Special Nutrition Programs Report Series
Office of Research and Analysis

Special Nutrition Programs Report No. CN-12-NSLP

Modeling of High Risk Indicators of Certification Error in the National School Lunch Program

Final Report

USDA United States Department of Agriculture
Food and Nutrition Service

April 2012

Non-Discrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination in all of its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.)

Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write: USDA, Director, Office of Adjudication, 1400 Independence Ave., SW, Washington, DC 20250-9410 or call (866) 632-9992 (Toll-free Customer Service), (800) 877-8339 (Local or Federal relay), (866) 377-8642 (Relay voice users). USDA is an equal opportunity provider and employer.

April 2012
Special Nutrition Programs
Report Number: CN-12-NSLP

Modeling of High Risk Indicators of Certification Error in the National School Lunch Program

Final Report

Authors:
Quinn Moore
Nancy Cole
Elizabeth Potamites

Submitted by:
Mathematica Policy Research, Inc.
P.O. Box 2393
Princeton, NJ 08543-2393

Submitted to:
Office of Research and Analysis
USDA, Food and Nutrition Service
3101 Park Center Drive, Room 1014
Alexandria, VA 22302-1500

Project Director:
Nancy Cole

Project Officer:
Karen Castellanos-Brown

This study was conducted under Contract number AG-3198-D-09-0068 with the Food and Nutrition Service.

This report is available on the Food and Nutrition Service website: *http://www.fns.usda.gov/ora*

Suggested Citation:

U.S. Department of Agriculture, Food and Nutrition Service, Office of Research and Analysis, Modeling of High Risk Indicators of Certification Error in the National School Lunch Program, by Quinn Moore, Nancy Cole, & Elizabeth Potamites. Project Officer: Karen Castellanos-Brown. Alexandria, VA: April 2012.

This page has been left blank for double-sided copying.

ABSTRACT

This study facilitates further efforts to combat certification error in the National School Lunch Program (NSLP). The project included two distinct efforts. First, we developed statistical models to identify indicators of Local Education Agencies (LEAs) with high-risk of certification error. Second, we designed a web-based monitoring tool that will apply the model parameters to Verification Summary Report (FNS-742) data annually, and publish results for access by State Child Nutrition agencies (SAs).

Statistical models were estimated using certification error measures from two other studies: (1) the NSLP and School Breakfast Program (SBP) Access, Eligibility, and Certification (APEC) study; and (2) the Regional Office Review of Applications (RORA). Explanatory variables are from VSR, Common Core of Data (CCD), Census Small Area Income and Poverty Estimates (SAIPE), and Bureau of Labor Statistics Local Area Unemployment Survey (LAUS). In developing these models we tested a variety of alternative model specifications and selected final models based on predictive power and good fit to the data. The resulting models perform well in validation analysis, indicating that they are good predictors of certification error. Model results suggest that districts with higher overall expected certification error risk include: (1) larger districts, (2) districts not using random verification samples and with higher levels of benefit reduction through verification, (3) districts not using random verification samples and with higher levels of verification nonresponse, and (4) districts with lower levels of students certified through categorical eligibility.

The statistical models produce overall certification error estimates that can be used by the monitoring tool to categorize district certification risk in a way that is simple, targeted, and responsive to time-varying LEA characteristics. In 2009, the 16 percent of districts identified as high- risk by the tool are estimated to account for 68 percent of national certification error. In the six years of data examined in the study, most districts were never high-risk and only 7 percent of districts were high-risk in every year.

The monitoring tool can be used by SAs to select LEAs for additional administrative reviews (AARs). The tool synthesizes the model-based certification error estimates and other LEA information to provide a platform for consistent application of AAR selection criteria. The tool also provides historical information from VSR since SY 2008-2009, and the tool stores SA selections for AARs for review and consideration in future years.

This page has been left blank for double-sided copying.

ACKNOWLEDGMENTS

The authors wish to express their gratitude to the many individuals who assisted with this study. At Mathematica, several colleagues providing invaluable support: Eric Lundquist and Ama Takyi assisted with programming support, Kari Beckmann provided clerical support, James Mabli helped with the initial project design, and Phil Gleason reviewed the statistical modeling approach.

This project was completed under the guidance of Karen Castellanos-Brown, the project officer at the Food and Nutrition Service (FNS), who reviewed drafts of the final report and provided comments on the risk development tool throughout its stages of development. We also thank Sheku Kamara, the initial project officer, who provided review and comments on drafts of the analysis plan and initial steps of database development.

Many other individuals at the USDA Food and Nutrition Service read this report, reviewed the risk assessment tool, and provided helpful comments: Margaret Applebaum, Jay Hirschman, Ted Macaluso, Lynn Rodgers, Cindy Long, and Susan Weeks.

Finally, we thank our collaborators, Chris Macek, Blaise Barstow, and Susan Rice at Relyon Media who built the Risk Assessment Tool and brought this study to life for Child Nutrition Administrators.

This page has been left blank for double-sided copying.

CONTENTS

EXECUTIVE SUMMARY xiii

I STUDY OBJECTIVES AND BACKGROUND 1

A. National School Lunch Program Certification 2

1. Direct Certification 3
2. NSLP Applications 4
3. Provisions I, II, and III 5

B. National School Lunch Program Verification 6

C. Prior Research on NSLP Certification Error 7

D. Organization of the Report 7

II STUDY DESIGN 9

A. Data Sources 9

1. Creating Analysis Files 10
2. Constructing Measures of Certification Error 12
3. Constructing Variables Potentially Related to Certification Error 16

B. Methodological Approach 17

1. Specification of Statistical Models 17
2. Selection of Dependent Variables 18
3. Selection of Explanatory Variables 20
4. Assessment of Model Performance and Reporting of Model Results 25

III MODELING RESULTS 27

A. APEC Overall Certification Error 28

1. Specification for Certification Error Models 28
2. Results of Certification Error Models 31

B. APEC Household Reporting Certification Error 36

1. Specification for Household Reporting Certification Error Models 36
2. Results of Certification Error Models 37

C. APEC Administrative Certification Error 41

1. Specification for Administrative Certification Error Models 41
2. Results of Certification Error Models 42

III *(continued)*

D. RORA Administrative Certification Error 44

1. Specification for Administrative Certification Error Models 44
2. Results of Certification Error Models 45

IV DEVELOPMENT OF RISK ASSESSMENT MONITORING TOOL 47

A. Design and Development of Risk Assessment Tool 47

1. Development of the Risk Assessment Tool 47
2. Risk Assessment Tool Criteria for Selecting SFAs for AARs 48
3. Thresholds for High and Medium-Risk of Certification Error 49
3. Characteristics of Districts by Risk Category 58
4. Relationship of District Size to Chosen Risk Definitions 60

B. Operation and Reporting of the Monitoring Tool 61

1. Reporting in the Monitoring Tool 62

C. Strengths and Weaknesses of the Monitoring Tool 65

V CONCLUSION 68

A. Study Achievements 68

B. Limitations of the Study 70

C. Conclusion 71

REFERENCES 72

APPENDIX A: GOODNESS OF FIT MEASURES FOR CANDIDATE MODELS

APPENDIX B: STATE-SPECIFIC THRESHOLDS FOR CERTIFICATION ERROR RISK CATEGORIZATION

APPENDIX C: ADDITIONAL RESULTS FROM STATISTICAL MODELS: APEC OVERALL REPORTING ERROR

APPENDIX D: ADDITIONAL RESULTS FROM STATISTICAL MODELS: APEC HOUSEHOLD REPORTING ERROR

APPENDIX E: ADDITIONAL RESULTS FROM STATISTICAL MODELS: APEC ADMINISTRATIVE ERROR

APPENDIX F: CHARACTERISTICS OF DISTRICTS BY CATEGORY OF RISK FOR HOUSEHOLD REPORTING ERROR AND ADMINISTRATIVE ERROR

TABLES

II.1 Analysis Files for Modeling of High-Risk Indicators of NSLP Certification Error 11

II.2 Measures of Certification Error Rates Used in Regression Models, by Analysis File 15

II.3 List of Core Variables Included in Statistical Models, by Error Rate Used as a Dependent Variable in the Relevant Model 22

II.4 List of Candidate Variables Considered for Inclusion in Statistical Models, by Data Source 23

III.1 Validation Results for Different Specifications of Tobit Models of APEC Overall Certification Error Rates (Percentages) 29

III.2 Coefficient Estimates from Tobit Model of APEC Overall Certification Error Rate Related, by Error Subcomponent 32

III.3 Validation Results for Different Specifications of Tobit Models of APEC Household Reporting Certification Error Rates (Percentages) 37

III.4 Coefficient Estimates from Tobit Models of APEC Household Reporting Certification Error Rate, by Error Subcomponent 38

III.5 Validation Results for Different Specifications of Tobit Models of APEC Administrative Certification Error Rates (Percentages) 42

III.6 Coefficient Estimates from Tobit Model of APEC Administrative Certification Error Rate 43

III.7 Validation Results for Different Specifications of Tobit Models of RORA Administrative Certification Error Rates Applied to SY2009–10 VSR Data (Percentages) 45

III.8 Coefficient Estimates from Tobit Model of RORA Administrative Reporting Certification Error Rate 46

IV.1 Average Dollar Amount and Rate of Imputed Erroneous Payments for Districts in the 2009 VSR, by Certification Error Risk Category 53

IV.2 Sum Total Dollar of Imputed Erroneous Payments Across Districts in the 2009 VSR, by Certification Error Risk Category (In Millions of Dollars) 53

IV.3 Targeting in the 2009 VSR for Certification Error Risk Definitions Based on Certification Error Levels, State-Specific Thresholds, and Different Certification Error Rate Floors 55

IV.4 Examples of Risk Scores for Different Estimated Erroneous Payment Amounts and Different State Distributions of Erroneous Payments 58

IV.5 Average Characteristics of Districts in the 2009 VSR, by Certification Error Risk Category (Percentage Unless Otherwise Noted) 59

FIGURES

I.1 Growth in the Percentage of LEAs with Directly Certified Students 4

I.2 Distribution of Students Certified for Free/RP School Meals 5

I.3 NSLP Verification Sample Sizes 6

IV.1 Percentage of VSR Districts Classified as High or Medium-Risk of Certification Error, 2004-2009 51

IV.2 Certification Error Risk Score for VSR Districts, 2004-2009 56

IV.3 Number of Years VSR Districts Identified as High or Medium-Risk for Certification Error, 2004-2008 54

IV.4 Number of Years VSR Districts Identified as High or Medium-Risk for Certification Error for 2004-2008, by Risk Definition Rate Floor 55

EXHIBITS

IV.1 Process Used by the Monitoring Tool to Generate Annual District Certification Error Risk Estimates 61

IV.2 Screenshot of the Primary Report Generated by the Monitoring Tool 63

This page has been left blank for double-sided copying.

EXECUTIVE SUMMARY

Previous studies have found that certifications for free or reduced price (FRP) meals are prone to error. The most recent study—the NSLP and School Breakfast Program (SBP) Access, Eligibility, and Certification (APEC) study—found that one in five children certified for FRP meals in SY 2005-2006 was erroneously certified or incorrectly denied benefits, with overpayments accounting for more than three-fourths of errors (Ponza et al. 2007).[1] The APEC study was conducted to comply with the Improper Payments Information Act (IPIA) of 2002, which also required follow-up action to reduce payment errors.

