To determine HUB availability, we obtained estimates of the number of HUBs and the number of all establishments with at least one paid employee. We obtained information on the number of HUBs that are sole proprietors, partnerships and sub-Chapter S corporations from the *Census of Minority and Women-Owned Businesses*,[83] a government survey that has been conducted by the U.S. Census every five years since 1972.[84] The most recent data available are for 1987.[85] We estimated the number of HUBs that are 1120 Corporations using a combination of the GSC HUB directory and the State's sales tax and ES202 data. We used the *Current Population Surveys* and the *Census of Population and Housing* to determine annual growth rates, allowing us to estimate HUB availability for 1990.[86,87] To determine the total number of available establishments, we used 1990 *County Business Patterns* data.[88]

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into separate size classifications did not eliminate the disparities: disparities still exist within each of the separate pools of small firms and large firms.

[83] For simplicity, we refer to the *Survey of Minority-Owned Business Enterprises* and the *Survey of Women-Owned Businesses* as the *Census of Minority and Women-Owned Businesses*. Both surveys are part of the 1987 Economic Census.

[84] See U.S. Bureau of the Census, *Survey of Minority-Owned Business Enterprises* and the *Survey of Women-Owned Business Enterprises*, various years. The race/ethnic groups are defined as follows by Census: (1) *African Americans* (Black persons having origins in any of the Black African racial groups); *(2) Hispanics* (Mexicans, Puerto Ricans, Dominicans, Cubans, Central or South Americans of either Indian or Hispanic descent); (3) *Asians and Other Minorities* include Asian/Pacific Islanders (persons with origins in any of the Far East countries, South East Asia, Indian subcontinent, or Pacific islands) and Native Americans/Alaskans (native persons having origins in any of the original peoples of North America).

[85] As complete 1987 data were not available until mid-1991, we expect that the 1992 data will become available sometime in 1996.

[86] *Labor Extracts*, National Bureau of Economic Research, Cambridge, MA, data files for 1987, 1988, 1989, 1990; based on data from the *Current Population Survey*, CPS Outgoing Rotation Group Annual files, Bureau of Labor Statistics, Washington, D.C.

[87] *Census of Population and Housing*, 1990: Public Use Microdata Samples, U.S., All data files, prepared by the Bureau of the Census, Washington: The Bureau, 1992.

[88] *County Business Patterns 1990*, (CD-ROM, containing data for 1989 and 1990), Bureau of Census, Washington, D.C.

(1) Total Number of HUBs

We determined the number of HUB establishments with paid employees using the *Census of Minority and Women-Owned Businesses* data.[89] To evaluate the usefulness of the Census data, it is important to understand how the Census identifies HUBs. In 1987, the Census identified HUBs by identifying from IRS records all firms that:

(1) Filed a Schedule C with their IRS 1040 for the given tax year. These firms comprise all individual proprietorships or self-employed individuals that reported income to the IRS in that year;

(2) Filed a Form 1065 for the given tax year. These firms comprise all partnerships that reported income to the IRS in that year; or

(3) Filed a Form S for the tax year. These firms comprise all Subchapter S corporations that reported income to the IRS in that year. A Subchapter S corporation is one that is treated as a partnership for tax purposes.

Each of these tax returns contains the social security number(s) of the individual(s) filing the return (this would be a single individual for Schedule C's, two or more individuals for partnerships and one or more individuals for Subchapter S corporations). The Census uses these social security numbers to identify the race, ethnicity and gender of the corresponding individuals from Social Security Administration records. Until 1981, social security applications requested that individuals identify their race as white, African American or other. The Census identified Asians, Hispanics and Native Americans by examining surnames and conducting selective mail surveys.[90] In 1981, social security

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[89] The *Census of Minority and Women-Owned Businesses* reports the number of firms with paid employees. HUBs are typically smaller, single-establishment firms. Therefore, for the purposes of our analysis, we assume that the firms reported by the Census are single-establishment firms. To the extent that HUB firms are not single-establishment firms, we will have underestimated availability.

[90] For example, in the case of Hispanics, Census identified firm owners who had indicated their race as "Hispanic" or "Other" on their social security application or whose last names corresponded to a master list of Hispanic surnames. Census then sent a mail survey to a stratified sample of these firms to estimate the number of Hispanic firms. In the case of firms with paid employees, surveys were sent to at least one out of every two firms. A similar approach was taken with Asians.

applications were revised to collect race and ethnic information for Asians, Asian Americans, Pacific Islanders, Hispanics, Northern American Indians and Alaskan Natives. However, the majority of firms that were counted in the 1987 *Census of Minority and Women-Owned Businesses* applied for their social security number prior to 1981. Therefore, Hispanic and Asian-owned firms are identified as in earlier years.

The U.S. Bureau of the Census (Census) publishes various tabulations based on the results of its censuses. Because of its concerns about disclosing confidential information, Census reports tabulations for relatively broad industry categories and geographic areas. They have, however, provided us with unpublished 1987 data on the number of HUBs in each county in the United States by detailed industry category. The industry data were provided at the two-digit SIC level using the U.S. Bureau of the Census' Standard Industrial Classification (SIC) code system. Examples of two-digit SIC codes include special trade construction (SIC17), wholesale trade–durable goods (SIC50) and medical services (SIC80).[91]

(2) HUB Growth

We used *Current Population Survey* data and *Census of Population and Housing* data to calculate the growth in minority and female self-employment from 1987 to 1990. We applied the growth rates to the number of establishments in the 1987 *Census of Minority and Women-Owned Businesses* to estimate the number of HUBs in 1990.

Using data from the *Census of Minority and Women-Owned Businesses*, we were able to determine the number of HUBs in each 2-digit SIC code and county in Texas for 1987. To forecast the number of HUBs in 1990 we had to use a different source of data. The best data available after 1987 are contained in the annual *Current Population Surveys* (CPS) and the 1990 *Census of*

[91] See Appendix E for a listing of all two-digit SIC codes and corresponding descriptions.

