overcome with a data collection strategy that consists of the following components.

1. MacroSys Research and Technology (MacroSys) develops a sample of prime contractors for data collection;
2. With assistance from NWBC in coordination with SBA, MacroSys contacts procurement offices and associates each sampled prime contractor with a government agency;
3. MacroSys designs a questionnaire for data collection and drafts a cover letter for each procurement office;
4. MacroSys obtains the signatures of the procurement officers from all procurement offices for the cover letter and mails the signed cover letter with the questionnaire to the prime contractors;
5. MacroSys handles all data entry, processing, analysis, and reporting;
6. MacroSys produces a micro dataset for each procurement office containing the data collected from prime contractors of that office;
7. NWBC in coordination with SBA distributes the report and the micro dataset to the procurement offices.

To increase the willingness of the procurement offices to participate in this effort, they should be assured that the extent of their involvement is really negligible. It would also be useful to emphasize that the questionnaire will be limited to questions about the nature and the amount of subcontracting work awarded to WOSBs. The following discussion focuses on sample generation and questionnaire design.

4.2 Sampling Frame and the Sample

We decided to use the list of prime contractors reporting to the FPDC as the sampling frame. The number and identity of prime contractors in the FPDC frame vary from year to year. Therefore, the number and identity of firms in a sample varies from year to year,

⁸ There is one complication. Subcontracts for WOSBs may not always come from prime contractors. A prime contractor may subcontract with a large business concern that in turn subcontracts with a WOSB. A prime contractor-based data collection effort will not cover such subcontracting activities. FPDC data may provide an indication of how extensive this type of subcontracting is.

too. For 1999, a total of 3,651 firms reported to FPDC. That number for 2000 was 3,682. All prime contractors do not utilize subcontractors to the same extent. For example, there were 126 firms (3.5 % of the total) that reported zero amount of subcontracting in 1999. The number increased to 174 in 2000, accounting for almost 5% of the total. Our sampling frames for 1999 and 2000 exclude the firms without any reported amount of subcontracting.

Among firms with reported subcontracting, the subcontracting amount is very unevenly distributed. Most of the firms have very small amounts of subcontracting, while larger subcontracting tends to be concentrated. In 1999, 77% of firms that reported a non-zero subcontracting amount accounted for about 7% of the total subcontracting amount, while 4% of the firms accounted for 64% of that total. Table 6 provides more details.

Table 6. Prime Contractors and Subcontracting Amount, 1999

| Range of Subcontracting Amount | 1999 | | | |
|---|--------|-----------|-----------------------|-----------|
| | Firms | | Subcontracting Amount | |
| | Number | Share (%) | Total (\$) | Share (%) |
| Below \$1 million | 1,482 | 44 | 440,243,538 | 1 |
| At least \$1 million but below \$10 million | 1,210 | 33 | 4,521,980,911 | 6 |
| At least \$10 million but below \$100 million | 696 | 20 | 21,700,559,535 | 29 |
| At least \$100 million | 137 | 4 | 47,141,029,292 | 64 |
| Overall | 3,525 | 100 | 73,803,813,276 | 100 |

The overall situation remained unchanged in 2000, although slightly fewer firms reported with non-zero amount of subcontracting. See table 7 for more details.

Table 7. Prime Contractors and Subcontracting Amount, 2000

| Range of Subcontracting Amount | 2000 | | | |
|---|--------|-----------|-----------------------|-----------|
| | Firms | | Subcontracting Amount | |
| | Number | Share (%) | Total (\$) | Share (%) |
| Below \$1 million | 1,433 | 44 | 420,927,148 | 1 |
| At least \$1 million but below \$10 million | 1,201 | 33 | 4,659,360,366 | 6 |
| At least \$10 million but below \$100 million | 732 | 19 | 22,275,499,457 | 29 |
| At least \$100 million | 142 | 4 | 49,641,800,742 | 64 |
| Overall | 3,508 | 100 | 76,997,587,713 | 100 |

Table 6 and table 7 show that a large majority of prime contractors had a very small amount of total subcontracting. This and other considerations led to our choice of a

stratified sampling approach for sample generation. There are three steps in this approach.

