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WIC Erroneous Payments to Vendors: Annual Estimates for 2009 Final Report

***Summary of Vendor Overcharges and
Undercharges for 2009***



United States
Department of
Agriculture

Food and
Nutrition
Service

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Summary of Vendor Overcharges and Undercharges for 2009

Author:

Richard Mantovani, Ph.D., ICF Macro

Submitted By:

ICF Macro
7315 Wisconsin Avenue, Suite 400W
Bethesda, MD 20814

Submitted To:

Office of Research and Analysis
Food and Nutrition Service
3101 Park Center Drive
Alexandria, VA 22302-1500

Project Director:

Richard Mantovani

Project Officer:

Sheku G. Kamara
Karen Castellanos-Brown

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EXECUTIVE SUMMARY

BACKGROUND

The U.S. Department of Agriculture Food and Nutrition Service (FNS) Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) was designed to respond to the health and nutritional needs of low-income pregnant, breastfeeding, and postpartum women; infants; and children up to age 5. WIC provides participants with food instruments that can be used at authorized vendors to obtain a monthly package of supplemental foods. It also provides nutrition education, and health care and social service referrals.

About every 7 years, FNS performs a nationally representative study to examine the extent of error and abuse among food vendors authorized to accept WIC food instruments. The most recent study, the 2005 WIC Vendor Management Study (2005 bookend study¹), found that overcharges amounted to \$6.1 million, while undercharges amounted to \$15.4 million. In terms of the \$3.32 billion redeemed² in that year, overcharges amounted to 0.18 percent, and undercharges amounted to 0.46 percent.

This report provides improper payments estimates for FY 2009 using a methodology for “aging” the 2005 bookend study. This updates previous reports providing estimates from 2005 to 2008. The methodology yields nationally representative estimates of the number of vendors that over- and undercharged and the amount of over- and undercharges across all WIC vendors. (It is important to note that the term “overcharge” refers to a vendor charging the WIC customer more than a non-WIC customer, not charging higher prices than other vendors, and the term “undercharge” refers to a vendor charging the WIC customer less than a non-WIC customer.)

RESULTS

WIC improper payments for FY 2009 amounted to \$49.8 million, constituting about 1.2 percent of total WIC food outlays of \$4.3 billion³ (see Figure ES-1). Overcharges were estimated at \$36.7 million (0.9 percent), undercharges at \$13.1 million (0.3 percent), and net

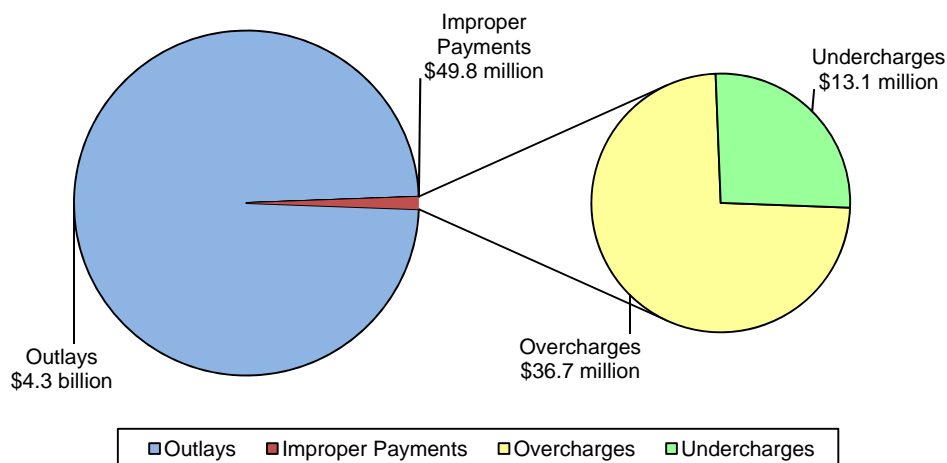
¹ The term “bookend” derives from the fact that these studies occur about every 7 years and as such frame a period of time during which no observations were made. This fiscal year (FY) 2009 study provides estimates for the years between the 2005 WIC Vendor Management Study and the next WIC Vendor Management Study. The 2005 bookend study represents data collected between October 2004 and March 2005.

² Throughout this report, the term “redeem” and similar terminology such as “redemption dollars” is used to describe outlays for WIC food purchases, i.e. WIC food costs after rebates have reduced the net cost to the government.

³ The \$4.3 billion represents outlays for food items (not infant formula) within 45 States and the District of Columbia. Five States (Alaska, Hawaii, Mississippi, North Dakota, and Vermont) were excluded from the estimate to maintain consistency with the estimates generated for the 2005 bookend study.

improper payments at \$23.6 million of the annual food outlays. There was a \$3 million decrease from FY 2008 in improper payments, reflecting a notable decrease in the undercharge estimate.

Figure ES-1. WIC Improper Payments, FY 2009 Update

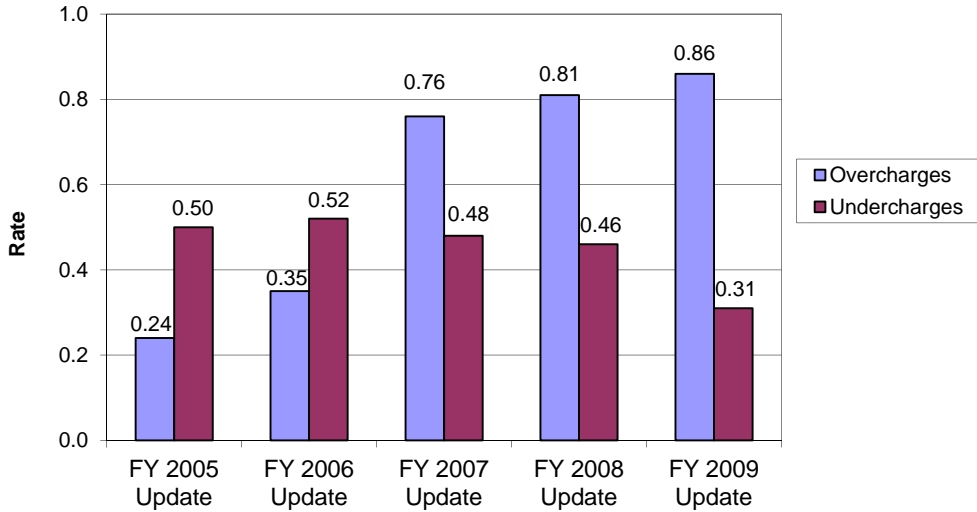


Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Figure ES-2 shows the trends in overcharges and undercharges as percentages of redemption dollars for 2005–2009. The overcharge rate for redemption dollars continued to rise in FY 2009, compared with the last 2 years. Both the overcharge amount and rate in FY 2009 continued to exceed the undercharge amount and rate⁴. In FY 2009, the undercharge rate and amount declined substantially, from \$19.3 million to \$13.1 million.

⁴In the past few years both the WIC and SNAP program changed the way retailers are categorized as vendors, making recent estimates inconsistent with earlier ones. Whether the apparent rise in overcharges is real or an artifact of changed definitions is being explored in the 2010 estimate.

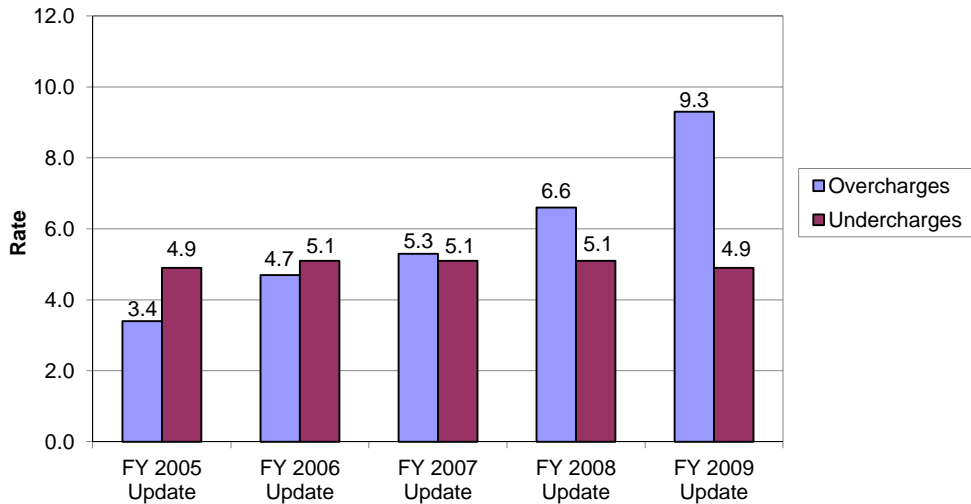
Figure ES-2. Comparison of Overcharge and Undercharge Rates by Fiscal Year (FY 2005–FY 2009) (Percentage of Redemption Dollars)



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

The vendor-based overcharge rate (i.e., the proportion of vendors overcharging) increased from 6.6 percent in FY 2008 to 9.3 percent in FY 2009—a considerable increase in the estimated number of vendors overcharging (see Figure ES-3). In contrast, the proportion of vendors undercharging decreased slightly, from 5.1 percent in FY 2008 to 4.9 percent in FY 2009.

Figure ES-3. Comparison of Overcharge and Undercharge Rates by Fiscal Year (FY 2005–FY 2009) (Percentage of Vendors)



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

The results indicate a decline in the amount of improper payments from the previous year due largely to the decline in estimated undercharge amounts. Whereas the overcharge trend continues to increase slightly in terms of both dollar amount and vendors overcharging, the undercharge trend shows a relatively large decline in terms of both amounts and vendors undercharging. It should be noted again that the total amount of improper payments for FY 2009 were estimated at \$49.8 million, which is only about 1.2 percent of all redemption dollars.

CHAPTER 1:

INTRODUCTION

BACKGROUND

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) was designed to respond to the health and nutritional needs of low-income pregnant, breastfeeding, and postpartum women; infants; and children up to age 5. Established by the Child Nutrition Act of 1966 (as amended by P.L. 92-433) and implemented in 1972, WIC was most recently reauthorized in 2010 through P.L. 111-296. WIC is now administered by agencies in the 50 States, the District of Columbia, the 34 independent tribal organizations, and the 5 U.S. Territories.

WIC provides women and children with food instruments for purchasing a monthly allotment of nutritious foods, including eggs, cheese, cereal, fruit juice, milk, peanut butter, and beans.⁵ Breastfeeding is a priority in the WIC Program and WIC staff are committed to educating WIC participants about the many benefits of breastfeeding as well as providing the support breastfeeding mothers need to meet their infant feeding goals. However, for various reasons, some women cannot or choose not to breastfeed. For these mothers, the WIC Program provides the option of iron-fortified infant formula to assure the health and well-being of their infants. Breastfeeding mothers may also receive tuna fish, carrots, and nutritional supplements. WIC participants obtain these foods by using a food instrument, which designates the type and amount of foods participants may redeem at authorized vendors.

Approximately 73 percent of national program expenditures are used for the purchase of supplemental foods. The remaining funds are used for management functions, nutrition education and counseling, breastfeeding promotion, and health care and social service referrals.

WIC works through transactions with authorized vendors. The participant presents the food instrument to the vendor, who rings up the purchase, collects the food instrument, adds the food costs for each item, and redeems the instrument with the State agency. These vendors include

⁵ This study was completed prior to revisions in the WIC food packages that were mostly implemented in 2009 as a result of the interim rule published in the Federal Register December 6, 2007 (with some exceptions, e.g. New York and Delaware). Changes to the WIC food packages include adding fruits and vegetables, whole grains, and foods that serve the diverse population eligible for WIC.

small and large food retailers, pharmacies, WIC-only vendors,⁶ and commissaries. In Federal fiscal year (FY) 2009 there were 47,829 authorized vendors in the United States and its territories and possessions.⁷

One of the programmatic concerns of the Food and Nutrition Service (FNS) is vendor overcharging.⁸ Overcharging occurs when vendors, intentionally or not, charge the WIC participant more than a non-WIC customer for food items prescribed by the food instrument. This results in reducing the funds available to serve more participants. More recently, undercharging has been a concern, although it results in no apparent benefit to the vendor. The Improper Payments Information Act of 2002 (P.L. 107-300) requires FNS to report on these activities.

PURPOSE OF THE STUDY

About every 7 years, FNS performs a study to examine improper payments, in particular over- and undercharges, in WIC. Such studies were conducted in 1991, 1998, and 2005⁹ using covert purchases in a nationally representative sample of vendors to produce estimates of the proportion of stores and the total dollar value of over- and undercharges. These studies have been denoted as bookend studies because they provide estimates at periodic intervals. The last study, the 2005 bookend study, provides the benchmark estimates that were “aged” for subsequent years.

On an annual basis, FNS also receives information on investigations and other actions taken by States and other entities as part of the TIP data system. The TIP system also provides information on other authorized vendors that were not subject to investigations or other actions, including total amounts redeemed during a year. Through TIP, a comprehensive, continually updated portrait of violation-prone vendor activity is provided. Because vendors that have a high-risk profile are selected for investigation, the data from State investigations alone would be expected to overestimate violations and not provide a representative sample, as does the 2005 bookend study. With this in mind, this project is being conducted to adjust the TIP data to provide estimates that are consistent with the 2005 bookend estimates.

The first set of estimates was published using the FY 2005 TIP data. The estimates yielded nationally representative statistics on the proportions of vendors found violating (vendor-based rates) and the total amount of redemption dollars resulting in over- or undercharges (redemption-based rates). The focus of the examination was to validate a methodology for producing estimates on an annual basis. Additional estimates were generated by studies conducted using

⁶ WIC-only vendors are stores that sell only WIC foods to WIC participants. In addition, there are WIC above-50-percent vendors, whose WIC redemption dollars are more than 50 percent of their total sales. WIC-only vendors are a special case of WIC above-50-percent vendors, in that all their sales derive from WIC redemptions.

⁷ The source for this total is The Integrity Profile (TIP) data file. Some States, such as Mississippi and Vermont, operate food delivery systems independent of the State retail vendor communities.

⁸ Other programmatic concerns include partial buys, substitutions, and trafficking because these subvert the intention of the program. Substitution occurs when an item not on the program is purchased; trafficking involves the outright purchase of food instruments at a discount by the vendor, who then redeems them at full value.