Population and Housing (1990 Census). The CPSs and the 1990 Census report the number of individuals who own sole proprietorships, partnerships and small corporations by race and sex; the number of individuals who own such enterprises is roughly equal to the number of businesses that are organized as sole proprietorships, partnerships, 1120-S Corporations or small 1120 Corporations. Consequently, this definition of business ownership is more expansive than the definition we are using for availability because it includes businesses without paid employees and because it includes some 1120 Corporations. Nonetheless, we believe it is a reasonable proxy to track trends over time.

We analyzed growth rates in HUB firms between 1982 and 1987 using the *Census of Minority and Women-Owned Business* data and the growth rate in minority and female self-employment using the CPS and 1990 Census data. We found, in all procurement categories and Census regions, that both minority and female self-employment grew at a slower rate during the 1987-1990 period than did the total number of HUB firms with paid employees during the 1982-1987 period. As the economy took a significant shift downward after 1987 with the growth in the nation's gross domestic product decreasing by almost half, we decided that firm growth during the 1982-1987 period would not accurately reflect firm growth between 1987 and 1990. Thus, we used the growth in self-employment to estimate firm growth. To the extent that our methodology underestimates the growth in HUB firms, we provide a conservative estimate of HUB establishments with paid employees for 1990.

The CPS interviews a selected set of 57,000 households each month to determine employment statistics. Using CPS data from 1986, 1987 and 1988, we selected minority and female respondents who identified themselves as self-employed and who worked a minimum of 35 hours a week. With weighting factors provided in the data, we expanded the CPS sample to estimate state self-employment totals for women and minorities in selected industry codes. Based on the codes, we

classified these workers into construction, commodity purchasing, and services. We then calculated the number of self-employed minorities and women in the three industry categories in Texas for 1987.[92,93]

The 1990 Census reports self-employment totals for women and minorities based on a larger population sample than the CPS. These data classify workers as full-time self-employed and provide counts by industry codes. We calculated the total number of women and minority self-employed workers in construction, services and commodities. For each procurement category, we calculated the growth of HUB firms with paid employees between 1987 and 1990 as the ratio of the 1990 Census self-employment total to the 1987 self-employment number calculated from the CPS data. Separate growth rates were calculated for minorities and women for construction, services and commodities.[94] We applied these growth rates to the number of establishments with paid employees from the 1987 *Census of Minority and Women-Owned Business* to estimate the number of HUBs in 1990 with paid employees for each county and two-digit SIC code in Texas.

(3) Adjustment for 1120 HUB Corporations

Census of Minority and Women-Owned Business data include only corporations that file Subchapter S returns since only these returns contain the social security numbers necessary to identify race, ethnicity and gender. The Census data does not include corporations that file 1120 corporate

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[92] As mentioned in Chapter 4 and above, the self-employed consist of all owners of sole proprietorships, partnerships, and small corporations (1120-S and small 1120s).

[93] We estimated 1987 self-employment as the average of 1986, 1987 and 1988 totals to minimize the effects of small survey sample sizes.

[94] The following annual growth rates were calculated: for woman-owned firms—12.2 percent in construction, 4.8 percent in services and 13.6 percent in commodities; for minority-owned firms—9.3 percent in construction, 14.2 percent in services and 1.6 percent in commodities.

tax returns.[95] To adjust for 1120 corporations, we used a combination of GSC HUB directory data and State sales tax and ES202 data to estimate the number of 1120 corporations that were HUBs by county, two-digit SIC code, race, ethnicity and gender.

To estimate the number of 1120 corporations that were HUBs, we selected HUB firms that were identified in the GSC HUB directory by their federal identification number instead of by their social security number. Using the federal identification number, we merged the selected firms to the State's sales tax and ES202 data to obtain each firm's two-digit SIC code. We then used the HUB's zip code to determine the county in which the firm was located. Using the combined data, we calculated the number of HUB corporations in each county and two-digit SIC code by race, ethnicity and gender.[96]

HUBs identified from the sources described above are firms that could in principle operate more than one establishment. However, since most HUBs are small firms, few operate in multiple locations. To take a more conservative approach, we assume that HUB corporations that are 1120 corporations are single-establishment firms. Treating these firms as single-establishment firms, we added them to the number of establishments identified in the *Census of Minority and Women-Owned Business* data. To the extent that this assumption is wrong, our availability estimates are underestimated.

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[95] In contrast to Subchapter S corporations, which are treated as partnerships for tax purposes, 1120 corporations are treated as regular corporations.

[96] There were 4,069 HUB firms identified by federal identification numbers in the GSC HUB directory. We were able to obtain two-digit SIC codes for 2,217 of these firms. Only those HUB corporations that were assigned a two-digit SIC code were included in our estimates of HUB availability. To the extent that all HUB corporations are not included in the GSC's HUB Directory and to the extent that we were not able to obtain complete information for all HUB corporations in the GSC's HUB Directory, our estimates of HUB availability are underestimated.

(4) Total Number of Establishments

We used *County Business Patterns* data to determine the total number of establishments in each two-digit SIC industry and each county in Texas. The *County Business Patterns* data provided the most comparable data on the population of all establishments with paid employees. *County Business Patterns* counts the establishments (i.e., multiple locations of firms) of a firm, are available yearly and contain information for each county and two-digit SIC code industry.

2. How Do We Calculate the HUB Availability Percent?

Using the *Census of Minority and Women-Owned Businesses* data and the 1990 *County Business Patterns* data, we calculated the percentage of all establishments with paid employees that are HUBs for each county in Texas.[97] For example, the estimated percent of establishments that are Hispanic-owned for each county and two-digit SIC code industry is given by:

$$H_{IC} = \frac{\textit{Number of Hispanic-owned establishments with paid employees}}{\textit{Number of all establishments with payroll}} * 100$$

where

H = *availability of Hispanic-owned firms*

I = *a two-digit SIC code*

C = *a county*

For example, in 1990, in Travis County, there were 168 Hispanic-owned establishments and 697 total establishments with paid employees in SIC17. Dividing the number of Hispanic-owned establishments by the total number of establishments yields Hispanic availability of 24 percent for SIC17 in Travis County.

