Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) Erroneous Payments to Vendors: Annual Estimates for FY 2011

Summary of Vendor Overcharges and Undercharges for FY 2011

United States Department of Agriculture   **Food and Nutrition Service**   **December 2012**

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Summary of Vendor Overcharges and Undercharges for FY 2011

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ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

BACKGROUND

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), which is administered by the U.S. Department of Agriculture's Food and Nutrition Service (FNS), 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 program violations among food vendors authorized to accept WIC food instruments. The most recent completed study,[1] the 2005 WIC Vendor Management Study (2005 bookend study[2]), found that overcharges amounted to $6.1 million, while undercharges amounted to $15.4 million. In terms of the $3.32 billion paid by WIC for food in that year, overcharges amounted to 0.18 percent, and undercharges amounted to 0.46 percent.[3]

This report provides improper payments estimates for FY 2011 using a methodology for "aging" the 2005 bookend study estimates, updating previous annual reports providing estimates from FY 2005 to FY 2010. 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 2011 amounted to $52.5 million, constituting 1.1 percent of the $4.6 billion in WIC food outlays. This is more in dollar terms than the FY 2010

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[1] A new iteration of the WIC Vendor Management Study is currently underway. Results should be available by 2013.

[2] 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. The 2005 bookend study represents data collected between October 2004 and March 2005. These updates provide estimates for the years between the 2005 WIC Vendor Management Study and the next WIC Vendor Management Study.

[3] It should be noted that these estimates were different from previous studies in two ways. First, overpayments showed a significant decline in dollar amount. Second, underpayments exceeded overpayments for the first time.

figure of $44.0 million and slightly more in percentage terms[4] (see Figure ES-1). Overcharges were estimated at almost $37.0 million (0.8 percent), undercharges at $15.6 million (0.3 percent), and net improper payments at $21.4 million of the annual food outlays.

Figure ES-1. WIC Improper Payments, FY 2011 Update
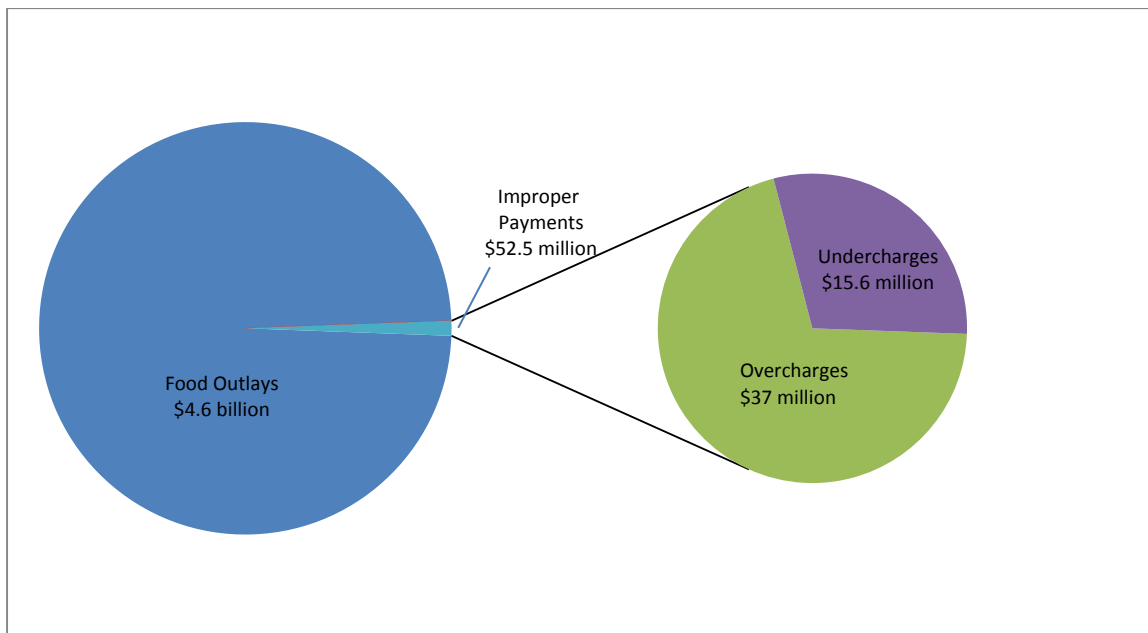
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Figure ES-2 shows the trends in overcharges and undercharges as percentages of WIC food outlays for FY 2005–FY 2011. The FY 2011 food outlay based overcharge rate (0.81 percent) is higher than the rate observed in FY 2010 (0.74) but less than the rates observed in FY 2009 (0.86 percent). In last year's report, an analysis of confidence intervals indicated that the FY 2010 rate strongly suggested that the FY 2010 rate did not change from the FY 2009 rate (differing by 0.12 percentage points), and since this year's estimate is between the two, we would expect that the three rates are consistent.[5]

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[4] The $4.6 billion represents post-rebate food outlays within 45 States and the District of Columbia. Five States (Alaska, Hawaii, Mississippi, North Dakota, and Vermont) were excluded from the estimate, as were the value of foods delivered by direct distribution in other States and transactions in pharmacies and commissaries, to maintain consistency with the estimates generated for the 2005 bookend study. The improper payment estimate reported in USDA's *Performance and Accountability Report* applies the same improper payment rate to all post-rebate food outlays to yield a national estimate.

[5] Appendix E provides the confidence limits for this year's estimates. The 5th and 95th percentiles include the values between 0.59 and 1.04 percent—easily accommodating both the FY 2009 and FY 2010 studies. In general, the confidence limits for each year have accommodated each other, meaning that it is not possible to conclude that the overcharge rate has statistically changed in recent years. For further information, see the 2010 report.

For undercharge rates, the percentage for FY 2011 was identical to that in FY 2010 (0.34 percent). This rate is larger than the FY 2009 rate (0.31 percent). As pointed out in last year's report, the lower value for FY 2009 was outside the confidence range of the FY 2010 value and therefore would be outside the range of the FY 2011 value. Again, this suggests a small increase in the undercharge rate from FY 2009 to FY 2010 and FY 2011, but any speculation should be tempered by the size of the difference and the fact that the FY 2009 through FY 2011 rates are lower than the rates for previous years.

**Figure ES-2. Comparison of Overcharge and Undercharge Rates
by Fiscal Year (FY 2005–FY 2011)
(Percentage of WIC food outlays)**
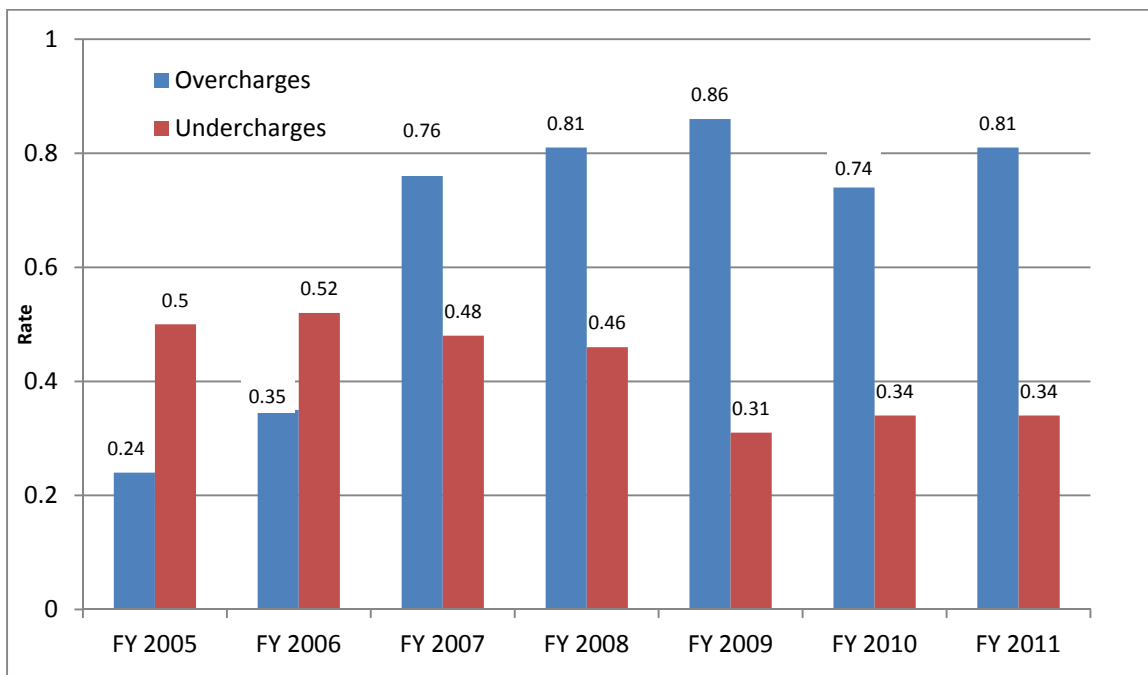
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

The 9.3 percent vendor-based overcharge rate for FY 2011 (i.e., the proportion of vendors overcharging; see Figure ES-3) is greater than the FY 2010 rate (8.3 percent), but consistent with the FY 2009 rate (9.3 percent). The 5th and 95th percentiles for FY 2011 are 8.01 and 10.65 percent—which indicates that all three values cannot be said to be statistically different. This is further supported by last year's report, which found that the difference between the FY 2009 and FY 2010 rates was statistically negligible. The same cannot be said for the differences between overcharge rates in earlier years, particularly those from FY 2005 to FY 2007.

No real change is observed in the vendor-based undercharge rates from FY 2005 to FY 2011.

**Figure ES-3. Comparison of Overcharge and Undercharge Rates
by Fiscal Year (FY 2005–FY 2011)
(Percentage of Vendors)**
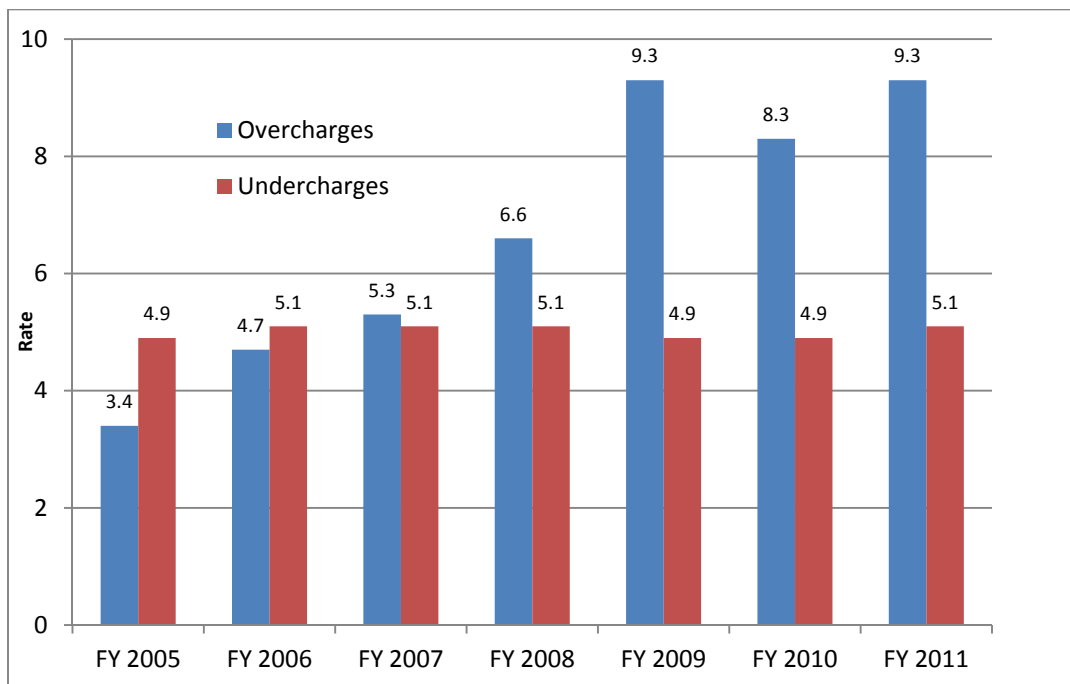
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

This year's estimates seem to indicate that improper payments seem to have continued to level off, at least in terms of rates. However, the larger WIC program (in terms of food outlays) led to increases in the overall level of improper payments. In addition, overcharges exceeded undercharges by a considerable amount. It should be noted, however, that State-level vendor management practices seem to influence these statistics.[6]

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[6] It should be noted that the approach used to generate these estimates does not take into account the variance in the number of investigations across States and in the outcomes of these investigations. Thus, States like New York that have a proportionately high number of investigations will exert more influence on the estimates than another State with far fewer investigations. If a State, as New York does, also has a high overcharge violation rate, they will result in higher estimates. Other States that have a relatively low overcharge violation rate will result in lower estimate. Because of initial specification of the post-stratification approach and the inherent limitation of the approach in adding new State-level post-stratification variables, State-to-State variations were not taken into account. Because of the presence of New York, the results tend to reflect overcharge behaviors in New York more than those in other parts of the country.

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 administered by agencies, most frequently by Department of Health, in the 50 States, the District of Columbia, 34 Indian Tribal Organizations (ITOs), and the 5 U.S. Territories.

WIC provides nutritious foods, nutrition education including breastfeeding promotion and support, and referrals to health and other social services to participants at no charge. WIC serves low-income pregnant, postpartum, and breastfeeding women, infants, and children up to age 5 who are at nutritional risk. Beginning on October 1, 2009, all WIC agencies implemented updated food packages to better meet the nutritional needs of WIC participants. The updated WIC food packages are based on recommendations of the Institute of Medicine and infant feeding practice guidelines of the American Academy of Pediatrics and align with the U.S. *Dietary Guidelines for Americans*. These food packages better promote and support the establishment of successful, long-term breastfeeding, provide WIC participants with a wider variety of foods including fruits and vegetables and whole grains, and provide WIC State agencies greater flexibility in prescribing food packages to accommodate the cultural food preferences of WIC participants.

WIC participants obtain these foods by using a food instrument,[7] which designates the types and amounts of food items participants may purchase at authorized vendors, and cash value vouchers, which can be used to purchase fresh fruits and vegetables. It should be noted that the cash value voucher, unlike the food instrument, is in the form of a dollar-denominated coupon or check that contributes to the purchase of an unspecified kind and amount of fruits and/or vegetables.

Approximately 72 percent of national program expenditures were used for the purchase of supplemental foods in FY 2011. The remaining funds were used for management functions,

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[7] In recent years, several States have implemented Electronic Benefits Transfer (EBT) systems. These systems do not use the standard paper food instrument for transactions. Instead, they provide information on the food types and amounts prescribed to the participant on a monthly basis along with an EBT card to make the purchases. The participant then purchases any or all of these foods using the EBT card, and that purchase is then reconciled in real time against a WIC database to ensure that the purchases conform to the prescription.

nutrition education and counseling, breastfeeding promotion, and health care and social service referrals.

WIC's retail food delivery system works through transactions with authorized vendors. The WIC participant presents the food instrument to the vendor, who adds up the eligible food items that are presented for purchase, inputs the total purchase amount for the food items on the food instrument, and redeems the instrument with the State agency for reimbursement. These vendors include small and large food retailers, pharmacies, WIC-only vendors,[8] and commissaries. In Federal fiscal year (FY) 2011 there were approximately 50,000 vendors authorized by WIC State agencies.[9,10]

PURPOSE OF THE STUDY

One of the programmatic concerns of the Food and Nutrition Service (FNS) is vendor overcharging.[11] Overcharging occurs when vendors, intentionally or not, charge the WIC participant more than a non-WIC customer would pay for food items prescribed by the food instrument. This results in reducing the funds available to serve other participants. Undercharging has also 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.

About every 7 years, FNS performs a study to examine improper payments and other program violations by WIC vendors. Of particular concern relative to improper payments are over- and undercharges. Such studies were conducted in 1991, 1998, and, most recently, 2005,[12, 13] using covert purchases in a nationally representative sample of vendors to produce estimates of the proportion of stores' over- and undercharges and the total dollar value of these transactions. These studies have been denoted as bookend studies because they provide nationally

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[8] 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.