⁹ Although the last study references 2005, e.g. the first quarter of FY 2005, it used data collected for vendors authorized at the end of the 2004 calendar year. To avoid confusion, we will refer to that study as the 2005 bookend study.

FY 2006, FY 2007, and FY 2008 data. The estimates provided in this study use the FY 2009 TIP data file. The following research questions were examined:

- What are the national and regional dollar estimates of vendor over- and undercharges to the WIC program as a result of erroneous payments to WIC vendors?
- Do the rates and dollar estimates of erroneous payments vary by type of vendor (e.g., regular retail, WIC-only, WIC above-50-percent) and/or the duration of vendor authorization (new or existing)?

CHAPTER 2:

METHODOLOGY

To address the research questions, an approach for updating the statistics generated by the 2005 bookend study was developed. The approach required consistency with the definitions of that study. Two separate methodologies were developed: one each for the estimations of overcharges and undercharges.

To estimate overcharges, a post-stratification weighting algorithm known as raking was applied to the TIP data. TIP is a roster of all WIC vendors authorized by State agencies. It contains information on WIC vendor characteristics, annual redemption dollars, monitoring, investigations, and audit activities. Because investigators target vendors that are most likely to be error prone, using TIP data without adjustment for this tendency would result in an overestimate of erroneous payment activity. The weights generated through the raking algorithm allow the TIP data to be adjusted to more reasonably reflect the activities of all WIC vendors.

Estimating undercharges required a different approach because TIP does not contain information on vendor undercharging. (While undercharging is an error that is not in the vendor's best interest, it is not a sanctionable offense.) Undercharge estimates were based on the data collected in the 2005 bookend study, adjusted for changes in WIC redemption dollars and vendor characteristics. Using the results of a logistic regression conducted with the 2005 bookend data, the probability of undercharging was estimated for every vendor in the TIP file. Similarly, using the results of a linear regression conducted with the 2005 bookend data, the dollar value of annual undercharges (assuming that the vendor undercharged) was calculated for each vendor in the TIP file. For each vendor, the probability of undercharging was then multiplied by the annual value of undercharges to determine the expected value of undercharges. Undercharge estimates presented in this report are based on this expected value.

This report provides information that updates the 2005 bookend study and subsequent estimates through FY 2008, using data from the FY 2009 TIP profile. Estimates are provided on four measures of improper payments:

- **Overcharges**—the extent to which the WIC program overpaid on safe transactions with vendors, where a safe transaction is defined as one in which the foods presented to the retailer match, both in identity and quantity, those listed on the food instrument;
- **Undercharges**—the extent to which the WIC program underpaid on safe transactions with vendors;
- **Total improper payments**—the sum of the absolute values of overpayments and underpayments; and
- **Net improper payments**—the difference between total overpayments and total underpayments.

In this report, the measurement of overcharges uses a post-stratification methodology that focuses on translating the results of TIP investigations to the population of WIC vendors.¹⁰ Undercharges are estimated through the use of relationships suggested by the 2005 bookend data projected onto the entire FY 2009 population of WIC vendors.¹¹ Each of these measures is presented in the form of vendor-based and redemption-based estimates, defined as follows:

- **Vendor-based estimates**—numbers and percentages of vendors involved in over- or undercharging during the FY 2009 reporting period. Because of the definitions and methodologies employed, vendor-based rates for the total and net improper payment estimates are not possible.
- **Redemption-based estimates**—numbers and percentages of all redeemed WIC dollars resulting from over- or undercharging. Redemption-based rates are also provided for total and net improper payment estimates¹².

This report presents estimates of vendor- and redemption-based over- and undercharge rates for FY 2009 in comparison with estimates derived in the FY 2005 through FY 2008 annual updates. It describes potential factors affecting variations in improper payments (over- and undercharges) such as vendor type and authorization status. Significance testing was not done because the focus was on whether there were any large differences, rather than on the detection of small differences that might be significant. It should be noted that all the estimates indicate that over- and undercharging represent a relatively small proportion of all redemptions and thus pose a small risk to program integrity. Although no significance testing was done, information on confidence intervals is presented in Appendix E. This should give the reader a context for noting possible differences due to the samples and methodologies used to produce the estimates.

¹⁰ See Appendix B for a more complete discussion of the methodology for developing estimates of overcharges.

¹¹ The methodology for developing estimates of undercharges is described in Appendix C.

¹² Although referred to as redemption-based, these dollar estimates actually reflect food outlays. Since food outlays are not available by individual WIC vendors, they have to be estimated. This estimate was derived by dividing state level outlay figures by the sum of all redemptions within a state as provided by TIP. All vendors in the state were included in this calculation. This state-level ratio was applied to redemptions reported in TIP for each retailer.

CHAPTER 3:

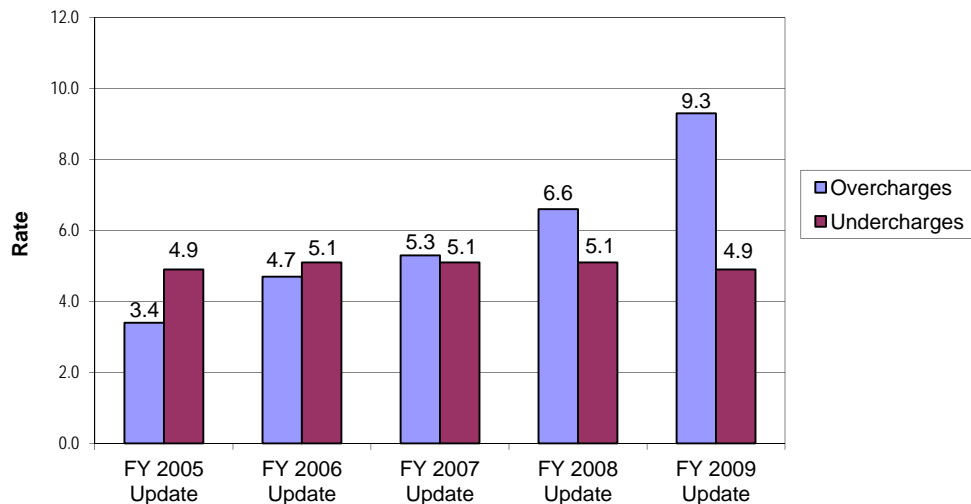
RESULTS

NATIONAL ESTIMATES OF OVERCHARGES AND UNDERCHARGES

Overcharges

The overcharge estimate generated in this study showed a continued upward trend in vendor- and redemption-based rates (see Figures 1a and 1b). The FY 2009 estimate indicated that approximately 9.3 percent of WIC vendors overcharged and that their overcharges accounted for \$36.7 million, or 0.86 percent, of the \$4.3 billion redeemed that year. This is an increase from the amount estimated for FY 2008, in which 6.6 percent of WIC vendors were estimated to have overcharged about \$34.0 million, or 0.81 percent, of all redemption dollars. The vendor overcharging rate rose by more than 40 percent (from 6.6 percent to 9.3 percent) over the FY 2008 estimate, while the redemption-based overcharge rate rose about 6 percent (0.81 percent to 0.86 percent).

Figure 1a. Comparison of Overcharge and Undercharge Rates by Fiscal Year (FY 2005–FY 2009) (Percentage of Vendors)



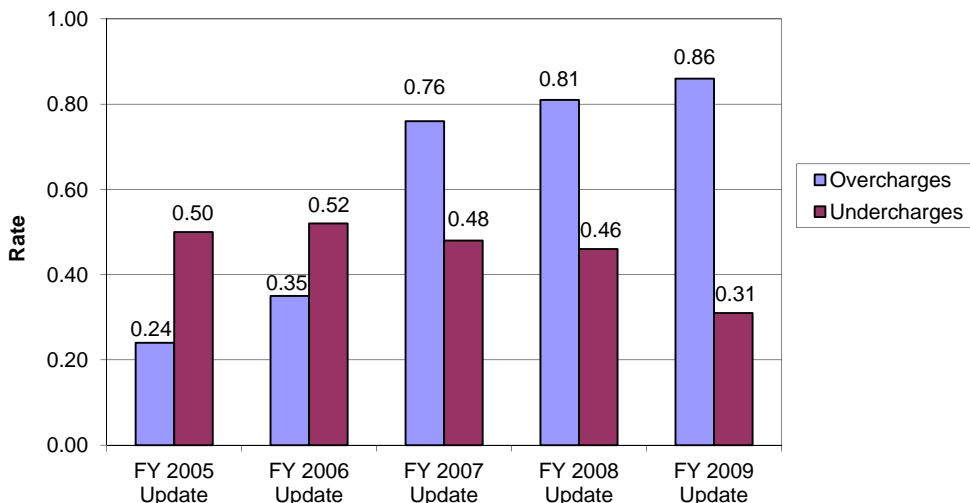
Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Undercharges

Vendor-based and redemption-based undercharge rates declined in comparison to previous estimates for FY 2005–FY 2008 (see Figures 1a and 1b). In FY 2009, 4.9 percent of

the vendors were estimated to have undercharged, for an estimated amount of \$13.1 million, or 0.31 percent, of the total food outlay for that year. In comparison, in the FY 2008 update, 5.1 percent of the vendors undercharged an estimated equivalent of \$19.3 million in food outlays—a rate of 0.46 percent of all redemption dollars.

Figure 1b. Comparison of Overcharge and Undercharge Rates by Fiscal Year (FY 2005–FY 2009) (Percentage of Redemption Dollars)



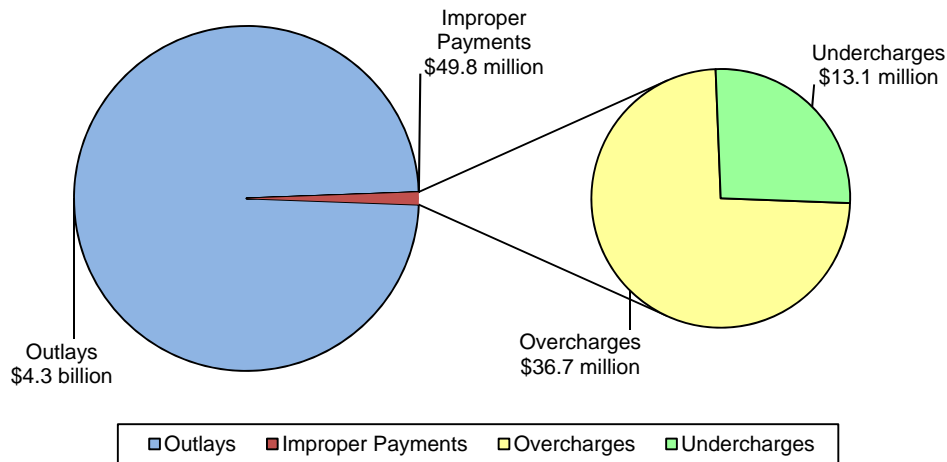
Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

With regard to both over- and undercharges, it should be noted that the redemption-based rates are very small—translating to about \$0.86 overcharged and \$0.31 undercharged for every \$100 redeemed in FY 2009 (see Figure 1b). The small magnitude of error should be kept in mind when examining the estimates, especially when considering the drop in undercharge rates.

Total Improper Payments

Total improper payments for FY 2009 were estimated at \$49.8 million (see Figure 2). This figure accounts for about 1.2 percent of all redemption dollars. Net improper payments were equal to \$23.6 million, indicating that overpayments, by a relatively large degree, exceeded underpayments.

Figure 2. WIC Improper Payments, FY 2009 Update



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

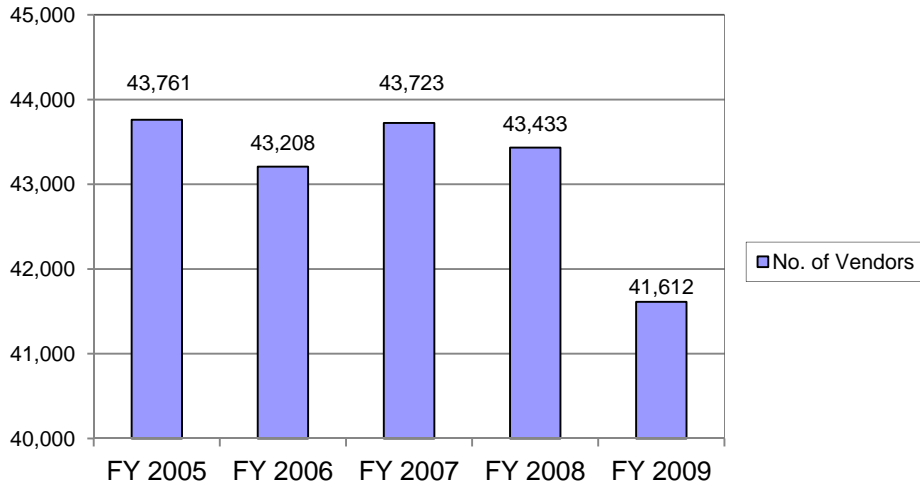
SUMMARY OF ACTIVITY (FY 2005–2009)

Figures 3a–3c present summary trends of the number of vendors included in the study, the amount of food outlays accounted for by these vendors, and WIC over- and undercharge improper payments.

From FY 2005 to FY 2008, the number of WIC vendors remained between 43,000 and 44,000 stores. However, in FY 2009 the number of vendors dropped to 41,612, or almost 2,000 fewer vendors than the previous year (see Figure 3a). This number represents vendors in 45 States and the District of Columbia. Five States (Alaska, Hawaii, Mississippi, North Dakota, and Vermont) were excluded from the estimate to maintain consistency with the estimates generated for the 2005 bookend study. The reason for the 5 percent decrease is unexplained, but it apparently had little effect on the upward trend in food outlays (see Figure 3b). From FY 2005 to FY 2009, food outlays increased from \$3.3 billion to \$4.3 billion¹³. This increase was especially notable between FY 2007 and FY 2008, which showed an increase of about \$600 million. The food outlay amounts presented in Figure 3b excluded redemptions of vendors from the States and territories cited as excluded above and attempted to eliminate formula rebate redemptions.