The USDA Food and Nutrition Service (FNS) took action to reduce erroneous payments in the NSLP by disseminating the APEC results and providing technical assistance to States and LEAs based on those findings. Further, FNS completes two collections of information about school meal certification and verification: (1) the Verification Summary Report (FNS-742) and (2) the Regional Office Review of Applications (RORA). Analyses of data from these collections are now published annually. FNS has also encouraged the use of systems of records and computer matching for NSLP direct certification and direct verification as a way to improve the accuracy of eligibility determinations, improve access for eligible children, and reduce burden for households and local education agencies (LEAs). FNS annually reports to Congress on direct certification implementation progress and direct certification effectiveness.

The above efforts have identified aggregate trends in NSLP certification practices and verification results. Certification is the process by which LEAs approve (or deny) applications for free or reduced-price school meals. Verification is the process by which LEAs annually select a small sample of NSLP applications and contact households for documentation to verify the application. Since SY 2005-2006, verification samples are not random (except for LEAs qualifying for alternative sampling) and do not provide unbiased estimates of certification error rates.

Further efforts to combat certification error require information about where problems exist and where they are most severe. It is not feasible, however, to accurately measure certification error at each LEA on an ongoing basis. Accurate measurement requires an independent audit of a sufficiently large sample of NSLP applications. An alternative is to identify measurable characteristics of LEAs that are indicators of their risk for certification error.

The Food and Nutrition Service (FNS) contracted with Mathematica Policy Research to develop a model of high-risk indicators of certification error. This study has two objectives:

- Develop an econometric model, based on APEC data and findings, to identify indicators of LEAs with high risk of certification error.

[1] Ponza et al. found that, among certified students, 15.8 percent of students were certified for a higher level of benefits than that for which they were eligible (the overcertification rate); 6.0 percent of students either certified for a lower level of benefits than that for which they were eligible (the undercertification rate). The total certification error rate for certified students was 21.8 percent (15.8 + 6.0); and overcertification accounted for nearly three-fourths of errors (15.8/21.8 = 72.4 percent).

- Provide a web-based monitoring tool that will apply the model parameters to Verification Summary Report (FNS-742) data annually, and publish results for access by State Child Nutrition (CN) agencies.

The second objective provides a tool that States may use to identify LEAs for annual reviews and assistance aimed at reducing certification errors.

A. Methods for Developing of Statistical Models of Certification Error

A key step in developing the certification error monitoring tool is to estimate statistical models of certification error. These models summarize the relationship between LEA characteristics and three types of certification error:

- ***Household reporting certification error***, which occurs when parents do not report correct information about their household circumstances on their application,
- ***Administrative certification error***, which occurs when LEA staff make errors processing an application, and
- ***Overall certification error***, which is the result of either household reporting or administrative error.[2]

The APEC study provides measures of household reporting, administrative, and overall error; RORA provides additional measures of only administrative error. LEA characteristics used in the models are drawn from a broad set of datasets, including Verification Summary Report (VSR), Common Core of Data (CCD), Census Small Area Income and Poverty Estimates (SAIPE), and Bureau of Labor Statistics Local Area Unemployment Survey (LAUS).

Three analysis files, described in Table ES.1, were constructed and used for this study. The APEC and RORA files were used to develop statistical models of certification error; these files contain measures of error that were used as dependent variables in regression analysis. VSR contains a census of LEAs participating in the NSLP, with counts of students certified for free and reduced-price meals, and results of LEA verification efforts. VSR does not contain unbiased measures of certification error and could not be used to estimate models of certification error. The results of models based on APEC and RORA are applied to VSR data to provide estimates of certification error in available years.

To develop the statistical models, we tested alternative model specifications and selected final models based on predictive power and good fit to the data. We used Tobit regression to model certification error rates because these rates are percentages that are bounded between 0 and 100. We tested models of total certification error (based on all NSLP applications), and disaggregated measures of overpayment and underpayment errors within each category of students approved for free meals, reduced-price meals, and not certified. Selection of LEA characteristics for the model was determined by both the theoretical relationships with certification error, and an automated process of determining characteristics that are correlated with error. We tested the model by applying model parameters developed from APEC and RORA to a national census of LEAs in VSR data. These features of the modeling process are described in Table ES.2.

[2] Reporting and administrative error do not always result in the student receiving the incorrect certification status. For the purposes of this study, we consider only cases in which the error affected certification status.

Table ES.1. Analysis Files for Modeling of High-Risk Indicators of NSLP Certification Error

	Analysis Files		
	APEC	RORA	VSR
Measures of NSLP Certification Error	Administrative error Household reporting error Total certification error	Administrative error	None- This data file is used for validation of statistical models developed in the APEC and RORA analysis
Number of Observations	86	321	82,149
School Years	SY2005-06	SY2004-05 SY2007-08 SY2005-06 SY2008-09 SY2006-07 SY2009-10	SY2004-05 SY2007-08 SY2005-06 SY2008-09 SY2006-07 SY2009-10
Primary Data Source	Subset of variables from the final public-access APEC SFA file, plus measures generated from archived student-level files.	Constructed from RORA school year files of sampled applications, aggregated to the SFA-level.	Includes all public SFAs reported to the FNS-742 Verification Summary Report (VSR).[a]
Supplementary Data Sources[b]	VSR, CCD, LAUS, SAIPE	VSR, CCD, LAUS, SAIPE, FNSND	CCD, LAUS, SAIPE, FNSND[c]

[a]VSR includes public and private SFAs but only public SFAs were included in the analysis file, which was matched with public LEA data from the Common Core of Data. The certification error rate assessment tool includes all data from the VSR, including public and private SFAs.

[b]The acronyms and abbreviations for supplementary data sources are defined in the text.

[c]Supplemental data sources for SY2009-2010 are not included in the VSR analysis file.

Table ES.2. Key Features of Statistical Models of Certification Error

	Model Feature
Estimation Method	Tobit Regression Models
Selection of Certification Error Measure	All models were based on rates of certification error. We tested both aggregate measures (based on all NSLP reimbursements) and measures that were disaggregated into six subcomponents (specific to free, reduced-price, or not certified students). Final measures were selected based on model performance.
Selection of Explanatory Variables	LEA characteristics were selected based on their likely responsiveness to changes in policy, their theoretical relationship to certification error, or their observed correlation with certification error. Variables that are likely to be policy-responsive are verification results and certification characteristics. Enrollment size and student characteristics are theoretically related to true error rates. Additional explanatory variables were added to the models using an automated process and retained in the model if correlated with certification error.
Assessment of Model Performance	After developing models based on APEC and RORA certification error measures, we applied the model parameters to VSR data to generate national estimates of mean (predicted) values of certification error. If the statistical models are valid, these national estimates should match closely to the national estimates of mean certification error from APEC and RORA data because the VSR data are a census of districts offering NSLP.

B. Results of Statistical Models of Certification Error

This study developed statistical models of certification error with two goals in mind: (1) to develop a model that may be built into a monitoring tool to annually identify LEAs at high-risk for certification error, and (2) to identify the key relationships between certification error and LEA characteristics.

The usefulness of statistical models for annual monitoring depends on whether the models do well in predicting certification error for samples other than the ones on which they were estimated. We assessed model performance by comparing the distributions of estimated error rates in APEC and RORA with the distribution of predicted error rates obtained by applying model parameters to VSR data. As shown in Table ES.3, predicted certification error estimates from VSR data match well with estimates from APEC and RORA data.

The most important section of Table ES.3 is the top panel showing estimates of overall certification error; this measure is used in the monitoring tool. The strong correspondence between national estimates of overall certification error from APEC and estimates imputed by applying the APEC statistical models to VSR data (from the same year) is encouraging. However, the model validation analysis only provides an assessment of model performance for the time period on which the models were estimated. For example, we can assess the validity of the model of overall certification error for SY2005-2006 by comparing the APEC estimates of error with the error rates imputed by applying model parameters to VSR data. We cannot assess the validity of the model in future years, because we do not have estimates of true error from a study such as APEC for years after SY 2005-2006. If the underlying relationships between the certification error measures and LEA characteristics change over time, then the performance of the models may erode resulting in less accurate risk assessments.[3] Thus, a key assumption in applying these models to future years of data within the monitoring tool is that these relationships change little over time. It is likely that the models will provide reasonable estimates of certification error in the short run, but they may be limited if the relationships between certification error and LEA characteristics are not stable over time. In the longer term, it will be important to update the tool with statistical models that incorporate information from future national studies of certification error.

Our statistical models identified key relationships between certification error and LEA characteristics. Verification results are strongly associated with certification error. For all three measures of certification error available in the APEC data, there is a significant relationship between certification error and verification results for districts not using random verification samples; the relationship between certification error and verification is not significant for RORA administrative error. Additional significant relationships are discussed briefly below.

APEC Overall Certification Error. The final model of APEC overall certification error, selected over alternative model specifications based on predictive power and good fit to the data, is based on a disaggregated measure in which certification error is broken out into six subcomponents. Therefore, there are six separate regression equations in the APEC overall certification error model. For Free-certified-not-eligible (FCNE) error, which accounts for about half of overall certification error, some important explanatory variables are related to verification results and enrollment. For districts not using random verification samples, higher rates of reduction or termination of benefits

[3] Assessment of model validity in future years will be possible only if a study such as APEC is conducted to provide an independent assessment of certification rates for comparison with model estimates.

through verification are associated with higher FCNE error, as are higher rates of verification nonresponse. Enrollment also has a positive relationship with FCNE error. Districts with higher percentages of students certified for free meals and districts that are publicly operated tend to have lower FCNE error rates.

Table ES.3. Validation Results for Preferred Model of Each Measure of Certification Error (Percentages)

		Percentile of Error Rate Distribution			
	Mean Error	25	50	75	90
APEC Overall Certification Error Rates					
APEC Estimates	9.4	5.6	6.1	11.8	17.5
Imputed Estimates from Preferred Model	8.9	4.8	8.3	12.1	15.4
APEC Household Reporting Certification Error Rates					
APEC Estimates	7.7	4.5	5.6	10.3	13.8
Imputed Estimates from Preferred Model	7.2	3.9	6.7	9.8	12.7
APEC Administrative Certification Error Rates					
APEC Estimates	1.5	0.0	0.4	1.4	4.3
Imputed Estimates from Preferred Model	1.1	0.0	0.7	1.8	2.9
RORA Administrative Certification Error Rates					
RORA Estimates, SY 2009-2010	1.3	0.2	0.7	1.9	3.4
Imputed Estimates from Preferred Model	1.5	0.8	1.4	2.1	2.9

APEC Household Reporting Certification Error. The preferred model of APEC certification error due to household reporting is also based on a disaggregated measure. As with overall certification error, reduction of benefits through verification has a strong positive relationship with FCNE reporting error (the largest component of household reporting error) for districts not using random verification samples. Unlike overall certification error, verification nonresponse does not have a significant relationship with household reporting error. Districts with higher percentages of students certified for free meals and districts that are publicly operated tend to have lower FCNE reporting error rates.

APEC Administrative Certification Error. The preferred model of APEC administrative certification error is based on a single, aggregated measure. As was the case with models of overall and household reporting error rates, we find verification results are significantly related to error rates for districts not selecting random verification samples. We find no other factors included in the model have a statistically significant relationship with administrative error rates.

RORA Administrative Certification Error. The preferred model of RORA administrative certification error is based on a single, aggregated measure. The only statistically significant coefficient is the one associated with enrollment—districts with more students tend to have higher administrative error rates. Contrary to the findings for other types of certification error, verification results are not significantly associated with RORA administrative error rates.

C. Using Model Results within the Monitoring Tool

After developing statistical models of certification error, we incorporated the model parameters into a web-based monitoring tool to be applied to VSR data on an annual basis. The monitoring tool

is designed to identify the districts at risk of certification error so that States may provide reviews and assistance aimed at reducing errors.