[9] 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.

[10] The roster of WIC agencies in TIP contains duplicate stores. They are duplicates because they are authorized by two different WIC State agencies or have exited the program and reemerged as a new entity. In some cases, larger supermarkets with pharmacies have a WIC authorization number for each component.

[11] 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.

[12] Although the last study references 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.

[13] Another study is scheduled to be fielded in 2012, with an expected final report publishing date in late 2013 or early 2014.

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representative estimates at periodic intervals, leaving the years within for the yearly "aging" estimates, of which this study is one.

On an annual basis, FNS receives information on investigations and other actions taken by WIC State agencies and other entities as part of The Integrity Profile (TIP) data system. The TIP system also provides information on authorized vendors that were not subject to investigations or other actions, including total amounts redeemed during a given fiscal 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 therefore not provide a nationally 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 report under this series of updates 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 food outlay dollars that were paid to vendors.[14] The focus of that examination was to validate a methodology for producing estimates on an annual basis. Additional estimates were generated by studies conducted for FY 2006 through FY 2010 using the TIP data submitted by the States for each year. The estimates provided in this study use the FY 2011 TIP data file. The following research questions are 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)?
- Did the change in WIC eligible foods impact over- and undercharging?

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[14] When a vendor redeems WIC food instruments, they report all transactions made at their stores. The vendor receives a reimbursement from the State. However, the State also receives a contracted reimbursement from formula manufacturers (i.e., the formula rebate), which offsets the amount they pay to vendors. The subject of this study is the amount reimbursed to vendors less the amount reimbursed by formula manufacturers. We refer to this amount as food outlays and this is the amount that is used as the denominator for the estimates produced in this study. The methodology for allocating the rebate to retailers is provided in Appendix A, page A1.

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.

Overcharges represent 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. 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 food outlay dollars, monitoring, investigations, and audit activities. Because investigators target vendors that are most likely to be error prone, using TIP investigation 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.[15]

Undercharges are the extent to which the WIC Program underpaid on safe transactions with vendors. Estimating undercharges required a different approach because TIP does not contain information on vendor undercharging. Undercharge estimates were based on the data collected in the 2005 bookend study, adjusted for changes in WIC food outlay 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.[16]

This report provides information that updates the 2005 bookend study and subsequent estimates through FY 2010, using data from the FY 2011 TIP profile. In addition to estimates on over- and undercharges, two other measures of improper payments are:

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[15] See Appendix B for a more complete discussion of the methodology for developing estimates of overcharges.
[16] The methodology for developing estimates of undercharges is described in Appendix C.

- **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.

Each of these measures is presented in the form of vendor-based and food outlay-based estimates, defined as follows:

- **Vendor-based estimates**—numbers and percentages of vendors involved in over- or undercharging during the FY 2011 reporting period. Because of the definitions and methodologies employed, vendor-based rates for the total and net improper payment estimates are not possible.
- **Food outlay-based estimates**—numbers and percentages of all WIC food outlay dollars resulting from over- or undercharging. Food outlay-based rates are also provided for total and net improper payment estimates.

This report presents estimates of vendor- and food outlay-based over- and undercharge rates for FY 2011 and compares these estimates with those derived in the FY 2005 through FY 2010 annual updates. It describes potential factors affecting variations in improper payments (over- and undercharges), such as vendor type. 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 food outlays 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.

In addition to developing estimates of over- and undercharging, this report explores the effect of the changes in the WIC food package on over- and undercharging. The essence of this analysis is to use previous and current estimates to describe trends were the changes not implemented and to compare them to what occurred in FY 2009 through FY 2011. Finally, an alternative methodology for estimating over and undercharges is explored. The description of the methodology and the results are presented in the 2011 Methodology Report produced under this contract. In this report, we will apply that methodology to the 2011 data, and compare the results to the FY 2009 and FY 2010 results.

RESULTS

NATIONAL ESTIMATES OF OVERCHARGES AND UNDERCHARGES

Overcharges

After the vendor and food-outlay based overcharge estimate dropped slightly in 2010, the 2011 estimates indicated a rate more consistent with the FY 2009 rate (see Figures 1a and 1b). The FY 2011 estimate indicated that approximately 9.3 percent of WIC vendors overcharged and that their overcharges accounted for $37.0 million, or 0.81 percent of the $4.6 billion in food outlays for that year. This vendor-based violation rate is an increase of 1 percentage point from the amount estimated for FY 2010, and an increase of about 7 million dollars, or .07 percentage points over the FY 2010 estimate. Some sense of whether the difference is real or an artifact of sampling differences can be examined by looking at confidence intervals.[17] Confidence intervals were estimated for each of the annual rates to provide a measure of precision. Although the samples used to establish annual confidence intervals were not designed to test for differences across years, they can be useful in determining whether the annual rates are similar. FY 2011's food outlay-based overcharge rate of 0.81 is higher than the FY 2010 estimate (0.74) but lower than the FY 2009 estimate (0.86). Simulation studies show that 90 percent of the subsamples using FY 2011 data lay between 0.59 and 1.04 percent, which would suggest that the two previous years are consistent with this year's estimate. It should be noted however that prior to the estimate produced in FY 2009, the rates showed an upward trend.

The 9.3 percent vendor-based overcharge rate for FY 2011 (i.e., the proportion of vendors overcharging) is an increase over the rate recorded in FY 2010 but the same as that observed in FY 2009. Since 90 percent of the subsamples taken from the TIP 2011 file resulted in estimates between 8.0 and 10.7 percent, the three estimates can be considered to be similar. The same cannot be said for the overcharge rates in earlier years, particularly those from FY 2005 to FY 2007, in which the rate was lower.

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[17] Sampling in this instance refers to the investigation file, and we explore the degree to which estimates vary if one were to select a different set of vendors to investigate. However, it should be noted that the confidence intervals derive from subsamples of the investigated stores, and not from a subsample derived from the whole vendor population.

**Figure 1a. Comparison of Overcharge and Undercharge Rates
by Fiscal Year (FY 2005–FY 2011)
(Percentage of Vendors)**
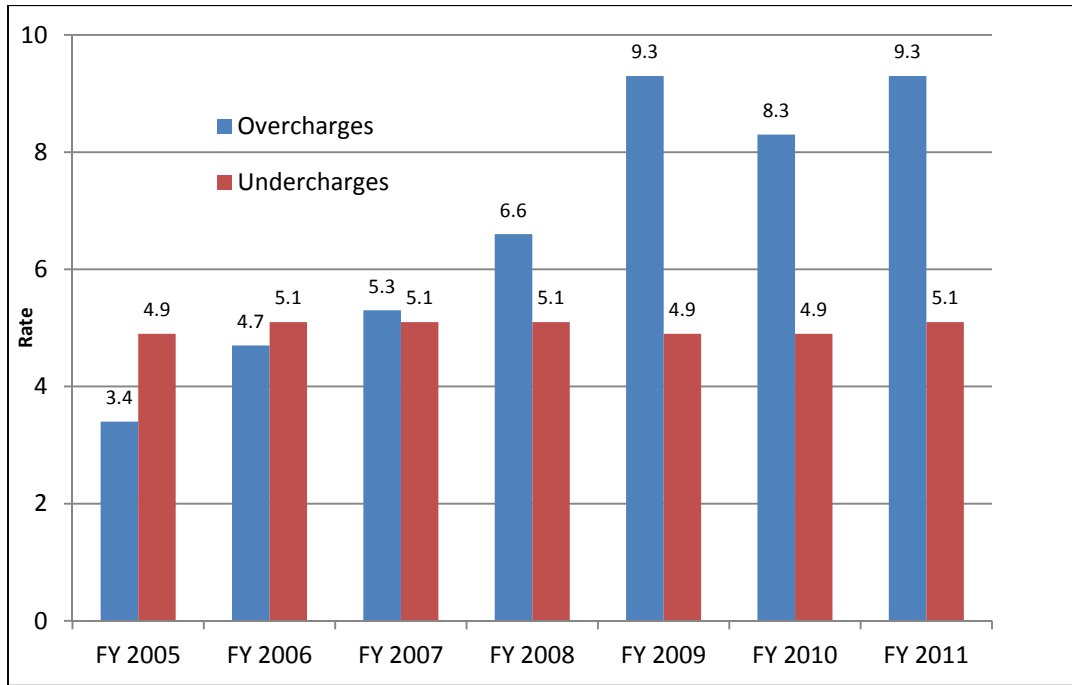
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Undercharges

Vendor-based undercharge rates increased slightly over the FY 2010 undercharge rates, but demonstrated no long term trends when compared to vendor-based undercharge rates since 2006 (see Figures 1a and 1b). In FY 2011, 5.1 percent of the vendors were estimated to have undercharged, for an estimated amount of $15.6 million, or 0.34 percent of the total food outlay for that year. Although the vendor-based rate increased slightly and the total outlays undercharged increased by about $1.5 million, the food outlay-based rate did not change. This discrepancy in the amount undercharged and the undercharge rate is a result of higher overall food outlay figures. In the FY 2010 update, 4.9 percent of the vendors undercharged an estimated equivalent of $13.9 million in food outlays, a rate of 0.34 percent of all food outlay dollars.

For undercharge rates as a percent of food outlays, the FY 2011 estimate is equal to the FY 2010 estimate (0.34 percent) and 90 percent of the subsample estimates falls in a narrow range of 0.33 to 0.35 percent. The FY 2009 estimate of 0.31 percent falls outside this range, and therefore could be considered different. Whether or not this suggests a small increase in the undercharge

rate from FY 2009 to FY 2010, it should be noted that the FY 2009 through FY 2011 rates are lower than the rates for previous years.[18]

**Figure 1b. Comparison of Overcharge and Undercharge Rates
by Fiscal Year (FY 2005–FY 2011)
(Percentage of Food Outlay Dollars)**
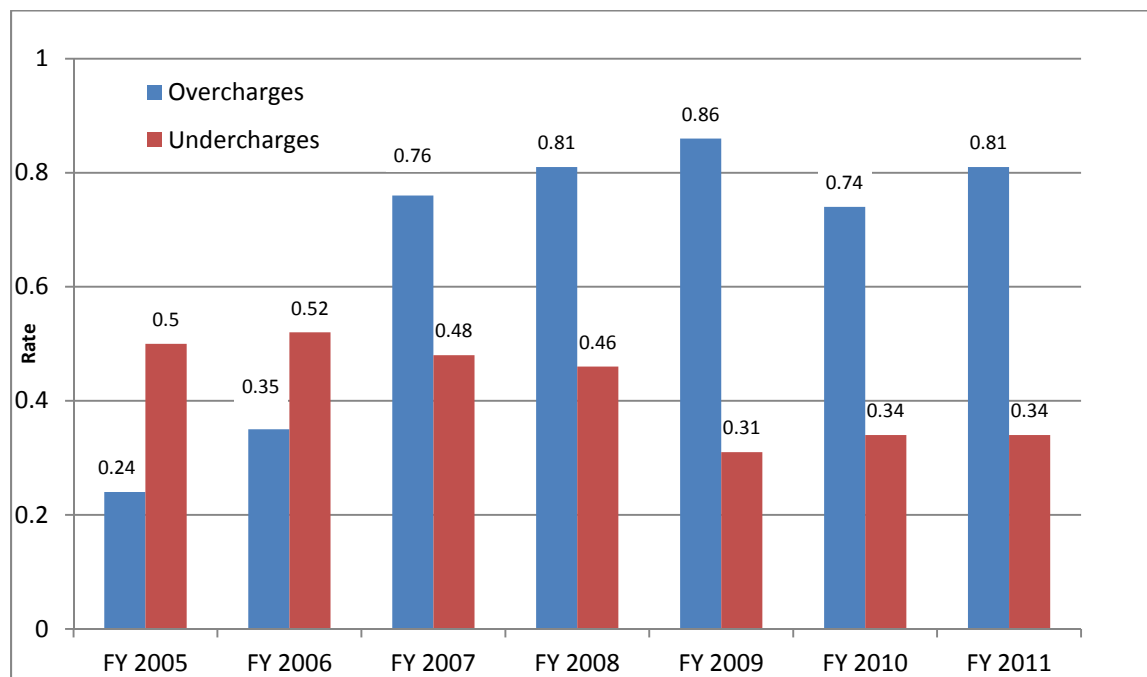
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

With regard to both over- and undercharges, it should be noted that the food outlay-based rates are very small, translating to about $0.81 overcharged and $0.34 undercharged for every $100 spent on food in FY 2010 (see Figure 1b). The small extent of error should be kept in mind when examining the estimates, especially when considering the dramatic drop in undercharge rates.

Total Improper Payments

Total improper payments for FY 2011 were estimated at $52.5 million (see Figure 2). This figure accounts for about 1.1 percent of all food outlay dollars. Net improper payments were equal to $21.4 million, indicating that overpayments, by a relatively large degree, exceeded underpayments.

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[18] It should be noted that the regression equation used for this estimate only reflects factors that are not apt to change dramatically from year to year—thereby imparting a high degree of certainty to the estimates, and very narrow confidence limits. Some of the issues associated with this approach were explored in the 2011 Methodology Report.

Figure 2. WIC Improper Payments, FY 2011 Update

Improper Payments $52.5 million

Food Outlays $4.6 billion

Undercharges $15.6 million

Overcharges $37 million
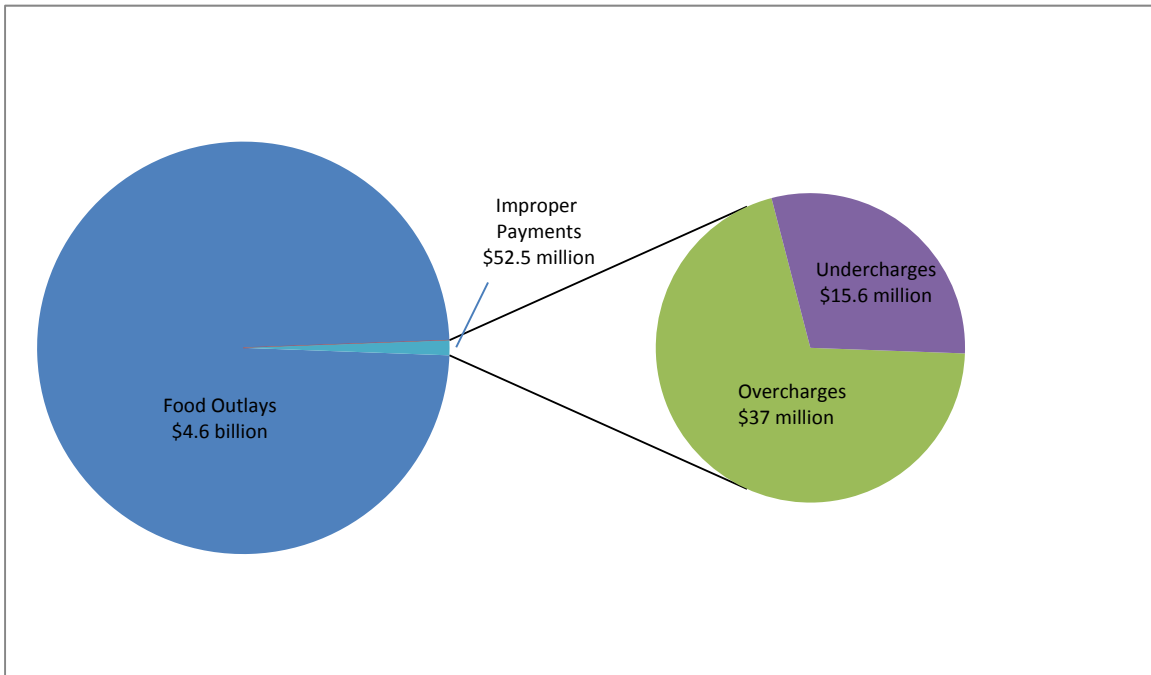
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

SUMMARY OF ACTIVITY (FY 2005–FY 2011)

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 undercharges.