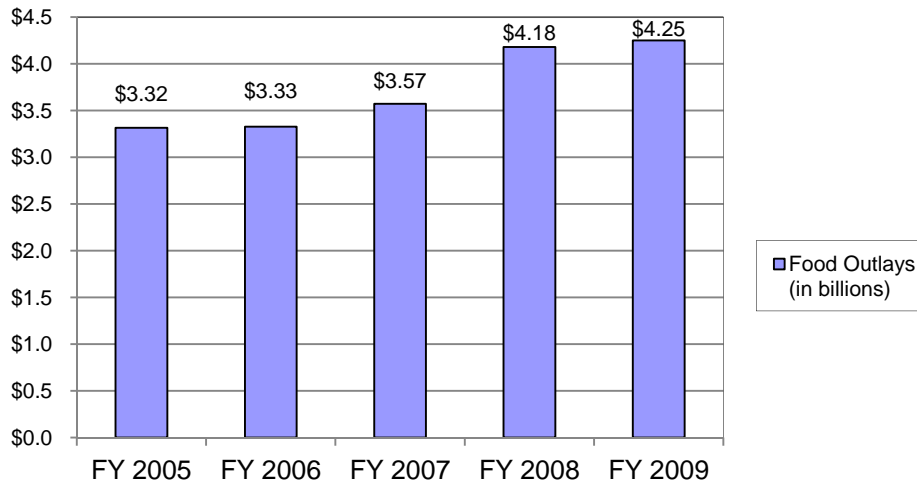
¹³ Food outlays in this report represent 97% of total food costs for each fiscal year.

Figure 3a. Number of Vendors Used To Generate Estimates



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

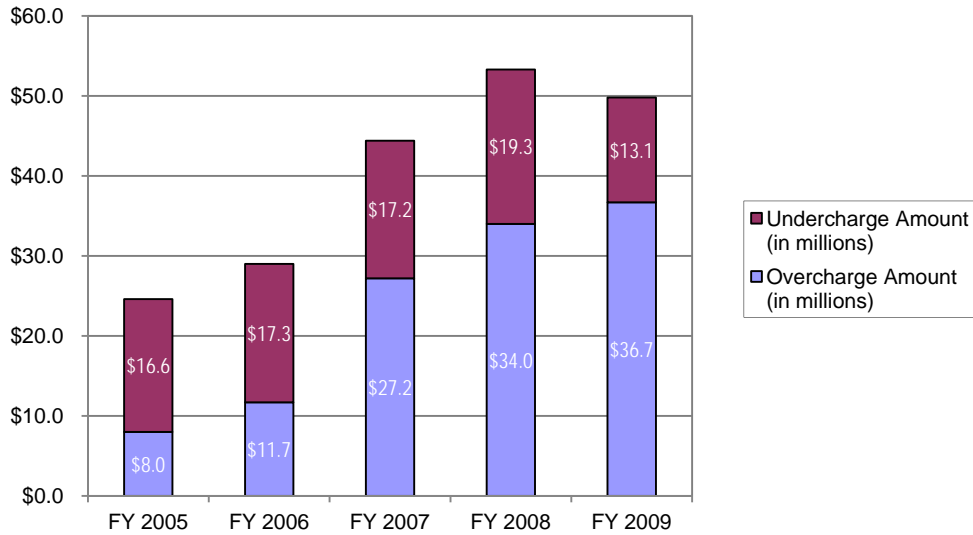
Figure 3b. Food Outlays of Vendors Included in the Study



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

During the FY 2005 to 2009 period, total improper payments (over- and undercharges) increased from about \$25 million to about \$50 million (see Figure 3c). This was largely due to the increase in overcharges, which increased from \$8 million to almost \$37 million. Undercharges also increased between FY 2005 and FY 2008, but then suddenly declined in FY 2009 to \$13.1 million, from \$19.3 million in FY 2008. This decrease in undercharges was reflected in a \$3.5 million drop in overall improper payments between FY 2008 and FY 2009.

Figure 3c. Trends in Total Improper Payments, Overcharge and Undercharge Amounts



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

POTENTIAL CONTRIBUTING FACTORS TO OVERCHARGING AND UNDERCHARGING

As previously indicated, interpretation of the data in this report must take into account the fact that because the overcharge and undercharge numbers are very small, there is the possibility that differences from one year to the next could be within normal acceptable limits of variation. This is particularly the case when trying to examine or assess the effects of the potential contributing factors to over- and undercharging.

In addition to the overall national figures presented above, vendor-based and redemption-based over- and undercharge rates were examined in more detail by selected vendor characteristics for the following reasons:

- To provide information on the possible factors leading to the increase or decrease in improper payments rates; for example, a higher rate for a vendor type may mean that the vendor type is more prone to over- or undercharging;
- To gain an understanding of changes in investigative patterns that might affect the national level statistics on improper payments; and
- To seek ways to improve the estimation methodologies.

Vendor Type

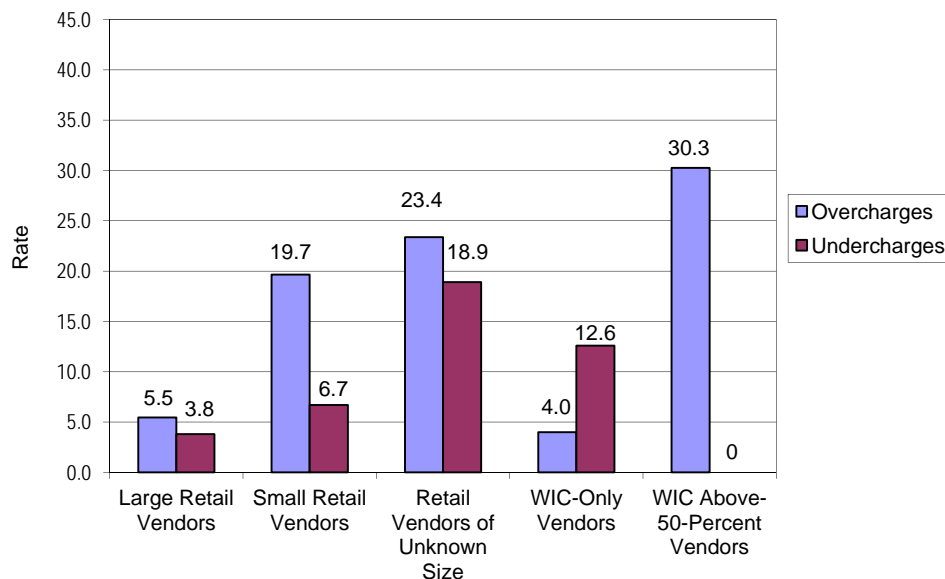
In FY 2009, large retail vendors had a vendor-based overcharge rate of 5.5 percent (see Figure 4a), compared with 2.9 percent in the previous year. Other types of vendors had overcharge rates as follows:

- 19.7 percent for small retail vendors, compared with 15.2 percent in the previous year;
- 23.4 percent for retail vendors of unknown size, compared with 10.8 percent in the previous year;
- 4.0 percent for WIC-only vendors, compared with 38.7 percent in the previous year; and
- 30.3 percent for WIC above-50-percent vendors, compared with 14.8 percent in the previous year.

With regard to overcharges, most categories of stores, with the exception of WIC-only vendors, showed a large increase in the vendor-based rate in FY 2009 compared with FY 2008.

With regard to undercharges, the FY 2009 vendor-based rates were generally similar to FY 2008 estimates. WIC above-50-percent and large retail vendors showed the lowest undercharge rates (no undercharging and 3.8 percent, respectively), and retail vendors of unknown size exhibited the highest undercharge rate (18.9 percent) (see Figure 4a).

Figure 4a. Vendor-Based Overcharge and Undercharge Rates, by Vendor Type, FY 2009 Update

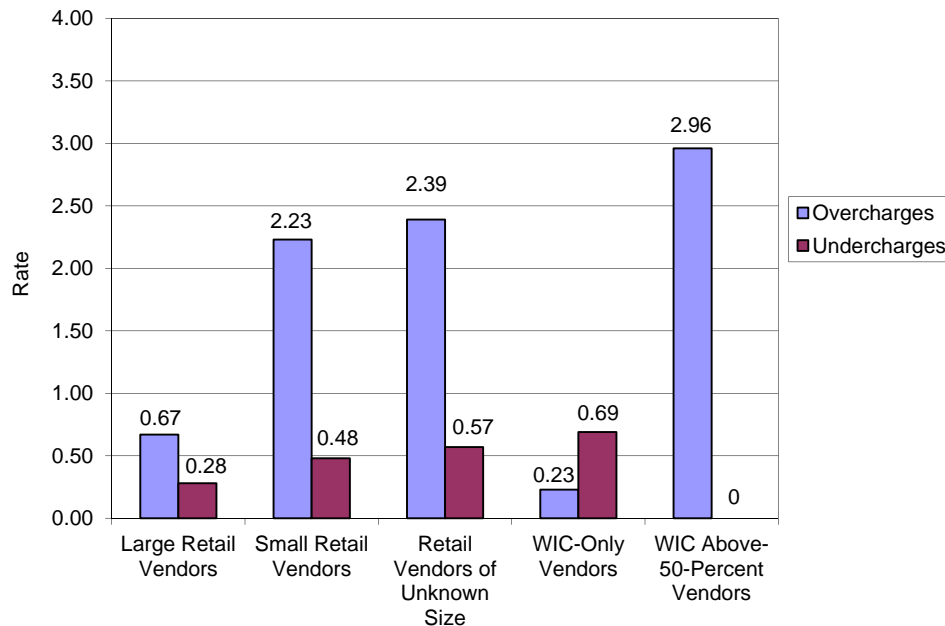


Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

In terms of redemption dollars, large retail vendors had a low overcharge rate (0.67 percent), but in stark contrast to the overcharge rate in FY 2008 of 3.34 percent, WIC-only vendors had the

lowest overcharge rate (0.23 percent in FY 2009) (see Figure 4b). With regard to redemption-based undercharges, in FY 2009 large retail vendors had the lowest rate (0.28 percent), aside from WIC above-50-percent vendors, which showed no undercharging. The FY 2009 WIC-only vendor rate was again lower than the FY 2008 rate (0.69 percent and 0.98 percent, respectively).

Figure 4b. Redemption-Based Overcharge and Undercharge Rates, by Vendor Type, FY 2009 Update



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Newly Authorized Vendors

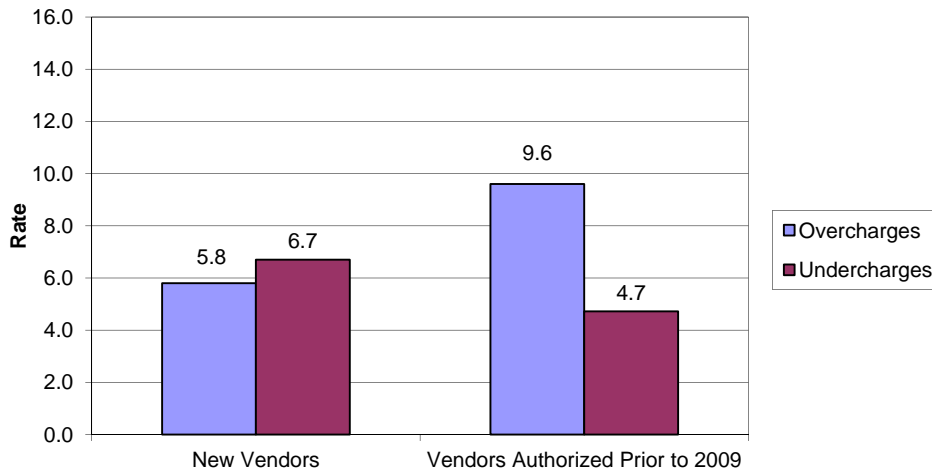
In FY 2009, about 8.4 percent of the vendor population designated themselves as new vendors.¹⁴ Newly authorized vendors exhibited a 5.8 percent vendor-based overcharge rate, while vendors previously authorized had a rate of 9.6 percent (see Figure 5a). Although the figures were higher for FY 2009 than for FY 2008, this result was nevertheless consistent in direction with the FY 2008 results, in which new vendors has an overcharge rate of 3.3 percent and previously authorized vendors had a rate of 7.0 percent.

The vendor-based undercharge rate was 6.7 percent for newly authorized vendors and 4.7 percent for vendors authorized prior to FY 2009. The FY 2008 estimates showed that the new

¹⁴ An examination of the TIP files revealed that many of these new vendors were “reincarnations” of vendors previously in the program. These stores were located at the same address as an older store and in some cases had similar names, but they were assigned a new TIP vendor identification number. In many cases, however, the stores kept their Supplemental Nutrition Assistance Program (SNAP) identification number. We speculate that these stores underwent ownership changes. The major issue in this recoding is whether we expect these “new” stores to exhibit behaviors different from the previously authorized store at that location. (We treated these stores as new vendors.)

vendor undercharge rate was 5.3 percent, compared with 5.1 percent for previously authorized vendors.

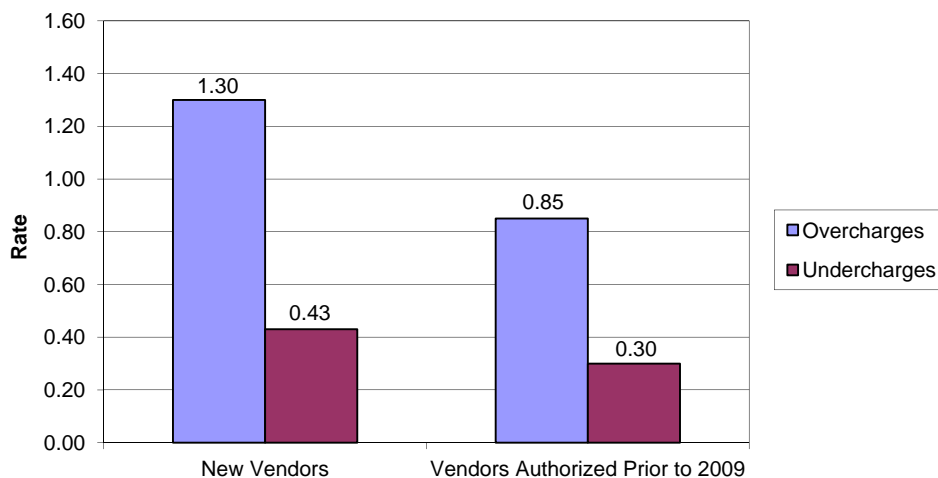
Figure 5a. Vendor-Based Overcharge and Undercharge Rates, by Authorization Status, FY 2009 Update



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

For new vendors, overcharges accounted for 1.30 percent of all redemption dollars, while for previously authorized vendors, overcharges accounted for 0.85 percent of all redemption dollars (see Figure 5b). New vendor overcharges, as a percentage of total redemptions, declined. Redemption-based undercharge rates were 0.43 percent for new vendors and 0.30 percent for vendors authorized prior to FY 2009. Both of these rates were lower than the estimates for FY 2008, which were 0.51 percent and 0.46 percent, respectively.