Risk of certification error is defined by the estimated dollar amounts of NSLP benefits approved or denied in error. Therefore, the monitoring tool applies the statistical model to VSR data to estimate LEAs' certification error rates, and then applies these rates to total NSLP reimbursements for each LEA. The estimated erroneous payments are then assigned to a risk category (low, medium, and high-risk). We use State-specific thresholds when assigning risk categories.[4]

We imputed each district's certification error amount using a three-step process:

1. Apply the parameters of the APEC overall certification error model to district characteristics.[5] This provides six imputed certification error rates for each district.
2. Multiply each of the disaggregated error rates by the appropriate estimate of district National School Lunch Program (NSLP) reimbursements. For example, the percentage of reimbursements made to students certified for NSLP-free who are estimated to be not eligible (FCNE) is multiplied by the district's estimated free meal reimbursements. This gives an imputed estimate of the dollar amount of certification error related to FCNE students.
3. Sum the dollar amount estimates across the six types of disaggregated certification error to get an estimate of overall erroneous payments due to certification error. To facilitate comparisons across years, we convert this estimate to 2005 dollars using the consumer price index available from the Bureau of Labor Statistics.

Next, we compared the imputed certification error estimates to State-specific thresholds for high and medium risk of certification error. An LEA is identified as high-risk if their estimated dollar value of certification error is greater than $50,000 (roughly the 85th percentile of the national imputed certification error distribution) multiplied by the ratio of State median enrollment to national median enrollment. An LEA is identified as medium-risk if their estimated dollar value of certification error is below high-risk and greater than $25,000 (roughly the 65th percentile of the national imputed certification error distribution) multiplied by the ratio of State median enrollment to national median enrollment. Finally, the imputed *rate* of erroneous payments is compared to a rate floor, or a minimum rate at which districts can be categorized as high-risk. A rate floor is applied because it ensures that districts with very low error rates are not the focus of State administrative reviews. Using a five-percent rate floor, this process categorizes about one in six districts as high-risk and one in six as medium-risk during school years 2004 through 2009, with little variation over time.

In addition to generating a district risk category based on the State-specific thresholds and the imputed error amount, the monitoring tool provides a risk score for each district. The score provides a way to assess the degree of risk among high-risk districts. It does not determine the estimated risk category nor is it intended to be used for districts other than those at high-risk.

[4] The State-specific thresholds were developed to adjust for the median district enrollment in each State. Without this adjustment, districts in States with districts that are large on average would be more likely to be identified as at risk while districts in States with small districts on average will be less likely to be identified as at risk. The State-specific thresholds appear in Table B.1.

[5] Model parameters for the six error rate models are presented in Table III.2.

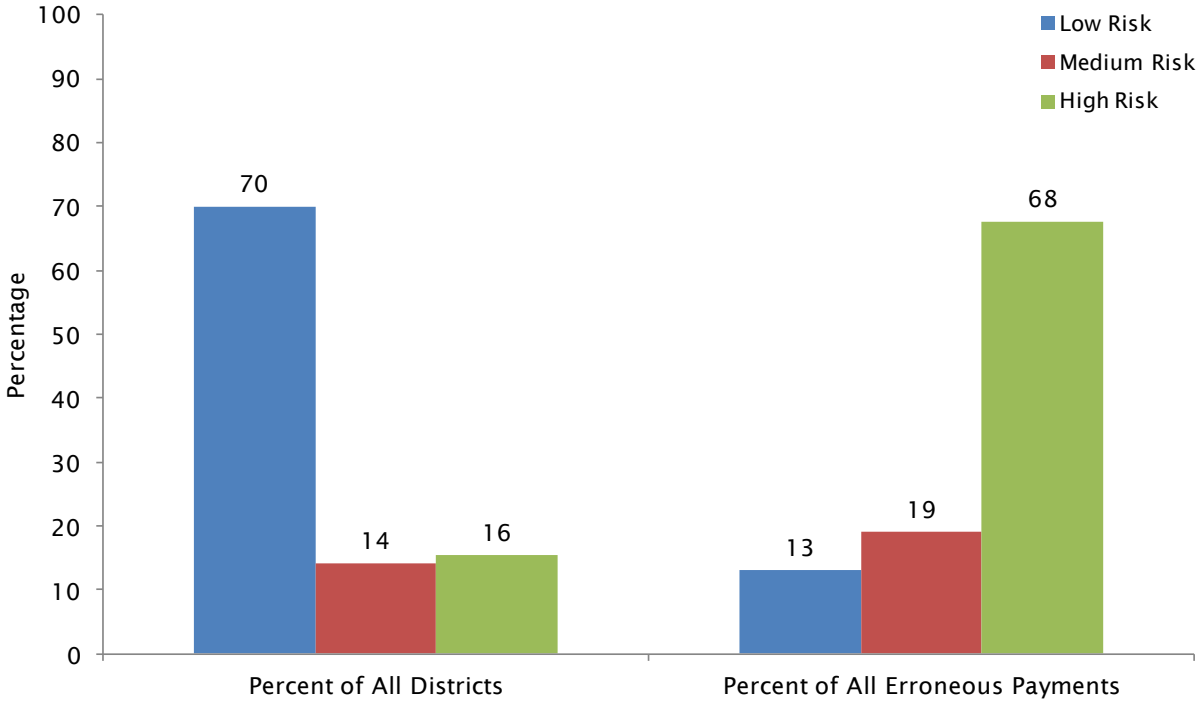
Rather, it reflects how high erroneous payments are relative to the threshold for high-risk, accounting for the distribution of district erroneous payments within the State. Specifically, the score is a function of estimated dollar amount of erroneous payments, the State threshold for high-risk, and the dispersion of district erroneous payments in the State. This score is constructed on a scale of 0 to 100 such that all scores higher than 50 result in a categorization of high-risk.

The risk categories used in the monitoring tool are well targeted in the sense that they identify a set of districts accounting for a disproportionate share of national erroneous payments due to certification error. As shown in Figure ES.1, in 2009, the 16 percent of districts identified as high-risk are estimated to account for 68 percent of national certification error.

The process described above was applied to six years of VSR data. The model is responsive to LEA characteristics that change over time. For example, the FCRE error rate (free certified, RP eligible) decreases as the percentage of students categorically certified or certified without application rises. Moreover, the model does not identify the same set of districts as high-risk in every year, confirming its responsiveness to factors that change over time. For the six-year period examined, most districts were never ranked as high-risk, but it was relatively uncommon for districts to be ranked as high-risk in every year (Figure ES.2).

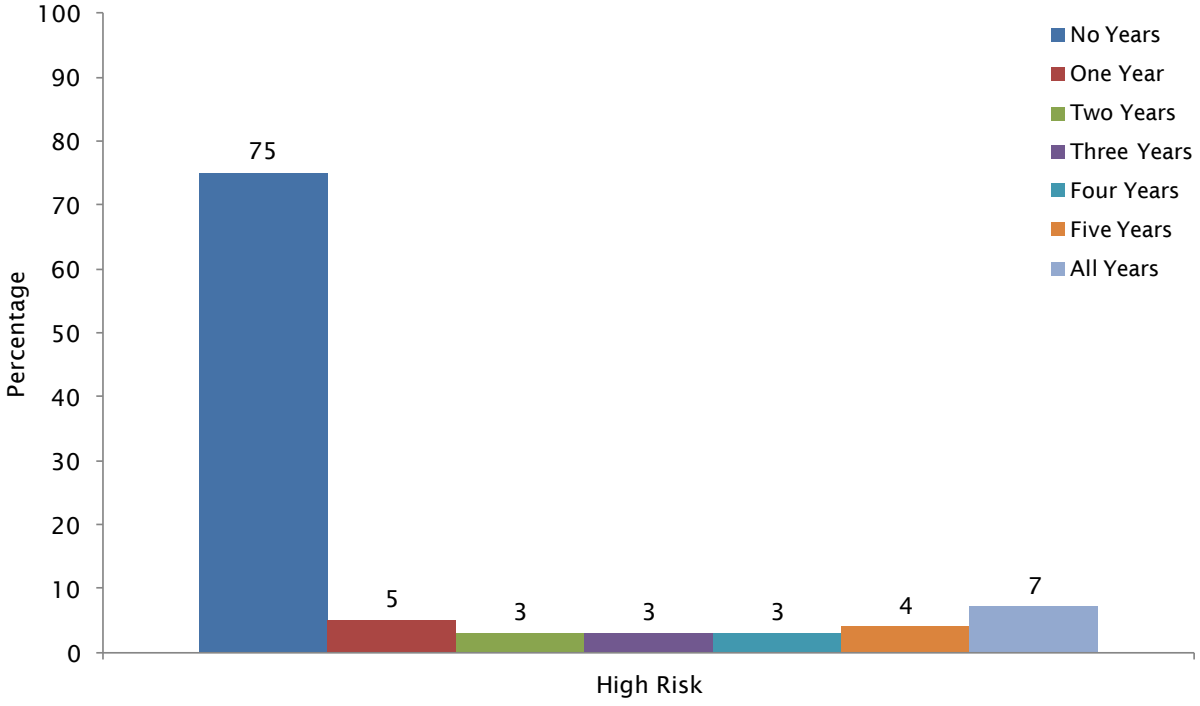
High- and medium-risk ranked districts have very different characteristics than low-risk ranked districts; for every characteristic examined, there are significant differences between low-risk ranked districts and both medium and high-risk ranked districts (Table ES.4). Among the most striking differences in these groups is in their enrollment numbers. The average enrollment for low-risk ranked districts is 996; for medium-risk ranked districts it is 5,121, increasing to 11,935 for high-risk ranked districts. Moreover, 65 percent of districts with more than 10,000 students are identified as high-risk (Figure ES.3) and about 30 percent of these large districts were identified as high-risk in all VSR years available for this study.

Figure ES.1. Percent of Districts and of Estimated Erroneous Payments in 2009, by Certification Error Risk Category



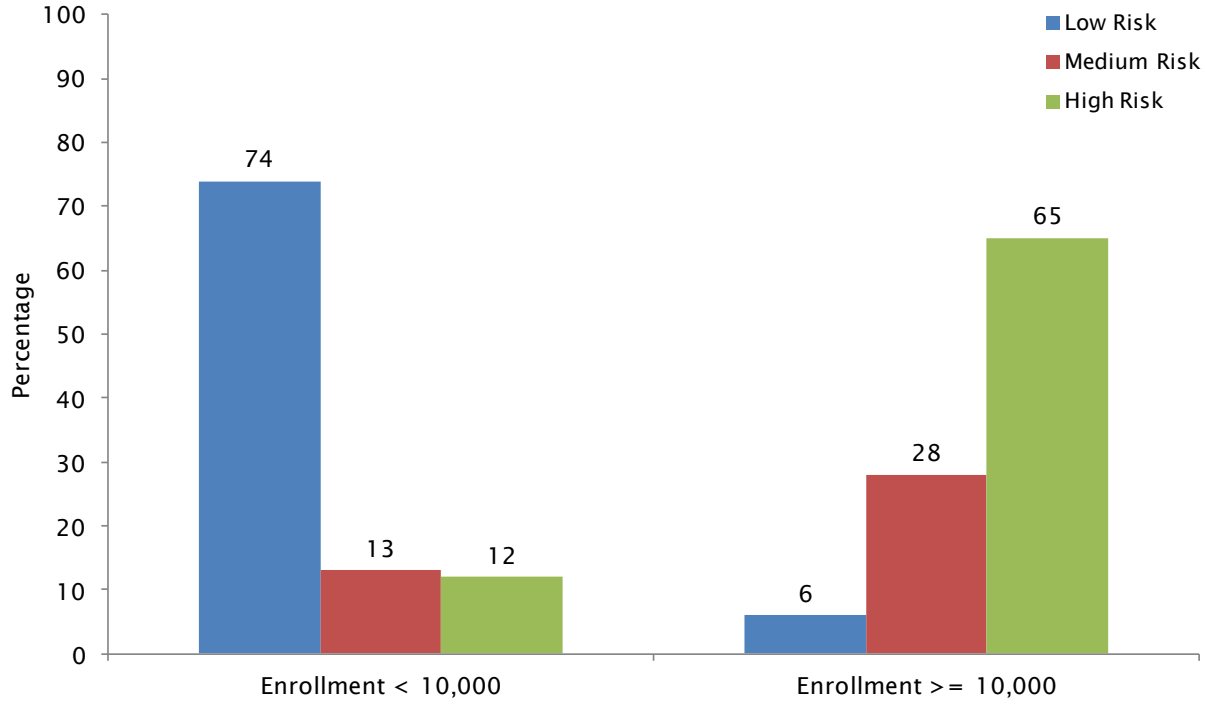
Note: Based on certification error risk definition using a five-percent rate floor.