From FY 2005 to FY 2008, the number of WIC vendors remained between 43,000 and 44,000 stores. However, after falling to 41,612 in FY 2009, the number of vendors increased to 42,651 in FY 2010, and again to 44,419 in FY 2011. This number represents vendors in 45 States and the District of Columbia.[19] From FY 2005 to FY 2009, food outlays increased from $3.3 billion to $4.3 billion, but declined to $4.1 billion in FY 2010, and then increased again in FY 2011 to $4.6 billion. The food outlay amounts presented in Figure 3b included vendors classified as retailer, WIC-only vendors, and WIC above-50 percent vendors.

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[19] Five States (Alaska, Hawaii, Mississippi, North Dakota, and Vermont) in addition to the Territories and the Indian Tribal Organizations (ITO's) are excluded. Home-delivery vendors, commissaries and pharmacies are also excluded from this number. These exclusions were consistent with the sampling frame of the 2005 bookend study.

Figure 3a. Number of Vendors Used To Generate Estimates (FY 2005-FY 2011)
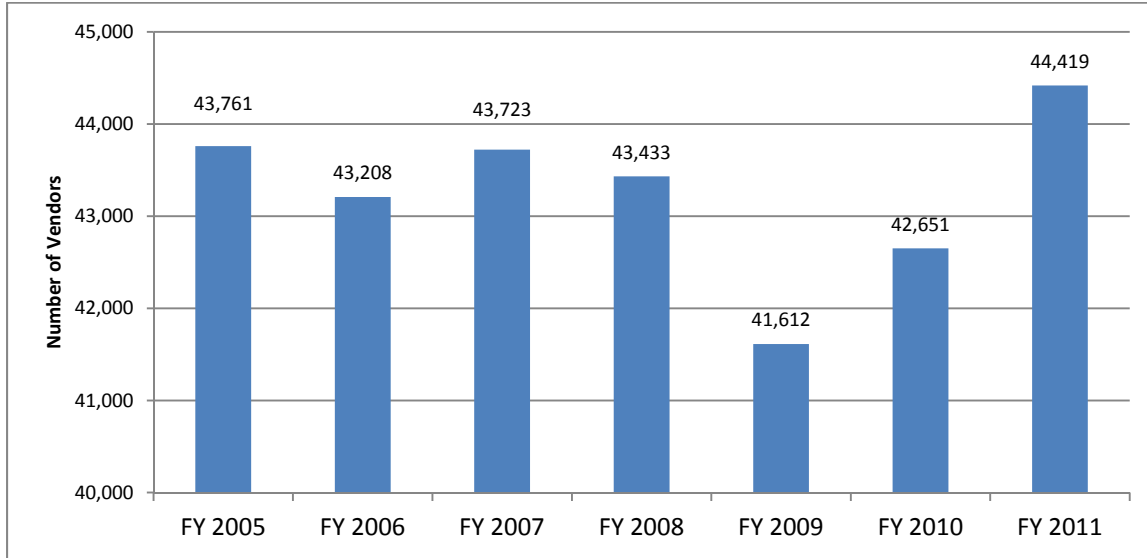
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Figure 3b. Food Outlays of Vendors Included in the Study (2009-2011)
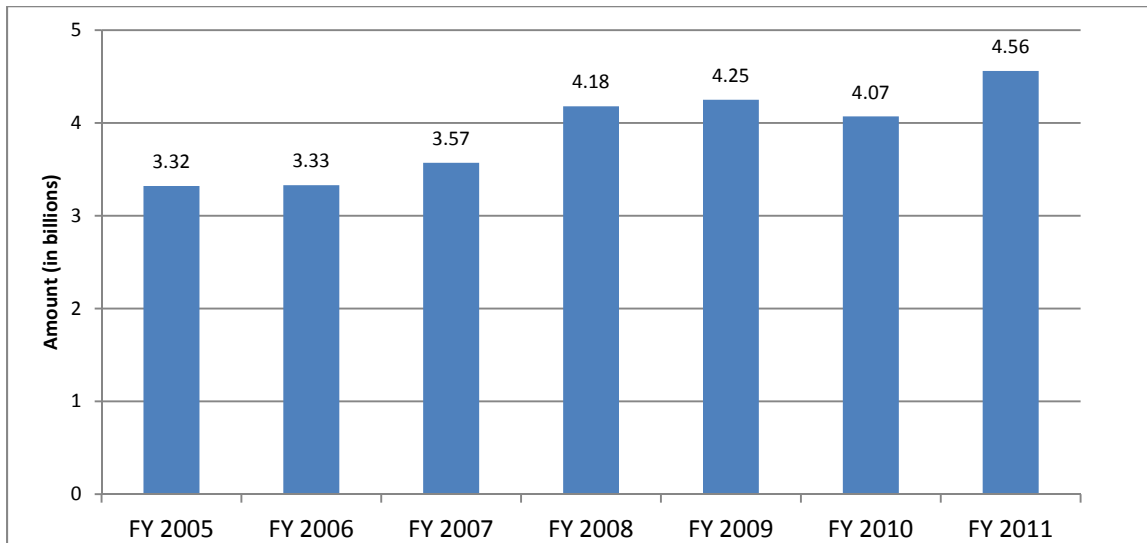
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

During the FY 2005 to FY 2009 period, total improper payments (over- and undercharges) increased from about $25 million to about $50 million, declined to $44 million in FY 2010 (see Figure 3c), and increased to a high of about $53 million in FY 2011. Overcharges increased to $37 million—the highest dollar amount since FY 2005. Undercharges 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. Undercharges increased slightly in dollar terms in FY 2011 to $15.6 million, and remained steady in terms of its share of total food outlays.[20]

Figure 3c. Trends in Total Improper Payments,
Overcharge and Undercharge Amounts (FY 2005-FY 2011)
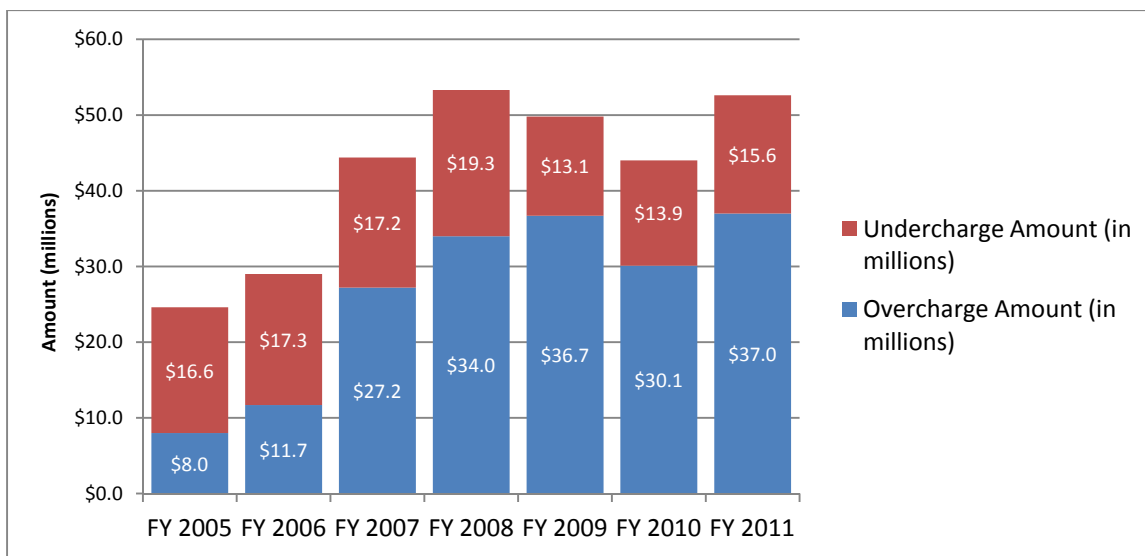
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

POTENTIAL CONTRIBUTING FACTORS TO CHANGING LEVELS OF 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 food outlay-based

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[20] It should be noted that the undercharge amount is directly related to the number of vendors as well as to their composition.

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 2011, large retail vendors (i.e., vendors with gross sales of more than $500,000) had a vendor-based overcharge rate of 4.5 percent (see Figure 4a) compared with a rate of 3.9 percent in the previous year. Still, the amount was less than the 5.5 found in FY 2009. Other types of vendors had overcharge rates as follows:

- 19.3 percent for small retail vendors (i.e., vendors with gross sales equal or less than $500,000), compared with 17.7 percent in the previous year;
- 19.9 percent for retail vendors of unknown size, compared with 31.2 percent in the previous year;
- 18.0 percent for WIC-only vendors, compared with 15.0 percent in the previous year; and
- 18.8 percent for WIC above-50-percent vendors, compared with 18.9 percent in the previous year.

With regard to trends in overcharge amounts, large stores have always maintained a very low rate, indicating that with possibly more oversight over prices and employee behavior in these stores, there is little opportunity for mischarging. It should be noted that the Supplemental Nutrition Assistance Program (SNAP) store classifications, which were used to characterize WIC retailer vendors, were modified in 2007. This reclassification could affect the final statistics when post-FY 2007 estimates are compared to previous years. The most pronounced effect of the reclassification is in our limited ability to classify some stores as large or small. The store types affected are combination stores and convenience stores—both categories including large and small retail stores. In recent years, we have also found it difficult to match a small but notable number of WIC vendors to their characteristics, due to issues with the SNAP identification code reported in TIP. Finally, store categories other than retailers have relatively small representation, thereby possibly leading to issues with the stability of estimates for these vendors over time.

With regard to undercharges, the FY 2011 vendor-based rates were generally similar to previous estimates. WIC above-50-percent and large retail vendors showed the lowest undercharge rates (no undercharging and 3.8 percent, respectively), while 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 2011 Update
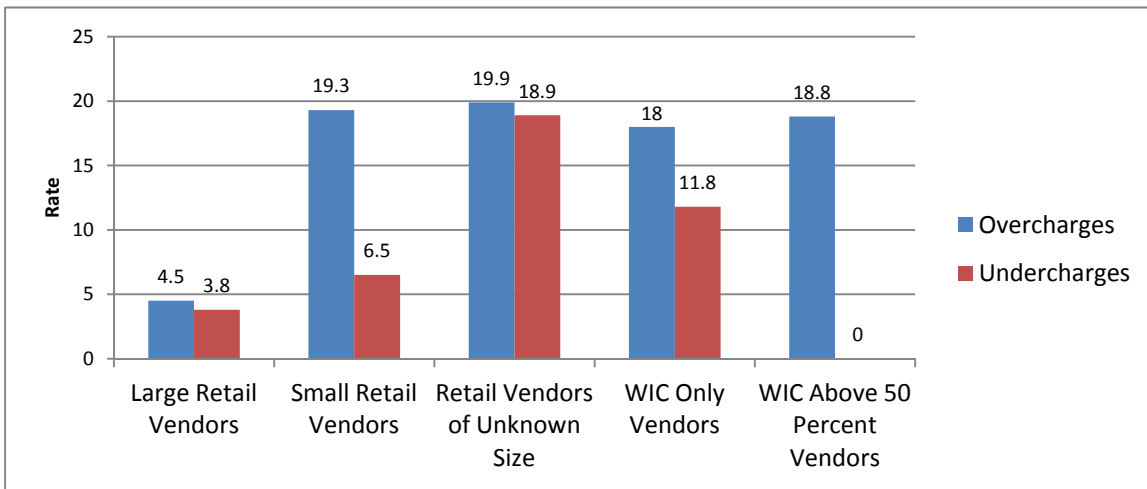
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

In terms of food outlay dollars, large retail vendors had the lowest overcharge rate (0.38 percent) of all store types. This rate is the same as the previous year, but is lower than the rate (0.67 percent) estimated for FY 2009. Retail vendors of unknown size had the highest rate at 3.2 percent, while other types of vendors clustered between 1 and 3 percent (see Figure 4b). With regard to food outlay-based undercharges, in FY 2011 large retail vendors had the lowest rate (0.28 percent), aside from WIC above-50-percent vendors, which showed no undercharging. The other vendor types ranged from 0.49 to 0.70 percent of food outlays. These figures are consistent in relative magnitude with the FY 2010 estimates.

Figure 4b. Food Outlay-Based Overcharge and Undercharge Rates, by Vendor Type, FY 2011 Update
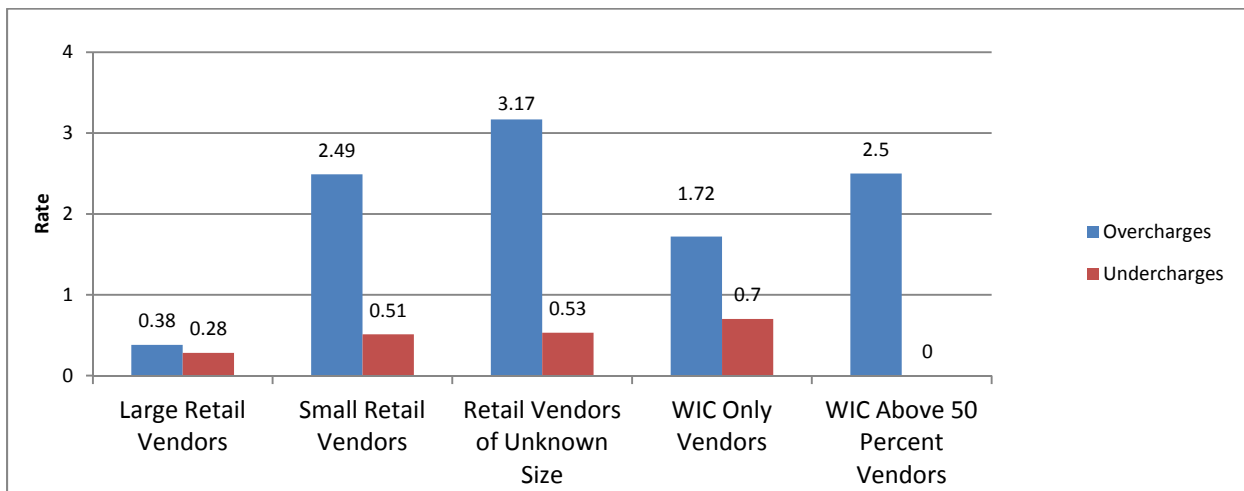
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Ownership Type

Retailers were classified as publicly and privately owned, with some retailers, some WIC above 50 percent vendors and all WIC-only stores classified as unknown. In this context, publicly owned means publicly traded while privately owned means not publicly traded (i.e., all stores in this study are in what is known as the private sector). The thought here was that publicly owned stores have operations that are likely to be open and transparent and thus would be more likely to have management controls in place to avoid violations. The results, as observed in previous studies, reveal that there is a disparity between these two types of vendors. Publicly owned vendors are much less likely to over- and undercharge than privately owned retailers. For example, in Figure 5a, the figures indicate that 0.8 percent of publicly owned retailers overcharged, compared with 12.0 percent of privately owned retailers. Furthermore, those vendors that could not be classified were notably more prone to overcharge than the other two groups. The patterns for undercharges were similar, although the disparity between publicly and privately owned stores was much less.