Figure 5b. Redemption-Based Overcharge and Undercharge Rates, by Authorization Status, FY 2009 Update



Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

REFERENCES

- Neuberger Z., and Greenstein R. (2004). *WIC-Only Stores and Competitive Pricing in the WIC Program*. Center on Budget and Policy Priorities (May). <http://www.cbpp.org/5-17-04wic.htm>.
- U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation (1991). *WIC Vendor Issues Study, 1991 Report*. Alexandria, VA.
- U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation (2001). *WIC Vendor Management Study, 1998 Report*, by Loren Bell, et al. Project Officers: Patricia McKinney, Boyd Kowal. Alexandria, VA. <http://www.fns.usda.gov/oane/menu/Published/WIC/FILES/vendor.pdf>.
- U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation (2007). *2005 WIC Vendor Management Study, Final Report*, by Loren Bell, et al. Project Officer: Sheku G. Kamara, Ph.D. Alexandria, VA. <http://www.fns.usda.gov/oane/menu/Published/WIC/FILES/2005WICVendor.pdf>.
- U.S. Department of Agriculture, Food and Nutrition Service, Office of Research and Analysis, *WIC Improper Payments to Vendors: 2005-2008 Trends Summary*, by Sheku G. Kamara, FNS, Karen Castellanos-Brown, FNS, and Richard Mantovani, ICF Macro. Project Officer: Karen Castellanos-Brown, Sheku Kamara, Alexandria, VA: 2012.
- U.S. Department of Agriculture, Food and Nutrition Service, Supplemental Food Programs Division (2010). *The Integrity Profile (TIP) Report—Fiscal Year 2009*. Alexandria, VA.

APPENDIX A: VENDOR CHARACTERISTICS

APPENDIX A:

VENDOR CHARACTERISTICS

This appendix describes the distributions of characteristics of the 41,612 WIC vendors described in the FY 2009 TIP data file and used in this analysis, and the associated redemption dollars.

DERIVATION OF THE ANALYTIC DATASET

The FY 2009 TIP system maintains records for a total of 47,829 authorized WIC vendors in the United States and its territories and possessions. This report, like the previous updates, focuses on only those vendor types and locations considered in the 2005 bookend study.

The 2005 bookend study used only WIC vendors with traditional retail delivery systems operating in the continental United States. As a result, the following classes of vendors were removed from that study¹⁵:

- Direct distribution delivery systems—all vendors in Mississippi and a few in Illinois;
- Home delivery systems—all Vermont vendors and vendors in some areas of Ohio;
- Military commissaries—located on military bases;
- Pharmacies that only provide prescription infant formula and WIC-approved medical foods;
- All vendors in Alaska, Hawaii, and the U.S. Territories;
- North Dakota vendors, which were not included in the 2005 sampling frame; and
- All vendors authorized solely by Indian Tribal Organizations.

In order to replicate in the 2009 study the population examined by the 2005 bookend study, 6,217 vendors in the groups listed above were removed from the FY 2009 TIP file. In addition, it should be noted that the remaining vendors were assigned store type values based on the vendor type code provided in the TIP file and information provided in SNAP's administrative authorized store files. The information from TIP data indicated that many vendors were assigned a vendor type value not consistent with designations in previous TIP files. In addition, SNAP had mounted an effort to redesign its store type categories and undertook a concerted effort to reassign retailers to the new categories. Both activities changed the distribution of WIC vendor types for this study across the raking matrix used.

Redemption dollar figures reported through TIP for each vendor were adjusted. The focus of this study was on redemptions related to non-formula food sales only. However, redemption dollars reported by the States through TIP did not separate formula redemption dollars from food

¹⁵ It is important to note that a refinement was made in the 2010 report data analysis where commissaries and pharmacies were removed at the beginning of the process instead of at the end of the process. This means that the program-wide estimates included in this report included the redemption amounts from those vendors instead of excluding them as was done in the 2010 report.

redemption dollars. TIP provided a national redemption dollar figure of almost \$5.48 billion for the subset of vendors used in this study. FNS recorded WIC food outlays of \$4.25 billion for FY 2009, which excluded formula rebates. Because FNS furnished food outlays by State and TIP provided redemption dollars by State, we adjusted the amount reported in TIP by the ratio of outlays over TIP-reported redemption dollars by State. The adjusted figure equaled the reported food outlays figure provided by FNS.

As was mentioned above, information from SNAP from the Store Tracking and Redemption System (STARS) II database was used to add store type information as well as whether the store was publicly traded. Census 2000 data were used to add geographic information on areas served by the vendor.

VENDOR TYPE

This study included the following TIP vendor categories: retailers, WIC-only vendors, and WIC above-50-percent vendors. STARS II data were matched to authorized SNAP retailers and used to further categorize WIC retailer vendors. After matching WIC vendors in the FY 2009 TIP file to the STARS II retailer list, store business type and retailer size from that list were used to further separate retailer vendors into large or small retailers. Retailers that could not be matched with SNAP were categorized as stores with unknown sales. In comparison with previous years, large retail vendors accounted for a slightly higher proportion of all vendors. They represented almost three-quarters (73.3 percent) of all WIC vendors, redeeming about 86.9 percent of WIC benefits (see Exhibits A1 and A2). In contrast, large retail vendors represented half (44.8 percent) of investigated vendors and also accounted for 60.4 percent of all investigated vendors' redemption dollars. Both these figures are small decreases compared with the last update, which means that although the percentage of large vendors in the population increased, the percentage of the number investigated decreased slightly. Conversely, small retail vendors made up 23.3 percent of all WIC vendors and 49.8 percent of investigated vendors. Like small retail vendors, WIC above-50-percent vendors and retailers of unknown size were investigated at a higher rate (relative to their proportion of the population) than other vendors.

The most notable statistic is for WIC-only vendors, which saw a decline in their numbers and were investigated at the same rate as their presence in the population. From a comparison with the 2008 TIP data, we found that many WIC-only vendors were reclassified to other vendor type categories and thus their number declined (from 700 to 152 vendors). It should be noted that this decline in WIC-only vendors was also observed for redemptions. There was a reduction of about \$300,000 in WIC-only redemptions, which went from accounting for 8.1 percent of redemptions in FY 2008 to less than 0.8 percent in FY 2009. This decline may have had an effect on the estimates and could be a partial explanation for the drop in undercharges.

Exhibit A1. Distribution of Vendors, by Vendor Type (TIP 2009)

Vendor Type	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
Large retail vendors (superstores, supermarkets, and grocery stores with gross sales of more than \$500,000)	2,856	44.8	30,510	73.3
Small retail vendors (retailers with gross sales of \$500,000 or less)	3,175	49.8	9,676	23.3
Retail vendors of unknown size	227	3.6	1,061	2.5
WIC-only vendors	20	0.3	152	0.4
Vendors for which WIC redemption dollars represented 50 percent or more of revenues	95	1.5	213	0.5
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit A2. Distribution of Redemption Dollars, by Vendor Type (TIP 2009)

Vendor Type	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
Large retail vendors (superstores, supermarkets, and grocery stores with gross sales of more than \$500,000)	\$395,145	60.4	\$3,694,031	86.9
Small retail vendors (retailers with gross sales of \$500,000 or less)	\$192,520	30.4	\$411,253	9.7
Retail vendors of unknown size	\$39,127	6.2	\$81,962	1.9
WIC-only vendors	\$5,304	0.8	\$36,725	0.9
Vendors for which WIC redemption dollars represented 50 percent or more of revenues	\$14,004	2.2	\$27,377	0.6
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

OWNERSHIP

To categorize the ownership type of WIC retailers (private or public), WIC retailer vendors were matched to their SNAP records in STARS II. Stores were classified as public or privately owned. Unmatched retailers were categorized as stores with unknown ownership, although an algorithm was used to determine whether the store was part of a chain and, as such, could be classified as public or private based on the classification of other stores in the chain. Almost 70 percent (69.7 percent) of all WIC vendors were privately owned. Privately owned WIC vendors accounted for only 58.3 percent of all redemption dollars (see Exhibits A3 and A4)—a slight increase over their observed share in FY 2008. Privately owned vendors were also more frequently investigated (87.4 percent) than publicly owned vendors, and these investigated vendors accounted for a high level of redemptions (78.6 percent) relative to the share of redemptions transacted by these stores in the population.

Exhibit A3. Distribution of Vendors, by Vendor Ownership (TIP 2009)

Ownership Type	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
Private	5,572	87.4	28,985	69.7
Public	724	11.4	11,887	28.6
Unknown	77	1.2	740	1.8
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit A4. Distribution of Redemption Dollars, by Vendor Ownership (TIP 2009)

Ownership Type	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
Private	\$498,387	78.6	\$2,480,507	58.3
Public	\$121,715	19.2	\$1,704,025	40.1
Unknown	\$13,784	2.2	\$66,815	1.5
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

URBANIZATION

WIC vendors were matched by their ZIP Code to Census files, which contained information to calculate the level of urbanization within that ZIP Code. More than half of all WIC vendors (57.2 percent) were located in highly urbanized areas (90 percent or more urbanization) (see Exhibit A5). Also, 73.6 percent of all investigated vendors were located in highly urbanized areas. The corresponding proportions of redemption dollars of highly urbanized vendors among all vendors (65.6 percent) and among investigated vendors (77.3 percent) were also high (see Exhibit A6).

Exhibit A5. Distribution of Vendors, by Urbanization (TIP 2009)

Percentage of Population in ZIP Code Identified as Living in Urbanized Area	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
50 percent or less	849	13.3	8,051	19.3
More than 50 percent but less than 90 percent	836	13.1	9,750	23.4
90 percent or more	4,688	73.6	23,811	57.2
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009

Exhibit A6. Distribution of Redemption Dollars, by Urbanization (TIP 2009)

Percentage of Population in ZIP Code Identified as Living in Urbanized Area	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
50 percent or less	\$49,310	7.8	\$419,843	9.9
More than 50 percent but less than 90 percent	\$94,548	14.9	\$1,041,805	24.5
90 percent or more	\$490,028	77.3	\$2,789,699	65.6
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

PERCENTAGE IN POVERTY

WIC vendors were matched by their ZIP Code to Census files, which contained information to calculate the percentage of households below the poverty level. Three-quarters of vendors (74.5 percent) and 55.4 percent of investigated vendors were located in areas in which 20 percent or less of households live in poverty (see Exhibit A7). Just more than 9.4 percent of all vendors and almost 21.6 percent of investigated vendors were in areas in which 30 percent or more of households live in poverty. Thus, vendors in these higher poverty areas were investigated at a

relatively higher rate than other vendors. The redemption dollar values reflected a similar result (see Exhibit A8). In terms of vendors and redemption dollars, the lowest poverty areas were investigated least, relative to their representation in the overall population. The trend toward increasing investigations in areas of higher poverty continues relative to investigations in areas of lower poverty.

Exhibit A7. Distribution of Vendors, by Poverty Level (TIP 2009)

Percentage of Households Below Poverty Level	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
20 percent or less	3,532	55.4	31,012	74.5
More than 20 percent but less than 30 percent	1,464	23.0	6,680	16.1
30 percent or more	1,377	21.6	3,920	9.4
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit A8. Distribution of Redemption Dollars, by Poverty Level (TIP 2009)

Percentage of Households Below Poverty Level	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
20 percent or less	\$394,170	62.2	\$3,210,940	75.5
More than 20 percent but less than 30 percent	\$150,373	23.7	\$712,236	16.8
30 percent or more	\$89,343	14.1	\$328,171	7.7
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

REDEMPTIONS

Vendors with fewer redemption dollars tended to be investigated to a greater extent than their high-redemption counterparts (see Exhibit A9). Exhibit A10, displaying redemption dollars by quartile, shows that the majority of all redemption dollars (67.7 percent) were accounted for by investigated vendors redeeming more than \$126,633 per vendor per year.

Exhibit A9. Distribution of Vendors, by Redemption Dollar Quartile (TIP 2009)

Redemption Dollar Quartile	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
Less than or equal to \$17,834	1,507	23.6	10,403	25.0
Greater than \$17,834 but less than or equal to \$51,302	1,959	30.7	10,402	25.0
Greater than \$51,302 but less than or equal to \$126,633	1,571	24.7	10,404	25.0
Greater than \$126,633	1,336	21.0	10,403	25.0
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit A10. Distribution of Redemption Dollars, by
Redemption Dollar Quartile (TIP 2009)**

Redemption Dollar Quartile	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
Less than or equal to \$17,834	\$12,761	2.0	\$80,341	1.9
Greater than \$17,834 but less than or equal to \$51,302	\$64,011	10.1	\$340,665	8.0
Greater than \$51,302 but less than or equal to \$126,633	\$128,175	20.2	\$861,865	20.3
Greater than \$126,633	\$428,939	67.7	\$2,968,475	70.0
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

GEOGRAPHIC REGION

FNS has seven offices serving distinct geographic regions. All vendors are associated with a particular region, and this information is provided in the TIP data file. About 49.1 percent of all investigated vendors were in the Northeast, which accounted for only 16.2 percent of all vendors (see Exhibit A11). The proportion investigated in this region decreased slightly from FY 2008, as did the proportion investigated in the Midwestern region. In redemption dollar terms, the proportion of dollar values investigated was higher in the Northeast region (28.7 percent) than in the other regions (see Exhibit A12).