Figure ES.2. Number of Years VSR Districts Identified as High-Risk for Certification Error, 2004-2009



Note: Includes districts present in at least five of the six VSR years between 2004 and 2009. Based on certification error risk definition using a five-percent rate floor.

Figure ES.3. Distribution of High-Risk Districts by Enrollment Category, SY2009-2010



Note: Based on certification error risk definition using a five-percent rate floor.

Table ES.4. Average Characteristics of Districts in the 2009 VSR, by Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	11.8	21.8***	31.2***
Error Rate	16.0	26.8***	28.9***
Percentage of Certified Students			
Categorically Eligible	12.5	10.0***	9.3***
Not Subject to Verification	28.4	33.9***	33.6***
District Demographic Characteristics			
Enrollment			
Number of Students	996	5,121***	11,935***
Number of Students is:			
Less Than 1,000	71.2	9.2***	0.8***
At Least 1,000, Less than 5,000	26.9	66.8***	45.9***
At Least 5,000, Less than 10,000	1.3	12.1***	28.3***
At Least 10,000	0.5	11.9***	25.1***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	49.1	47.8**	49.0
Number of Districts	**10,344**	**2,104**	**2,303**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of overall certification error rates estimated based on APEC data to districts in the 2008 VSR. Risk categorization was determined using State-specific thresholds and a five-percent rate floor. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

The high probability of identifying large districts as high-risk for certification error is largely a function of the focus on levels of certification error rather than rates. Because their levels of reimbursements are necessarily high, large districts can have high levels of error even if they have low rates of certification error. There are two ways to view this pattern. On the one hand, large districts are the ones contributing the most to certification error nationally. Moreover, a small change in the certification error rate in a large district would result in a much larger dollar reduction in erroneous payments due to certification error than would a similar error rate change in a smaller district. For these reasons, it may be appropriate that larger districts are much more likely to be identified as high-risk by the monitoring tool. On the other hand, large districts with low certification error rates may regard their selection as unfair if they view it as being related to a factor that cannot be changed. Moreover, repeated selection of large districts for review of certification practices may result in diminishing opportunities for improvement of certification error rates in those districts.

It is difficult to reduce the probability of identifying large districts while focusing on levels of certification error rather than on certification error rates. However, risk categories based on certification error rates tend to be poorly targeted. For example, districts in the top 20 percent of the imputed certification error rate distribution account for only about 30 percent of the national sum of erroneous payments due to certification error. This figure is dramatically lower than the targeting achieved by the categorization based on certification error levels (as noted above, the 16 percent of districts categorized as high-risk account for 68 percent of national erroneous payments).

I. STUDY OBJECTIVES AND BACKGROUND

The National School Lunch Program (NSLP) provides subsidized lunches to more than 30 million children each school day. Nationwide, 5.3 billion subsidized lunches are served annually at a cost of $10.8 billion.[6] In FY 2010, 55.8 percent of school lunches were served free and 9.4 percent at reduced price to children who are eligible for these subsidies on the basis of household income.[7]

There are three methods by which children may be certified as eligible for free or reduced-price (FRP) school meals:

- Income eligibility for free and reduced-price meals determined by application—based on household income reported on school meal applications submitted to the local school district[8]
- Categorical eligibility for free meals determined by application—based on participation in other means-tested programs with income limits at or below the limit for free school meals
- Categorical eligibility for free meals determined by direct certification—based on a match with systems of records from other means-tested programs

Direct certification due to participation in the Supplemental Nutrition Assistance Program (SNAP) was mandated as of school year (SY) 2008-2009. In most States, direct certification is now achieved through computer matching of systems of records, thereby eliminating paperwork for most categorically eligible children. Direct certification for free meals currently accounts for 31 percent of FRP certifications. The remaining 69 percent of certifications, those based on application, are subject to verification, though less than 3 percent of applications are verified annually.

Previous studies have found that certifications for FRP meals are prone to error. The most recent study—the NSLP and School Breakfast Program (SBP) Access, Eligibility, and Certification (APEC) study—found that one in five children certified for FRP meals was erroneously certified or incorrectly denied benefits, with overpayments accounting for more than three-fourths of errors (Ponza et al. 2007). The APEC study was conducted to comply with the Improper Payments Information Act (IPIA) of 2002, which also required follow-up action to reduce payment errors.

The USDA Food and Nutrition Service (FNS) took action to reduce erroneous payments in the NSLP by disseminating the APEC results and providing technical assistance to States and LEAs based on those findings. Further, FNS completes two collections of information about school meal certification and verification: (1) the Verification Summary Report (FNS-742) and (2) the Regional

[6] USDA, Food and Nutrition Service, Program Data, Child Nutrition Tables. Available at [http://www.fns.usda.gov/pd/cnpmain.htm]. Accessed April 2011.

[7] In FY2010, the reimbursement rates for school lunches were $2.72 for free lunches, $2.32 for reduced-price lunches, and $0.26 for full-price lunches.

[8] Students certified as eligible for NSLP free or reduced-price meals are also certified for the School Breakfast Program (SBP) in schools participating in the SBP.

Office Review of Applications. Analyses of data from these collections are now published annually.[9] FNS has also encouraged the use of systems of records and computer matching for NSLP direct certification and direct verification as a way to improve the accuracy of eligibility determinations, improve access for eligible children, and reduce burden for households and local education agencies (LEAs). FNS annually reports to Congress on direct certification implementation progress and direct certification effectiveness.[10]

The above efforts have identified aggregate trends in NSLP certification practices and verification results. Further efforts to combat certification error require information about where problems exist and where they are most severe. It is not feasible, however, to accurately measure certification error at each LEA on an ongoing basis. Accurate measurement requires an independent audit of a sufficiently large sample of NSLP applications. An alternative is to identify measureable characteristics of LEAs that are indicators of their risk for certification error.

The Food and Nutrition Service (FNS) contracted with Mathematica Policy Research to develop a model of high-risk indicators of certification error. This study has three objectives:

- Develop an econometric model, based on APEC data and findings, to identify indicators of LEAs with high risk of certification error.
- Identify the key relationships between certification error and LEA characteristics.
- Provide a web-based monitoring tool that will apply the model parameters to Verification Summary Report (FNS-742) data annually, and publish results for access by State Child Nutrition (CN) agencies.

The third objective provides a tool that States may use to identify LEAs for annual reviews and assistance aimed at reducing certification errors.

A. National School Lunch Program Certification

The NSLP is administered at the federal level by the U.S. Department of Agriculture (USDA) Food and Nutrition Service (FNS). In each State, child nutrition directors oversee operation of the program and maintain agreements with local education agencies (LEAs). State child nutrition directors usually reside within State departments of education. LEAs administer school districts or groups of school districts.

LEAs are charged with the task of certifying children eligible for free and reduced-price meals. Children in families with income at or below 130 percent of the poverty level are eligible for free lunch, and children in families with income between 130 and 185 percent of the poverty level are eligible for reduced-price lunch. Children are categorically eligible for free lunches if their household

[9] Analysis of Verification Summary Data, School Years 2004-2005, 2007-2008, 2008-2009; Regional Office Review of Applications (RORA) for School Meals 2005 through 2009. Available at [http://www.fns.usda.gov/ora/MENU/Published/CNP/cnp.htm].

[10] Direct Certification in the National School Lunch Program: State Progress in Implementation: Report to Congress: 2008, 2009, 2010. Available at [http://www.fns.usda.gov/ora/MENU/Published/CNP/cnp.htm].

receives benefits from SNAP, Temporary Assistance for Needy Families (TANF), or the Food Distribution Program on Indian Reservations (FDPIR).[11]

There are two main methods by which students are certified annually for NSLP FRP meals: by direct certification or by application. Variations on these two methods provide a reduction in application burden through Provisions I, II, or III of the National School Lunch Act.

1. Direct Certification

Beginning in SY2008-2009, all LEAs are required to directly certify students using SNAP data. Typically, State SNAP agencies provide to the State Department of Education a data file of school-age children currently enrolled in SNAP. The State Education Department matches this file with student enrollment records (State match) and distributes match results to districts, or the State may distribute the SNAP data to districts for them to match the file with district enrollment data (district match). The exchange of data files and computerized matching algorithms for linking SNAP data with student enrollment data results in accurate certification of children for free meals.

Direct certification has a potentially large impact on certification error rates. First, children certified on the basis of SNAP data are certified with little error, and second, direct certification increases enrollment in the NSLP (drawing in children who may not apply to the NSLP), thereby increasing the denominator for calculating error rates (Gleason 2008).[12]

While direct certification with SNAP is mandated, at the discretion of State and local agencies it may also be used for students who are categorically eligible for free meals due to enrollment in qualifying TANF programs or FDPIR. Direct certification is generally completed prior to the start of the school year and prior to the distribution of NSLP applications. Students who are directly certified are not subject to eligibility verification.

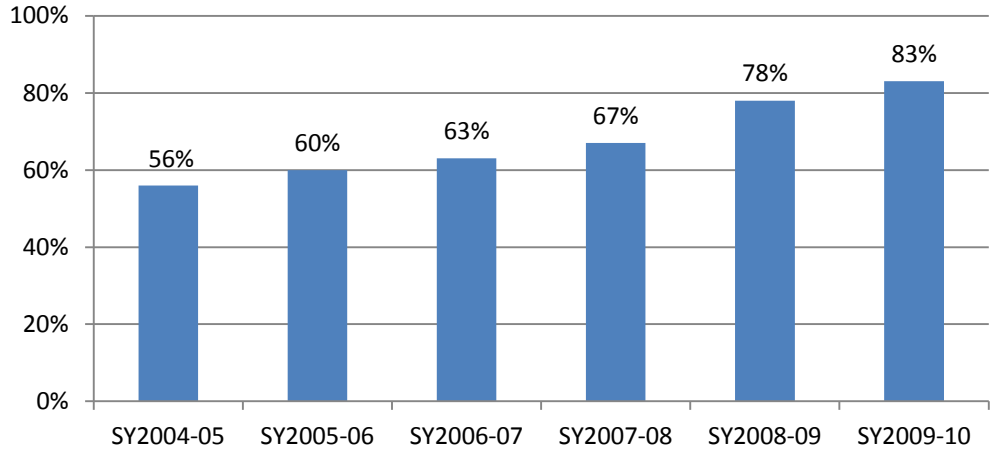
The mandate for LEAs to use methods for direct certification was phased in over a three-year period beginning with SY2006-07. Beginning with SY2008-09, all districts were required to use direct certification. Prior to the mandate, use of direct certification was growing and methods improving, especially with regard to computerized matching of SNAP and student enrollment data (Cole and Logan 2007). The prevalence of direct certification accelerated with the mandate so that one year after the mandate took effect, 83 percent of LEAs had directly certified students, an increase of nearly 50 percent over the prior six-year period (Figure I.1).[13]

[11] TANF information can be used for direct certification of children only in States with TANF income eligibility criteria comparable to or more restrictive than those in effect on June 1, 1995 (P.L. 104-193).