Figure 5a. Vendor-Based Overcharge and Undercharge Rates,
by Vendor Ownership, FY 2011 Update
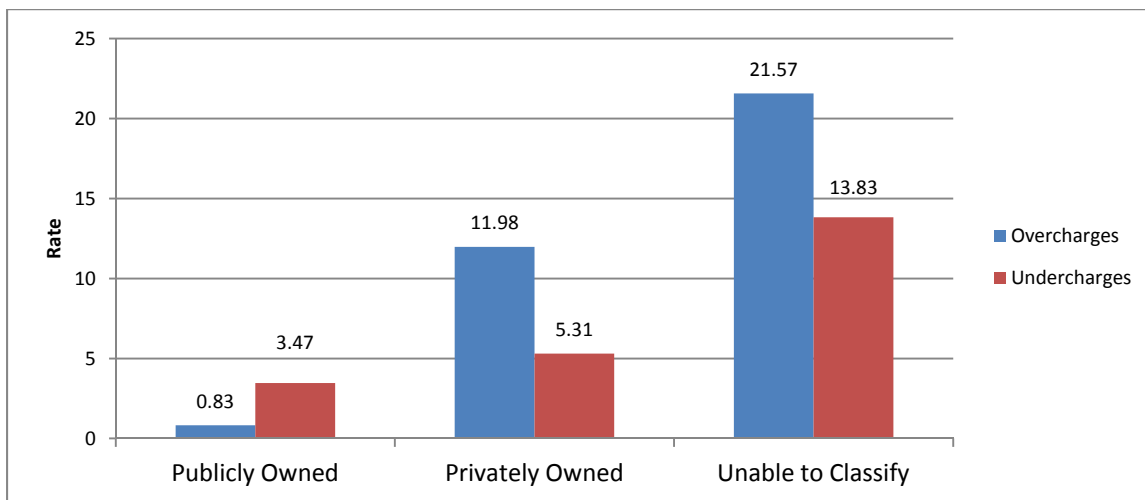
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

In terms of food outlays, there is a relatively large difference in food outlay-based overcharge rates between publicly and privately owned vendors (0.06 percent to 1.15 percent; see Figure 5b). It should be noted that vendors that could not be classified have a much higher overcharge rate (2.1 percent) than privately owned vendors. With regard to undercharges, variation across the three ownership types is less notable, although the pattern of smaller rates of undercharges within publicly owned stores is sustained.

**Figure 5b. Food Outlay-Based Overcharge and Undercharge Rates,
by Vendor Ownership, FY 2011 Update**
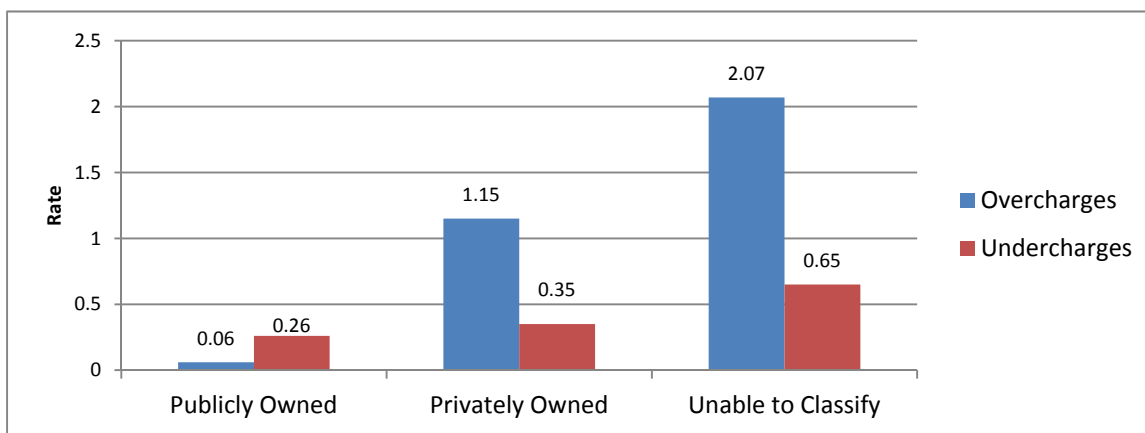
CHANGES IN THE WIC FOOD PACKAGE

FNS required that State agencies implement a revised WIC food package by October 2009, or at the beginning of the 2010 Fiscal Year. This package included additional foods that have more appeal to individuals with different ethnic backgrounds, and it allowed for the purchase of fruits and vegetables. The additional foods would be purchased using the traditional food instrument that specifies the type and quantity of the product (and not the price, although a not-to-exceed amount may be identified), but the purchase of fruits and vegetables is facilitated through a separate cash value voucher in non-EBT states, and a cash benefit voucher in EBT states. With these changes, the potential for errors would be expected to increase, because the new food packages may result in processing complications for the WIC retailer. For example, errors may result from the fact that the new fruit and vegetable benefit is dollar denominated and offered on a separate voucher, while traditional WIC food instruments are defined based on number and size of package or product weight. However, the change was expected to dissipate with time as vendors became familiar with the new instrument and voucher. This section attempts to measure the effects, if any, of these changes in the food package on over- and undercharges.

EFFECT ON OVERCHARGING

For the development of annual overcharge estimates, TIP has been the primary source of information on overcharging in general. However, neither TIP nor any other currently available data source offers any specific information on how the investigations are conducted and thus no linkage to whether overcharges were related to changes in the WIC food packages. However, if we assume that investigations include the full range of purchase options available through food instruments and cash value vouchers, we might expect that any confusion due to the changes would show up during regular food purchases, and thus during purchases made within investigations. In other words, this expression would yield a greater percentage of violations than

would have occurred had the new food packages not been implemented. To examine this question, an interrupted time series approach is used to detect significant differences between pre-change and post-change outcomes, with outcomes being defined as an overcharge. The major comparison is based on constructing an intervention variable that represents the period in which the food package changes were in effect. That intervention variable would indicate the degree to which the outcome variable, as measured in the intervention period, changed relative to earlier periods.

As explained in the above justification, we used TIP data to assess the impact of the changes in food packages on overpayments.[21] TIP data from FY 2005 to FY 2011 were assembled, and the file was processed to include only those records in which the investigation was completed.[22] We also confined the study to the States and vendor types that were used for generating the FY 2011 estimates presented earlier in this chapter. Two State agencies, New York and Delaware, implemented the new food package in early January 2009, about 3 months into FY 2010. All other WIC State agencies implemented the new food package in the latter part of FY 2010.[23] Because TIP does not provide a monthly profile of investigative activity, we considered FY 2010 as the start of the intervention period for New York and Delaware and FY 2011 as start of the intervention period for all other States. For New York and Delaware, we assumed that if the change in the food package had any effect, it would begin to show up in FY 2010.[24]

In examining the changes in the overcharge rate over time, Exhibit 6 reveals that the violation rate (blue line) trends upward between FY 2006 and FY 2009. The rate declines slightly in FY 2010 and then rises again in FY 2011. It should be noted that New York accounted for a very large proportion of investigations. Of the 3,831 investigations occurring in FY 2011, 1,247 (32.6 percent) were conducted in New York. Thus, in the following analysis we will look at New York separately from other State agencies. The trend line for New York showed dramatic increases in the overcharge rate, including the time period from FY 2009 to FY 2010. Although this might be consistent with the hypothesis that overcharging increased as a result of the introduction of the new food package, it does not account for the dramatic rise in the overcharge rate throughout the period. For other State agencies, the rate in both FY 2010 and FY 2011 was about the same as it was in previous years.

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[21] As discussed previously, this sample contains a selection bias that tends toward including those vendors that are most prone to violate. However, we would expect that the sample would be consistently biased over the years with the no reason to assume that there are selection issues with the magnitude of the bias.

[22] The use of completed cases focuses attention on those cases that have a violation/no-violation outcome. Although these outcomes are also present for ongoing and initialized cases, they are most likely the result of the TIP data structure, which does not allow representation of multiple cases involving a particular vendor within a particular year. However, completed cases also are associated with a lag between the actual investigation and its resolution. This lag can span two or more years. Because of this lag, there is an issue concerning whether the intervention can be effectively modeled even with the FY2011 data.

[23] See Appendix F for implementation dates.

[24] One issue is the lag between the actual covert purchases made during an investigation and its completion. Many investigations completed in FY 2011 were conducted in FY 2010, the first year in which the new food package was adopted.

Exhibit 6. Trend in the Overcharge Violations Rate
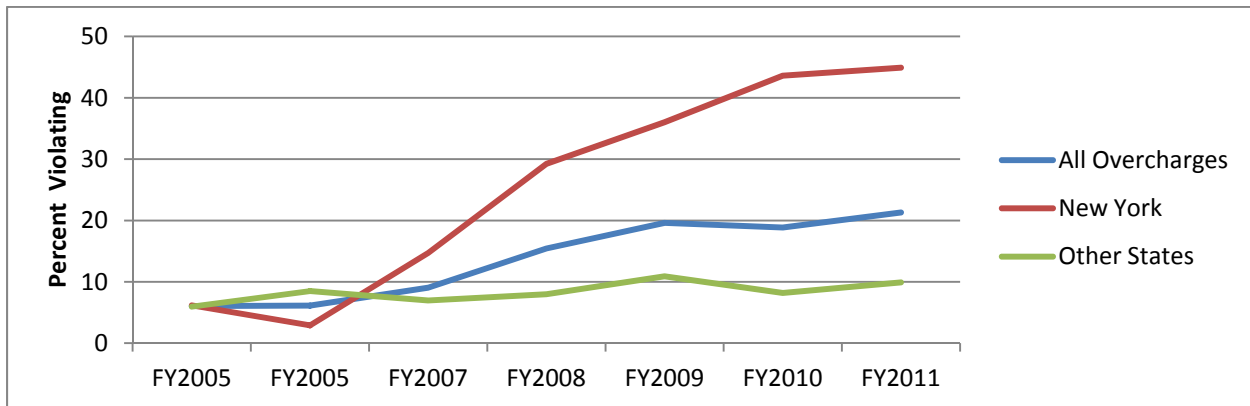
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

To measure the effect independent of the trend and changes in the composition of the vendors, we developed the following model.[25]

$$\Pr(Overcharge(i)) = e^y / (1 + e^y)$$

Where y is a linear combination defined by:

$$y = \alpha + b1\ trend + b2\ intervention \sum_{i=3}^{15} \beta iXi + \varepsilon$$

- α is an intercept term that contains the estimate for cases that are not explicitly included in the equation.
- $b1$ represents a linear trend term, which controls for the linear increase in the proportion of violations.
- $b2$ represents the effect of the impact of the change in the food package (the intervention) controlling for the trend and other variables.
- β_i represent terms that will help ensure that any effect is not due to changes in the vendor population.
- ε is the error term.

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[25] This model is a simple representation meant to identify the effect of the change in the food package controlling for vendor characteristics and other related variables. A more sophisticated model using Bayesian MCMC methods was developed as part of the methodology report. That model, we believe, would be an improvement over the model specified here. However, at the current time, that model can only support analyses for FY2009 and after, which is insufficient for this analysis. That model is discussed in the next section.

The X_i's include the following covariates or control variables. All variables, except for the vendor authorization status, represent those used in the raking process.

- Store Type:

  - Large Stores
  - Small Stores
  - Retailers of Unknown Size
  - WIC-Only Retailers
  - WIC Above-50-Percent Stores

- Ownership:

  - Public
  - Private
  - Ownership Not Known

- Poverty Level:

  - Twenty Percent Under the Poverty Level
  - Twenty to Thirty Percent Under the Poverty Level
  - Thirty or More Percent Under the Poverty Level

- Urbanization Level:

  - Less Than 50 Percent Urbanized
  - Between 50 and 90 Percent Urbanized
  - More Than 90 Percent Urbanized

- Vendor Authorization Status:

  - Authorized in Last Fiscal Year
  - Authorized Prior to Last Fiscal Year

Analysis for New York—Since 2006, almost 30 percent of vendors in New York have been found to be overcharging. Equation 1 was fit to these observations through a logistic regression, with the percentage increasing each year. In last year's study, we found that the change in the food package decreased the probability of an overcharge after other factors (including the long term trend) were considered. This year, the change in the food package was not associated at all with the probability of an overcharge (see Exhibit 7).

Exhibit 7. GLM Regression Results for Predicting the Probability of an Overcharge (New York State)

Source	DF	Chi-Square	Pr > ChiSq
Trend Term	1	276.35	<.0001
Change in Food Package	1	2.43	0.1189
Vendor Type	3	268.42	<.0001
Ownership Type	2	27.94	<.0001
Urbanization Level	2	242.75	<.0001
Poverty Level	2	0.97	0.6161
Vendor Authorization Status	1	113.65	<.0001

Exhibit 8 presents details on these factors. The exhibit shows the variables, the value being modeled, the degrees of freedom, an estimate, standard error, confidence limits, chi-square, and probability that the estimate is significant. The estimates show that there is a significant and positive trend, and the difference between the intervention and nonintervention periods is not significant. Thus, in New York, the period starting with FY 2010 showed no significant difference from that prior to that year. Of course, the number of retailers found overcharging increased dramatically over the whole period, with a possible implication that some of the change could be nested within the trend term.

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Exhibit 8. Maximum Likelihood Parameter Estimates

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	-971.715	59.9767	-1089.27	-854.163	262.49	<.0001
Trend	1	0.4829	0.0299	0.4244	0.5415	261.22	<.0001
Change in Food Package	1	-0.1678	0.1075	-0.3785	0.0429	2.44	0.1185
Large Stores	1	-1.1301	0.2095	-1.5407	-0.7196	29.11	<.0001
Small Stores	1	0.1092	0.1982	-0.2793	0.4977	0.30	0.5818
Store Type Unknown	1	0.4622	0.2955	-0.1169	1.0413	2.45	0.1177
Privately Owned	1	1.2400	0.3143	0.6239	1.8561	15.56	<.0001
Publicly Owned	1	0.2437	0.4555	-0.6490	1.1364	0.29	0.5926
Low Urbanization	1	0.3447	-3.5405	-2.1891	69.06	<.0001	0.3447
Suburban	1	0.2391	-2.4237	-1.4864	66.85	<.0001	0.2391
Low Level of Poverty	1	0.0237	0.0672	-0.1080	0.1554	0.12	0.7246

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Moderate Level of Poverty	1	-0.0466	0.0714	-0.1866	0.0934	0.43	0.5141
New Vendor	1	-1.1900	0.1229	-1.4309	-0.9492	93.79	<.0001

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011

Analysis for State Agencies Other Than New York—In WIC State agencies other than New York, the overall overcharge rate was almost 9 percent. Exhibit 9 provides information on the significance of the various factors in the regression model. All except for the poverty level of the vendor's neighborhood are significant, including the intervention representing the change in the food package.

Exhibit 9. GLM Regression Results for Predicting the Probability of an Overcharge (Other States)

Source	DF	Chi-Square	Pr > ChiSq
Trend	1	10.97	0.0009
Change in the Food Package	1	11.25	0.0008
Store Type	4	273.69	<.0001
Ownership Type	2	79.64	<.0001
Urbanization Level	2	113.82	<.0001
Poverty Level	2	1.65	0.4390
New Vendor	1	16.21	<.0001

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011

Exhibit 10 provides the specific results of the analysis. In short, the trend line is significant and positive, and the intervention (change in food package) is significant and negative.

Conclusions on the Effect of Food Package Changes on Overcharges—Both models show that the effect of food package changes is not positive (i.e., vendors were less likely to overcharge after the food package changes were implemented). This defies our expectation, which was based on the possibility that new products would cause confusion and increase overcharging. Our initial conclusion is that the effect of the food package changes had little effect on overcharge rates. As we noted in the report for the FY 2010 estimates, many cases completed in New York in FY 2009 may have begun in FY 2008, and for all other State agencies, many of the cases completed in FY 2010 may have begun in FY 2009. In addition, many cases that had their field work completed in FY 2009 were still being considered in FY 2010, and many cases initiated in FY 2010 will not be completed until FY 2011. So in general, there is a lag in when the cases were initiated and when they were, or will be, completed. This is

also true of the FY 2011 data as well. We recommend a further examination of this issue for the FY 2012 analysis. However, we also recommend using a more sophisticated approach utilizing the Bayesian regression models utilized in the next major section. This recommendation is based on the kinds of uncertainty related to whether the timing of implementations and investigations. Because there was no positive effect, we did not attempt to estimate the impact in dollar terms.