Step 1. Sample Size Determination

We use the standard method for determining the sample size for estimating a population mean with adjustment. If we let N be the size of population, n' the unadjusted sample size, n the adjusted sample size, the sample size is determined as follows.

$$(7) \quad n' = \left[\frac{t_a S}{\Delta} \right]^2$$

$$n = \frac{n'}{\left(1 + \frac{n'}{N} \right)}$$

where S is the population standard deviation, Δ the tolerable error of estimation or margin of error, and t_a the t -value at the significance level α .

The 1999 and 2000 FPDC data allow us to calculate S for both years. Applying these data to equation (7) with Δ set to .02 units and α to .05, we obtain a sample size of 182 firms for 1999 and 171 firms for 2000. See the following for details.

| Year | N | S | Δ | $t_{.05}$ | n' | n |
|------|------|-------|----------|-----------|------|-----|
| 1999 | 3525 | .1412 | .02 | 1.96 | 192 | 182 |
| 2000 | 3508 | .1369 | .02 | 1.96 | 180 | 171 |

Step 2. Sample Allocation

The sample firms are allocated to different strata. We stratify the population by the size of subcontracting amount. Under this design, firms with larger amounts of subcontracting are more likely to be selected for the survey while those with very small subcontracting amounts may not be selected at all. Although this approach of stratification may not be appropriate for purposes such as studying behavioral differences in subcontracting, because our purpose is to collect data for constructing the WOSB share in total subcontracting, it is entirely appropriate.

If we let n_i be the number of firms allocated to stratum i , x_i the total subcontracting amount of stratum i , s_i the standard deviation for stratum i , and n the size of the total sample, as defined before, the optimal allocation rule following the variance minimization is given by equation (8).

$$(8) \quad n_i = n \frac{p_i s_i}{\sum p_i s_i}$$

$$p_i = \frac{x_i}{\sum x_i}$$

where p_i , measured in relative subcontracting amounts, is used as the relative stratum size or weight. Therefore, the strata with larger subcontracting amounts and larger variances get larger allocations.

We divided all firms with positive amounts of subcontracting into four strata according to the level of their subcontracting amounts. We then calculated standard deviations and relative sizes for all strata. Applying to equation (8) these results and the total sample sizes for 1999 and 2000, we derived earlier results in optimal sample allocations for 1999 and 2000 as follows.

The 182 sample firms for 1999 should all go to the strata of firms with their individual subcontracting amounts at least equal to \$10 million. There were 833 such firms in 1999, accounting for 24% of the total number of firms in the year. In other words, 76% of the population does not even get one sample. Although at first glance this seems very extreme, because these firms did not have much subcontracting, the sample result will remain representative without counting them. For 2000, the 171 sample firms again all go to the strata of firms with their individual subcontracting amounts at least equal to \$10 million. There are 874 such firms in 2000, accounting for 25% of the total number of firms in the year.

Step 3. Sample Generation

It is straightforward to select the firms from the corresponding strata. For both years, firms in the stratum with at least \$100 million of subcontracting are completely selected. The remaining sample firms are selected from the second largest stratum. Since the sample size is larger than the stratum size in this case, some kind of random sampling procedure should be followed.

Note that as discussed above, we use the subcontracting amount rather than the number of firms of a stratum to measure the relative size of the stratum. The number of firms is not a good choice since the strata with most firms do not have much subcontracting. Sampling from these strata will not result in a very representative dataset since the sample misses about 75% of the total subcontracting activities. Sampling more firms where there is more subcontracting will generate more representative and informative results. The problem is that the subcontracting amount and the number of firms diverge so much for both 1999 and 2000 that the optimal allocation of sample firms results in more sample firms for the largest stratum than total number of firms within that stratum.