[12] This study estimates that only 7 percent of directly certified students are ineligible for benefits compared to 12 to 33 percent among all certified students.

[13] LEAs may use methods for direct certification and have no directly certified students if their student enrollment does not include SNAP participants. The 83 percent of LEAs with directly certified students represent 97 percent of NSLP enrollment. Most LEAs with no directly certified students are single-school LEAs or private LEAs (USDA/FNS 2010).

Figure I.1. Growth in the Percentage of LEAs with Directly Certified Students



Source: USDA Food and Nutrition Service 2010.

The effectiveness of direct certification varies across States. Each year FNS estimates the effectiveness of direct certification, defined as the number of students directly certified as a percentage of students estimated to be enrolled in SNAP at the start of the school year. Nationwide, about 70 percent of SNAP children are directly certified. In SY2009-2010, FNS found that direct certification effectiveness was at or above 70 percent for 28 States and the District of Columbia, and between 47 and 69 percent for 22 States. Variations across States are due to the method of implementation, the timing of direct certification relative to the start of the school year, and the frequency of direct certification during the school year (USDA/FNS 2010). Because direct certification eliminates NSLP applications, states with more effective direct certification may have lower certification error rates.

2. NSLP Applications

Most children certified for free school meals and all children certified for reduced-price meals are certified by application (Figure I.2). The specific information required on the application depends on the eligibility category.

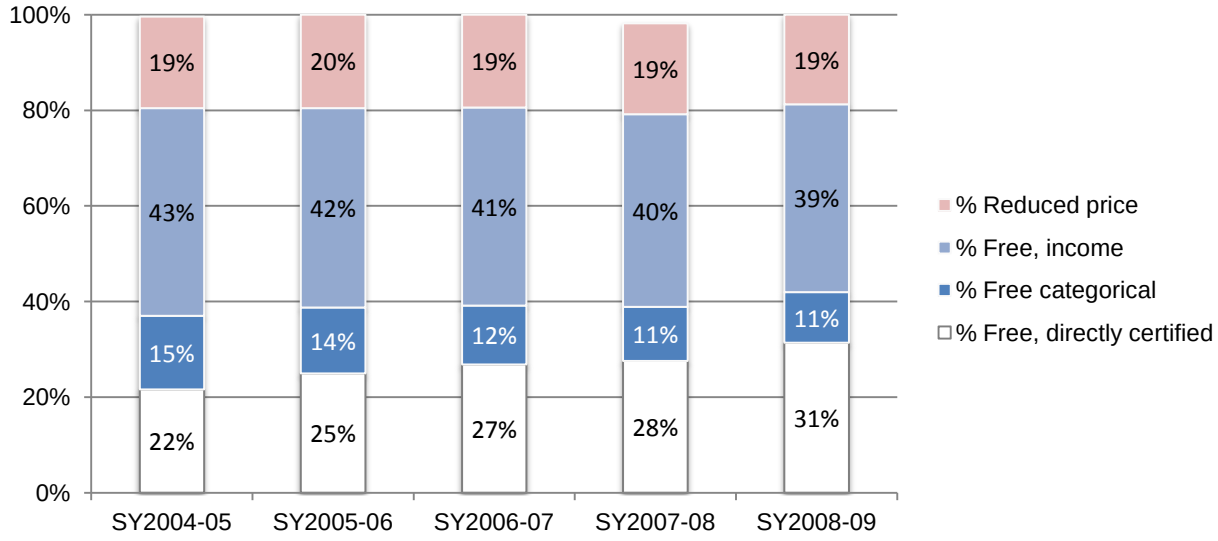
- ***Categorical eligibility***. Application must include names of all children for whom benefits are sought and their SNAP, TANF, or FDPIR case number, and signature of adult household member submitting the application.
- ***Income eligibility***. Application must include the name of each person in the household, current month's income, and signature and last four digits of the SSN of adult household member submitting an application (or indication that they do not have an SSN).[14]

[14] The application requires income by source, from (1) work; (2) welfare, child support, or alimony; (3) pensions, retirement, and Social Security; and (4) other. NSLP regulations define income as income received during the month prior to application (7CFR245.6(a)). Regulations further provide that "If such income does not accurately reflect the household's annual rate of income, income shall be based on the projected annual household income. If the prior year's income provides an accurate reflection of the household's current annual income, the prior year may be used as a base for the projected annual rate of income."

At the time of application, the NSLP requires no documentation of income or program participation; eligibility is determined on the basis of self-reported information. Certification errors derive mainly from household reporting error, although administrative errors may also occur in processing applications.

The percentage of students certified for free meals on the basis of application has decreased over time as the prevalence of direct certification increased. This decrease in applications for free meals was shared about equally between categorical and income applications (Figure I.2).

Figure I.2. Distribution of Students Certified for Free/RP School Meals



3. Provisions I, II, and III

School districts may reduce the frequency of certification of students for the NSLP (that is, application processing) by using Provisions 1, 2, or 3 of the National School Lunch Act.

- ***Provision 1*** allows a two-year certification period to be used for students certified for free meals in schools with at least 80 percent of students certified for FRP meals.
- ***Provision 2*** allows schools to serve all meals at no charge for a four-year period and receive USDA reimbursement based on claiming percentages established during the base year.
- ***Provision 3*** allows schools to serve all meals at no charge for a four-year period and receive the base-year level of Federal cash and commodity support, with some adjustments.

The decision to use Provision 1, 2, or 3 is made at the school level; a school district may have one or more schools enrolled in these options and therefore not collecting NSLP applications in a given school year. Use of these provisions means that certification errors can occur only in a single base year, but errors in reimbursement will persist throughout the provision period. Since SY2004-

2005, less than 10 percent of students certified for free meals are enrolled in a Provision 2/3 school in a non-base year.[15]

B. National School Lunch Program Verification

The NSLP verification process provides important indicators of certification error. Each year, districts are required to verify a sample of approved applications on file as of October 1 and to complete verification by November 15. Rules for selecting verification samples are shown in Figure I.3. Districts verify applications by sending a letter to households requiring documentation of household income or program participation. Documentation is reviewed and the application is either verified without change or the school meal certification category is changed to reflect the documented income level.

NSLP verification results do not provide accurate estimates of district certification error for two reasons: (1) samples sizes are too small and (2) most verification samples are not random because the standard sample is selected from among error-prone applications. Furthermore, because verification samples are small, the verification process is not considered a deterrent for household misreporting, even though the process is designed to catch errors by sampling from among error-prone applications.

Figure I.3. NSLP Verification Sample Sizes

Standard Verification Sample of Applications as of October 1

- Three percent of all approved applications, selected from error-prone applications, up to a maximum of 3,000 applications.[a]

Alternative Sample of Applications as of October 1

- **3,000/3 percent option:** Three percent of approved applications selected at random from all approved applications, up to a maximum of 3,000 applications; or
- **1,000/1 percent plus option:** One percent of approved applications, selected from error-prone applications, up to a maximum of 1,000 applications; plus 0.5 percent of applications approved based on a SNAP, TANF, or FDPIR case number, up to a maximum of 500.

School Districts Qualify for an Alternative Sample if:

- The verification nonresponse rate for the preceding school year is less than 20 percent; or
- The school district has more than 20,000 children approved by application as of October 1 and the nonresponse rate for the preceding school year is at least 10 percent below the nonresponse rate for the second preceding school year.

[a]Error-prone applications are income applications with a total household income within $100 of the monthly applicable Income Eligibility Guideline. "Error-prone" replaces the previously used term "focused sample."

[15] USDA, Food and Nutrition Service. Analysis of Verification Summary Data, School Year 2008-2009, March 2011.

C. Prior Research on NSLP Certification Error

The APEC study provides the most recent national estimates of NSLP certification error (SY2005-2006). APEC found that slightly more than one in five certified or denied applicant students was not certified accurately or was erroneously denied benefits (Ponza et al. 2007). APEC provided detailed information about the nature of certification errors, which informs this study.

- Overcertification was more common than undercertification (15.0 percent of students received a higher level of benefits than their eligibility level; 7.5 percent received a lower level of benefits.)
- The rate of certification error was lower for students certified for free meals compared with those certified for reduced-price meals (14 percent versus 59 percent in error).
- Most errors for certified students are misclassifications between free and reduced-price status. These errors are less costly than certification of students who are not eligible for any level of benefits.
- Household reporting error was substantially more prevalent than administrative error (23.2 versus 8.3 percent of applicants had a household versus an administrative error).

D. Organization of the Report

The remainder of this report describes the development of an econometric model, based on APEC data and findings, to identify indicators of LEAs with high risk of certification error. Chapter II describes the analytical methods and the data compiled for the model estimation and for operating the monitoring tool. Chapter III presents the findings from the econometric modeling, including factors associated with each type of certification error. Chapter IV describes the assessment of certification error risk used by the monitoring tool and provides characteristics of districts estimated to have medium and high risk for certification error.

This page has been left blank for double-sided copying.

II. STUDY DESIGN

The certification error monitoring tool is based on statistical models that estimate the relationship between certification error and a set of factors that are highly predictive of certification error. This chapter describes the sources of data used in this empirical work and presents the details of the process for developing statistical models of certification error.

Chapter Highlights

- Statistical models summarize the relationship between certification error and LEA characteristics. The models can be used to predict certification error. We develop models for overall, household reporting, and administrative certification error measures that are available from the APEC study, as well as for administrative certification error measures available from the RORA study.
- The core explanatory variables included in the models were selected either based on policy relevance or theoretical relationship to certification error. These variables include verification results, variables related to method of certification, and other LEA characteristics. Additional explanatory variables were added to the models based on their observed correlation with certification error.
- The list of candidate explanatory variables was drawn from a broad set of datasets, including Verification Summary Report, Common Core of Data, Census Small Area Income and Poverty Estimates, and Local Area Unemployment Survey.
- We identified the preferred model specifications based on model performance. To do this, we applied model parameters to national data from the Verification Summary Reports and compared the distribution of predicted certification error with APEC measures used for model development.

A. Data Sources

The data required for the statistical models include the district-level measures of certification error rates to be used as dependent variables, as well as a comprehensive set of district characteristics to be used as explanatory variables. The error rate measures used as dependent variables come from three different data sources and include information on three types of certification error—household reporting, administrative, and overall certification error. The explanatory variables we considered for the model include district verification results, administrative features of the National School Lunch Program (NSLP) in the districts, and demographic characteristics of students and families in the districts. These data are drawn from a variety of sources. This section describes the process for creating analysis files based on these various data sources, constructing measures of certification error, and constructing measures used as explanatory variables.

1. Creating Analysis Files

As described above, the analysis for this study required measures of certification error as well as a set of district characteristics likely to be correlated with certification error. The measures of certification error come from the following data sets:

1. Access, Participation, Eligibility, and Certification (APEC) study
2. The Regional Office Review of Applications (RORA) data.

Information on district characteristics comes from the following data sets:

1. Verification Summary Reports (VSR)
2. Common Core of Data (CCD) LEA Universe Survey
3. CCD School District Financial Survey
4. Census Small Area Income and Poverty Estimates (SAIPE)
5. Bureau of Labor (BLS) Local Area Unemployment Survey (LAUS)
6. Food and Nutrition Service National Data File (FNSND)

The data sets containing information on district characteristics were merged to each of the two data sets containing certification error measures to create two separate analysis files that allow for estimation of statistical models of certification error. A third analysis file based on the VSR was created to assess the validity of these statistical models. These three analysis files are described below and in Table II.1.