[97] We used the *Census of Minority and Women-Owned Businesses* data as adjusted by NERA to account for 1987-1990 growth rates and for 1120 Corporations, as described above.

We calculated the availability figures in exactly the same way for other race/ethnic and gender groups. However, an adjustment was required for the Hispanic, Asian and Native American figures because the methods used by the Census to identify Asian and Hispanic-owned businesses were less precise than those used for African American and woman-owned businesses for the reasons discussed above. Census surveyed 73,000 firms to determine their race and ethnicity. As a result of this survey, they estimated that they had undercounted the number of Hispanic-owned firms by 19.6 percent and the number of Asian and Native American-owned firms 21.4 percent. We therefore adjusted our availability percentages to compensate for this undercount.[98]

As a result of the manner in which Census collects and reports data on HUBs, minority woman-owned firms are counted in both Census minority-owned business figures and Census woman-owned business figures. To obtain an estimate of total HUBs, it is necessary to adjust for this double counting. We did this by assuming that the percent of woman-owned business enterprises in Texas that are white is the same as the percent of self-employed women in Texas that are white (80.1 percent).[99]

C. How Do We Tailor Availability by Geographic Area and Industry Markets?

At this point in our analysis, we have estimates of the percent of HUB establishments in each county and each two-digit SIC code industry in Texas. The next issue we looked at concerned the following problem: Suppose the State spent the majority of its construction dollars on heavy road

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[98] See Bureau of the Census, *Survey of Minority-Owned Business Enterprises: Hispanics*, Appendix D and *Survey of Minority-Owned Business Enterprises: Asians*, Appendix D, for further discussion. According to unpublished Census data, 20,210 Hispanic firms with payroll were not counted and 82,908 were counted; 26,260 Asian firms with payroll were not counted and 96,457 were counted.

[99] Based on data from the 1990 *Census of Population and Housing*. We counted women as self-employed if they were full-time self-employed (incorporated or not-incorporated).

construction and suppose that the firms available to do heavy road construction made up only 5 percent of the market. In this scenario, we must take into account the spending patterns of the State and tailor our estimates of HUB availability to reflect the State's requirements. We do this by calculating the percentage of State spending in each two-digit SIC code industry associated with each major procurement category. For each procurement category, we then calculate a weighted average of availability where the weights are given by the percentage of State spending in each two-digit SIC code industry.[100] For example, in Table 3.9 we show that less than 2 percent of all heavy construction (SIC16) firms in Travis County are Hispanic-owned firms. However, the State spends 78.5 percent of all its construction dollars on heavy construction. Based on the State's spending patterns, we put more weight on the availability of the heavy construction firms than on the firms that do other types of construction work. Partly for this reason, the weighted availability of Hispanic-owned construction firms in Travis County is 4.3.

Having tailored our estimate of HUB availability to the State's spending patterns in particular industries, we then turned to the following question: Suppose the State is doing major roadwork to the highways around Dallas. Are heavy construction firms in Corpus Christi as available to work on the project as heavy construction firms based locally in Dallas? If not, then we must take into account the State's spending patterns by geographic location.

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[100] The formula describing spending on construction weighted by industry for a given county **C** is:

$$H_{CONST_C} = \sum_{1}^{N} W_I \, H_{IC}$$

where **CONST** denotes the construction procurement category, $\mathbf{W_I}$ denotes the fraction of spending in industry **I**, $\mathbf{H_{IC}}$ denotes the availability of Hispanic-owned firms in industry **I** within county **C**, and **N** denotes the number of two-digit industries that comprise the procurement category.

TABLE 3.9

HISPANIC AVAILABILITY
WEIGHTED BY THE TWO-DIGIT SIC INDUSTRIES
IN WHICH THE STATE SPENDS ITS CONSTRUCTION DOLLARS
(Weights are based on FY92-FY93 expenditures)

Industry	Fraction of Construction Firms that Are Hispanic-owned in Travis County	Share of State's Total Construction Spending in Two-Digit SIC Industry	Contribution to Overall Availability
Building Construction	12.3%	13.6%	1.7%
Heavy Construction	1.9	78.5	1.5
Specialty Construction	24.0	4.2	1.0
Other 2-Digit SIC Industries	1.6	3.7	0.1
Weighted Average		100.0	4.3

Note: Data reported for "Other 2-Digit SIC Industries" were derived for representational purposes only.

As a practical matter, we would expect that firms (especially construction firms) are more likely to pursue procurement opportunities that are closer to their location. There are several reasons for this. First, nearby firms have lower transportation costs and, therefore, are at a competitive advantage. Following up on our previous example, the heavy construction firm in Corpus Christi would have to move its heavy equipment and possibly some staff to the construction site outside of Dallas. Dallas-based firms, on the other hand, would not have to transport their equipment or their staff. These firms would have lower transportation costs than the firm in Corpus Christi and could, therefore, make lower bids, assuming all else is equal. To take another example, the market for concrete is generally local because of the high cost of transporting concrete between distant locations.

A further reason for procurement to be more localized is that local firms are more likely to know about procurement opportunities. This results partly from the fact that agencies are often required to advertise procurement opportunities locally and regionally, but not necessarily statewide or nationally.[101] It also results from the fact that it is easier for firms to learn about procurement opportunities through local business networks.

For all these reasons, firms that are more distant from the geographic vicinity of the procuring agency or from the area in which the work is to be performed may be less available. To account for this, we took a weighted average of availability (for each major procurement category) across the counties in Texas. As an approximation to the likelihood that firms would be willing and able to work, we used the percentage of vendors and the percentage of dollars paid to vendors (in each major procurement category) in each county in Texas.[102] These distributions identify the counties from which vendors have typically been awarded State contracts.