Exhibit 10. Maximum Likelihood Parameter Estimates

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	-227.832	68.7949	-362.668	-92.9964	10.97	0.0009
Trend	1	0.1129	0.0343	0.0457	0.1801	10.85	0.0010
Change in Food Package	1	-0.3759	0.1117	-0.5948	-0.1570	11.33	0.0008
Large Stores	1	-1.0139	0.2075	-1.4207	-0.6071	23.87	<.0001
Small Stores	1	0.0584	0.2024	-0.3383	0.4552	0.08	0.7729
Store Type Unknown	1	0.2465	0.2521	-0.2477	0.7406	0.96	0.3283
WIC-Only Stores	1	-0.9420	0.2978	-1.5257	-0.3583	10.01	0.0016
Privately Owned	1	-0.4635	0.1756	-0.8077	-0.1192	6.96	0.0083
Publicly Owned	1	-1.5283	0.2233	-1.9659	-1.0906	46.84	<.0001
Low Urbanization	1	-0.9155	0.0986	-1.1088	-0.7223	86.26	<.0001
Suburban	1	-0.4703	0.0911	-0.6489	-0.2917	26.64	<.0001
Low Level of Poverty	1	0.1235	0.0972	-0.0670	0.3139	1.62	0.2037
Moderate Level of Poverty	1	0.1027	0.1062	-0.1054	0.3108	0.94	0.3335
New Vendor	1	-0.6374	0.1709	-0.9724	-0.3024	13.90	0.0002

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011

EFFECT ON UNDERCHARGING

The effect of the food package changes on underpayments is more difficult to estimate because TIP does not contain information on occurrences of undercharges, and the only available source of information is the 2005 WIC Vendor Management Study. We constructed a two-stage approach. First, using data from the 2005 WIC Vendor Management Study, we generated an equation predicting the probability of an undercharge. This is similar to what was done for estimating the undercharge estimates (see Appendix C), except that we revised the equation to include an overcharge variable. This is possible because each vendor was visited three times, during which they could have over- or undercharged. Any instance of undercharging was used.

In this first stage, we estimated the probability of an undercharge using the following factors:

- Large retailers versus all other vendors,
- Small retailers versus all other vendors,
- Newly authorized vendors versus previously authorized vendors,
- Poverty level of the neighborhood,
- Urbanization level of the neighborhood, and
- Whether the store overcharged.

This yielded a set of parameters that were then applied to the dataset that included all complete investigations to obtain the probability of undercharging for each store in the investigative file. Exhibit 11 shows the trend lines for all investigations during the FY 2005 to FY 2011 period and the trend lines for investigations of New York vendors and vendors in other State agencies.[26]

In general, the trend lines show the same trends that we saw when we examined overcharges, except the lines are not as dramatic and they do not drop off during FY 2011. As before, we estimated the impact of the new food package on erroneous payments separately in New York and in other State agencies.

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[26] It should be noted that the estimates here are generally higher than those obtained for overcharges. The belief is that this reflects results showing a higher propensity to undercharge as reported by the 2005 WIC Vendor Management Study.

Exhibit 11. Trend in the Undercharge Violations Rate
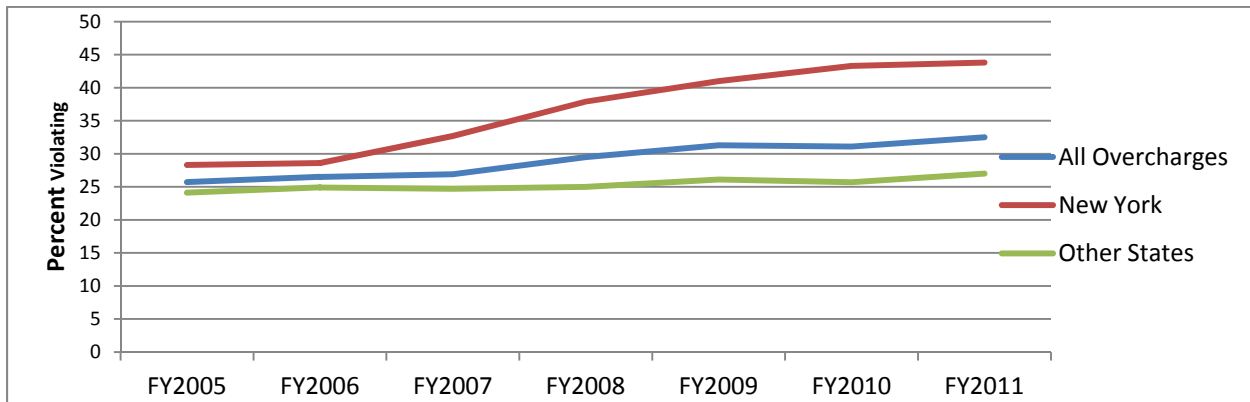
Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Analysis for New York—For this analysis, we used a regression with a probit link function because the dependent variable was a continuous variable within the range of 0 to 1. The results indicate that the linear trend term is positive and significant (see Exhibit 12). The intervention variable was negative and significant, indicating that there was a lower probability that an undercharge would occur during the period in which the new food package was put into place.

Exhibit 12. Analysis of Maximum Likelihood Parameter Estimates

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	-273.731	17.6683	-308.360	-239.102	240.03	<.0001
Trend	1	0.1359	0.0088	0.1187	0.1532	238.47	<.0001
Change in Food Package	1	-0.0664	0.0293	-0.1239	-0.0089	5.13	0.0235
Large Stores	1	-0.5907	0.0613	-0.7108	-0.4706	92.93	<.0001
Small Stores	1	0.4534	0.0584	0.3390	0.5679	60.33	<.0001
Store Type Unknown	1	0.1144	0.0840	-0.0502	0.2790	1.85	0.1732
Privately Owned	1	0.2448	0.0847	0.0788	0.4107	8.35	0.0038
Publicly Owned	1	0.2102	0.1031	0.0081	0.4123	4.15	0.0415
Low Urbanization	1	-0.5937	0.0492	-0.6902	-0.4973	145.49	<.0001
Suburban	1	-0.1347	0.0382	-0.2096	-0.0597	12.41	0.0004
Low Level of Poverty	1	-0.1218	0.0182	-0.1573	-0.0862	45.00	<.0001

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Moderate Level of Poverty	1	0.0146	0.0191	-0.0229	0.0521	0.58	0.4446
New Vendor	1	-0.2792	0.0278	-0.3337	-0.2247	100.88	<.0001

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011

Analysis for State Agencies Other Than New York—Exhibit 13 shows the results when we regress the probability of an undercharge on a trend, intervention, and other factors for State agencies other than New York. Again, the results indicate a positive trend and a negative intervention.

Conclusions on the Effects of the New Food Package on Undercharges— As with overcharges, there seemed to be no positive effects on undercharges from the food package. Therefore, estimating the dollar impact is not appropriate. Because the outcome variable was estimated through a rather circuitous procedure that first obtained a general equation generated from the 2005 WIC Vendor Management Study, then applied that to the completed investigations file to predict the probability of an undercharge, and finally used a regression approach to explore its effect in the intervention period, the estimate may be subject to a great deal of measurement error. As with overcharges, we believe that FY 2012 data will allow for a better estimate.

Exhibit 13. Analysis of Maximum Likelihood Parameter Estimates

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	-44.9705	8.4234	-61.4799	-28.4610	28.50	<.0001
Trend	1	0.0220	0.0042	0.0138	0.0303	27.59	<.0001
Change in Food Package	1	-0.0692	0.0139	-0.0965	-0.0420	24.73	<.0001
Large Stores	1	-0.4896	0.0295	-0.5475	-0.4317	274.82	<.0001
Small Stores	1	0.3791	0.0291	0.3222	0.4361	170.23	<.0001
Store Type Unknown	1	0.0490	0.0373	-0.0241	0.1220	1.72	0.1892
WIC-Only Stores	1	-0.1584	0.0403	-0.2374	-0.0794	15.44	<.0001
Privately Owned	1	-0.1005	0.0254	-0.1503	-0.0507	15.65	<.0001
Publicly Owned	1	-0.1663	0.0281	-0.2213	-0.1113	35.11	<.0001

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Low Urbanization	1	-0.3262	0.0110	-0.3478	-0.3046	876.09	<.0001
Suburban	1	0.0620	0.0099	0.0426	0.0815	39.17	<.0001
Low Level of Poverty	1	-0.0903	0.0121	-0.1141	-0.0665	55.30	<.0001
Moderate Level of Poverty	1	0.0303	0.0132	0.0044	0.0562	5.27	0.0217
New Vendor	1	-0.0997	0.0188	-0.1366	-0.0627	28.00	<.0001

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011

ANALYSIS RELATING TO THE USE OF AN ALTERNATIVE METHODOLOGY

One of the objectives of this project is to advance the development of an alternative method that would replace and improve the current approaches for estimating over and undercharges. A critique of the current raking approach was provided in a methodology report and addendums that were prepared for the 2010 and 2011 WIC Erroneous Payment studies. The 2011 methodology report in particular forwarded an approach that addressed many of the issues associated with the raking algorithm. That approach was based on a post-stratification adjustment regression approach that was cast in the form of a Bayesian solution to providing estimates. Although detailed in the methodology report, we provide a very quick description of the approach with the following.

- TIP completed investigations data are used to estimate a predictive equation that described the probability of an overcharge as a function of WIC vendor characteristics, and State vendor management activities. The model includes notable interaction effects, and allows the regression parameters to vary. Variables used in the raking approach were included.

- The predictive model was applied to all WIC vendors—thereby resulting in a probability of a violation for every WIC vendor, regardless of whether they were investigated or not.

- The sum of these probabilities was calculated is the expected value for the number of overcharge violations nationally. The mean for the average provides the rate.

- Next, using the 2005 WIC Vendor Management study, a distribution was derived that would reflect on the percentage of food outlays that are associated with overcharge violations. Although we attempted to use various vendor characteristics to inform this percentage, no systematic relationships were found relative to vendor characteristics.

- We then used the product of this percentage distribution, with the probability of an overcharge, and total food outlays redeemed by the vendor, to derive the overcharge amount for each vendor. When summed, this value resulted in the total amount of food outlays that were overcharged nationally.

The approach for undercharges was linked to the above approach—mainly by the introduction of an overcharge indicator in the regression for predicting the probability of an undercharge. The rationale for including the variable was that if over and undercharging represent random errors in charging behaviors, the probability of an overcharge and the probability of an undercharge should be associated for a particular retailer. Retailers that are error prone will commit a large number of over and undercharges, while those less error prone will commit a fewer number. Systematic fraud (overcharges) will reduce this association. The approach for estimating undercharging is the following.

- The 2005 WIC Vendor Management study was used to generate a predictive equation that would be applied to the entire WIC Vendor Population to obtain a probability that a vendor would undercharge. As indicated above, in this equation, we estimated the effect of an overcharge on an undercharge. Because the data source is a one-time only survey, this equation will not change from year to year, and will eventually become less valid for depicting undercharge behavior.

- The predictive equation is applied to all vendors in the WIC file. The overcharge variable is the previously derived overcharge probability.

- The sum of the probabilities, once the equation was applied to the population of WIC vendors, provides an overall incidence of undercharging.

- To obtain a dollar value, we developed, from the WIC Vendor Management study, a distribution of values that express the variation in the amount undercharged in the population. This, in addition to the probability of an undercharge, and the amount of food outlays redeemed, was used to develop a vendor based undercharge, which was then summed to obtain a national level figure.

A difference between our approach here and that described in the 2011 Methodology Report is how the regression estimates were handled. In the methodology report, we used the regression parameters estimated from the FY 2010 TIP data to generate an estimate for FY 2009. In this

section, we used the variables specified in the methodology report, and estimated the parameter values for each of three years (FY 2009, FY 2010 and FY 2011) using the data for that year.[27]

The results relating to vendor violation rates are presented in Exhibit 14. Since the current approach uses all investigations to estimate overcharges (raking) and undercharges (regression), not just those that were completed, an important comparison is between the all investigations row and the current estimates row. For overcharges, the alternative approach produces estimates about half as large as the raking approach estimates. For undercharges, the two set of estimates are close. When completed investigations are examined, we again see that the alternative approach produces estimates that are notably smaller (except for FY 2009) than the raking approach. The undercharge estimates are again consistent with those that have been traditionally produced.

Exhibit 14. Comparison of Overcharge and Undercharge Rates
(Percentage of Vendors Overcharging)

Year	Overcharge Estimate			Undercharge Estimate		
	FY 2009	FY 2010	FY 2011	FY 2009	FY 2010	FY 2011
Completed Investigations	9.08%	5.05%	6.28%	4.48%	4.63%	4.75%
All Investigations	4.15%	3.04%	4.41%	4.42%	4.61%	4.72%
Current Approach	9.30%	8.3%	9.3%	4.9%	4.9%	5.1%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011

Exhibit 15 shows in a similar format, the estimates for percent of food outlay dollars over- and undercharged. The results reflect the estimates presented in Exhibit 14. For overcharges, the current approach produces, by far, the highest percentages while the alternative approach using all investigations exhibit the smallest percentages. The drop off in the completed investigation percentages after FY 2009 also reflects the drop off demonstrated in Exhibit 14. The undercharge estimates across the three approaches remain relatively consistent.

Exhibit 15. Comparison of Overcharge and Undercharge Rates
(Percentage of Food Outlays Overcharged)

Year	Overcharge Estimate			Undercharge Estimate		
	FY 2009	FY 2010	FY 2011	FY 2009	FY 2010	FY 2011
Completed Investigations	0.67%	0.41%	0.48%	0.36%	0.37%	0.41%
All Investigations	0.34%	0.29%	0.39%	0.36%	0.40%	0.41%
Current Approach	0.86%	0.74%	0.81%	0.31%	0.34%	0.34%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011

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[27] The approach needs to be explored further in terms of a model that can perhaps include a longitudinal perspective in the regression such as could be described in a hierarchical approach. Such enhancements are discussed in the methodology report.

Discussion

It should be noted that although the development of an alternative approach utilizing Bayesian regression techniques is promising, it needs additional work to address several questions relating to substantive methodological and computational issues. This work should address the following issues:

- An explanation for the drop off in the overcharge rate between FY 2009 and FY 2010 is needed. Explanation for this drop off may lie in events that were occurring in 2009 and in previous years, and not in other years. Examination of a full range of years could provide more information on this pattern. Another issue may be related to the TIP files and how the regression estimates were applied.

- The difference between the current raking overcharge approach and the alternative approaches is large and needs to be assessed. The difference could probably be ascribed to the fact that the raking approach does not stratify by State agency vendor management practices, while the alternative approach takes some State agency vendor management practices into account. In particular, New York is unique in the high number of investigations conducted, and in its high investigative violation rate. The exclusion of State agency vendor management practices from the raking approach allows New York to contribute more to the estimate than other State agencies, thereby yielding a higher rate than if those practices were considered. This leads to a substantive question of whether the New York violation rate is typical nationally or whether State agencies with lower rates are more typical of what actually occurs outside the investigative context.

- The lack of differences in the undercharge rates is expected given that the current method relies on a regression approach, albeit with different specifications. One issue is that the equation derives from information collected as part of the 2005 WIC Vendor Management Study, and reflected the results from that study. New information from the currently ongoing WIC Vendor Management Study would certainly assist in revamping the regression equations and possibly generating better models.

- The alternative approach is similar to the raking approach in being computationally intensive, especially in its approach to generate upper and lower bounds on the estimate. However, some of the files utilized in the alternative approach exceed the ability to generate certain statistics. It may lead to some type of additional sampling techniques to address computational concerns.

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APPENDIX A: VENDOR CHARACTERISTICS

APPENDIX A:

VENDOR CHARACTERISTICS

This appendix describes the distributions of characteristics of the 44,419 WIC vendors described in the FY 2011 TIP data file and used in this analysis, and the associated food outlay dollars.

DERIVATION OF THE ANALYTIC DATASET

The FY 2011 TIP system maintains records for a total of 50,502 authorized WIC vendors in the United States and its Territories and possessions.[28] 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 study:

- 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 ITOs.