- **APEC Analysis File.** The analysis file for the APEC data references a single cross section of 86 districts for school year (SY) 2005-2006. This file includes three measures of certification error: administrative certification error, household reporting error, and total certification error. Certification error rates were measured from a nationally representative sample of NSLP applications that were independently verified for the APEC study (Ponza et al. 2007).
- **RORA Analysis File.** This file contains records from six school-year samples of NSLP applications selected for the RORA for school meals, SY2004-05 through SY2009-2010. Each year since SY2004-05, the Food and Nutrition Service examines administrative error incurred during the local educational agency's (LEA) approval process of applications for free and reduced-price meals in the NSLP. For each school year, the original RORA files from FNS contain samples of approximately 50 NSLP applications from each of 56 LEAs selected for review. The analysis file constructed for this study includes one record for each public LEA, after aggregation of the application-level data into measures of the percentages of applications with errors.

Table II.1. Analysis Files for Modeling of High-Risk Indicators of NSLP Certification Error

	Analysis Files		
	APEC	RORA	VSR
Number of Observations	86	321	82,149
Unit of Observation	SFA	SFA-year	SFA-year
School Years	SY2005-06	SY2004-05 SY2007-08 SY2005-06 SY2008-09 SY2006-07 SY2009-10	SY2004-05 SY2007-08 SY2005-06 SY2008-09 SY2006-07 SY2009-10
Primary Data Source	Subset of variables from the final public-access APEC SFA file, plus measures generated from archived student-level files.	Constructed from RORA school year files of sampled applications, aggregated to the SFA-level.	Includes all public SFAs reported to the FNS-742 Verification Summary Report (VSR).[a]
Measures of NSLP Certification Error	Administrative error Household reporting error Total certification error	Administrative error	None[b]
Supplementary Data Sources[c]	VSR, CCD, LAUS, SAIPE	VSR, CCD, LAUS, SAIPE, FNSND	CCD, LAUS, SAIPE, FNSND[d]

[a]VSR includes public and private SFAs but only public SFAs were included in the analysis file, which was matched with public LEA data from the Common Core of Data. The certification error rate assessment tool includes all data from the VSR, including public and private SFAs.

[b]The VSR data file is used for validation of statistical models developed in the APEC and RORA analysis files. A measure of total certification error is available in the VSR but it does not provide an accurate and precise measure, as discussed in the text.

[c]The acronyms and abbreviations for supplementary data sources are defined in the text.

[d]Supplemental data sources for SY2009-2010 are not included in the VSR analysis file.

The primary challenge in constructing these analysis files was merging data from supplementary data sources. This was a particular challenge with the VSR data because of the large number of districts in the file and because identifying information was not always consistent.[16] Data from the supplementary data sources were matched to SFAs in the VSR data as follows:

- CCD records were matched to SFAs using a multistep process that involved deterministic and probabilistic matching based on State, district identification code, and name, as well as matching based on manual review. Match rates between these data sources were high—over 95 percent of school districts in the VSR were matched to the CCD for each VSR school year. Most SFAs were matched to CCD data on a one-to-one basis. Approximately two percent of CCD records were aggregated prior to the match with VSR files to account for SFAs that administer school food service for multiple LEAs.

[16] Data from supplementary sources were not added for SY2009-2010 because these data only recently became available.

- SAIPE school district data contain the same LEA identification variable as CCD data. Therefore, we were able to match SAIPE data to districts in the VSR after conducting the match of VSR to CCD data. Not all districts appear in the SAIPE school district data. The percentage of LEAs that did not appear in the school district SAIPE file ranged from 7.4 percent in SY2004-05 to 10.5 percent in SY2008-09, reflecting the growth in charter schools. SAIPE county data were matched to all SFAs that were not matched to SAIPE school district data. The county variable used for this match was also identified from CCD data.
- LAUS data were matched to SFAs by county. The monthly LAUS unemployment rates were averaged over the calendar year corresponding to the start of the school year. (For SY2006-07, unemployment is measured for calendar year 2006.)
- The FNSND was matched to SFAs by State. State meal counts from this file were used to impute SFA meal counts based on SFA enrollment by meal certification status. No covariates were constructed based on these data.

After constructing the three analysis files, we used them to estimate and validate statistical models of certification error.

2. Constructing Measures of Certification Error

A key step in modeling various types of certification error was constructing a set of certification error measures that are informative and comparable across data sources. This section describes the measures of certification error available in each analysis file.

a. Characteristics of Measures of Certification Error by Analysis File

Various measures of certification error were constructed using measures available in the APEC and RORA analysis files. We also evaluated a measure of overall certification error available in the VSR analysis file but determined that this measure is better suited for use as an explanatory variable than as a measure of certification error on its own. The strengths and weaknesses of each certification error measure are discussed below.

APEC Certification Error Measures. The most complete measures of certification error are available in data collected for the APEC study. These are the only data that contain measures of administrative error, household reporting error, and overall certification error. Some beneficial features of these measures are that they were rigorously determined by independent researchers and are based on a nationally representative sample of districts.

APEC measures of administrative error were created by comparing students' meal benefit applications to their certification status. Measures of household reporting error were generated based on household survey responses to items related to household composition, income, and means-tested benefit receipt.

Although these measures have a number of advantageous attributes, there are some drawbacks. In particular, the APEC sample is quite small, which limits our ability to conduct subgroup analysis and limits the degrees of freedom available for model estimation. Furthermore, APEC data were only collected for SY2005-2006, so changes over time in the relationship between certification error and various factors cannot be examined using these data.

RORA Certification Error Measures. The certification error measures available from RORA provide nationally representative information on administrative error. As with APEC, these measures are based on a comparison between information on applications and on districts' eligibility roster lists.[17] These data are collected for annual cross-sectional samples of districts, thus, unlike APEC, they provide the opportunity to examine changes over time in factors associated with certification error. However, like APEC, the cross-sectional samples available in RORA are small, placing limitations on the types of analysis that can be conducted using the RORA certification error measures. Additionally, the RORA data do not provide information on household reporting error or overall certification error.

VSR Certification Error Measures. Beginning in SY2004-05, districts are required to report the results of their verification activities to FNS via the Verification Summary Report (FNS-742; VSR). To complete verification, districts select a sample of applications, conduct a confirmation review to verify that certification status was determined correctly for sampled applications, and request documentation from households to verify the information on the applications. Thus, verification results reported on the VSR provide estimates of combined administrative and household reporting errors or overall certification error rates for each district.

An important part of the verification process, however, is the method by which districts select their verification sample. Beginning in SY2005-06, districts are required to select a sample of three percent of all applications selected from among error-prone applications, except for districts qualifying for alternative sampling, which allows for random sampling. Because districts with error-prone sampling do not draw applications randomly, it is unlikely that verification results for these districts represent an accurate estimate of certification error in the district. However, we considered the possibility that VSR measures of certification error may be good estimates of overall certification error for districts using random sampling. The percentage of districts using random sampling was 55 percent in SY2005-06 and 40 percent in SY2007-08.

There are two strengths of VSR certification error measures. First, the VSR is a census of all districts participating in the school meal programs and conducting verification. Thus, VSR data do not have the sample size limitations that affect APEC and RORA data. Second, VSR data have been collected annually since SY2004-05, allowing for investigation of changes over time in overall certification error.

The VSR certification error measures have a number of notable disadvantages. First, VSR data do not provide unbiased estimates of certification error for all districts because of error-prone sampling. Second, households selected for verification often choose not to respond, thus the data are subject to high rates of nonresponse. The high nonresponse rate may introduce bias to certification error measure if households with certification error are less likely to respond to verification. Third, the data do not provide separate measures of administrative error and household reporting error. Fourth, the quality of the VSR certification error measures is likely to be uneven because verification was conducted by districts, which may have constrained analytical resources and

[17] RORA presents two estimates of administrative error. The first is based on accuracy of districts' meal benefit eligibility determination at certification. The second is based on a comparison of FNS's determination of eligibility status to the status on the master eligibility list. Thus, this measure includes error in transmitting the district eligibility determination to the eligibility roster. Since the second measure is more directly comparable to the administrative error measure used in the APEC study, that is the one we use in our analysis.

could have incentive to underreport certification error. Fifth, if districts did not use a truly random process to select their verification samples, VSR measures of certification may be biased estimates of overall certification error for districts using random sampling. Sixth, VSR does not include sampling of students who applied for and were denied meal benefits. Thus, unlike measures based on APEC and RORA data, VSR measures do not include underpayments related to denied applicants. Finally, if districts using random verification sampling are not representative of districts more generally, it may not be appropriate to base analysis on this set of districts.

Our analysis indicates that some of the concerns about using verification results as measures of certification error are merited. For example, we find evidence that districts using random sampling are quite different from those using other sampling methods—on average they are much smaller, have more favorable verification results, and serve less disadvantaged populations. We also find that estimates of average overall certification error rates based on VSR measures are less than half of those based on APEC measures. This discrepancy is consistent with the notion that households that do not respond to verification are likely to have certification error, causing the VSR measure to understate certification error rates. It is also consistent with districts' incentives to underreport certification error.

Because of these potential problems, verification results could be regarded as a certification error measure with important amounts of measurement error. If this is the case, verification results may be strong covariates when included in models of certification error, but weak measures of certification error on their own. When used as covariates, the statistical models identify the portion of the variation in verification results that is correlated with observed certification error as measured in APEC and RORA, while ignoring the portion of the variation that is related to measurement error. When used as a measure of certification error on its own, measurement error is not removed. Therefore, we do not use the VSR overall certification error on its own as a dependent variable, but we do include verification results in all statistical models.[18]

b. Measures of Certification Error

This study uses a number of different measures of certification error. Table II.2 shows the different certification error specifications created in each analysis file. We examine certification error expressed both as the dollar amount of reimbursements subject to certification error and as the percentage of reimbursements subject to certification error. We also examine both aggregated and disaggregated measures of certification error. Aggregated measures include the overall level of certification error and the percentage of all reimbursements subject to certification error.

[18] When VSR certification error measures are used as dependent variables, the resulting models have very poor validation performance. The findings of this analysis suggest either that districts not using random verification sampling have different characteristics than those that do, or that the model's estimates do not generalize to samples other than the ones on which they were estimated. In either case, the appropriateness of using this model with a general set of districts is suspect.

Table II.2. Measures of Certification Error Rates Used in Regression Models, by Analysis File

Aggregate Measures of Certification Error Rate	Disaggregated Measures of Certification Error Rate
APEC	
Administrative Certification Error Rate	Separately for administrative, household reporting, and overall certification error, rates of error due to students who are:
Household Reporting Error Rate	Certified free, reduced price eligible
Overall Certification Error	Certified free, not eligible Certified reduced price, not eligible Certified reduced price, free eligible Not certified, free eligible Not certified, reduced price eligible
RORA	
Administrative Certification Error Rate	Rates of error due to students who are: Certified free, reduced price eligible Certified free, not eligible Certified reduced price, not eligible Certified reduced price, free eligible Not certified, free eligible Not certified, reduced price eligible

Notes: Aggregate rate of certification error is the percentage of total reimbursements subject to certification error. Disaggregated rate of certification error is the percentage of reimbursements made to students of a given certification status that are subject to a given type of disaggregated certification error. An example of a disaggregated certification error rate is the percentage of reimbursements to students certified for free meals that were made to students who were eligible for reduced-price meals. We also estimated models based on analogous measures of levels of certification error (the dollar amount of certification error of a given type). Models based on certification error rates performed better than those based on dollar amounts of certification error.