Before providing an illustration, it is important to emphasize that we are not assuming that procurement markets are local, statewide or national. We are letting the State's own procurement data decide this issue. To the extent that markets are localized we would expect that a relatively large

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[101] For example, the GSC typically advertises in one or more newspapers of general circulation in the region where the construction work is being conducted. The GSC may advertise in other large cities if the expected project is considered large (i.e., over $5 million) or if it is determined that the number of firms in the region that are available to bid on the project is too small to engender adequate competition. (Information collected through telephone interview with John Hodges of GSC).

[102] The formula is given by:

$$H_{CONST} = \sum_{1}^{M} W_C \, H_{CONST_C}$$

where CONST denotes the construction major procurement category, W_C denotes the fraction of spending in county C, H_{CONST_C} denotes the availability of Hispanic-owned firms in county C, weighted by industry as described previously, and M denotes the number of counties in the geographic market.

fraction of the State's spending will occur in the State or in particular locations. To the extent that markets are broader geographically, we would expect that the State's spending will be more geographically diverse. That, in fact, is exactly what the data show. Spending on construction tends to be more localized than spending on services which in turn tends to be more localized than spending on commodities. This makes sense. Construction firms face significant costs in moving equipment and people to distant locations. Such costs are less significant for professional services firms who can conduct a good portion of business by phone, fax or mail. These costs are even less significant for commodities firms where the location of the supplier is, except for shipping costs, largely irrelevant to the procuring agency. The geographic weighting simply customizes the analysis to the State's own geographic spending patterns.[103]

Table 3.10 provides an illustration of the calculation for construction. The availability of Hispanic-owned firms (weighted by two-digit SIC industry) varies across counties in Texas. Similarly, the distribution of dollars paid by the State to construction firms varies by geographic location. During FY92 and FY93, the State paid 20 percent of its construction dollars to firms in Harris County, 12 percent to firms in Bexar County, almost 12 percent to firms in Travis and Dallas Counties, 8 percent to firms in Tarrant County, 3 percent to firms in Nueces County, 2 percent to firms in Potter and McLennan Counties and less than 2 percent to firms in each of the remaining Texas counties. The table shows how we calculated the county-weighted average availability. The overall county-weighted average of availability for Hispanic-owned construction firms is 8.2 percent.

[103] To determine the effect of the geographic weighting on our estimates of HUB availability, we calculated estimates of availability that did not rely on the State's geographic spending patterns and that were weighted only by the State's spending patterns in particular industries. We found that the differences between these estimates and those weighted for geography were insignificant.

TABLE 3.10

AVAILABILITY OF HISPANIC-OWNED CONSTRUCTION FIRMS WEIGHTED BY CONSTRUCTION SPENDING IN EACH COUNTY (Weights are based on FY92-FY93 expenditures)

County	Fraction of Construction Firms that are Hispanic-owned	Fraction of Spending in County	Contribution to Overall Availability
Harris	5.6%	20.3%	1.1%
Bexar	11.4	12.4	1.4
Travis	4.3	11.5	0.5
Dallas	4.8	11.6	0.6
Tarrant	3.3	7.9	0.3
Nueces	19.4	3.1	0.6
Potter	0.0	1.9	0.0
McLennan	3.2	2.0	0.1
Other Texas Counties	12.3	29.3	3.6
Weighted Average		100%	8.2%

Note: Data reported for "Other Texas Counties" were derived for representational purposes only.

Source: State of Texas central payment data.

Given our estimates of two-digit SIC code industry weights and county weights for each major procurement category, we calculate the overall weighted average of availability for each race/ethnic/gender group and for each major procurement category. We combine these weights as described above. For each two-digit SIC code industry and county, we weight the HUB availability percent by the percentage of State spending in that two-digit SIC code industry and county.[104]

[104] The formula is given by:

We estimate HUB availability weighted by the percent of vendors in each two-digit SIC industry and each county in Texas in the same manner. We use vendor-weighted estimates of HUB availability to determine whether HUBs are adequately represented in the State's vendor pool.

IV. Have HUBs Been Underutilized in State Procurement Opportunities?

The results of the disparity analysis show that HUBs have been underutilized in State procurement opportunities. Prior to the implementation of the HUB program, HUBs received less than half of the dollars we would have expected them to receive in construction, professional services and other services based on their availability in these respective markets. In commodity purchasing, HUBs received 63 percent of the dollars we would expect them to receive given their availability in the marketplace. Under the State's HUB Program, these disparities decreased slightly. We describe these results in more detail, below.

A. Statistical Framework

To determine whether HUBs have been underutilized in State procurements, we compare the percentage of dollars that were received by HUBs (utilization) to the percentage of available firms that are HUBs (availability). The Dollar Disparity Index is given by:[105]

$$H_{CONST} = \sum_{1}^{C} \sum_{1}^{M} H_{IC} \, W_I \, W_C$$

where **CONST** denotes the construction major procurement category, $\mathbf{H_{IC}}$ denotes the availability of Hispanic-owned firms in industry **I** within county **C**, $\mathbf{W_I}$ denotes the fraction of spending in industry **I**, $\mathbf{W_C}$ denotes the fraction of spending in county **C**, **C** denotes the number of counties in the geographic market and **M** denotes the number of industries.