This explains why no random sampling is needed for the largest strata for both 1999 and 2000. This strategy of sample generation will not exactly minimize the sample variance but is still more preferable than its alternative. If sample firms are allocated according to strata sizes measured in the number of firms, all sample firms will go to the strata with a combined subcontracting amount under 10% of the total subcontracting amount.

4.3 Questionnaire Design

Questionnaire design is generally a lengthy process but is relatively straightforward in this case. The data to be collected are well defined and the original sources are also relatively well identified. There are no complicated interrelationships among the targeted data items. No extensive interpretative efforts are required for what exactly are to be reported. Almost no qualitative data are collected. No open-ended questions need to be asked. Unlike the questionnaire for a typical survey, contingency and filter questions are completely unnecessary here, and question sequencing is not a concern. The challenge is not what questions to ask or how to ask them to obtain the data you need, but rather to decide who may have the subcontracting data and the kind of detail available in those data. However, these are questions that must be answered before selecting a sampling frame.

We designed two versions of the questionnaire in the format of a regular data collection form. The two versions differ in the level of detail at which data are collected. Version 1 requires contract-by-contract information on subcontract number, subcontractor name, nature of work in terms of SIC code, subcontractor's small and disadvantaged business status, and subcontracting amount. Version 2 allows the respondents to aggregate the subcontracts by SIC code and indicate the number of subcontract awards and subcontracting amount in total and for WOSBs by SIC groups.

Version 1 has the advantage of providing more detail but requires more data entry. Version 2 collects the necessary information with less data entry but requires respondents to regroup data, which may be difficult and result in more errors. Since the extra data entry for version 1 is relatively easier than the data regrouping necessary for version 2, version 1 seems preferable. Government and industry reviewers' comments on the two versions of the form show a similar preference. The two versions of the form and their associated instructions are attached as appendices.

General Instructions

1. This form collects subcontract award data from prime contractors/subcontractors that are required to submit Form 295, Summary Subcontract Report.
2. Only subcontracts involving performance within the U.S., its possessions, Puerto Rico, and the Trust Territory of the Pacific Islands should be included in this report.
3. Subcontracts awarded by affiliates of the prime/sub contractor should be excluded in this report.

Special Instructions

Block 2a: Enter subcontract number.

Block 2b: Enter the standard industry classification (SIC) code for the work performed under the subcontract. This code should be specified in the subcontract.

Block 2c: Report the dollar amount of the subcontract rounded off to the nearest dollar.

Block 3a: Enter the name of the subcontractor that performed the work under the subcontract.

Block 3b: Check all that are applicable, where

LB = Large Business

SB = Small Business

SDB = Small Disadvantaged Business including 8(a)'s

WOSB = Women Owned Small Business

HBCU/MI = Historically Black Colleges and Universities/Minority Institutions

HUBZ = HUBZone Small Business

General Instructions

1. This form collects subcontract award data from prime contractors/subcontractors that are required to submit Form 295, Summary Subcontract Report.
2. Only subcontracts involving performance within the U.S., its possessions, Puerto Rico, and the Trust Territory of the Pacific Islands should be included in this report.
3. Subcontracts awarded by affiliates of the prime/sub contractor should be excluded in this report.
4. Report all subcontracts that have the same first two digits in their standard industry classification codes as one entry.

Special Instructions

Block 2: Enter the standard industry classification (SIC) code for the work performed under the subcontracts. Take the first two digits of the SIC code specified in the subcontract. If more than one subcontract has this SIC code, enter only once and report the related combined totals in the following blocks.

Block 3a: Enter the total number of subcontracts with SIC codes that have the same numbers for the first two digits as entered in **Block 2**.

Block 3b: Report the total dollar amount of all the subcontracts specified in **Block 3a**.

Block 4a: Enter the total number of subcontracts specified in **Block 3a** that are awarded to Women-Owned Small Business (WOSB) concerns.

Block 4b: Report the total dollar amount of all the subcontracts specified in **Block 4a**.