Disaggregated measures include certification error levels and rates associated with:

1. Students certified for NSLP-free but not FRP eligible (FCNE)
2. Students certified for NLSP-free but eligible for NSLP-RP (FCRE)
3. Students certified for NSLP-RP but not FRP eligible (RCNE)
4. Students certified for NSLP-RP but eligible for NSLP-free (RCFE)
5. Students not certified for FRP but eligible for NSLP-free (NCFE)
6. Students not certified for FRP but eligible for NSLP-RP (NCRE)

As discussed in the next section, we conducted analysis using all of these different certification error measures and selected a final measure based on the relative performance of statistical models based on different measures.

A challenge in constructing these certification error measures is that estimates of reimbursements require an estimate of the number of meals served. Although this information is available in APEC, it is not available in either the VSR or RORA data. However, these latter data sources have information on (1) the number of enrolled *students* in each certification category in each

district (using VSR data) and (2) the number of meals of each type that were served in each State (using the FNS national database). We use this information to impute an estimate of the number of meals served to students in each category.

For the purposes of imputing meals served in a given district, we assume that the proportion of all meals of a given type in the district's State that were served in the district are the same as the analogous proportion of all students of the same type in the State who were enrolled in the district. For example, if two percent of all of Pennsylvania's free-certified students were enrolled in District X, we will assume that two percent of all the free meals served in Pennsylvania were served in District X. Following this example, imputing the number of free school lunches served in District X requires the following:

- Dividing the number of free-certified students in District X by the sum of free-certified students in all of Pennsylvania's districts who were present in the VSR data. This fraction represents the proportion of Pennsylvania's free-certified students in District X.
- Obtaining data on the total number of free lunches served in Pennsylvania from the FNS national data file.
- Multiplying the proportion of Pennsylvania's free-certified students in District X by the total number of free lunches served in Pennsylvania. The resulting product represents the imputed number of free lunches served in District X.

The key assumption of these imputed values is that the proportion of a State's meals of a given type served in a given district is equal to the proportion of the State's students of that type enrolled in that district. In other words, NSLP participation rates among students in a particular meal-price category are the same across districts within a State. While this assumption is likely to be accurate on average, the imputed participation values may differ from actual participation in individual districts. Thus, this assumption will introduce some error to the certification error measures. However, the cost of this assumption is outweighed by the benefit of being able to summarize and combine different types of certification error.

3. Constructing Variables Potentially Related to Certification Error

Using data from the complementary data sources, we constructed a comprehensive set of measures associated with certification error to be considered for inclusion in the statistical models of certification error. These candidate explanatory variables include verification results, characteristics related to district meal programs (such as method of certification and use of Provisions 2 or 3), demographic characteristics (such as student enrollment and racial/ethnic composition of enrolled students), administrative characteristics (such as number of district administrators and support staff), and local characteristics (such as urbanicity and local poverty rate among school-age children). A complete listing of explanatory variables used in the analysis is provided in the next section, along with a description of how these variables were incorporated into the statistical models.

Data for these explanatory variables can be missing either if the data are not available in the variable's source file due to item nonresponse, or if we are unable to match the district in the analysis file to the district in the explanatory variable's source file. If missing explanatory variable data are not imputed, cases with missing data would be omitted from any multivariate analysis, which could lead to biased results and reduced statistical power. In order to avoid this situation, we imputed missing data for explanatory variables using a hot-decking procedure in which missing

values were replaced with nonmissing values from districts with similar characteristics. Hot-decking is one of the most widely used imputation procedures because it limits item nonresponse bias while preserving the distribution of the imputed variable (Seastrom 2002). The imputation procedures used for this study follow those described by Carlson, et al. (1995).

B. Methodological Approach

This section describes the development of statistical models of the relationship between district characteristics and NSLP certification error. We discuss model specification, the selection of dependent and explanatory variables, and the process for developing and validating statistical models. These models identify the factors most strongly related to each type of certification error (household reporting error, administrative error, and overall error) and provide parameter estimates for predicting certification error. The results also inform the development of the monitoring tool to assist States in identifying error-prone districts.

1. Specification of Statistical Models

Statistical modeling of district certification error is based on a Tobit regression framework, which accounts for the fact that the certification error rates cannot be less than zero (that is, that they are censored at zero). These regression models are of the basic form:

Equation II.1. $$Error_{kj} = \max\left[0, X_{kj}\beta_{kj} + u_{kj}\right]$$

where $Error_{kj}$ is a measure of certification error type "*k*" in district "*j*." For example, $Error_{1j}$ is the percentage of reimbursements attributable to overall certification error as measured in the APEC data. The vector X_{kj} represents characteristics of district *j* included in the model for error type *k*. As discussed later in this section, the set of explanatory variables is tailored to the measure of certification error examined in each model. The vector β_k contains the parameters that summarize the relationships between each district characteristic and the certification error measure $Error_{kj}$. These parameters represent marginal effects, or changes in the underlying error rate associated with a unit change in the explanatory variable. Finally, u_{kj} is an error term, representing unobserved effects on the error rate $Error_{kj}$. The dependent variable $Error_{kj}$ takes on a value of zero if the underlying linear error equation $X_{kj} + u_{kj}$ is less than zero. This relationship reflects the fact that observed error rates cannot be less than zero, and therefore predicted error rates based on these models (and used in the monitoring tool) should not be either.

Although Tobit regressions are an appropriate specification for modeling certification error rates, these models can be sensitive to functional form. Parameters estimated in Tobit regressions can be particularly sensitive if the variance of the error term in Equation (II.1) varies from observation to observation, a condition known as heteroskedasticity. Therefore, as a robustness check, we re-estimated all models using OLS regressions. Although, OLS models do not account for censored dependent variables, their results are less sensitive to heteroskedasticity. Results from the OLS models are very similar to those estimated using Tobit models.

In addition to testing sensitivity to functional form, we also conducted various other tests of the sensitivity of the results to changes in the model specification. We estimated models that include interactions between independent variables as well as nonlinear functions of key independent variables such as enrollment. As a result of this analysis, we included a broader set of alternative specifications for enrollment as candidates to be included as explanatory variables. We also

estimated separate models for subgroups defined by enrollment. This alternative specification does not improve model performance relative to the specifications presented in this report.

2. Selection of Dependent Variables

The modeling effort has two goals: (1) to understand the factors associated with certification error and (2) to develop a model that is highly predictive of certification error. The modeling results, presented in Chapter III, address both of these goals. There is some tension between these two goals, as simpler models are easier to interpret but may not explain variation in certification error measures as well as more complicated sets of models do. Thus, we examined many specifications of dependent variables and examined the tradeoff between simplicity in interpreting the model versus the added predictive power of a more complex model.

Several measures of the dependent variables were considered for models of NSLP certification error. On one dimension, we modeled the separate types of error (household misreporting and administrative error) and the overall certification error. On another dimension, we considered (1) a single aggregated measure of error from all certifications versus (2) disaggregated measures by certification level (free, reduced-price, paid). And finally, we considered modeling the level of certification error (total dollars of reimbursement paid in error) versus rates of certification error.

Disaggregating error by certification level. As discussed earlier, NSLP certification error consists of six components (FCNE, FCRE, RCNE, RCFE, NCFE, and NCRE). Therefore, modeling disaggregated measures requires six regression equations rather than a single equation (one for each component of error and overall error). The disaggregated measures may yield models with more predictive power if different factors are associated with different types of error, however, more models provide more results for synthesis and interpretation.

We conducted a set of analysis to assess the benefits of using single or disaggregated error rate measures—assessing the performance of these models on samples other than those on which they were estimated. For example, we estimated models on the APEC data and then applied the model parameters to national data from the VSR for the 2005 school year. We then compared actual values of certification error measures in APEC to those that were imputed for the VSR based on the model estimates.[19] Finally, based on this analysis, we selected either the single measure or disaggregated measures.

Modeling rates versus levels of reimbursement error. In developing the statistical models, we conducted analyses using both rates of reimbursements made in error and levels of reimbursements made in error. However, models of error levels often predicted error amounts that were not appropriate for individual districts. For example, for some districts, the predicted error amount was larger than the total amount of NSLP reimbursements. Predicted error amounts such as these are not plausible and not appropriate for use in the monitoring tool. Therefore, the final models are based on rates of error.[20]

[19] Validation methods are discussed in greater detail later in the chapter.

[20] We did not model erroneous certification dollars per approved student. This is equivalent to modeling the disaggregated certification error rate because benefits are the same per student.

Although the statistical modeling based on error rates produces more appropriate estimates than modeling based on error levels, it is important to generate estimates of error levels in the monitoring tool for the purpose of identifying districts at risk of certification error. This is because districts with high certification error levels tend to contribute more erroneous payments to total NSLP improper payments than do districts with high certification error rates. Analysis of data from the APEC study indicates that the total erroneous payments of districts in the top quintile of error level account for about 80 percent of national erroneous payments due to certification error, while the total erroneous payments of districts in the top quintile of error rate make up about 30 percent of the national total.

In order to generate estimates of error levels using predicted values of error rates, we apply predicted error rates to districts' total estimated NSLP reimbursements. This calculation of error levels is straightforward in models based on an aggregate certification error measure:

Equation II.2. $$L_j^{Total} = R_j^{Total} * Reim_j$$

where L_j^{Total} represents the level of reimbursements due to certification error for district *j*, R_j^{Total} represents the proportion of reimbursements due to certification error for district *j*, and $Reim_j$ represents estimated total reimbursements for district *j*.

The calculation based on models of disaggregated certification error measures is analogous, but includes multiple components:

Equation II.3. $$L_j^{FCNE} = R_j^{FCNE} * Reim_j^{Free}$$

Equation II.4. $$L_j^{FCRE} = R_j^{FCRE} * Reim_j^{Free}$$

Equation II.5. $$L_j^{RCNE} = R_j^{RCNE} * Reim_j^{RP}$$

Equation II.6. $$L_j^{RCFE} = R_j^{RCFE} * Reim_j^{RP}$$

Equation II.7. $$L_j^{NCFE} = R_j^{NCFE} * Reim_j^{NC}$$

Equation II.8. $$L_j^{NCRE} = R_j^{NCRE} * Reim_j^{NC}$$

Equation II.9. $$L_j^{Total} = L_j^{FCNE} + L_j^{FCRE} + L_j^{RCNE} + L_j^{RCFE} + L_j^{NCFE} + L_j^{NCRE}$$

where L_j^{FCNE} represents the dollar amount of reimbursements for students certified for free meals but not eligible for free or reduced-price meals, R_j^{FCNE} represents the proportion of reimbursements for free meals made to students not eligible for free or reduced-price meals, and $Reim_j^{Free}$ represents reimbursements for free meals in district *j*. Analogous terms are defined for each of the components of error, as defined previously (FCRE, RCNE, RCFE, NCFE, and NCRE). Total level of reimbursements due to certification error for district *j* is the sum of these disaggregated error subcomponents.

3. Selection of Explanatory Variables

Three criteria were used in selecting explanatory variables or covariates for the models: (1) covariates should be highly correlated with certification error rates, (2) at least some covariates should be proxy for or influenced by districts' efforts to improve the integrity of the NSLP certification process, and (3) covariate measures should be available on an ongoing basis for use in monitoring error-prone districts.

Student demographics are an example of covariates that may be highly correlated with error rates; however, demographics are unlikely to change from year to year. A model with only covariates that change little from year to year will lead to a model (and thus a monitoring tool) that identifies the same districts as high-risk from year to year. On the other hand, covariates related to district certification policies are expected to change as underlying policies changes. For example, the method of selecting the NSLP verification sample may change over time.