Exhibit A11. Distribution of Vendors, by Geographic Region (TIP 2009)

Geographic Region	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
Mid-Atlantic	457	7.2	4,750	11.4
Midwestern	924	14.5	7,220	17.4
Mountain Pacific	261	4.1	3,242	7.8
Northeast	3,129	49.1	6,759	16.2
Southeast	705	11.1	8,782	21.1
Southwest	518	8.1	4,179	10.0
Western	379	5.9	6,680	16.1
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit A12. Distribution of Redemption Dollars, by Geographic Region (TIP 2009)

Geographic Region	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
Mid-Atlantic	\$46,310	7.3	\$411,621	9.7
Midwestern	\$111,387	17.6	\$624,177	14.7
Mountain Pacific	\$23,503	3.7	\$236,849	5.8
Northeast	\$181,684	28.7	\$444,186	10.4
Southeast	\$78,120	12.3	\$894,580	21.0
Southwest	\$103,806	16.4	\$592,657	13.9
Western	\$89,077	14.1	\$1,047,276	24.6
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

NEW VENDORS

A new vendor is identified in TIP as a vendor that was not authorized at the beginning of the fiscal year but became an authorized vendor sometime during the fiscal year. Relative to their representation in the vendor population, new vendors were investigated at a rate slightly higher than that for preexisting vendors. These new vendors represented 9.6 percent of those vendors that were investigated, and they represented about 8.4 percent of the vendor population (see Exhibit A13). In terms of dollars, new vendors accounted for 3.3 percent of redemption dollars and a comparable percentage (2.9 percent) for investigated vendors (see Exhibit A14). It should be noted that the TIP file contained many stores identified as new vendors that had the same address and sometimes that same name as another vendor that had left the program. Thus, although technically new vendors, these were stores that offered the same set of services as the stores that were previously at those locations.

Exhibit A13. Distribution of Vendors, by Vendor Tenure (TIP 2009)

New Vendor	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
No	5,762	90.4	38,115	91.6
Yes	611	9.6	3,497	8.4
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit A14. Distribution of Redemption Dollars, by Vendor Tenure (TIP 2009)

New Vendor	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
No	\$612,709	96.7	\$4,126,860	97.1
Yes	\$21,177	3.3	\$12,449	2.9
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

CHILDREN UNDER 5

Using Census data matched to the vendor's ZIP Code, the percentage of children under 5 was calculated for the vendor's area. Vendors in areas with high densities of children under 5 were investigated more often than vendors in lower child-density areas—both absolutely and proportional to their representation in the population. For example, 36.2 percent of all investigated vendors were from high child-density areas—10.7 percentage points more than their proportion of the vendor population (see Exhibit A15). About 43 percent (43.2 percent) of all redemption dollars of investigated vendors occurred in the highest child-density areas, while the redemption dollars of vendors in these areas accounted for 34.2 percent of all redemption dollars (see Exhibit A16).

Exhibit A15. Distribution of Vendors, by Percentage of Children Under 5 (TIP 2009)

Percentage of Children Under 5	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
Less than or equal to 5.86 percent	1,075	16.9	10,392	25.0
Greater than 5.86 percent but less than or equal to 6.78 percent	1,223	19.2	10,228	24.6
Greater than 6.78 percent but less than or equal to 7.89 percent	1,766	27.7	10,374	24.9
Greater than 7.89 percent	2,309	36.2	10,618	25.5
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit A16. Distribution of Redemption Dollars, by Percentage of Children Under 5 (TIP 2009)

Percentage of Children Under 5	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
Less than or equal to 5.86 percent	\$87,034	13.7	\$762,576	17.9
Greater than 5.86 percent but less than or equal to 6.78 percent	\$98,408	15.5	\$930,871	21.9
Greater than 6.78 percent but less than or equal to 7.89 percent	\$174,851	27.6	\$1,105,754	26.0
Greater than 7.89 percent	\$273,593	43.2	\$1,452,146	34.2
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

CHILDREN UNDER 1

Using Census data matched to the vendor's ZIP Code, the percentage of children under 1 was calculated for the vendor's area. Similar to vendors in areas with a high density of children under 5, vendors located in areas with a high density of children under 1 accounted for a proportionately greater percentage of investigations (35.1 percent) than their proportion of the vendor population (25.5 percent) (see Exhibit A17). Investigated vendors in areas with high densities of children under 1 also accounted for a greater proportion of redemption dollars of investigated vendors (41.6 percent) than their proportion of the vendor population (33.0 percent) (see Exhibit A18).

Exhibit A17. Distribution of Vendors, by Percentage of Children Under 1 (TIP 2009)

Percentage of Children Under 1	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
Less than or equal to 1.11 percent	999	15.7	10,404	24.0
Greater than 1.11 percent but less than or equal to 1.37 percent	1,330	20.9	10,255	24.6
Greater than 1.37 percent but less than or equal to 1.66 percent	1,807	28.4	10,359	24.9
Greater than 1.66 percent	2,237	35.1	10,594	25.5
Total	6,373	100.0	41,612	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit A18. Distribution of Redemption Dollars, by Percentage of Children Under 1 (TIP 2009)

Percentage of Children Under 1	Investigated Vendors		All Vendors	
	Total Redemptions (in thousands)	Percent of All Redemption Dollars	Total Redemptions (in thousands)	Percent of All Redemption Dollars
Less than or equal to 1.11 percent	\$71,829	11.3	\$748,990	17.6
Greater than 1.11 percent but less than or equal to 1.37 percent	\$136,776	21.6	\$996,314	23.4
Greater than 1.37 percent but less than or equal to 1.66 percent	\$161,931	25.6	\$1,102,792	28.3
Greater than 1.66 percent	\$263,349	41.6	\$1,403,251	33.0
Total	\$633,886	100.0	\$4,251,347	100.0

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

***APPENDIX B: METHODOLOGY FOR THE ESTIMATION
OF OVERCHARGE***

APPENDIX B:

METHODOLOGY FOR THE ESTIMATION OF OVERCHARGE

DEFINITION AND DISCUSSION OF OVERCHARGE VIOLATIONS

For the purpose of this study, an overcharge occurs when the WIC program makes a payment to a vendor (for a food item) that is greater than the price that a non-WIC customer would have paid. This definition is consistent with the TIP data system and the 2005 bookend study.

Operationally, however, there are a number of differences between the overcharge definitions used in TIP and the 2005 bookend study. First, the definition used by State investigators recorded in the TIP file is associated with a sanction, which occurs when a vendor displays a pattern of overcharges. Because one overcharge does not constitute a pattern, a single instance is not likely to result in a sanction. The TIP file, therefore, reveals only recurring overcharge behavior. In the 2005 bookend study an overcharge is defined as a single occurrence of an overcharge on a particular buy. By this definition, a single occurrence would not necessarily reflect a pattern of overcharging, which creates a lower threshold for recording overcharges. Thus, if the two studies examined the same population, the proportion of vendors overcharging would be expected to be larger in the 2005 bookend study.

A second difference in the overcharge definition reflects how overcharging relates to safe buys (the purchase of items specified on the food instrument), partial buys (the purchase of only some of the items specified on the food instrument), and substitutions (the replacement of an item on the food instrument with another item) in the bookend study. With regard to safe buys, overcharge has one meaning, which is the amount charged by the retailer over and above the amount that should have been charged for the same items on the food instrument. With regard to partial buys and substitutions, overcharges can occur in two ways:

- As in a safe buy, an overcharge can occur with regard to a particular item that is bought (e.g., peanut butter is charged at \$2.40 rather than \$2.20).
- An overcharge may reflect a charge that occurs with regard to an item that is specified on the food instrument but is not purchased (e.g., the charged but unpurchased item is peanut butter at \$2.20).

Partial buys and substitutions were included in the 2005 bookend study; however, their prevalence as a proportion of all transactions is not known. WIC investigations data recorded in TIP do not provide any evidence of the kind of buy that was used, resulting in our inability to exactly replicate the 2005 bookend study in this regard. The working assumption for this study is that TIP investigations data only represent safe buys, thereby making the results, at least in interpretation, equivalent to those produced by the 2005 bookend study. This allows us to use statistics produced by the bookend study for establishing the percentage of redemptions

represented by overcharges (see below). However, it should be noted that use of these statistics may lead to the underestimation of overcharge rates since partial buys offer the greatest opportunity for overcharging and these are not being considered in the estimate since there is no reporting of partial buys to OMB for improper payments.

DESCRIPTION OF THE ESTIMATION APPROACH FOR OVERCHARGES

The estimation approach for overcharges involves three steps:

- The estimation of weights that allow sample information to be translated to the population of vendors,
- The application of those weights to vendor redemption dollar information, and
- The application of an adjustment factor for characterizing vendors' erroneous payment behaviors.

These steps are described in the following sections.

Estimation of Weights That Allow Sample Information To Be Translated to the Population of Vendors

The approach used for developing overcharge estimates is a post-stratification adjustment known as raking.

The following illustration provides an explanation of the raking process. Starting with a two-dimensional matrix with three categories in each dimension, suppose that the population consisting of 10,000 vendors is scattered across the cells as shown in Exhibit B1. Suppose also that the corresponding sample of 1,000 investigated vendors is scattered across the same nine cells as shown in Exhibit B2.

Exhibit B1. Vendor Population Distributed Across Two Dimensions

Dimension 1 (e.g., urbanization)	Dimension 2 (e.g., poverty)			
	Low	Medium	High	Total
Low	300	400	300	1,000
Medium	1,500	1,500	1,000	4,000
High	700	600	3,700	5,000
Total	2,500	2,500	5,000	10,000

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit B2. Vendor Sample Distributed Across Two Dimensions

Dimension 1 (e.g., urbanization)	Dimension 2 (e.g., poverty)			
	Low	Medium	High	Total
Low	40	60	100	200
Medium	100	200	200	500
High	60	40	200	300
Total	200	300	500	1,000

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

In comparing Exhibits B1 and B2, it can be seen that the sample is not consistent with the population—overstating representation in certain categories and understating it in others. The object of raking is to determine weights that would allow the translation of the sample to the population so that the sample is truly representative of the population.

Exhibit B3 provides an example of the initial raking matrix. The cell entries represent sample values, and the marginal totals represent population values. As discussed above, the idea is to identify values for the cells that will add up to the marginal population values. Each value is assigned a weight that allows this transformation to occur. Multiple iterations are needed to accomplish this when the transformation involves two or more dimensions.

Exhibit B3. Initial Raking Matrix

Dimension 1 (e.g., urbanization)	Dimension 2 (e.g., poverty)			
	Low	Medium	High	Population Values
Low	40	60	100	1,000
Medium	100	200	200	4,000
High	60	40	200	5,000
Population Values	2,500	2,500	5,000	10,000

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

For the first iteration, the weight is calculated by dividing the population total by the sum of the cell sample values (see Exhibit B4). Thus, 1,000 is divided by 200 for a weight of 5. The weights are calculated for the first iteration. Note that the weights for the second iteration are not calculated.

Exhibit B4. Marginal Frequencies and Percentages for the Population and Sample

Dimension		Population (Marginals)		Sample (Marginals)		Weight
		Number	Percent	Number	Percent	
Dimension 1	Low	1,000	10	200	20	5
	Medium	4,000	40	500	50	8
	High	5,000	50	300	30	16.7
	Total	10,000	100	1,000	100	
Dimension 2	Level 1	2,500	25	200	20	*
	Level 2	2,500	25	300	30	*
	Level 3	5,000	50	500	50	*
	Total	10,000	100	1,000	100	

* = no weight assigned at this stage.

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

A new sample cell frequency is calculated by applying the weights to the original sample cell frequency (see Exhibit B5). These new cell frequencies will add to the Dimension 1 marginals but not to the Dimension 2 marginals. Therefore we have to adjust the cell values to the Dimension 2 marginals.

Exhibit B5. Weights Resulting From Initial Rake

Dimension 1	Dimension 2	Original Sample Cell Frequency	Weights From Initial Rake (Exhibit 4)	New Cell Frequency
Low	Low	40	5	200
	Medium	60	5	300
	High	100	5	500
Medium	Low	100	8	800
	Medium	200	8	1,600
	High	200	8	1,600
High	Low	60	16.7	1,000
	Medium	40	16.7	760
	High	200	16.7	3,340

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

The second step is to divide the population marginals for Dimension 2 by the new cell frequencies summed over Dimension 2. This gives a new set of weights as shown in Exhibit B6. Note that Dimension 1 is ignored in this iteration.

Exhibit B6. Marginal Frequencies and Percentages for the Population and Sample

Dimension		Population (Marginals)		New Cell Frequencies (Marginals)		Weight
		Number	Percent	Number	Percent	
Dimension 1	Low	1,000	10	1,000	20	*
	Medium	4,000	40	4,000	50	*
	High	5,000	50	5,000	30	*
	Total	10,000	100	10,000	100	
Dimension 2	Level 1	2,500	25	2,000	20	1.25
	Level 2	2,500	25	2,660	27	0.94
	Level 3	5,000	50	5,340	53	0.94
	Total	10,000	100	10,000	100	

* = no weight assigned at this stage.

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

When the Dimension 2 weights are applied to the cell frequencies, we get the results displayed in Exhibit B7. When added, the cell values sum to the Dimension 2 marginals; however, they lose their coherence with Dimension 1 marginals. To ensure that the cell values maintain coherence with both the first and second dimensions, we repeat the raking, first across Dimension 1, then over Dimension 2. Each repetition will result in values that are closer to the population values. Raking will be completed when the marginals calculated from the cell values are equal, or close to equal, to the population marginals for all dimensions. The ultimate weight after these iterations will represent the number of vendors represented by each sample point.