In order to replicate the study population examined by the 2005 bookend study, 5,083 vendors in the groups listed above were removed from the FY 2011 TIP file. The remaining vendors were matched with SNAP files to identify their retailer and ownership type.[29]

TIP reports total redemption dollars per vendor including amounts related to the purchase formula. Since the focus of the study is on post-rebate dollars (i.e., food outlays), the TIP redemption dollar figures had to be adjusted. TIP provided a national redemption dollar figure of almost $5.76 billion for the subset of vendors used in this study. FNS recorded WIC food

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[28] TIP reporting on vendors in Alaska was not available for this study.   The absence of Alaska does not affect this analysis since it is one of the States considered "out-of-scope". It should be noted that about 1 to 2 percent of the stores identified as different stores within TIP are in actuality the same vendor (located at the same location), or vendors which were previously authorized. There are various reasons for this including authorization of the same store by two States, the separation of food stores, and associated pharmacies within those stores, and other circumstances that lead stores to seek authorization after they leave the program.

[29] In 2007 SNAP mounted an effort to redesign its store type categories and reassigned retailers to the new categories. Every effort was made to ensure that the store type categories used for the FY 2011 estimate matched those used in previous years.

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outlays of \$4.56 billion for FY 2011 for these stores.[30] Because FNS furnished food outlays by State agency and TIP provided redemption dollars by State agency, we adjusted the amount reported in TIP by the ratio of outlays over TIP-reported redemption dollars by State agency.

As was mentioned above, information from SNAP from the Store Tracking and Redemption System (STARS) 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 focused on the following TIP vendor categories: retailers, WIC-only vendors, and WIC above-50-percent vendors. STARS data were matched to authorized SNAP retailers and used to further categorize WIC retailer vendors. After matching WIC vendors in the FY 2011 TIP file to the STARS 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 FY 2010, large retail vendors' proportion of all vendors declined slightly. In FY 2011, these stores represented 67.3 percent of WIC vendors, compared with 69.4 percent in FY 2010 and redeemed 77.4 percent of all food outlays in FY 2011 (see Exhibits A1 and A2). In contrast, large retail vendors only represented 37.5 percent of all investigated vendors and about 52.2 percent of all investigated vendors' food outlays. Conversely, small retail vendors made up 26.9 percent of all WIC vendors and 54.9 percent of investigated vendors. Like small retail vendors, WIC above-50-percent vendors were investigated at a higher rate (relative to their proportion of the population) than other vendors. Thus, as in earlier years, the focus of investigation tended not to target large retailers.

As mentioned in the main body of this report, one of the issues confounding comparisons with previous years is the use of SNAP to clarify store type information for vendors also participating in the food stamp program. The translation of previous store type designations and current ones was not clear for stores currently classified as combination stores, which include stores that offer a variety of goods but may be of very different sizes. For example, Wal-Mart, despite its usually large grocery offerings, was sometimes paired with very small stores. In addition, the new SNAP store classification schema segmented large, medium, and small-size groceries, designations which were not totally consistent with previous designations. Convenience stores, which can be very large or very small in business volume, pose a similar issue in terms of classification. Another type of issue related to instances of situations where the SNAP authorized store was assigned an unknown store type of SNAP administrative staff. This situation, in particular, led to a relative increase of stores in the unknown category and a seeming decrease in large stores.

Another issue relates to our discovery that the same SNAP ID number was duplicated in the file. Having the same SNAP ID would indicate that the stores, although treated as different stores in WIC, are in fact the same store. There were three reasons for these duplicate IDs. First, the

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[30] The amount was based on those vendors and agencies that were previously defined as being in scope.

vendor provided the wrong SNAP ID, or the State agency erred in recording the information. Second, some vendors, usually on the border of two or more States, are authorized by different WIC State agencies. Because TIP is assembled from State agency files, duplication in this regard cannot be avoided. The third reason this occurs is when a store, located at the same address and having the same or similar name, has one SNAP ID number but multiple WIC vendor ID numbers. Our conclusion is that stores are exiting (voluntarily or not) the roster of WIC authorized vendors and then reentering as a new vendor or being reinstated with a new WIC vendor ID. In any case, the number of stores listed in TIP is somewhat greater than the actual number of different vendors.

Exhibit A1. Distribution of Vendors, by Vendor Type (TIP FY 2011)

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)	2,279	37.47	29,907	67.33
Small retail vendors (retailers with gross sales of $500,000 or less)	3,339	54.89	11,968	26.94
Retail vendors of unknown size	237	3.90	1,357	3.06
WIC-only vendors	115	1.89	875	1.97
WIC above-50-percent vendors	113	1.86	312	0.70
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A2. Distribution of Food Outlay Dollars, by Vendor Type (TIP FY 2011)

Vendor Type	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars
Large retail vendors (superstores, supermarkets, and grocery stores with gross sales of more than $500,000)	$312,683	52.19	$3,530,050	77.38
Small retail vendors (retailers with gross sales of $500,000 or less)	$196,993	32.88	$534,472	11.72
Retail vendors of unknown size	$24,001	4.01	$71,767	1.57
WIC-only vendors	$42,457	7.09	$366,259	8.03
WIC above-50-percent vendors	$22,992	3.84	$59,567	1.31
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

OWNERSHIP

Using STARS, 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. In FY 2011, 69.7 percent of WIC vendors considered for this study were privately owned (about the same percent as in FY 2010). Privately owned WIC vendors accounted for only 53.0 percent of all food outlay dollars (see Exhibits A3 and A4), about the same as in FY 2010. As in the previous years, privately owned vendors were also more frequently investigated (88.4 percent) than publicly owned vendors, and these investigated vendors accounted for a high level of food outlays (75.7 percent) relative to the share transacted by these stores in the population.

Exhibit A3. Distribution of Vendors, by Vendor Ownership (TIP FY 2011)

Ownership Type	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
Private	5,379	88.43	30,678	69.07
Public	490	8.06	12,054	27.14
Unknown	214	3.52	1,687	3.80
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A4. Distribution of Food Outlay Dollars, by Vendor Ownership (TIP FY 2011)

Ownership Type	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars
Private	$453,651	75.72	$2,416,972	52.98
Public	$90,251	15.06	$1,756,005	38.49
Unknown	$55,224	9.22	$389,138	8.53
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

URBANIZATION

WIC vendors were matched by their ZIP Code to Census files, which contained information for calculating the level of urbanization within that ZIP Code. Almost three-fifths of all WIC vendors (59.0 percent) were located in highly urbanized areas (90 percent or more urbanization) (see Exhibit A5). Vendors in these areas also constituted 75.0 percent of all investigated vendors, thus indicting that they were overrepresented in the investigated vendor list. The corresponding proportions of food outlay dollars of highly urbanized vendors among all vendors (67.1 percent) and among investigated vendors (80.5 percent) were also high (see Exhibit A6).

Exhibit A5. Distribution of Vendors, by Urbanization (TIP FY 2011)

Percentage of Population in ZIP Code Identified as Living in Urbanized Area	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
50 percent or less	755	12.41	8,063	18.15
More than 50 percent but less than 90 percent	767	12.61	10,159	22.87
90 percent or more	4,561	74.98	26,197	58.98
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A6. Distribution of Food Outlay Dollars, by Urbanization (TIP FY 2011)

Percentage of Population in ZIP Code Identified as Living in Urbanized Area	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars
50 percent or less	$33,365	5.57	$416,231	9.12
More than 50 percent but less than 90 percent	$83,207	13.89	$1,085,432	23.79
90 percent or more	$482,553	80.54	$3,060,452	67.08
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

PERCENTAGE IN POVERTY

Census files also provided information on the percentage of households below the poverty level within the vendor's ZIP Code area. Three-quarters of vendors (74.7 percent) and 55.5 percent of investigated vendors were located in areas in which 20 percent or less of households live in poverty (see Exhibit A7). About 9.4 percent of all vendors and 22.0 percent of investigated vendors were in areas in which 30 percent or more of households live in poverty. As in previous years, vendors in these higher poverty areas were investigated at a relatively higher rate than other vendors. The food outlay dollar values reflected a similar result (see Exhibit A8). In terms of vendors and food outlay dollars, the lowest poverty areas were investigated least, relative to their representation in the overall population.

Exhibit A7. Distribution of Vendors, by Poverty Level (TIP FY 2011)

Percentage of Households Below Poverty Level	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
20 percent or less	3,316	54.51	33,166	74.67
More than 20 percent but less than 30 percent	1,429	23.49	7,095	15.97
30 percent or more	1,338	22.00	4,158	9.36
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A8. Distribution of Food Outlay Dollars, by Poverty Level (TIP FY 2011)

Percentage of Households Below Poverty Level	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars
20 percent or less	$344,371	57.48	$3,375,808	74.00
More than 20 percent but less than 30 percent	$156,312	26.09	$819,428	17.96
30 percent or more	$98,443	16.43	$366,879	8.04
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

FOOD OUTLAYS

In general, vendors estimated to transact fewer outlay dollars tended to be investigated at approximately the same rate as their high-food outlay counterparts (see Exhibit A9). Exhibit A10, displaying food outlay dollars by quartile, shows that the majority of all food outlay dollars (69.7 percent) were accounted for by investigated vendors redeeming more than $15,954 per vendor per year. This is about the same proportion that was observed in the population (71.3 percent).

Exhibit A9. Distribution of Vendors, by Food Outlay Dollar Quartile (TIP FY 2011)

Food Outlay Dollar Quartile	Investigated Vendors		All Vendors	
	Number	**Percent**	**Number**	**Percent**
Less than or equal to $15,698	1,395	22.93	11,103	25.00
Greater than $15,698 but less than or equal to $48,897	1,978	32.52	11,105	25.00
Greater than $48,897 but less than or equal to $125,839	1,407	23.13	11,106	25.00
Greater than $125,839	1,303	21.42	11,105	25.00
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A10. Distribution of Food Outlay Dollars, by Food Outlay Dollar Quartile (TIP FY 2011)

Food Outlay Dollar Quartile	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	**Percent of All Food Outlay Dollars**	**Total Food Outlays (in thousands)**	**Percent of All Food Outlay Dollars**
Less than or equal to $15,698	$10,005	1.67	$69,532	1.52
Greater than $15,698 but less than or equal to $48,897	$59,993	10.01	$338,404	7.42
Greater than $48,897 but less than or equal to $125,839	$111,596	18.63	$899,578	19.72
Greater than $125,839	$417,531	69.69	$3,254,601	71.34
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

GEOGRAPHIC REGION

FNS has seven Regional Offices serving distinct geographic regions. About 46.4 percent of all investigated vendors were located in the Northeast, which accounted for only 13.8 percent of all vendors (see Exhibit A11). The proportion investigated in this Region is a slight increase (4 percent) from the previous year and an almost 7 percent drop from FY 2009. Most of these investigations took place in New York. The second largest Region in terms of investigations was the Midwest Region (15.1 percent). In food outlay dollar terms, the proportion of dollar values investigated was higher in the Northeast Region (29.2 percent) than in the other Regions (see Exhibit A12).   This variable is not used in the raking approach for estimating overcharges, but the disparity across Regions in the investigated vendor to total vendor ratio would indicate that it might be an important post-stratification factor.   Fortifying this belief is the high rate of investigations resulting in an overcharge outcome (20.5 percent) in the Northeast (similar to that found in the Western—21.4 percent). These rates are different from that found in other regions, thus implying that region should probably be considered in the post-stratification process. However, incorporating this variable in the raking approach would lead to estimation issues as noted in the methodology report (attached as an appendix).

Exhibit A11. Distribution of Vendors, by Geographic Region (TIP FY 2011)

Geographic Region	Investigated Vendors		All Vendors	
	Number	**Percent**	**Number**	**Percent**
Mid-Atlantic	357	5.87	4,736	10.66
Midwest	921	15.14	7,833	17.63
Mountain Plains	424	6.97	5,192	11.69
Northeast	2,824	46.42	6,111	13.76
Southeast	621	10.21	8,726	19.65
Southwest	463	7.61	3,430	7.72
Western	473	7.78	8,391	18.89
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A12. Distribution of Food Outlay Dollars, by Geographic Region (TIP FY 2011)

Geographic Region	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars
Mid-Atlantic	$43,648	7.29	$432,543	9.48
Midwest	$95,387	15.92	$574,341	12.59
Mountain Plains	$40,139	6.70	$456,791	10.01
Northeast	$174,791	29.17	$416,085	9.12
Southeast	$71,997	12.02	$942,114	20.65
Southwest	$61,214	10.22	$513,050	11.25
Western	$111,949	18.69	$1,227,191	26.90
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

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. Unlike previous years, relative to their representation in the vendor population, new vendors were investigated at a rate similar to that for previously authorized vendors. These new vendors represented 8.0 percent of those vendors that were investigated, and they represented about 8.2 percent of the vendor population (see Exhibit A13). In terms of dollars, new vendors accounted for 2.9 percent of food outlay dollars and investigated vendors accounted for a slightly higher percentage (5.6 percent) (see Exhibit A14). Two issues should be noted with regard to new vendors. First, the TIP file contained some stores identified as new vendors that had the same address and sometimes the same name as another vendor that had left the program. Although technically new vendors, these were stores that offered the same set of services as the stores that were previously at those locations. Second, in terms of investigations, many new vendors investigated as "new vendors" in FY 2011 still had undecided cases at the end of year. Because these vendors will not retain the "new vendor" designation in FY 2010, the outcomes of these investigations will be associated with previously authorized vendors, not new vendors.

Exhibit A13. Distribution of Vendors, by Vendor Tenure (TIP FY 2011)

New Vendor	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
No	5,597	92.01	40,794	91.84
Yes	486	7.99	3,625	8.16
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A14. Distribution of Food Outlay Dollars, by Vendor Tenure (TIP FY 2011)

New Vendor	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars
No	$565,473	94.38	$4,432,085	97.15
Yes	$33,653	5.62	$130,030	2.85
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

CHILDREN UNDER 5

Using Census data, the percentage of children under 5 was calculated for the vendor's ZIP Code 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, 35.6 percent of all investigated vendors were from high child-density areas, about 10 percentage points more than their proportion of the vendor population (see Exhibit A15). Of all food outlay dollars accounted for by investigated stores, 45.7 percent were transacted in the highest child-density areas, while the percentage of all food outlay dollars of vendors in these areas was 33.9 percent (see Exhibit A16).

Exhibit A15. Distribution of Vendors, by Percentage of Children Under 5 (TIP FY 2011)

Percentage of Children Under 5	Investigated Vendors		All Vendors	
	Number	Percent	Number	Percent
Less than or equal to 5.86 percent	1,061	17.44	11,104	25.00
Greater than 5.86 percent but less than or equal to 6.78 percent	1,204	19.79	11,106	25.00
Greater than 6.78 percent but less than or equal to 7.89 percent	1,650	27.13	11,106	25.00
Greater than 7.89 percent	2,168	35.64	11,103	25.00
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A16. Distribution of Food Outlay Dollars, by Percentage of Children Under 5 (TIP FY 2011)

Percentage of Children Under 5	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars
Less than or equal to 5.86 percent	$76,826	12.82	$787,236	17.26
Greater than 5.86 percent but less than or equal to 6.78 percent	$94,824	15.83	$1,010,155	22.14
Greater than 6.78 percent but less than or equal to 7.89 percent	$153,803	25.67	$1,217,320	26.68
Greater than 7.89 percent	$273,672	45.68	$1,547,404	33.92
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

INFANTS

Similar to vendors in areas with a high density of children under 5, vendors located in areas with a high density of infants (0-12 months of age) accounted for a greater percentage of investigations (36.2 percent) than their proportion of the vendor population (25.01 percent) (see Exhibit A17). Investigated vendors in areas with high densities of infants also accounted for a greater proportion of food outlay dollars of investigated vendors (44.7 percent) than their proportion of the vendor population (32.3 percent) (see Exhibit A18).