[105] This approach to evaluating disparity—dividing the utilization percent by the availability percent—has been uniformly accepted by the courts. See, e.g., *Contractors Association v. Philadelphia*, 6 F.3d 990, 1005 (3d Cir. 1993); *AGC of California v. Coalition for Economic Equity*, 950 F.2d 1401, 1414 (9th Cir. 1991); *Concrete Works of Colorado, Inc. v. Denver*, 823 F. Supp. 821, 834 (D. Colo. 1993).

$$D = \frac{\textit{Percent of Dollars Received by HUBs}}{\textit{Percent of Firms that are HUBs}} \times 100$$

We would expect that the percentage of dollars received by HUBs and the percentage of firms that are HUBs would be roughly equal, so that the dollar disparity index would be 100.[106] An index of 100 means that HUBs are receiving the proportion of projects or dollars that we would expect them to get based on their availability. An index of greater than 100 percent means that HUBs are receiving a greater proportion of the dollars than we would expect them to receive based on their availability. An index of less than 100 means that HUBs are receiving less than their expected share. For example, an index of 60 for African Americans based on construction projects means that African Americans received 60 percent of the construction dollars we would expect them to receive given the availability of African-American firms in construction. An index of 60 could result if African American-owned construction firms received 9 percent of all construction dollars and 15 percent of all construction firms were owned by African Americans (9 percent/15 percent x 100 = 60).

Similarly, we compare the percentage of vendors (firms from which the State has procured goods or services) that are HUBs to the percentage of available firms that are HUBs. The Vendor Disparity Index is given by:

$$V = \frac{\textit{Percent of Vendors that are HUBs}}{\textit{Percent of Firms that are HUBs}} \times 100$$

Again, we would expect that the percentage of Texas vendors that are HUBs and the percentage of Texas firms that are HUBs would be roughly equal, so that the vendor disparity index

[106] As mentioned earlier, we have decided not to consider detailed qualifications because they are likely to be contaminated by the effects of discrimination. Therefore, we have decided to take as our benchmark for the fair utilization of HUBs the situation where the percent of firms that are HUBs, as a percent of all establishments with paid employees, equals the percent of dollars received by HUBs.

would be 100. An index of 100 means that HUBs are represented in the State's vendor pool in proportion to their availability in the marketplace. An index of greater than 100 percent means that HUBs are overrepresented based on their availability. An index of less than 100 means that HUBs are underrepresented in the State's vendor pool based on their availability.

To determine whether a disparity index indicates significant underutilization of HUBs it is useful to distinguish between ***substantive significance*** and ***statistical significance***. We consider a disparity to be substantively significant—i.e. large enough to be of concern—if the index is less than 80 percent. We have used 80 percent as our benchmark because the Equal Employment Opportunity Commission considers minorities and women to be underutilized in employment if they constitute less than 80 percent of the relevant category.[107]

We consider a disparity to be statistically significant if the likelihood that it could have occurred by chance is less than five percent.[108] It is possible to have a disparity that is not substantively significant—i.e., the disparity is relatively small—but is statistically significant—i.e., the disparity is unlikely to have arisen by chance. It is also possible to have a disparity that is substantively significant—i.e., the disparity is relatively large—but is not statistically significant—i.e., the disparity, although large, could have arisen by chance.[109]

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[107] See Barbara L. Schlei and Paul Grossman, *Employment Discrimination Law* (Washington D.C.: Bureau of National Affairs, 1976).

[108] See David C. Baldus and James W. L. Cole, *Statistical Proof of Discrimination* (New York: McGraw Hill, 1980).

[109] While tests for statistical significance are extremely useful for assessing whether chance can explain disparities that we observe, they do have important limitations. First, the fact that a disparity is not statistically significant does not mean that it *is* due to chance. It merely means that we cannot rule out chance. Second, there are circumstances under which tests for statistical significance are not helpful for distinguishing disparities due to chance from disparities due to other reasons (e.g., discrimination). In the particular statistical application presented in this chapter, the chance that a test for statistical significance will incorrectly attribute to chance disparities that are due to discrimination becomes greater when (a) we examine a relatively small number of procurements and (b) the expected utilization of particular race/ethnic/gender groups—measured by their

In technical terms, the test statistics we used to assess statistical significance were:

1. The Vendor Numerical Disparity Statistic

From FY89 through FY93, the State contracted with almost 180,000 vendors in Texas. Some of these vendors were HUBs, others were not. In the absence of discrimination, we would expect that the percentage of these vendors that are HUBs will be roughly equal to the percentage of available firms that are HUBs. We calculated HUB utilization as the percentage of all utilized vendors that belong to a particular race/ethnic/gender and procurement group. We then calculated the "Vendor Numerical Disparity Statistic" (t-statistic), to evaluate the level of HUB utilization relative to HUB availability (weighted by vendors) for each race/ethnic/gender group and major procurement category. The t-statistic is given by the following formula:

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availability—is relatively small.

Factor (a) is fairly obvious. Chance phenomena tend to average out when considering larger samples so that a given percentage disparity is less likely to be due to chance in a larger sample than in a smaller sample. The role of chance is therefore much greater when we examine 20 procurements than when we examine 1,000.

Factor (b) is less obvious. The following example provides the intuition behind this factor. Consider an urn with 1,000 red and white balls. Fifty percent of the balls are white and 50 percent are red. You pick 100 balls from the urn. You would expect that 50 of the balls you pick will be red and 50 will be white. You would probably be very surprised if only 25 were red and 75 were white—this draw is probable but unlikely. But now suppose two percent of the balls were red and 98 percent were white in an urn with 1000 balls. Again you pick 100. This time you would expect that two of the balls will be red and 98 will be white. You would probably not be very surprised, however, if you picked one red ball and 99 white balls. In both of these examples—one where 50 percent of the balls are red and the other where 2 percent of the balls were red—you picked only half as many red balls as you would have expected (25/50 in the first case and 1/2 in the second case). You were surprised in the first case because the disparity between the actual number of balls you picked and the expected number of balls you picked—25 versus 50—results from having picked a white ball instead of a red ball 25 times. You were not surprised in the second case because the disparity between the actual number of balls you picked and the expected number of balls you picked—1 versus 2—results from having picked a red ball instead of a white ball only a single time.

$$t = \frac{\hat{v} - v_0}{\sqrt{\frac{v_0(1-v_0)}{M}}}$$

$$\text{where} \begin{cases} \hat{v} & = \text{ratio of HUBs to total vendors used.} \\ v_0 & = \text{ratio of HUBs to total firms available.} \\ M & = \text{number of total vendors used.} \end{cases}$$

Using the t-statistic it is then possible to calculate the probability of observing a disparity as large or larger than the one observed.