Exhibit B7. Weights Resulting From Initial Rake

Dimension 1	Dimension 2	New Cell Frequency	Weights From Initial Rake	New Cell Frequency After Dimension 2 Rake
Low	Low	200	1.25	250
	Medium	300	0.94	282
	High	500	0.94	470
Medium	Low	800	1.25	1,000
	Medium	1,600	0.94	1,504
	High	1,600	0.94	1,504
High	Low	1,000	1.25	1,250
	Medium	760	0.94	714
	High	3,340	0.94	3,140

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit B8 shows the population of vendors in the FY 2009 TIP file that were sanctioned for overcharging by type of oversight (or compliance investigation).¹⁶ Compliance investigations are covert activities in which an undercover purchaser seeks to uncover instances of fraud and abuse.¹⁷ Of the 5,777 vendors undergoing compliance investigations, 797, or 13.8 percent, were identified as overcharging. Compared with FY 2008, this was an increase of 2 percentage points. Both the number and proportion of overcharges have increased dramatically over last year’s results. When routine monitoring visits were considered, the total percentage of vendors overcharging decreased to almost 6 percent within the monitored population. Monitoring visits did not identify any instances of overcharging that were not observed for the other methods. This is because monitoring, which is overt, is not considered to be an effective method for identifying overcharge behavior.¹⁸ For the purposes of generating weights, routine monitoring visits were not considered an investigation, and monitoring was excluded from the analysis in this report. Furthermore, in identifying overcharging, only violations in which the State indicated that the reason for sanction was an overcharge were included. Other violations, such as substitutions or trafficking, were not counted as violations for this study.

¹⁶ There are other reasons for sanctions indicated in the TIP file, which could potentially increase overcharges. If these other reasons were used, the assumption would be that any vendor found to show a pattern of abuse, regardless of its specific nature, would also be a potential overcharger.

¹⁷ A compliance buy is a covert onsite investigation in which a representative of the program poses as a participant, parent or caretaker of an infant or child participant, or proxy; transacts one or more food instruments; and does not reveal during the visit that he or she is a program representative (7 CFR 246, p. 314).

¹⁸ Routine monitoring encompasses overt onsite monitoring, during which program representatives identify themselves to vendor personnel (7 CFR 246, p. 318).

Exhibit B8. Frequency of Overcharges, by Type of Oversight (TIP 2009)

Type of Oversight	Total Investigated	Total Overcharging	
		Sanctioned	Percent
Compliance investigations by State agency	5,777	797	13.8
Compliance investigations by State agency or other entity*	6,373	903	14.7
Compliance investigations by State agency, other entity, or routine monitoring visits	16,238	903	5.56

* The TIP User Guide Data Dictionary defines investigations by other entities as “compliance investigations conducted by an outside agency, such as another State agency or the Food Stamp Program, or a Federal law enforcement agency.”

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

As indicated above, the raking procedure attempts to translate sample results to the population through a set of characteristics. The five characteristics over which the data were raked (vendor type, ownership, urbanization, poverty level, and redemption dollar quartile) were chosen on the basis of previous research in the Supplemental Nutrition Assistance Program (SNAP) showing a relationship between food stamp trafficking and vendor and neighborhood characteristics.¹⁹ That research substantiated a basic set of indicators that, when modified, would be useful for characterizing WIC transactions and examining WIC over- and undercharges. It should be noted that the distribution of vendors by vendor type changed dramatically between FY 2008 and FY 2009. This would have an effect on raking results. These variables are described in greater detail in Appendix A.

Application of Weights to Vendor Redemption Dollar Information

Raking weights were used to provide initial estimates. The population estimate of vendors that overcharged was the sum of the weighted number of vendors found to be overcharging within the sample. The vendor-based overcharge rate was the weighted number of overcharging vendors divided by the total vendor population. The unadjusted value of overcharges was the sum of the weighted redemption dollars represented by the vendors that were found to be overcharging within the sample. The unadjusted redemption-based overcharge rate was the amount of

¹⁹ See U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation (2003). *The Extent of Trafficking in the Food Stamp Program: 1999–2002*, FSP-03-TRAF, by Theodore F. Macaluso, Ph.D., Alexandria, VA, and U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation (2000). *The Extent of Trafficking in the Food Stamp Program: An Update*, by Theodore F. Macaluso, Ph.D., Alexandria, VA.

overcharges found in the population of overcharging vendors divided by the total amount of redemption dollars reported in the population.

Preliminary raking estimates of the percentage of vendors overcharging in the WIC program in FY 2009 were based on vendors investigated by the State or another entity. An error was deemed to have occurred if TIP data indicated that a vendor was sanctioned for overcharging. The raked weights would adjust the numbers presented in Exhibit B8 to the population. After raking, the number of vendors sanctioned for investigation was estimated to be 3,885—a notable jump over the 2,869 vendors estimated in the last study. In percentage terms, this amounts to 9.34 percent of all vendors.

To estimate the variance associated with the raking estimates, a bootstrap approach was used in which estimates were made for random samples selected from investigated cases.²⁰ We provide the results of these bootstrap estimates in Appendix E.

Application of an Adjustment Factor for Characterizing Vendors' Erroneous Payment Behaviors

Redemption dollar results represent the total amount of redemption dollars that were estimated to occur with vendors that overcharged and include correctly charged redemption dollars as well as overcharges. The amount of actual overcharges is a proportion of these redemptions. Approximately \$342 million in redemption dollars were associated with vendors that overcharged. This overcharge estimate represents all redemption dollars for vendors that overcharged. Because it would be expected that not all of these redemption dollars were overcharges, the figures must be adjusted. This section describes the approach for doing so and presents adjusted overcharge amounts and rates.

The 2005 bookend study provided data that were useful in computing this adjustment factor. It examined three types of buys (safe, partial, and substitution buys) in which a purchase was made with a food instrument from a particular sampled vendor. The study provides information on the overall charge for each type of buy and the amount that was supposed to be charged. Thus, overcharges can be identified as a percentage of the total value of the food instrument that was redeemed. For the purposes of this study, only safe buys were used.

Exhibit B9 shows that the average overcharge was \$1.82 for safe buy violations. It should be noted that this amount reflects the activities of only those vendors that overcharged, which were very few. The data also show that the amount of the overcharge was very small in many cases. For example, for safe buys the minimum overcharge was \$0.02, with 25 percent of all safe buy overcharges valued at less than \$0.20.

²⁰ Samples were drawn from the investigative files and subjected to the raking algorithm. Each sample provided a mean. A grand mean and a standard deviation were estimated for all these samples.

**Exhibit B9. Weighted Distribution of Overcharges in the 2005 Bookend Study,
by Buy Type**

Buy Type	No. of Buys	Average	Minimum	25th Percentile	Median	75th Percentile	Maximum
Safe	46	\$1.82	\$0.02	\$0.20	\$0.64	\$2.01	\$10.00
Partial	65	\$7.86	\$0.02	\$0.44	\$2.39	\$7.87	\$65.54
Minor substitution	39	\$4.38	\$0.01	\$0.30	\$0.71	\$2.40	\$67.00
Major substitution	24	\$1.57	\$0.02	\$0.20	\$0.60	\$2.16	\$9.30

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

In the 2005 bookend study, the mean percentage overcharge for safe buys was 10.74 percent. This rate was used as the adjustment factor in the raking analysis. Exhibit B10 presents summary statistics on safe buy overcharges.

**Exhibit B10. Mean 2005 Bookend Study Overcharge as a Percentage of the
Food Instrument for Safe Buys Only**

Number of Safe Buy Overcharges	Mean Overcharge Percent	Standard Deviation	Minimum	Maximum
46	10.74	77.87	0.07	73.64

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Using the adjustment factor, the amount is reduced to \$37 million, which constitutes 0.86 percent of total redemptions. Appendix E provides confidence intervals resulting from bootstrapping.

***APPENDIX C: METHODOLOGY FOR THE ESTIMATION
OF UNDERCHARGE***

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METHODOLOGY FOR THE ESTIMATION OF UNDERCHARGE

DEFINITION AND DISCUSSION OF UNDERCHARGES

A formal definition of an undercharge in the WIC program does not exist in the Code of Federal Regulations or the 10 State vendor agreements and handbooks reviewed as part of this research. However, the 2005 bookend study defined an undercharge as a negative difference between the redeemed value of a food instrument and the best retail price for the food bundle as recorded by field data collectors. This study also used this definition.

Unlike overcharges, undercharges are not recorded in TIP and have not been used to issue sanctions. Therefore, both the probability of a vendor’s transacting an undercharge and the dollar amount of an undercharge were estimated using the 2005 bookend study and applied to the TIP data. This means that when applied to TIP data in subsequent years, the total expected value of undercharges will change strictly as a function of changes in redemption dollar amounts and the characteristics of the population of WIC vendors.

The 2005 bookend study allowed retailers to undercharge on any of three types of buys. As shown in Exhibit C1, the percentage of vendors undercharging in any one of the three buys is approximately 10 percent, which is equivalent to the result for overcharging when all three buy types are taken into consideration.

Exhibit C1. Weighted Frequency of Vendors With Undercharges, 2005 Bookend Study

Number of Undercharges	Number	Percent	Cumulative Number	Cumulative Percent
No undercharges	33,318	89.71	33,318	89.71
One undercharge	3,384	9.11	36,702	98.83
Two undercharges	346	0.93	37,047	99.76
Three undercharges	90	0.24	37,138	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

The proportion of vendors undercharging by type of buy is presented in Exhibit C2. The data show that the percentage of vendors undercharging on partial buys was lower than that for other buys. Vendors were more likely to undercharge for major substitutions than they were for partial or safe buys.

Exhibit C2. Weighted Frequency of Undercharges in the 2005 Bookend Study, by Buy Type*

Buy Type	Undercharge		No Undercharge		Total	
	Number	Percent	Number	Percent	Number	Percent
Safe	1,554	4.6	32,289	95.4	33,843	100.0
Partial	971	2.9	32,681	97.1	33,651	100.0
Minor substitution	1,131	5.1	20,995	94.9	22,127	100.0
Major substitution	656	6.0	10,308	94.0	10,963	100.0
Total	4,312	4.3	96,273	95.7	100,585	100.0

* Numbers represent the number of buys, not the number of vendors.

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

With regard to dollar amount, the average undercharge in a safe buy was \$0.94 for vendors undercharging (see Exhibit C3). In a partial buy, it was \$1.43; in a minor substitution, it was \$2.41; and in a major substitution, it was \$0.96. As opposed to overcharges, undercharges became larger when partial buys replaced safe buys.

**Exhibit C3. Weighted Distribution of Undercharges in the 2005 Bookend Study,
by Buy Type**

Buy Type	No. of Buys	Average	Minimum	25th Percentile	Median	75th Percentile	Maximum
Safe	74	-\$0.94	-\$5.43	-\$1.16	-\$0.49	-\$0.18	-\$0.01
Partial	40	-\$1.43	-\$9.00	-\$2.09	-\$0.60	-\$0.20	-\$0.01
Minor substitution	51	-\$2.41	-\$14.67	-\$3.00	-\$1.20	-\$0.40	-\$0.01
Major substitution	23	-\$0.96	-\$3.00	-\$1.42	-\$0.50	-\$0.23	-\$0.02

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

As shown in Exhibit C4, undercharges ranged from 5.5 percent (major substitutions) to almost 12 percent (partial buys and minor substitutions) of the total value of the food instrument, which supports the claim that undercharges vary with the type of interaction that WIC participants have with WIC vendors. However, because the relative frequency of the natural occurrence of buy types cannot be determined and because these estimates are meant to build on the 2005 bookend study results, only safe buys were used to generate estimates of undercharges.

Exhibit C4. Weighted Distribution of Undercharges as a Percentage of Food Instrument Value in the 2005 Bookend Study, by Buy Type

Buy Type	No. of Buys	Mean Percentage	Minimum Percentage	25th Percentile	Median	75th Percentile	Maximum Percentage
Safe	74	7.211	0.098	1.147	3.511	7.567	46.530
Partial	40	11.786	0.072	1.715	6.834	13.599	91.667
Minor substitution	51	11.759	0.031	1.105	6.651	16.534	71.030
Major substitution	23	5.483	0.314	1.401	3.840	8.186	25.063

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

STRATEGY FOR ESTIMATING UNDERCHARGES

Because the TIP files do not contain any information about undercharges, any estimate must be based solely on the undercharge behavior of those vendors sampled for the 2005 bookend study as applied to the TIP population. Our approach involved developing predictive equations based on behaviors revealed in safe buys only. In developing a predictive equation, logistic regression was used to model the probability of a vendor undercharge, and ordinary least squares regression techniques were used to model the amount of an undercharge.

The first step was to predict the probability of an undercharge. A predictive equation using a logit model was generated from the weighted 2005 bookend study sample. Because it is the probability of undercharging that is modeled at this stage, logistic regression is appropriate because it is nonlinear, allowing the modeler to take into account the fact that probabilities are bounded by 0 and 1. The vendor characteristics used as predictors were:

- Vendor type, expressed as a series of nominal variables, one each for large retail vendors, small retail vendors, and WIC-only vendors and an indicator for all other types of vendors. It should be noted that the 2005 bookend study did not include pharmacies that only provided special formulas and medical foods,²¹ commissaries, direct vendors, or home delivery vendors in its sample. As a result, the indicator for all other types of vendors was necessarily estimated based on WIC above-50-percent vendors only;
- Ownership type, either public or private;
- Percentage of families within the vendor's ZIP Code living in a U.S. Census Bureau-designated urban setting;
- Percentage of households within the vendor's ZIP Code living at or below the poverty level; and
- Vendor's total annual WIC redemption dollars in 2005.

Next, the logistic regressions, as estimated, were applied to all vendors in the TIP file, and the resulting log odds ratios were converted to probabilities. The equation that was applied is specified as follows:

$$P_v = \frac{1}{(1 + \exp(-(-1.8174 + 0.0598*U_v + 1.5633*PO_v - 3.54*(1/10^7)*R_v - 1.6523*LR_v - 1.2922*SR_v - 0.4434*WO_v - 0.0475*PU_v + 0.0835*PR_v)))}$$

Where: P_v is the probability that the vendor undercharged

U_v is the percentage of the population living in urban areas within the vendor's ZIP Code

PO_v is the percentage of households living in poverty within the vendor's ZIP Code

R_v is the annual amount of redemptions for that vendor

LR_v is whether the vendor is a large retailer

SR_v is whether the vendor is a small retailer

²¹ Because the focus was on food outlays, it was difficult on a store-by-store basis to isolate formula sales from food outlay sales. We made a decision to exclude pharmacies because most would sell formula, and although some would sell food, they would probably account for a small portion of overall food sales.