Exhibit A17. Distribution of Vendors, by Percentage of Infants (TIP FY 2011)

Percentage of Infants	Investigated Vendors		All Vendors	
	Number	**Percent**	**Number**	**Percent**
Less than or equal to 1.11 percent	958	15.75	11,105	25.00
Greater than 1.11 percent but less than or equal to 1.37 percent	1,256	20.65	11,104	25.00
Greater than 1.37 percent but less than or equal to 1.66 percent	1,666	27.39	11,101	24.99
Greater than 1.66 percent	2,203	36.22	11,109	25.01
Total	6,083	100.00	44,419	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit A18. Distribution of Food Outlay Dollars, by Percentage of Infants (TIP FY 2011)

Percentage of Infants	Investigated Vendors		All Vendors	
	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars	Total Food Outlays (in thousands)	Percent of All Food Outlay Dollars
Less than or equal to 1.11 percent	$64,067	10.69	$788,708	17.29
Greater than 1.11 percent but less than or equal to 1.37 percent	$107,939	18.02	$1,040,833	22.82
Greater than 1.37 percent but less than or equal to 1.66 percent	$159,617	26.64	$1,247,221	27.34
Greater than 1.66 percent	$267,503	44.65	$1,485,353	32.56
Total	$599,125	100.00	$4,562,115	100.00

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

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 indicators used in TIP and the 2005 bookend study. First, the bookend study indicators reflect outcomes that derive from a one-time data collection on randomly selected stores, while the TIP data reflect continuing investigative actions pursued by trained undercover personnel. This is likely to result in more concerted activity to work a case and perhaps different outcomes than those generated by the 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 not purchased 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 represent only safe buys, thereby making the results, as 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 food outlays represented by overcharges (see below). However, it should be noted that use of these statistics may lead to the underestimation of overcharge rates because partial buys offer the greatest opportunity for overcharging, and these are not being considered in the estimate.

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 food outlay 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

Raking Example

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 3 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 9 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 FY 2011.

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 FY 2011.

In comparing Exhibits B1 and B2, it can be seen that the sample is not consistent with the population—it overstates representation in certain categories and understates it in others. The object of raking is to determine weights that would allow for 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	Total
Low	40	60	100	1,000
Medium	100	200	200	4,000
High	60	40	200	5,000
Total	2,500	2,500	5,000	10,000

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

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 FY 2011.

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 FY 2011.

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 FY 2011.

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 rakings, 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 FY 2011.

Estimation of Weights

Exhibit B8 shows the population of vendors in the FY 2011 TIP file that were sanctioned for overcharging by type of oversight (or compliance investigation).[31] Compliance investigations are covert activities in which an undercover purchaser seeks to uncover instances of fraud and abuse.[32] In previous studies, the raking estimate was based on all investigations that were started in the fiscal year, not just those that were completed. This decision was based on the presence of resolved cases among investigations that were identified in TIP as initiated or ongoing. Discussions regarding the methodology in preparation for this report suggested appropriately that completed cases would probably provide more accurate estimates. In this report, we continue to report estimates using the definition used in previous studies, primarily to maintain our ability to detect trends in improper payments. However, we describe results associated with using completed cases here for comparison purposes.

Of the 6,083 vendors undergoing compliance investigations by State WIC and other agencies, 874, or 14.4 percent, were identified as overcharging. Compared with FY 2010, this was an increase in the number of cases, the number of overcharge violations, and the overcharge rate. In

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[31] 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.

[32] 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).

identifying overcharging, only violations in which the State agency indicated that the reason for sanction was an overcharge were included.

Exhibit B8. Frequency of Overcharges, by Type of Oversight (TIP FY 2011)

Type of Oversight	Total Investigated	Total Overcharging	
		Number	Rate
All compliance investigations by WIC State agency or other entity*	6,083	874	14.37
Competed compliance investigations by WIC State agency or other entity	3,875	734	18.90

* 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 FY 2011.

When the completed compliance investigations are included, the rate jumps 5 percentage points, and almost one of five vendors was caught overcharging.

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 food outlay dollar quartile) were chosen on the basis of previous research on SNAP showing a relationship between food stamp trafficking and vendor and neighborhood characteristics.[33] That research substantiated a basic set of indicators that, when modified, would be useful for characterizing WIC transactions and examining WIC over- and undercharges. These variables are described in greater detail in Appendix A. The raking process established weights for each investigated retailer.

Application of Weights to Vendor Food Outlay Dollar Information

The 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

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[33] 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.

sum of the weighted food outlay dollars represented by the vendors that were found to be overcharging within the sample. The unadjusted food outlay-based overcharge rate was the amount of overcharges found in the population of overcharging vendors divided by the total amount of food outlay dollars reported in the population.

Preliminary raking estimates of the percentage of vendors overcharging in the WIC Program in FY 2011 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 4,138. In percentage terms, this FY 2011 estimate amounts to 9.32 percent of all vendors.

To estimate the variance associated with the raking estimates, an iterative sampling approach was used in which estimates were made for random samples selected from investigated cases.[34] We provide the results of these bootstrap estimates in Appendix E.

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

Food outlay dollar results represent the total amount of food outlay dollars that were estimated to occur with vendors that overcharged and include correctly charged food outlay dollars as well as overcharges. The amount of actual overcharges is a proportion of these food outlays. In FY 2011 approximately $334 million in food outlay dollars were associated with vendors that overcharged, almost equivalent to the FY 2009 figure of $342 million but more than the $281 million observed in FY 2010. This overcharge estimate represents all food outlay dollars for vendors that overcharged. Because it would be expected that not all of these food outlay 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.

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[34] 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 FY 2011.

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 FY 2011.

Using the adjustment factor, the amount is reduced to $36.97 million, which constitutes 0.81 percent of total food outlays. Appendix E provides confidence intervals resulting from iterative sampling.

APPENDIX C: METHODOLOGY FOR THE ESTIMATION OF UNDERCHARGE

APPENDIX C:

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 WIC State agency 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 that 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 food outlay 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 FY 2011.

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 FY 2011.

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 FY 2011.

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 FY 2011.

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,[35] 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 estimated WIC food outlay 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:

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

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 estimated food outlays for that vendor

LR_v is whether the vendor is a large retailer

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[35] 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, these vendors would probably account for a small portion of overall food sales.

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

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 food outlay 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 food outlays estimated 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 food outlay undercharge rate was calculated by determining the total amount of undercharges as a percentage of all food outlay 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 following variables:

- 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 status: Exhibits D5a and D5b;
- Percent of Infants:D6a and D6b,
- Percent of Children Under Five Years of Age: D7a and D7b.

Exhibit D1a. Amount and Percentage of Food Outlay Dollars Overcharged and Undercharged by Vendor Type, FY 2011

Vendor Type	Total Food outlay Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Large retail vendors (superstores, supermarkets, and grocery stores with gross sales of more than $500,000)	$3,530,050,298	$13,603,126	0.38%	$9,890,772	0.28%
Small retail vendors (retailers with gross sales of $500,000 or less)	$534,472,026	$13,312,030	2.49%	$2,727,633	0.51%
Retail vendors with unknown sales	$71,766,526	$2,277,444	3.17%	$378,176	0.53%
WIC-only vendors	$366,258,981	$6,310,601	1.72%	$2,563,943	0.70%
WIC above-50-percent vendors	$59,567,064	$1,464,101	2.5%	$0	0.00%
All vendors	$4,562,114,895	$36,967,302	0.81%	$15,560,523	0.34%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D1b. Number and Percentage of Vendors Overcharging and Undercharging by Vendor Type, FY 2011

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)	29,907	1,340	4.48%	1,141	3.82%
Small retail vendors (retailers with gross sales of $500,000 or less)	11,968	2,312	19.32%	781	6.53%
Retail vendors with unknown sales	1,357	270	19.88%	256	18.86%
WIC-only vendors	875	157	17.98%	103	11.75%
WIC above-50-percent vendors	312	59	18.80%	0.00	0.00%
All vendors	44,419	4,138	9.32%	2,281	5.14%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D2a. Amount and Percentage of Food Outlay Dollars Overcharged and Undercharged by Store Ownership, FY 2011

Store Ownership	Total Food outlay Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Private	$2,416,972,118	$27,845,587	1.15%	$8,429,966	0.35%
Public	$1,756,004,739	$1,075,745	0.06%	$4,613,225	0.26%
Unknown	$389,138,038	$8,045,971	2.07%	$2,517,332	0.65%
All vendors	$4,562,114,895	$36,967,302	0.81%	$15,560,523	0.34%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

**Exhibit D2b. Number and Percentage of Vendors Overcharging and Undercharging
by Store Ownership, FY 2011**

Store Ownership	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
Private	30,678	3,674	11.98%	1,629	5.31%
Public	12,054	100	0.83%	419	3.47%
Unknown	1,687	364	21.57%	233	13.83%
All vendors	44,419	4,138	9.32%	2,281	5.14%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

**Exhibit D3a. Amount and Percentage of Food Outlay Dollars Overcharged and Undercharged by Poverty
Level, FY 2011**

Percentage of Households Below the Poverty Level in ZIP Code	Total Food outlay Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
20 percent or less	$3,375,807,782	$24,322,291	0.72%	$11,753,770	0.35%
More than 20 percent but less than 30 percent	$819,428,029	$8,768,079	1.07%	$2,843,026	0.35%
30 percent or more	$366,879,084	$3,876,942	1.06%	$963,726	0.26%
All vendors	$4,562,114,895	$36,967,302	0.81%	$15,560,523	0.34%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

**Exhibit D3b. Number and Percentage of Vendors Overcharging and Undercharging
by Poverty Level, FY 2011**

Percentage of Households Below the Poverty Level in ZIP Code	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
20 percent or less	33,166	2,532	7.64%	1481	4.47%
More than 20 percent but less than 30 percent	7,095	976	13.76%	452	6.37%
30 percent or more	4,158	629	15.13%	348	8.37%
All vendors	44,419	4,138	9.32%	2,281	5.14%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D4a. Amount and Percentage of Food Outlay Dollars Overcharged and Undercharged by Urbanization Area, FY 2011

Percentage of Population in ZIP Code Identified as Living in Urbanized Area	Total Food outlay Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
50 percent or less	$416,230,950	$693,233	0.17%	$1,356,597	0.33%
More than 50 percent but less than 90 percent	$1,085,432,111	$1,500,934	0.14%	$3,374,365	0.31%
90 percent or more	$3,060,451,834	$34,773,136	1.14%	$10,829,560	0.35%
All vendors	$4,562,114,895	$36,967,302	0.81%	$15,560,523	0.34%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D4b. Number and Percentage of Vendors Overcharging and Undercharging by Urbanization Area, FY 2011

Percentage of Population in ZIP Code Identified as Living in Urbanized Area	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
50 percent or less	8,063	224	2.77%	392	4.86%
More than 50 percent but less than 90 percent	10,159	234	2.30%	449	4.42%
90 percent or more	26,197	3,681	14.05%	1,440	5.50%
All vendors	44,419	4,138	9.32%	2,281	5.14%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D5a. Amount and Percentage of Food Outlay Dollars Overcharged and Undercharged by Vendor Authorization Status, FY 2011

Vendor Authorization Status	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Newly authorized vendors in FY 2011	$143,596,416	$3,345,796	2.33%	$674,903	0.47%
Previously authorized vendors	$4,418,518,479	$33,580,740	0.76%	$15,022,963	0.34%
All vendors	$4,562,114,895	$36,967,302	0.81%	$15,560,523	0.34%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D5b. Number and Percentage of Vendors Overcharging and Undercharging by Vendor Authorization Status, FY 2011

Vendor Authorization Status	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
Newly authorized vendors in FY 2011	2,875	183	6.35%	228	7.93%
Previously authorized vendors	41,544	3,955	9.52%	2,032	4.89%
All vendors	44,419	4,138	9.32%	2,281	5.14%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D6a. Amount and Percentage of Food Outlay Dollars Overcharged and Undercharged by Proportion of Infants Within ZIP Code, FY 2011

Proportion of Children Under 1 Years	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Less than or equal to 5.86 percent	$659,925,764	$2,375,733	0.36%	$2,111,762	0.32%
Greater than 5.86 percent but less than or equal to 6.78 percent	$993,223,842	$5,264,086	0.53%	$3,277,639	0.33%
Greater than 6.78 percent but less than or equal to 7.89 percent	$1,191,150,292	$11,196,813	0.94%	$4,169,026	0.35%
Greater than 7.89 percent	$1,717,814,997	$18,208,839	1.06%	$6,012,352	0.35%
All vendors	$4,562,114,895	$36,967,302	0.81%	$15,560,523	0.34%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D6b. Number and Percentage of Vendors Overcharging and Undercharging by Proportion of Infants Within ZIP Code, FY 2011

Proportion of Children Under 1 Years	Total Vendors	Overcharging		Undercharging	
		Number	Percent	Number	Percent
Less than or equal to 5.86 percent	10,044	479	4.59%	473	4.53%
Greater than 5.86 percent but less than or equal to 6.78 percent	10,704	968	9.04%	501	4.68%
Greater than 6.78 percent but less than or equal to 7.89 percent	11,367	1,337	11.76%	581	5.11%
Greater than 7.89 percent	12,303	1,373	11.16%	766	6.23%
All vendors	44,419	4,138	9.32%	2,281	5.14%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D7a. Amount and Percentage of Food Outlay Dollars Overcharged and Undercharged

by Proportion of Children Under 5 Year Within ZIP Code, FY 2011

Proportion of Children Under 5 Year	Total Redemption Dollars	Overcharges		Undercharges	
		Amount	Percent	Amount	Percent
Less than or equal to 1.11 percent	$742,252,133	$3,488,585	0.47%	$2,449,432	0.33%
Greater than 1.11 percent but less than or equal to 1.37 percent	$939,263,703	$5,541,656	0.59%	$3,099,570	0.33%
Greater than 1.37 percent but less than or equal to 1.66 percent	$1,127,150,781	$10,933,363	0.97%	$3,832,313	0.34%
Greater than 1.66 percent	$1,753,448,279	$17,008,448	0.97%	$6,312,414	0.36%
All vendors	$4,562,114,895	$36,967,302	0.81%	$15,560,523	0.34%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit D7b. Number and Percentage of Vendors Overcharging and Undercharging

by Proportion of Children Under 5 Year Within ZIP Code, FY 2011

Proportion of Children Under 1 Year	Total Vendors	Overcharges		Undercharges	
		Number	Percent	Number	Percent
Less than or equal to 1.11 percent	10,677	630	5.90%	486	4.55%
Greater than 1.11 percent but less than or equal to 1.37 percent	10,991	816	7.42%	502	4.57%
Greater than 1.37 percent but less than or equal to 1.66 percent	11,435	1,420	12.42%	580	5.07%
Greater than 1.66 percent	11,315	1,272	11.24%	717	6.34%
All vendors	44,419	4,138	9.32%	2,281	5.14%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

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 status: Exhibits E5a and E5b;
- Percent of Infants :E6a and E6b,
- Percent of Children Under Five Years of Age: E7a and E7b.