2. The Vendor Dollar Disparity Statistic

From FY89 through FY93, the State has also awarded a certain fraction of its total dollars to HUB vendors. In the absence of discrimination, we would expect that the percentage of dollars received by HUB vendors would be roughly equal to the percentage of firms that are HUBs. We calculated HUB utilization as the percentage of all dollars that were paid to a particular race/ethnic/gender and procurement group. We reported these figures in Table 3.6. We then calculated the "Vendor Dollar Disparity Statistic" (a t-statistic), to compare the level of HUB utilization to HUB availability (weighted by dollars) for each race/ethnic/gender group and major procurement category. The correct t-statistic cannot be calculated because it requires information on the dollar size of each contract. We have calculated an approximate t-statistic as described in the appendix to this chapter. We then used the approximate t-statistic to calculate the probability of observing the disparity by chance.

B. Disparity Test Results at the Prime Contractor Level

Tables 3.11 and 3.12 report the disparity results at the prime contractor level for the pre-program period and the program period, respectively.[110,111] For each table, the first column repeats the utilization figure (by vendors) from Table 3.6. The second column reports the availability percent (weighted by vendors) for the applicable procurement category and race/ethnic/gender group. The third column reports the disparity ratio of the percentage utilization to the availability percent by vendors. The fourth column repeats the utilization figure (by dollars) from Table 3.6. The fifth column reports the availability percent (weighted by dollars) for the applicable procurement category and race/ethnic/gender group. The sixth column reports the disparity ratio of the percentage utilization to the percentage availability by dollars. An asterisk beside a disparity ratio indicates that it is statistically significant.

For example, consider African Americans in other services during the pre-program period. Utilization by dollars is 0.8 percent—i.e., 0.8 percent of total other service payments were received by African-American prime contractors. African-American availability in other services is 3.3 percent—i.e., 3.3 percent of all other service firms are owned by African Americans. The ratio of 0.8 to 3.3 is 25.2 percent—i.e., African-American service firms received 25.2 percent of the dollars

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[110] Disparity results for TxDOT, TDCJ, the GSC, Comptroller, TPWD, UT-Systems and TAMU-Systems, based on the central payment data, are included in Appendix A. Disparity results using the data provided by the agencies listed above are included in Appendix B. At the agency level, there were too few vendors or contracts in particular procurement categories to report reliable disparity results.

[111] We report disparity results for selected two-digit SIC codes in Appendix H. The two-digit SIC codes included in that analysis were selected based on the following two criteria: (1) the State spent more than $1 million in procurements from that SIC code, and (2) there were more than 300 vendors in that SIC code during the study period FY89-FY93. This analysis found substantial disparities for both minorities and white women in most of the thirty-seven two-digit SIC code industries analyzed. The following were the only instances where we did not observe a substantial disparity: minorities and white women in wholesale trade—durable goods (SIC 50), miscellaneous retail (SIC 59), and real estate (SIC 65); white women in heavy construction (SIC 16), specialty trade construction (SIC 17), home furnishings (SIC 57); and minorities in oil and gas extraction, (SIC 13), chemicals/allied products (SIC 29), electricity, gas and sanitary services (SIC 49).

TABLE 3.11
SUMMARY OF DISPARITY RESULTS
BASED ON THE NUMBER OF PRIME VENDORS AND DOLLARS FOR
THE STATE OF TEXAS
PRE-PROGRAM PERIOD [1]

Race/Sex Group	Percent of Vendors			Percent of Dollars		
	Utilization	Availability	Disparity Ratio [2]	Utilization	Availability	Disparity Ratio [2]
	(Percent)			(Percent)		
	(1)	(2)	(3)	(4)	(5)	(6)
Construction						
African American	0.3 %	2.5 %	10.5 *	0.0 % [2]	1.5 %	1.4
Hispanic	3.4	20.3	16.5 *	1.9	8.2	23.7
Asian and Other Minorities [3]	0.3	1.1	25.5 *	0.1	0.2	47.8
Minority Subtotal	3.9	23.8	16.3 *	2.1	9.9	20.9
White Women	5.4	10.5	50.8 *	5.0	5.6	88.9
Total HUB	9.2	34.4	26.9 *	7.0	15.5	45.4
Professional Services						
African American	0.5	1.3	40.9 *	0.7	1.4	47.4
Hispanic	1.2	6.3	19.5 *	2.2	5.0	43.7
Asian and Other Minorities [3]	0.5	3.4	14.0 *	2.7	1.8	151.1
Minority Subtotal	2.2	11.0	20.2 *	5.6	8.2	67.9
White Women	0.7	10.2	6.3 *	1.2	11.5	10.3 *
Total HUB	2.9	21.2	13.5 *	6.7	19.7	34.2 *
Other Services						
African American	0.4	2.4	17.9 *	0.8	3.3	25.2 *
Hispanic	3.5	9.8	35.9 *	1.2	8.2	14.3 *
Asian and Other Minorities [3]	0.3	1.8	17.6 *	0.2	2.3	9.0 *
Minority Subtotal	4.3	14.0	30.5 *	2.2	13.8	16.0 *
White Women	9.8	16.7	58.7 *	5.3	16.6	31.7 *
Total HUB	14.1	30.7	45.9 *	7.5	30.4	24.6 *
Commodity Purchasing						
African American	0.4	1.1	36.2 *	0.7	0.8	88.0
Hispanic	2.4	5.3	45.4 *	1.8	2.9	62.3 *
Asian and Other Minorities [3]	0.5	1.3	39.1 *	0.6	1.2	51.2
Minority Subtotal	3.3	7.6	43.2 *	3.1	4.9	63.5 *
White Women	5.6	10.3	54.6 *	4.7	7.5	63.0 *
Total HUB	8.9	17.9	49.7 *	7.8	12.3	63.2 *

Note: This table summarizes HUB utilization, availability and resulting disparities for the State of Texas during the State's pre-program period. Utilization estimates are based on figures reported in Table 3.6. Availability estimates are based on 1990 HUB availability.
An asterisk (*) indicates that the disparity is statistically significant at the five percent level or better.
[1]The Pre-Program Period extends from September 1, 1988 to August 31, 1991.
[2]The Disparity Ratio figures shown may not reflect precisely utilization divided by availability due to rounding. Certain figures round to zero.
[3]Asians and Other Minorities include: Asian Indian, Chinese, Japanese, Korean, Vietnamese, Filipino, Hawaiian, other Asian or Pacific Islander, Aleut, Eskimo and American Indian.