WO_v is whether the vendor is a WIC-only store

PU_v is whether the vendor is publicly owned

PR_v is whether the vendor is privately owned

The second step was to predict the expected dollar value of an undercharge. Linear regression was appropriate because the predicted (dependent) variable is continuous, and unlike probabilities there was no reason to expect a nonlinear relationship. The regression used only those cases of undercharging in the estimation procedure. Thus, it provided the amount of the average undercharge, given certain vendor characteristics, if the vendor undercharged.

These predictive equations were applied to all vendors in the TIP file. Again, all values were predicted for each vendor using the parameters estimated based on safe buys. When predicting from the TIP file, total redemption dollars were substituted for the value of the food instrument that was used when generating the equation from the 2005 bookend study data. The prediction equation is specified as:

$$EU_v = 0.07302 - 0.01322*U_v - 0.20337*PO_v + 2.496827*(1/10^8)*R_v + 0.04108*LR_v + 0.06282*SR_v + 0.03089*WO_v - 0.00542*PU_v$$

Where: EU_v is the expected amount of underpayments given that the vendor undercharged

U_v is the percentage of the population living in urban areas within the vendor's ZIP Code

PO_v is the percentage of households living in poverty within the vendor's ZIP Code

R_v is the annual amount of redemptions for that vendor

LR_v is whether the vendor is a large retailer

SR_v is whether the vendor is a small retailer

WO_v is whether the vendor is a WIC-only store

PU_v is whether the vendor is publicly owned

The third step was to obtain the expected amount of an undercharge for each vendor in the TIP file. Multiplying the probability of undercharging (step 1) by the average amount undercharged (step 2) produced an expected value for undercharges for each vendor. This value represents the total dollar amount undercharged. This is represented as:

$$AU_v = R_v * P_v * EU_v$$

Where AU_v is the final adjusted undercharge for vendor v, and the other factors are defined above.

The vendor undercharge rate was calculated by summing the probabilities of undercharging across all vendors in the TIP file, and the redemption undercharge rate was calculated by determining the total amount of undercharges as a percentage of all redemption dollars.

APPENDIX D: SUPPORTING TABLES

APPENDIX D:

SUPPORTING TABLES

This appendix contains the raking overcharge estimates and regression-based undercharge estimates obtained for each of the variables discussed in the text. These variables are:

- Vendor type: Exhibits D1a and D1b,
- Store ownership: Exhibits D2a and D2b,
- Level of poverty: Exhibits D3a and D3b,
- Urbanization area: Exhibits D4a and D4b,
- Vendor authorization status: Exhibits D5a and D5b,
- Child density (proportion of children under 5 years within ZIP Code): Exhibits D6a and D6b, and
- Child density (proportion of children under 1 year within ZIP Code): Exhibits D7a and D7b.

Exhibit D1a. Amount and Percentage of Redemption Dollars Overcharged and Undercharged by Vendor Type, 2009

Vendor Type	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Large retail vendors (superstores, supermarkets, and grocery stores with gross sales of more than \$500,000)	\$369,4030,723	\$24,729,441	0.67	\$10,380,052	0.28
Small retail vendors (retailers with gross sales of \$500,000 or less)	\$411,252,861	\$9,159,604	2.23	\$1,958,006	0.48
Retail vendors with unknown sales	\$81,961,778	\$1,959,149	2.39	\$465,937	0.57
WIC-only vendors	\$36,724,687	\$83,116	0.23	\$252,791	0.69
Vendors for which WIC redemptions represent 50 percent or more of revenues	\$27,376,833	\$810,044	2.96	\$0	0.00
All vendors	\$4,251,346,882	\$36,741,354	0.86	\$13,056,785	0.31

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit D1b. Number and Percentage of Vendors Overcharging and Undercharging
by Vendor Type, 2009**

Vendor Type	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
Large retail vendors (superstores, supermarkets, and grocery stores with gross sales of more than \$500,000)	30,510	1,663	5.45	1,167	3.82
Small retail vendors (retailers with gross sales of \$500,000 or less)	9,676	1,903	19.66	647	6.69
Retail vendors with unknown sales	1,061	248	23.37	201	18.91
WIC-only vendors	152	6	3.99	19	12.59
Vendors for which WIC redemptions represented 50 percent or more of revenues	213	64	20.26	0	0.00
All vendors	41,612	3,885	9.34	2,034	4.89

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit D2a. Amount and Percentage of Redemption Dollars Overcharged and Undercharged by Store Ownership, 2009

Store Ownership	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Private	\$2,480,506,742	\$32,456,074	1.31	\$8,170,608	0.33
Public	\$1,704,025,127	\$3,658,690	0.21	\$4,478,579	0.26
Unknown	\$66,815,014	\$626,590	0.94	\$407,598	0.61
All vendors	\$4,251,346,882	\$36,741,354	0.86	\$13,056,785	0.31

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit D2b. Number and Percentage of Vendors Overcharging and Undercharging
by Store Ownership, 2009**

Store Ownership	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
Private	28,985	3,349	11.55	1,525	5.26
Public	11,887	372	3.13	408	3.43
Unknown	740	164	22.19	101	13.70
All vendors	41,612	3,885	9.34	2,034	4.89

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit D3a. Amount and Percentage of Redemption Dollars Overcharged and
Undercharged by Poverty Level, 2009**

Percentage of Households Below the Poverty Level in ZIP Code	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
20 percent or less	\$3,210,940,494	\$24,706,145	0.77	\$10,172,626	0.32
More than 20 percent but less than 30 percent	\$712,235,519	\$6,423,800	0.90	\$2,133,103	0.30
30 percent or more	\$328,170,869	\$5,611,409	1.71	\$752,056	0.23
All vendors	\$4,251,346,882	\$36,741,354	0.86	\$13,056,785	0.31

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit D3b. Number and Percentage of Vendors Overcharging and Undercharging
by Poverty Level, 2009**

Percentage of Households Below the Poverty Level in ZIP Code	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
20 percent or less	31,012	2,415	7.79	1,321	4.26
More than 20 percent but less than 30 percent	6,680	841	12.60	405	6.06
30 percent or more	3,920	628	16.03	308	7.85
All vendors	41,612	3,885	9.34	2,034	4.89

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit D4a. Amount and Percentage of Redemption Dollars Overcharged and Undercharged by Urbanization Area, 2009

Percentage of Population in ZIP Code Identified as Living in Urbanized Area	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
50 percent or less	\$419,843,106	\$1,194,963	0.28	\$1,334,989	0.32
More than 50 percent but less than 90 percent	\$1,041,805,276	\$5,432,283	0.52	\$3,093,127	0.30
90 percent or more	\$2,789,698,500	\$30,114,108	1.08	\$8,628,669	0.31
All vendors	\$4,251,346,882	\$36,741,354	0.86	\$13,056,785	0.31

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit D4b. Number and Percentage of Vendors Overcharging and Undercharging
by Urbanization Area, 2009**

Percentage of Population in ZIP Code Identified as Living in Urbanized Area	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
50 percent or less	8,051	233	2.89	381	4.74
More than 50 percent but less than 90 percent	9,750	420	4.31	408	4.18
90 percent or more	23,811	3,231	13.57	1,245	5.23
All vendors	41,612	3,885	9.34	2,034	4.89

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit D5a. Amount and Percentage of Redemption Dollars Overcharged and Undercharged by Vendor Authorization Status, 2009

Vendor Authorization Status	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Newly authorized vendors in 2009	\$93,616,004	\$1,176,393	1.33	\$540,035	0.43
Previously authorized vendors	\$4,157,730,878	\$35,564,961	0.85	\$12,516,740	0.30
All vendors	\$4,251,346,882	\$36,741,354	0.86	\$19,327,148	0.31

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit D5b. Number and Percentage of Vendors Overcharging and Undercharging
by Vendor Authorization Status, 2009**

Vendor Authorization Status	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
Newly authorized vendors in 2009	3,148	184	5.85	236	6.75
Previously authorized vendors	38,464	3,701	6.95	1,798	4.72
All vendors	41,612	3,885	5.85	2,034	4.88

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit D6a. Amount and Percentage of Redemption Dollars Overcharged and Undercharged by Proportion of Children Under 5 Years Within ZIP Code, 2009

Proportion of Children Under 5 Years	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Less than or equal to 5.86 percent	\$652,580,131	\$2,716,712	0.36	\$2,343,794	0.31
Greater than 5.86 percent but less than or equal to 6.78 percent	\$931,401,794	\$4,725,678	0.55	\$2,888,286	0.31
Greater than 6.78 percent but less than or equal to 7.89 percent	\$1,170,835,431	\$7,855,859	0.71	\$3,393,878	0.31
Greater than 7.89 percent	\$1,496,529,527	\$21,443,105	1.41	\$4,430,826	0.31
All vendors	\$4,251,346,882	\$36,741,354	0.86	\$13,056,785	0.31

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit D6b. Number and Percentage of Vendors Overcharging and Undercharging by Proportion of Children Under 5 Years Within ZIP Code, 2009

Proportion of Children Under 5 Years	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
Less than or equal to 5.86 percent	9,543	499	5.06	457	4.40
Greater than 5.86 percent but less than or equal to 6.78 percent	10,100	660	6.36	451	4.41
Greater than 6.78 percent but less than or equal to 7.89 percent	11,226	1,167	10.09	505	4.87
Greater than 7.89 percent	10,743	1,539	14.66	621	5.85
All vendors	41,612	3,885	9.34	2,034	4.89

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit D7a. Amount and Percentage of Redemption Dollars Overcharged and Undercharged by Proportion of Children Under 1 Year Within ZIP Code, 2009

Proportion of Children Under 1 Year	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Less than or equal to 1.11 percent	\$742,382,475	\$2,795,456	0.42	\$2,281,357	0.31
Greater than 1.11 percent but less than or equal to 1.37 percent	\$871,079,420	\$5,443,983	0.57	\$3,048,942	0.31
Greater than 1.37 percent but less than or equal to 1.66 percent	\$1,101,484,146	\$7,061,733	0.61	\$3,426,560	0.31
Greater than 1.66 percent	\$1,536,400,842	\$21,440,183	1.44	\$4,299,927	0.31
All vendors	\$4,251,346,882	\$36,741,354	0.86	\$13,056,785	0.31

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit D7b. Number and Percentage of Vendors Overcharging and Undercharging by Proportion of Children Under 1 Year Within ZIP Code, 2009

Proportion of Children Under 1 Year	Total Vendors	Overcharges		Undercharges	
		Number	Percent	Number	Percent
Less than or equal to 1.11 percent	9,859	509	5.34	453	4.35
Greater than 1.11 percent but less than or equal to 1.37 percent	10,366	750	7.40	460	4.48
Greater than 1.37 percent but less than or equal to 1.66 percent	10,875	1,170	10.42	512	4.94
Greater than 1.66 percent	10,512	1,455	13.58	609	5.75
All vendors	41,612	3,886	9.34	2,034	4.89

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

***APPENDIX E: CONFIDENCE INTERVALS FOR
CRITICAL VARIABLES***

APPENDIX E:

CONFIDENCE INTERVALS FOR CRITICAL VARIABLES

This appendix provides confidence intervals computed from bootstrap estimates on both over- and undercharges for each of the variables discussed in the text. In the case of overcharges, the estimates were based on iteratively based predictive values from regression results; in the case of undercharges, the estimates were based on iteratively derived raking values. The variables are:

- Vendor type: Exhibits E1a and E1b,
- Store ownership: Exhibits E2a and E2b,
- Level of poverty: Exhibits E3a and E3b,
- Urbanization area: Exhibits E4a and E4b,
- Vendor authorization status: Exhibits E5a and E5b,
- Child density (proportion of children under 5 years within ZIP Code): Exhibits E6a and E6b, and
- Child density (proportion of children under 1 year within ZIP Code): Exhibits E7a and E7b.

Exhibit E1a. Confidence Intervals for Redemption Dollars Overcharged and Undercharged by Vendor Type, 2009

Vendor Type		Estimate and Confidence Intervals for Overcharges			Estimate and Confidence Intervals for Undercharges		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Large retail vendors (superstores, supermarkets, and grocery stores with gross sales of more than \$500,000)	Amt.	\$24,729,441	\$15,966,042	\$34,579,081	\$10,380,052	\$9,988,784	\$10,737,011
	Rate	0.67%	0.43%	0.94%	0.28%	0.28%	0.28%
Small retail vendors (retailers with gross sales of \$500,000 or less)	Amt.	\$9,159,604	\$5,238,584	\$13,435,633	\$1,958,006	\$1,760,320	\$2,166,129
	Rate	2.23%	1.27%	3.27%	0.48%	0.31%	0.51%
Retail vendors with unknown sales	Amt.	\$1,959,149	\$515,554	\$4,217,591	\$465,937	\$239,119	\$726,692
	Rate	2.39%	0.63%	5.15%	0.57%	0.43%	0.66%
WIC-only vendors	Amt.	\$88,116	\$0	\$1,133,260	\$252,791	\$90,020	\$726,692
	Rate	0.23%	0.00%	3.09%	0.69%	0.56%	0.76%
Vendors for which WIC redemptions represented 50 percent or more of revenues	Amt.	\$810,044	\$177,252	\$1,650,792	\$0	\$0	\$0
	Rate	2.96%	0.65%	6.03%	0.00%	0.00%	0.00%
All vendors	Amt.	\$36,741,354	\$27,385,948	\$48,188,591	\$13,056,785	\$12,627,129	\$13,643,367
	Rate	0.86%	0.64%	1.13%	0.31%	0.30%	0.32%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E1b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Vendor Type, 2009