Exhibit E1a. Confidence Intervals for Food Outlay Dollars Overcharged and Undercharged by Vendor Type, FY 2011

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.	$13,603,126	$7,745,651	$20,316,142	$9,890,772	$9,509,228	$10,230,480
	Rate	0.38%	0.22%	0.58%	0.28%	0.28%	0.28%
Small retail vendors (retailers with gross sales of $500,000 or less)	Amt.	$13,312,030	$9,305,703	$17,634,789	$2,727,633	$2,442,843	$3,005,470
	Rate	2.49%	1.74%	3.30%	0.51%	0.50%	0.52%
Retail vendors with unknown sales	Amt.	$2,277,444	$44,597	$5,166,463	$378,176	$172,687	$663,836
	Rate	3.17%	0.06%	7.20%	0.53%	0.38%	0.62%
WIC-only vendors	Amt.	$6,310,601	$803,520	$13,423,594	$2,563,943	$1,918,717	$3,278,348
	Rate	1.72%	0.22%	3.67%	0.70%	0.67%	0.72%
WIC above-50-percent vendors	Amt.	$1,464,101	$65,952	$3,289,434	$0	$0	$0
	Rate	2.50%	0.11%	5.52%	0.00%	0.00%	0.00%
All vendors	Amt.	$36,967,302	$26,918,316	$47,301,612	$15,560,523	$14,748,951	$16,404,219
	Rate	0.81%	0.59%	1.04%	0.34%	0.33%	0.35%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E1b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Vendor Type, FY 2011

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.	1,340	916	1,795	1,141	1,122	1,160
	Rate	4.48%	3.06%	6.00%	3.82%	3.80%	3.83%
Small retail vendors (retailers with gross sales of $500,000 or less)	No.	2,312	1,973	2,636	781	751	810
	Rate	19.32%	16.48%	22.02%	6.53%	6.48%	6.58%
Retail vendors with unknown sales	No.	270	122	436	256	224	289
	Rate	19.88%	8.98%	32.13%	18.86%	18.44%	19.29%
WIC-only vendors	No.	157	35	292	103	86	121
	Rate	17.98%	3.96%	33.33%	11.75%	11.37%	12.16%
WIC above-50-percent vendors	No.	59	15	109	0	0	0
	Rate	18.80%	4.95%	35.00%	0.00%	0.00%	0.00%
All vendors	No.	4,138	3,558	4,731	2,281	2,250	2,311
	Rate	9.32%	8.01%	10.65%	5.14%	5.07%	5.21%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E2a. Confidence Intervals for Food Outlay Dollars Overcharged and Undercharged by Store Ownership, FY 2011

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.	$27,845,587	$20,611,181	$35,669,801	8,429,966	$7,983,109	$8,879,109
	Rate	1.15%	0.85%	1.48%	0.35%	0.34%	0.36%
Public	Amt.	$1,075,745	$0	$4,953,297	4,613,225	$4,327,416	$4,873,689
	Rate	0.06%	0.00%	0.28%	0.26%	0.26%	0.27%
Unknown	Amt.	$8,045,971	$1,945,439	$14,844,756	2,517,332	$1,892,917	$3,238,752
	Rate	2.07%	0.50%	3.81%	0.65%	0.61%	0.68%
All vendors	Amt.	$36,967,302	$26,918,316	$47,301,612	$15,560,523	$14,748,951	$16,404,219
	Rate	0.81%	0.59%	1.04%	0.34%	0.33%	0.35%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E2b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Store Ownership, FY 2011

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.	3,674	3,147	4,200	1,629	1,594	1,662
	Rate	11.98%	10.26%	13.69%	5.31%	5.24%	5.38%
Public	No.	100	0	317	419	401	436
	Rate	0.83%	0.00%	2.63%	3.47%	3.44%	3.51%
Unknown	No.	364	177	565	233	204	264
	Rate	21.57%	10.52%	33.49%	13.83%	13.19%	14.45%
All vendors	No.	4,138	3,558	4,731	2,281	2,250	2,093
	Rate	9.32%	8.01%	10.65%	5.14%	5.07%	4.91%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E3a. Confidence Intervals for Food Outlay Dollars Overcharged and Undercharged by Poverty Level of the Population in the Vendor's ZIP Code Area, FY 2011

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.	$24,322,291	$15,336,670	$33,914,606	$11,753,770	$11,054,249	$12,510,814
	Rate	0.72%	0.45%	1.00%	0.35%	0.34%	0.36%
More than 20 percent but less than 30 percent	Amt.	$8,768,079	$4,647,487	$13,657,861	$2,843,026	$2,457,171	$3,250,458
	Rate	1.07%	0.57%	1.67%	0.35%	0.32%	0.37%
30 percent or more	Amt.	$3,876,942	$1,963,683	$6,586,565	$963,726	$781,576	$1,195,381
	Rate	1.06%	0.54%	1.80%	0.26%	0.24%	0.29%
All vendors	Amt.	$36,967,302	$26,918,316	$47,301,612	$15,560,523	$14,748,951	$16,404,219
	Rate	0.81%	0.59%	1.04%	0.34%	0.33%	0.35%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E3b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Poverty Level of the Population in the Vendor's ZIP Code Area, FY 2011

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.	2,532	2,018	3,047	1,481	1,450	1,511
	Rate	7.64%	6.09%	9.19%	4.47%	4.40%	4.53%
More than 20 percent but less than 30 percent	No.	976	723	1,261	452	423	483
	Rate	13.76%	10.18%	17.77%	6.37%	6.16%	6.58%
30 percent or more	No.	629	471	793	348	321	375
	Rate	15.13%	11.34%	19.07%	8.37%	8.03%	8.67%
All vendors	No.	4,138	3,558	4,731	2,281	2,250	2,311
	Rate	9.32%	8.01%	10.65%	5.14%	5.07%	5.21%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E4a. Confidence Intervals for Food Outlay Dollars Overcharged and Undercharged by Urbanization Area, FY 2011

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.	$693,233	$64,859	$1,781,038	$1,356,597	$1,232,123	$1,477,529
	Rate	0.17%	0.02%	0.43%	0.33%	0.32%	0.33%
More than 50 percent but less than 90 percent	Amt.	$1,500,934	$297,211	$3,809,668	$3,374,365	$3,113,450	$3,644,168
	Rate	0.14%	0.03%	0.35%	0.31%	0.30%	0.32%
90 percent or more	Amt.	$34,773,136	$24,762,424	$45,085,567	$10,829,560	$10,038,907	$11,623,355
	Rate	1.14%	0.81%	1.47%	0.35%	0.34%	0.37%
All vendors	Amt.	$36,967,302	$26,918,316	$47,301,612	$15,560,523	$14,748,951	$16,404,219
	Rate	0.81%	0.59%	1.04%	0.34%	0.33%	0.35%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E4b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Urbanization Area, FY 2011

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.	224	49	421	392	368	413
	Rate	2.77%	0.61%	5.22%	4.86%	4.72%	5.01%
More than 50 percent but less than 90 percent	No.	234	100	398	449	428	471
	Rate	2.30%	0.99%	3.91%	4.42%	4.31%	4.54%
90 percent or more	No.	3,681	3,144	4,229	1,440	1,403	1,478
	Rate	14.05%	12.00%	16.14%	5.50%	5.40%	5.59%
All vendors	No.	4,138	3,558	4,731	2,281	2,250	2,311
	Rate	9.32%	8.01%	10.65%	5.14%	5.07%	5.21%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

**Exhibit E5a. Confidence Intervals for Food Outlay Dollars Overcharged and Undercharged
by Vendor Authorization Status, FY 2011**

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 FY 2010	Amt.	$3,345,796	$402,070	$7,251,619	$674,139	$498,281	$872,017
	Rate	2.33%	0.28%	5.05%	0.47%	0.35%	0.61%
Previously authorized vendors	Amt.	$33,580,740	$23,860,000	$53,022,222	$15,022,963	$14,046,254	$15,851,073
	Rate	0.76%	0.54%	1.20%	0.34%	0.32%	0.36%
All vendors	Amt.	$36,967,302	$26,918,316	$47,301,612	$15,560,523	$14,748,951	$16,404,219
	Rate	0.81%	0.59%	1.04%	0.34%	0.33%	0.35%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E5b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Vendor Authorization Status, FY 2011

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 FY 2010	No.	183	66	317	228	200	259
	Rate	6.35%	2.29%	11.02%	7.93%	6.97%	9.01%
Previously authorized vendors	No.	3,955	3,382	4,447	2,032	1,973	2,089
	Rate	9.52%	8.14%	10.70%	4.89%	4.75%	5.03%
All vendors	No.	4,138	3,558	4,731	2,281	2,250	2,093
	Rate	9.32%	8.01%	10.65%	5.14%	5.07%	4.91%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E6a. Confidence Intervals for Food Outlay Dollars Overcharged and Undercharged by Proportion of Infants Within ZIP Code, FY 2011

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.	$2,375,733	$729,824	$4,717,809	$2,111,762	$1,994,160	$2,353,070
	Rate	0.36%	0.11%	0.71%	0.32%	0.30%	0.36%
Greater than 1.11 percent but less than or equal to 1.37 percent	Amt.	$5,264,086	$2,372,492	$9,978,920	$3,277,639	$3,042,516	$3,597,464
	Rate	0.53%	0.24%	1.00%	0.33%	0.31%	0.36%
Greater than 1.37 percent but less than or equal to 1.66 percent	Amt.	$11,196,813	$5,679,615	$17,139,462	$4,169,026	$3,690,267	$4,661,100
	Rate	0.94%	0.48%	1.44%	0.35%	0.31%	0.39%
Greater than 1.66 percent	Amt.	$18,208,839	$10,332,320	$35,252,999	$6,012,352	$5,337,021	$6,867,579
	Rate	1.06%	0.60%	2.05%	0.35%	0.31%	0.40%
All vendors	Amt.	$36,967,302	$26,918,316	$47,301,612	$15,560,523	$14,748,951	$16,404,219
	Rate	0.81%	0.59%	1.04%	0.34%	0.33%	0.35%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E6b. Confidence Intervals for Number of Vendors Overcharging and Undercharging

by Proportion of Infants Within ZIP Code, FY 2011

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.	479	245	751	479	449	499
	Rate	4.59%	2.35%	7.19%	4.53%	4.29%	4.78%
Greater than 1.11 percent but less than or equal to 1.37 percent	No.	968	658	1,338	501	474	529
	Rate	9.04%	6.15%	12.50%	4.68%	4.43%	4.95%
Greater than 1.37 percent but less than or equal to 1.66 percent	No.	1,337	1,002	1,706	581	548	617
	Rate	11.76%	8.81%	15.01%	5.11%	4.82%	5.42%
Greater than 1.66 percent	No.	1,373	1,055	1,708	766	718	818
	Rate	11.16%	8.57%	13.88%	6.23%	5.84%	6.65%
All vendors	No.	4,138	3,558	4,731	2,281	2,250	2,093
	Rate	9.32%	8.01%	10.65%	5.14%	5.07%	4.91%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E7a. Confidence Intervals for Food Outlay Dollars Overcharged and Undercharged by Proportion of Children Under 5 Years Within ZIP Code, FY 2011

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.	$3,488,585	$1,204,165	$5,943,291	$2,449,432	$2,226,756	$2,672,108
	Rate	0.47%	0.18%	0.90%	0.33%	0.30%	0.36%
Greater than 5.86 percent but less than or equal to 6.78 percent	Amt.	$5,541,656	$2,289,716	$11,037,697	$3,099,570	$2,817,791	$3,381,349
	Rate	0.59%	0.23%	1.11%	0.33%	0.30%	0.36%
Greater than 6.78 percent but less than or equal to 7.89 percent	Amt.	$10,933,363	$5,781,601	$17,052,508	$3,832,313	$3,494,167	$4,395,888
	Rate	0.97%	0.49%	1.43%	0.34%	0.31%	0.39%
Greater than 7.89 percent	Amt.	$17,008,448	$9,304,112	$28,879,905	$6,312,414	$5,435,690	$7,013,793
	Rate	0.97%	0.54%	1.68%	0.36%	0.31%	0.40%
All vendors	Amt.	$36,967,302	$26,918,316	$47,301,612	$15,560,523	$14,748,951	$16,404,219
	Rate	0.81%	0.59%	1.04%	0.34%	0.33%	0.35%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

Exhibit E7b. Confidence Intervals for Number of Vendors Overcharging and Undercharging by Proportion of Children Under 5 Years Within ZIP Code, FY 2011

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.	630	354	914	486	461	514
	Rate	5.90%	3.39%	8.75%	4.55%	4.32%	4.81%
Greater than 5.86 percent but less than or equal to 6.78 percent	No.	816	529	1,113	502	476	531
	Rate	7.42%	4.94%	10.40%	4.57%	4.33%	4.83%
Greater than 6.78 percent but less than or equal to 7.89 percent	No.	1,420	1,057	1,811	580	547	614
	Rate	12.42%	9.30%	15.93%	5.07%	4.78%	5.37%
Greater than 7.89 percent	No.	1,272	1,046	1,738	717	672	767
	Rate	11.24%	8.51%	14.13%	6.34%	5.94%	6.78%
All vendors	No.	4,138	3,558	4,731	2,281	2,250	2,093
	Rate	9.32%	8.01%	10.65%	5.14%	5.07%	4.91%

Source: WIC Erroneous Payments to Vendors: Annual Estimates for FY 2011.

APPENDIX F: WIC FOOD PACKAGE IMPLEMENTATION FINAL DATES

Blue—Early Implementer

Green—Implemented by Regulatory Deadline of October 1, 2009

Red—Late implementer

WIC State Agency	Implementation Date
ACL (ITO)	10/01/2009
Alabama	09/28/2009
Alaska	10/01/2009
American Samoa	10/01/2009
Arizona	10/01/2009
Arkansas	10/01/2009
California	10/01/2009
Cherokee Eastern Band (ITO)	10/01/2009
Cherokee Nation of OK (ITO)	10/01/2009
Cheyenne River Sioux (ITO)	10/01/2009
Chickasaw Nation (ITO)	08/03/2009
Choctaw (MS) (ITO)	10/01/2009
Choctaw (OK) (ITO)	08/03/2009
Citizen Potawatomi (ITO)	10/01/2009
Colorado	06/01/2009
CNMI	10/01/2009
Connecticut	10/01/2009
Delaware	01/01/2009
District of Columbia	10/01/2009
Eastern Shoshone (ITO)	10/01/2009
Eight Northern Pueblo (ITO)	10/01/2009
Five Sandoval (ITO)	10/01/2009
Florida	10/01/2009
Georgia	10/01/2009
Guam	10/01/2009
Hawaii	10/01/2009
Idaho	10/01/2009
Illinois	08/03/2009
Indiana	09/28/2009
Indian Township (ITO)	10/01/2009

ITCA (ITO)	10/01/2009
ITCN (ITO)	10/01/2009
ITC (OK) (ITO)	08/03/2009
Iowa	10/01/2009
Kansas	08/01/2009
Kentucky	05/04/2009
Louisiana	10/01/2009
Maine	10/01/2009
Maryland	10/01/2009
Massachusetts	10/01/2009
Michigan	08/03/2009
Minnesota	09/01/2009
Mississippi	10/01/2009
Missouri	10/01/2009
Montana	11/30/2009
Muscogee (Creek) (ITO)	08/03/2009
Navajo Nation (ITO)	06/02/2009
Nebraska	10/01/2009
Nevada	10/01/2009
New Hampshire	10/01/2008
New Jersey	10/01/2009
New Mexico	10/01/2009
New York	01/03/2009
North Carolina	10/01/2009
North Dakota	10/01/2009
Northern Arapaho (ITO)	10/01/2009
Ohio	10/01/2009
Oklahoma	08/01/2009
Omaha Nation (ITO)	10/01/2009
Oregon	08/03/2009
Osage Nation (ITO)	08/03/2009
Otoe-Missouria (ITO)	08/03/2009
Pennsylvania	10/01/2009
Pleasant Point (ITO)	10/01/2009
Pueblo of Isleta (ITO)	10/01/2009

Pueblo of San Felipe (ITO)	10/01/2009
Pueblo of Zuni (ITO)	09/01/2009
Puerto Rico	10/01/2009
Rhode Island	10/01/2009
Rosebud Sioux Tribe (ITO)	10/01/2009
Santee Sioux (ITO)	10/01/2009
Santo Domingo (ITO)	10/01/2009
Seneca Nation (ITO)	10/01/2009
South Carolina	05/01/2009
South Dakota	09/03/2009
Standing Rock Sioux (ITO)	07/01/2009
Tennessee	10/01/2009
Texas	10/01/2009
Three Affiliated (ITO)	10/01/2009
Utah	07/01/2009
UTE Mountain (ITO)	05/01/2009
Vermont	10/01/2009
Virginia	10/01/2009
Virgin Islands	10/01/2009
Washington	10/01/2009
WCD Enterprises (ITO)	08/01/2009
West Virginia	10/01/2009
Winnebago (ITO)	10/01/2009
Wisconsin	08/03/2009
Wyoming	10/01/2009