Source: Column (1),(4): State of Texas central payment data (FY 89 - FY 93).
Column (2),(5): 1987 Census of Minority and Women-Owned Businesses.
1990 County Business Patterns.
Estimates of 1990 HUB availability were calculated by applying the growth in minority and female self-employment between 1987 and 1990 using Current Population Survey and Census of Population and Housing data.

TABLE 3.12
SUMMARY OF DISPARITY RESULTS
BASED ON THE NUMBER OF PRIME VENDORS AND DOLLARS FOR
THE STATE OF TEXAS
THE PROGRAM PERIOD [1]

Race/Sex Group	Percent of Vendors			Percent of Dollars		
	Utilization	Availability	Disparity Ratio [2]	Utilization	Availability	Disparity Ratio [2]
	(Percent)			(Percent)		
	(1)	(2)	(3)	(4)	(5)	(6)
Construction						
African American	0.6 %	2.5 %	22.5 *	0.1 %	1.6 %	3.2
Hispanic	3.5	20.5	17.1 *	1.9	8.4	22.4 *
Asian and Other Minorities [3]	0.2	1.0	23.3 *	0.2	0.3	65.6
Minority Subtotal	4.3	24.0	17.9 *	2.2	10.3	21.0 *
White Women	6.2	10.5	58.3 *	5.8	5.9	99.3
Total HUB	10.5	34.6	30.2 *	8.0	16.2	49.4 *
Professional Services						
African American	0.6	1.3	45.2 *	0.6	1.4	40.3
Hispanic	1.3	6.5	20.5 *	1.9	5.1	36.3
Asian and Other Minorities [3]	0.5	3.5	13.6 *	5.2	1.9	274.6
Minority Subtotal	2.4	11.3	21.1 *	7.6	8.4	90.8
White Women	0.7	10.1	7.1 *	3.9	11.6	33.9 *
Total HUB	3.1	21.4	14.5 *	11.5	20.0	57.7 *
Other Services						
African American	0.6	2.4	26.9 *	0.8	3.5	22.7
Hispanic	3.8	10.2	37.0 *	2.2	9.9	21.8 *
Asian and Other Minorities [3]	0.5	1.8	25.6 *	1.0	2.3	44.7
Minority Subtotal	4.9	14.4	34.0 *	4.0	15.7	25.3 *
White Women	10.1	17.0	59.4 *	5.7	17.3	33.0 *
Total HUB	15.0	31.4	47.7 *	9.7	33.0	29.3 *
Commodity Purchasing						
African American	0.5	1.1	43.8 *	0.3	0.8	32.9 *
Hispanic	2.7	5.8	46.4 *	1.7	3.1	55.7 *
Asian and Other Minorities [3]	0.7	1.4	52.5 *	2.0	1.1	175.7
Minority Subtotal	3.9	8.3	47.1 *	3.9	5.0	78.8
White Women	6.1	10.8	56.7 *	5.9	7.6	78.3 *
Total HUB	10.0	19.1	52.5 *	9.8	12.6	78.4 *

Note: This table summarizes HUB utilization, availability and resulting disparities for the State of Texas during the State's program period. Utilization estimates are based on figures reported in Table 3.6. Availability estimates are based on 1990 HUB availability.
An asterisk (*) indicates that the disparity is statistically significant at the five percent level or better.
[1]The Program Period extends from September 1, 1991 to August 31, 1993.
[2]The Disparity Ratio figures shown may not reflect precisely utilization divided by availability due to rounding.
[3]Asians and Other Minorities include: Asian Indian, Chinese, Japanese, Korean, Vietnamese, Filipino, Hawaiian, other Asian or Pacific Islander, Aleut, Eskimo and American Indian.

Source: Column (1),(4): State of Texas central payment data (FY 89 - FY 93).
Column (2),(5): 1987 Census of Minority and Women-Owned Businesses.
1990 County Business Patterns.
Estimates of 1990 HUB availability were calculated by applying the growth in minority and female self-employment between 1987 and 1990 using Current Population Survey and Census of Population and Housing data.

we would expect them to receive given their availability in the absence of discrimination. This disparity is substantively significant since the disparity ratio of 25.2 is well below the 80 percent threshold for substantive significance. Also, the asterisk indicates that this disparity ratio is statistically significant.

1. Disparity Results for the Pre-Program Period

During the pre-program period, in the absence of HUB participation goals, we find that HUBs were substantially underutilized in all four major procurement categories. As a group, HUBs received only 25 percent of their expected share of dollars in other services; 34 percent of their expected share of dollars in professional services; 45 percent of their expected share of dollars in construction; and 63 percent of their expected share of dollars in commodities, given their availability in the respective markets. These disparities are statistically significant for professional services, other services and commodities. Disparities for construction were not statistically significant. Similarly, HUBs were underrepresented in the State's vendor pool. Measured by the percentage of State vendors that are HUBs compared to the percentage of firms that are HUBs in the marketplace, we find their underrepresentation to be both substantial and statistically significant for each race/ethnic/gender group in all procurement categories.

For the four major procurement categories, we report the following results:

(i) <u>Construction</u>

- HUBs, as a group, received 45 percent of their expected share of construction dollars, given their availability in the marketplace. While the finding shows that substantial disparities exist overall, the disparities are not statistically significant.