Vendor Type		Estimate and Confidence Intervals for Vendors Overcharging			Estimate and Confidence Intervals for Vendors Undercharging		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Large retail vendors (superstores, supermarkets, and grocery stores with gross sales of more than \$500,000)	No.	1,663	1,165	2,174	1,167	1,150	1,185
	Rate	5.45%	3.82%	7.12%	3.82%	3.81%	3.84%
Small retail vendors (retailers with gross sales of \$500,000 or less)	No.	1,903	1,640	2,193	647	619	675
	Rate	19.66%	16.95%	22.66%	6.69%	6.63%	6.75%
Retail vendors with unknown sales	No.	248	107	398	201	170	229
	Rate	23.37%	10.05%	37.51%	18.91%	18.48%	19.34%
WIC-only vendors	No.	6	0	44	19	12	27
	Rate	399.00%	0.00%	29.00%	12.59%	11.61%	13.64%
Vendors for which WIC redemptions represented 50 percent or more of revenues	No.	64	25	110	0	0	0
	Rate	20.26%	11.88%	51.58%	0.00%	0.00%	0.00%
All vendors	No.	3,885	3,294	4,463	2,034	2,004	2,060
	Rate	9.34%	7.91%	10.73%	4.89%	4.82%	5.00%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E2a. Confidence Intervals for Redemption Dollars Overcharged and Undercharged by Store Ownership, 2009

Store Ownership		Estimate and Confidence Intervals for Overcharges			Estimate and Confidence Intervals for Undercharges		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Private	Amt.	\$32,456,074	\$23,694,912	\$42,645,347	\$8,170,608	\$7,767,999	\$8,579,828
	Rate	1.31%	0.96%	1.72%	0.33%	0.26%	0.27%
Public	Amt.	\$3,658,690	\$31,593	\$8,832,365	\$4,478,579	\$4,225,483	\$4,746,058
	Rate	0.21%	0.00%	0.52%	0.26%	0.26%	0.27%
Unknown	Amt.	\$626,590	\$32,011	\$2,397,845	\$407,598	\$205,420	\$632,212
	Rate	0.94%	0.05%	3.59%	0.61%	0.51%	0.68%
All vendors	Amt.	\$36,741,354	\$27,385,948	\$48,188,591	\$13,056,785	\$12,627,129	\$13,643,367
	Rate	0.86%	0.64%	1.13%	0.31%	0.30%	0.32%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E2b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Store Ownership, 2009

Store Ownership		Estimate and Confidence Intervals for Vendors Overcharging			Estimate and Confidence Intervals for Vendors Undercharging		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Private	No.	3,349	2,876	3,816	1,525	1,492	1,555
	Rate	11.55%	9.92%	13.17%	5.26%	5.18%	5.33%
Public	No.	372	76	709	408	392	424
	Rate	3.13%	0.64%	5.97%	3.43%	3.41%	3.46%
Unknown	No.	164	43	331	101	83	120
	Rate	22.19%	5.86%	44.77%	13.70%	12.70%	14.77%
All vendors	No.	3,885	2,432	3,366	2,034	2,211	2,277
	Rate	9.34%	5.60%	7.75%	4.89%	5.05%	5.20%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E3a. Confidence Intervals for Redemption Dollars Overcharged and Undercharged by Poverty Level of the Population in the Vendor's ZIP Code Area, 2009

Percentage of Households Below the Poverty Level in ZIP Code		Estimate and Confidence Intervals for Overcharges			Estimate and Confidence Intervals for Undercharges		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
20 percent or less	Amt.	\$24,706,145	\$16,110,825	\$34,620,623	\$10,172,626	\$9,736,155	\$24,706,145
	Rate	7.70%	0.50%	1.08%	0.32%	0.30%	7.70%
More than 20 percent but less than 30 percent	Amt.	\$6,423,800	\$3,330,750	\$10,559,940	\$2,133,103	\$1,889,346	\$6,423,800
	Rate	0.90%	0.47%	1.48%	0.30%	0.28%	0.90%
30 percent or more	Amt.	\$5,611,409	\$3,610,479	\$7,780,807	\$752,056	\$639,955	\$5,611,409
	Rate	1.71%	0.80%	2.98%	0.23%	0.21%	1.71%
All vendors	Amt.	\$36,741,354	\$27,385,948	\$48,188,591	\$13,056,785	\$12,627,129	\$36,741,354
	Rate	0.86%	0.64%	1.13%	0.31%	0.30%	0.86%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E3b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Poverty Level of the Population in the Vendor's ZIP Code Area, 2009

Percentage of Households Below the Poverty Level in ZIP Code		Estimate and Confidence Intervals for Vendors Overcharging			Estimate and Confidence Intervals for Vendors Undercharging		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
20 percent or less	No.	2,415	1,902	2,895	1,321	1,295	1,347
	Rate	7.79%	6.13%	9.33%	4.26%	4.20%	4.32%
More than 20 percent but less than 30 percent	No.	841	613	1,086	405	380	432
	Rate	12.60%	9.18%	16.26%	6.06%	5.88%	6.25%
30 percent or more	No.	628	483	809	308	281	334
	Rate	16.03%	12.32%	20.63%	7.85%	7.57%	8.13%
All vendors	No.	3,885	3,294	4,463	2,034	2,004	2,060
	Rate	9.34%	7.91%	10.73%	4.89%	4.82%	5.00%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E4a. Confidence Intervals for Redemption Dollars Overcharged and Undercharged by Urbanization Area, 2009

Percentage of Population in ZIP Code Identified as Living in Urbanized Area		Estimate and Confidence Intervals for Overcharges			Estimate and Confidence Intervals for Undercharges		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
50 percent or less	Amt.	\$1,194,963	\$82,734	\$3,828,208	\$1,334,989	\$1,230,141	\$1,450,474
	Rate	0.28%	0.02	0.91%	0.32%	0.29%	0.33%
More than 50 percent but less than 90 percent	Amt.	\$5,432,283	\$1,205,946	\$10,633,132	\$3,093,127	\$2,876,576	\$3,327,510
	Rate	0.52%	0.12%	1.02%	0.30%	0.29%	0.30%
90 percent or more	Amt.	\$30,114,108	\$21,846,298	\$40,515,796	\$8,628,669	\$8,151,157	\$9,079,307
	Rate	1.08%	0.78%	1.45%	0.31%	0.46%	0.32%
All vendors	Amt.	\$36,741,354	\$27,385,948	\$48,188,591	\$13,056,785	\$12,627,129	\$13,643,367
	Rate	0.86%	0.64%	1.13%	0.31%	0.30%	0.32%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E4b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Urbanization Area, 2009

Percentage of Population in ZIP Code Identified as Living in Urbanized Area		Estimate and Confidence Intervals for Vendors Overcharging			Estimate and Confidence Intervals for Vendors Undercharging		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
50 percent or less	No.	233	70	419	381	361	402
	Rate	2.89%	0.87%	5.20%	4.74%	4.60%	4.88%
More than 50 percent but less than 90 percent	No.	420	188	685	408	388	426
	Rate	4.31%	1.92%	7.02%	4.18%	4.08%	4.27%
90 percent or more	No.	3,231	2,718	3,721	1,245	1,211	1,277
	Rate	13.57%	11.42%	15.63%	5.23%	5.13%	5.33%
All vendors	No.	3,885	3,294	4,463	2,034	2,004	2,060
	Rate	9.34%	7.91%	10.73%	4.89%	4.82%	5.00%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit E5a. Confidence Intervals for Redemption Dollars Overcharged and Undercharged
by Vendor Authorization Status, 2009**

Vendor Authorization Status		Estimate and Confidence Intervals for Overcharges			Estimate and Confidence Intervals for Undercharges		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Newly authorized vendors in 2009	Amt.	\$1,176,393	\$134,640	\$3,205,868	\$540,035	\$424,921	\$653,198
	Rate	1.33%	0.16%	3.14%	0.43%	0.34%	0.52%
Previously authorized vendors	Amt.	\$35,564,961	\$26,220,906	\$46,839,097	\$12,516,750	\$12,293,229	\$13,258,360
	Rate	85.00%	0.63%	1.13%	0.30%	0.30%	0.32%
All vendors	Amt.	\$36,741,354	\$27,385,948	\$48,188,591	\$13,056,785	\$12,627,129	\$13,643,367
	Rate	0.86%	0.64%	1.13%	0.31%	0.30%	0.32%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

**Exhibit E5b. Confidence Intervals for Number of Vendors Overcharging and Undercharging
by Vendor Authorization Status, 2009**

Vendor Authorization Status		Estimate and Confidence Intervals for Vendors Overcharging			Estimate and Confidence Intervals for Vendors Undercharging		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Newly authorized vendors in 2009	No.	184	51	358	236	213	261
	Rate	5.85%	1.62%	11.36%	6.75%	6.09%	7.46%
Previously authorized vendors	No.	3,701	3,116	4,268	1,798	1,747	1,853
	Rate	6.95%	8.15%	11.11%	4.58%	4.58%	4.86%
All vendors	No.	3,885	3,294	4,463	2,034	2,004	2,060
	Rate	9.34%	7.91%	10.73%	4.89%	4.82%	5.00%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E6a. Confidence Intervals for Redemption Dollars Overcharged and Undercharged by Proportion of Children Under 5 Years Within ZIP Code, 2009

Proportion of Children Under 5 Years		Estimate and Confidence Intervals for Overcharges			Estimate and Confidence Intervals for Undercharges		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Less than or equal to 5.86 percent	Amt.	\$2,716,715	\$863,645	\$5,268,103	\$2,343,794	\$2,227,056	\$2,640,247
	Rate	0.36%	0.12%	0.75%	0.31%	0.29%	0.35%
Greater than 5.86 percent but less than or equal to 6.78 percent	Amt.	\$4,725,678	\$1,834,356	\$8,946,318	\$2,888,286	\$2,771,996	\$3,053,083
	Rate	0.55%	0.21%	1.01%	0.31%	0.30%	0.33%
Greater than 6.78 percent but less than or equal to 7.89 percent	Amt.	\$7,855,859	\$4,442,690	\$12,146,317	\$3,393,879	\$3,242,436	\$3,642,762
	Rate	0.71%	0.39%	1.13%	0.31%	0.29%	0.33%
Greater than 7.89 percent	Amt.	\$21,443,105	\$13,531,736	\$31,194,104	\$4,430,826	\$4,128,990	\$4,830,572
	Rate	1.41%	0.87%	2.04%	0.31%	0.28%	0.33%
All vendors	Amt.	\$36,741,354	\$27,385,948	\$48,188,591	\$13,056,785	\$12,627,129	\$13,643,367
	Rate	0.86%	0.64%	1.13%	0.31%	0.30%	0.32%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E6b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Proportion of Children Under 5 Years Within ZIP Code, 2009

Proportion of Children Under 5 Years		Estimate and Confidence Intervals for Overcharging			Estimate and Confidence Intervals for Undercharging		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Less than or equal to 5.86 percent	No.	499	273	747	457	436	482
	Rate	5.06%	2.78%	7.50%	4.40%	4.19%	4.64%
Greater than 5.86 percent but less than or equal to 6.78 percent	No.	660	411	912	451	430	476
	Rate	6.36%	4.04%	8.79%	4.41%	4.20%	4.65%
Greater than 6.78 percent but less than or equal to 7.89 percent	No.	1,167	858	1,545	505	477	533
	Rate	10.09%	8.03%	14.29%	4.87%	4.60%	5.14%
Greater than 7.89 percent	No.	1,539	1,206	1,943	621	585	661
	Rate	14.66%	11.59%	18.40%	5.85%	5.51%	6.22%
All vendors	No.	3,885	3,294	4,463	2,034	2,004	2,060
	Rate	9.34%	7.91%	10.73%	4.89%	4.82%	5.00%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E7a. Confidence Intervals for Redemption Dollars Overcharged and Undercharged by Proportion of Children Under 1 Year Within ZIP Code, 2009

Proportion of Children Under 1 Year		Estimate and Confidence Intervals for Overcharges			Estimate and Confidence Intervals for Undercharges		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Less than or equal to 1.11 percent	Amt.	\$2,795,456	\$802,247	\$6,279,073	\$2,281,357	\$2,202,603	\$2,427,514
	Rate	0.42%	0.12%	0.93%	0.30%	0.29%	0.32%
Greater than 1.11 percent but less than or equal to 1.37 percent	Amt.	\$5,443,983	\$2,191,671	\$9,482,429	\$3,048,942	\$2,918,754	\$3,386,669
	Rate	0.57%	0.23%	1.04%	0.31%	0.29%	0.34%
Greater than 1.37 percent but less than or equal to 1.66 percent	Amt.	\$7,061,733	\$4,306,212	\$10,633,413	\$3,426,560	\$3,263,959	\$3,628,154
	Rate	0.61%	0.37%	0.94%	0.31%	0.30%	0.33%
Greater than 1.66 percent	Amt.	\$21,440,183	\$13,312,820	\$31,839,783	\$4,299,927	\$3,996,029	\$4,691,942
	Rate	1.44%	0.91%	2.08%	0.31%	0.28%	0.33%
All vendors	Amt.	\$36,741,354	\$27,385,948	\$48,188,591	\$13,056,785	\$12,627,129	\$13,643,367
	Rate	0.86%	0.64%	1.13%	0.31%	0.30%	0.32%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.

Exhibit E7b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Proportion of Children Under 1 Year Within ZIP Code, 2009

Proportion of Children Under 1 Year		Estimate and Confidence Intervals for Vendors Overcharging			Estimate and Confidence Intervals for Vendors Undercharging		
		Estimate	Confidence Intervals		Estimate	Confidence Intervals	
			5th Percentile	95th Percentile		5th Percentile	95th Percentile
Less than or equal to 1.11 percent	No.	509	269	760	453	433	475
	Rate	5.34%	2.85%	7.86%	4.35%	4.16%	4.57%
Greater than 1.11 percent but less than or equal to 1.37 percent	No.	750	494	1,036	460	437	485
	Rate	7.40%	4.86%	10.19%	4.48%	4.26%	4.73%
Greater than 1.37 percent but less than or equal to 1.66 percent	No.	1,170	871	1,488	512	486	542
	Rate	10.42%	7.83%	13.21%	4.94%	4.69%	5.23%
Greater than 1.66 percent	No.	1,455	1,109	1,836	609	575	647
	Rate	13.58%	10.51%	16.92%	5.75%	5.42%	6.10%
All vendors	No.	3,885	3,294	4,463	2,034	2,004	2,060
	Rate	9.34%	7.91%	10.73%	4.89%	4.82%	5.00%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for 2009.