- All minority groups were underutilized by the State. African American-owned firms suffered the greatest disparity, receiving just over 1 percent of the construction dollars we would expect them to receive based on their availability in the marketplace. Hispanic-owned firms received 24 percent of their expected share of construction dollars given their availability. Asian-

owned firms received approximately 48 percent of the dollars we would expect them to receive given their availability in the marketplace. The disparities for all minorities were substantial but not statistically significant.

- White woman-owned firms received 89 percent of their expected share of State construction dollars based on their availability in the marketplace. The disparity is neither substantive nor statistically significant.

- When comparing the percentage of State vendors that are HUBs to the availability of HUBs in Texas, we find that each race/ethnic/gender group is substantially underrepresented in the State's vendor pool. In all cases, the underrepresentation of HUBs is statistically significant.

(ii) **Professional Services**

- HUBs as a group received only 34 percent of the professional service dollars we would expect them to receive based on their availability in the marketplace. This disparity is statistically significant.

- White woman-owned firms were the most underutilized of the HUB subgroups, receiving only 10 percent of the professional service dollars we would expect them to get based on their availability in the marketplace. The disparity was statistically significant.

- Hispanic and African American-owned professional service firms received 44 percent and 47 percent of their expected share of dollars, respectively, given their availability in the marketplace.

- Asian and other minorities received more than their expected share of dollars based on their availability in the marketplace.[112]

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[112] During the pre-program period, we find the distribution of Asian professional services dollars across the Asian subgroups to be as follows: 75 percent paid to Asians, 22 percent paid to Asian Indians and 3 percent paid to Native Americans. As the information on race of the State's vendors was derived from HUB directory data, we were only able to distinguish Asian Indians from Asians to the extent that these groups were distinguished in the directories. We expect, therefore, that there are Asian Indian-owned firms identified as Asian-owned firms.

We also compared disparities for Native American-owned businesses to disparities for Asian-owned businesses. For this exercise, we used availability rates that were not weighted for geographic spending patterns, because the best available information on how to divide availability between Native Americans and Asians was based on the self-employment rates of each for Texas as a whole. We used this information to divide availability between Native American and Asian-owned firms, and then compared these numbers to the State's utilization of each group in the pre-program and program periods. For the pre-program period, the disparity ratio for Native American-owned firms in construction was roughly half that for Asian firms (19 for Native Americans versus 38 for Asians), in professional services, both ratios are greater than 100, but that Asian ratio is much higher (295 for Asians, 121 for Native Americans). In other services, the disparity ratio

- When comparing the percentage of State vendors that are HUBs to the availability of HUBs, we find that each race/ethnic/gender group is substantially underrepresented. Disparities range from 6 percent (white woman-owned firms) to 41 percent (African American-owned firms). All disparities are statistically significant.

(iii) **Other Services**

- HUBs, as a group, and all HUB subgroups, are substantially underutilized in other services. The disparities ranged from the low of 9 percent of expected service dollars received by Asian and other minorities to the high of 32 percent of expected service dollars received by white woman-owned firms. In all cases, the disparities are statistically significant.

- When comparing the percentage of State vendors that are HUBs to the availability of HUBs, we find that each race/ethnic/gender group is substantially underrepresented in the State's vendor pool based on their availability in the marketplace. In all cases, the underrepresentation of HUBs is statistically significant.

(iv) **Commodity Purchasing**

- HUBs fared better in commodities than in any other procurement category, receiving 63 percent of their expected share of commodity dollars given their availability in the marketplace.

- Minorities as a group received 63 percent of their expected dollars based on their availability in the marketplace. This disparity is statistically significant. Of the minority subgroups, African American-owned firms received 88 percent; Hispanic-owned firms received 62 percent; and Asian-owned firms received 51 percent of their expected share of dollars based on their respective availability in the marketplace. The disparity for Hispanic-owned firms is statistically significant.

- As with the other procurement categories, HUBs are underrepresented in the State's vendor pool based on their availability in the marketplace. In all cases, these disparities are statistically significant.

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for Native Americans was roughly double that for Asians, but both were extremely low (15 for Native Americans and 8 for Asians). Finally, in commodities in the pre-program period, Native Americans had almost no disparity (the ratio was close to 100) while Asians had a very large disparity (ratios were 98 for Native Americans and 25 for Asians).

2. Disparity Results at the Prime Contractor Level for the Program Period

To measure the effectiveness of the State's HUB program, we compared HUB utilization to HUB availability during the program period (i.e., FY92-FY93). We found that, while disparities decreased for HUBs (as a group) across procurement categories, substantial disparities continued to exist under the program. Changes in disparities were relatively small for construction and other services. For example, HUBs received 45 percent of their expected share of construction dollars during the pre-program period given their availability in the marketplace. They received 49 percent of their expected share of dollars under the State's HUB Program given their availability in the marketplace. Disparities in professional services and commodity purchasing decreased somewhat more dramatically under the State's HUB Program, although HUBs still only received 58 percent and 78 percent of their expected share of dollars. In all cases, disparities found for HUBs (as a group) were statistically significant.

For the four major procurement categories, we found that:

(i) <u>Construction</u>

- HUBs, as a group, received 49 percent of their expected share of construction dollars, given their availability in the marketplace. The disparity is both substantial and statistically significant.

- All minority groups were underutilized by the State. African Americans continued to suffer the greatest disparities, receiving just over 3 percent of the construction dollars we would expect them to receive based on their availability in the marketplace. Hispanic-owned firms received 22 percent of their expected share of construction dollars given their availability, a slight decrease in the share that they received during the pre-program period. Asian-owned firms received almost 66 percent of their expected share of dollars (as compared to 48 percent during the pre-program period).

- Disparities were eliminated for white woman-owned firms. Where they had received 89 percent of their expected share of State construction dollars during the pre-program period, they received 99 percent of their expected share of dollars in the program period based on their availability in the marketplace.