Model results will be used in future years to assess districts' risk of high certification error. In order to apply estimated model parameters to annual national data, the model must be based on data that are annually available. This consideration led us to use the VSR data set as a starting point. Additional data, from sources listed in Section II.A, may be merged with annual VSR data, but that merge is not straightforward. Thus, any improvements in the model's predictive power arising from the inclusion of independent variables from these other data sources must be weighed against future costs of creating a merged data file. In particular, the monitoring tool is designed to produce estimates of certification risk with a simple and automated process. Increasing the number of merges the tool must conduct in an automated fashion (with little to no human oversight) increases the potential for introducing errors and increases the need for data checks by tool users in future years.

Our final approach for selecting explanatory variables was two-pronged:

1. Select a set of core variables to be included based on policy relevance or theoretical relationship to certification error.
2. Use an automated process to add additional variables to the model based on their observed correlation with certification error.

This two-pronged approach helps ensure that the model will have good predictive power and external validity. An approach that relies solely on variables that are considered important prior to the fact may fail to include some variables that are highly predictive of certification error in practice. On the other hand, a purely automated approach could fail to provide insight into the relationships that are most policy relevant or of greatest relevance to developing the monitoring tool. Furthermore, purely automated variable selection may be unduly influenced by some peculiar aspect of the sample that is unlikely to be true in the broader population of districts. The remainder of this section describes these two steps in the covariate selection process.

a. Selecting Core Variables

The core covariates that are expected to be predictive of certification error include (1) VSR verification results, (2) NSLP application characteristics, and (3) district enrollment characteristics. These types of measures were selected either because they are likely to be responsive to changes in policy or procedures that affect error or because of other theoretical relationships to certification error. The anticipated relationship of certification error to each set of core covariates is explained in

the text below. The estimated relationship of certification error to these variables is described in the discussion of model results in Chapter III.

In selecting core covariates, we experimented with different specifications of the variables of interest. The final set of core covariates, shown in Table II.3, is tailored to the dependent variable, with different core covariates used in models for aggregate certification error and for each disaggregated measure.

VSR verification results. Verification results are likely to be both predictive of districts' certification error rates and responsive to changes in districts' certification policies. For example, one might expect that districts with high underlying error rates would also have high rates of error among applications selected for verification.[21] However, some families selected for verification do not respond to the request for documentation. Therefore, families that respond are not necessarily representative of the full verification sample.

Verification results may also be a proxy for hard-to-measure aspects of districts' administration of the NSLP. Districts with high verification error rates may be ones that do a more careful job of protecting the integrity of the meal programs generally (more careful review of FRP applications, more assistance to families in completing FRP applications, and more diligent verification processes). In this scenario, districts with higher verification error rates may have lower underlying certification error rates.

The true relationship between verification results and certification error rates may vary across districts, leaving the question of which (if either) of the two explanations dominates an open, empirical question. It is also likely that the relationship between verification results and certification error differs based on whether a district selects a random or targeted verification sample. Therefore, all verification results are interacted with a variable indicating whether the district used random sampling in selecting their verification sample. By including these interaction terms, we are able to observe separately the relationship between verification results and certification error for districts not using random sampling (through the coefficients on the uninteracted terms related to verification results) and for districts using random sampling (through the sum of the coefficients on the interacted and uninteracted terms related to verification results).

Measures of verification results include the percentage of applications with benefits changed as a result of verification, and the percentage of households that did not respond to verification requests. These were defined differently for the aggregate certification error measure and for disaggregated certification error measures.[22] For aggregate certification error measures, the core covariates include verification results related to all verified applications (for example, percentage of all verified applications with a change in status resulting from verification). For disaggregated measures, the core covariates include verification results specific to the type of student affected by the disaggregated certification error type (for example, verification results for applications certified for NSLP-free).

[21]This may be more likely for districts that selected random, as opposed to focused, verification samples.

[22] We experimented with a number of other specifications of verification results variables, such as aggregating verification results to one percentage of all verified applications that changed or did not respond. We chose the selected specification based on the strength of the relationship with the dependent variables.

Table II.3. List of Core Variables Included in Statistical Models, by Error Rate Used as a Dependent Variable in the Relevant Model

			Disaggregated Error Rates					
		Aggregate Error Rate	Free Certified, Not Eligible (FCNE)	Free Certified, RP Eligible (FCRE)	RP Certified, Not Eligible (RCNE)	RP Certified, Free Eligible (RCFE)	Not Certified, Free Eligible (NCFE)	Not Certified, RP Eligible (NCRE)
(1)	Selected random verification sample	✓	✓	✓	✓	✓	✓	✓
(2)	Percentage of all verified applications that had benefits changed during verification	✓					✓	✓
(3)	Interaction of (1) and (2)	✓					✓	✓
(4)	Percentage of verified applications that had benefits reduced or terminated during verification among:							
	Free Applications		✓	✓				
	Reduced Price Applications				✓	✓		
(5)	Interaction of (1) and (4)		✓	✓	✓	✓		
(6)	Percentage of verified reduced price applications that had benefits increased during verification among:				✓	✓		
(7)	Interaction of (1) and (6)				✓	✓		
(8)	Percentage of applications selected for verification in which household did not respond to request for verification among:							
	All Applications	✓					✓	✓
	Free Applications		✓	✓				
	Reduced Price Applications				✓	✓		
(9)	Interaction of (1) and (6)	✓	✓	✓	✓	✓	✓	✓
	Certification Variables							
(10)	Percentage of certified students that were certified categorically	✓	✓	✓	✓	✓	✓	✓
(11)	Percentage of certified students that were certified non-applicants	✓	✓	✓	✓	✓	✓	✓
	Core SFA Characteristics							
(12)	Enrollment (in tens of thousands)	✓	✓	✓	✓	✓	✓	✓
(13)	Percentage of students certified eligible for free meals	✓	✓	✓	✓	✓	✓	✓
(14)	Percentage of students certified eligible for reduced-price meals	✓	✓	✓	✓	✓	✓	✓

Note: All core covariates are drawn from Verification Summary Report data.

NSLP application characteristics. The methods of certifying students for FRP benefits are expected to affect error rates. Having a higher percentage of students certified without an application reduces a district's total number of applications as well as opportunities to introduce administrative and household reporting error. Applications based on categorical eligibility also offer fewer opportunities for error by eliminating the calculation of household size and income, and the comparison of these values to program benefit thresholds. Household reporting error may also be lower on applications indicating categorical eligibility because households report program participation rather than household income. In addition to being correlated with certification error, these covariates are likely to be responsive to changes in districts' certification policies, especially direct certification practices that increase the number of certifications without application.

District demographic and administrative characteristics. The final set of core covariates are related to district characteristics, including enrollment, number of free-certified students, and number of reduced price-certified students. The direction of the relationships between each of these characteristics and certification error could be either positive or negative. For example, larger districts likely receive a large volume of applications. This could lead to lower rates of certification error if these districts are more efficient at processing applications. Alternatively, this could lead to higher rates of certification error if it is difficult to process a large volume of applications.

b. Automated Process for Selecting Additional Variables

After identifying a core set of explanatory variables for the model, we used an automated process to add additional variables to each model. These additional variables were selected in a stepwise fashion based on correlations of all candidate explanatory variables with the dependent variable, controlling for the core variables (that is, with the residual from the regression of the dependent variable on the core variables). The list of candidate variables considered for inclusion in the models through the automated process are listed in Table II.4.

Table II.4. List of Candidate Variables Considered for Inclusion in Statistical Models, by Data Source

Candidate Variables	Additional Information
Verification Summary Report	
Number of schools	
Number of non-base year P2/3 schools	
Enrollment	Includes categorical enrollment variables and nonlinear enrollment terms
Students enrolled in non-base year P2/3 schools	Number and percentage
Meal benefit certification composition	Number and percentage of free and RP-certified students
Free-certified students not subject to verification	Number, percentage of all students, and percentage of free students
Categorically eligible free-certified students	Number, percentage of all students, and percentage of free students
Free-certified students for non-base year P2/3 schools	Number, percentage of all students, and percentage of free students
Reduced price-certified students for non-base year P2/3 schools	Number, percentage of all students, and percentage of RP students

Table II.4 *(continued)*

Candidate Variables	Additional Information
Number of approved applications	Number and percentage free and RP-certified applications
Categorically eligible applications	Number and percentage of applications
Applications approved for free meals based on income	Number and percentage of applications
Applications selected for verification	Number of applications by certification category, percentage of all, free, and RP applications
Common Core of Data[a]	
Race/ethnicity composition	Number and percentage of students who were Black, Hispanic, White, and Asian
Migrant student composition	Number and percentage
Students eligible for free or reduced-price meals	Number and percentage
Urbanicity	Number and percentage of schools in urban, suburban, town, and rural settings
Number of schools	Number and students per school
Number of teachers	Number and per student
Number of LEA administrators	Number and per student
Number of school administrators	Number and per student
Number of LEA support staff	Number and per student
Food services spending	Total and per student
Food service salary spending	Total and per student
Census Bureau Small Area Income and Poverty Estimates	
School age poverty ratio	Poverty for those ages 5 to 17
Regional Office Review of Applications[b]	
Applications are stored centrally	Use of direct certification
Schools operation under Provision 2	Use of electronic point of sale
Use multichild application	
Bureau of Labor Statistics Local Area Unemployment Survey	
County unemployment rate	

[a]Includes items from LEA universe survey, LEA finance survey, school universe survey.

[b]These variables are only used in the RORA analysis file and are not available for all RORA years.

NSLP=National School Lunch Program; P2/3=Provisions 2 or 3.

We explored several different options in determining the optimal number of additional variables to select. As a starting point in each model, we added variables to the core set until the coefficient on the next additional variable was no longer statistically significant at the five percent level.[23] In most specifications, two or three additional variables were added before the next failed to meet this five percent significance threshold. Thus a large majority of the explanatory variables in the model come from the core set of covariates rather than from the automated process.

We conducted analysis comparing the starting point specification to specifications that had two fewer additional variables selected through the automated process, one fewer additional variable, one more additional variable, and two more additional variables. We also compared these specifications to ones that had only the core set of covariates.

We determined the optimal number of additional variables to select based on how well the models perform on samples other than those on which they were estimated, as well as model goodness of fit. For example, we estimated models using different numbers of additional covariates on the APEC data and then applied each set of model parameters to national data from the VSR for the 2005 school year. We then compared actual values of certification error measures to those that were imputed based on the model estimates. Based on this analysis, we selected the number of additional variables for the final model.

4. Assessment of Model Performance and Reporting of Model Results

It is important to verify that the models perform well on samples other than those on which they were estimated because the statistical models will be applied to different samples in future years as a part of the certification error monitoring tool. In assessing model performance, we also examined model goodness of fit, although we place relatively more importance on model performance in different samples because of its relevance to the performance of the monitoring tool.[24]

In assessing how well the models perform on other data samples (known as model validation), we used different techniques based on analytical feasibility. The one common model validation assessment is accomplished by dividing a sample, developing a model using one portion of the divided sample, and then applying the model to the reserved portion of the sample. If predicted values of the dependent variable derived from the model match actual values of the dependent variable for members of the reserved portion of the sample, more confidence can be placed in the validity and generalizability of the model.

We conducted this type of validation exercise for dependent variables based on the VSR. However, small sample sizes in APEC and RORA make sample reservation infeasible. As an alternative, we applied the models developed based on APEC and RORA certification error

[23] The five percent level of statistical significance is commonly used in automated processes for selecting explanatory variables but is at the low end of the range suggested by the related literature (Lee and Korval 1997; Shtatland et al. 2003). Use of a threshold of statistical significance at five percent will result in fewer variables being added to the model than would a higher threshold. This result is appropriate given the limited degrees of freedom in our small analysis samples. We also experimented by including larger numbers of explanatory variables through the automated process, as described in the text.

[24] In assessing predictive power, we examined each model's McKelvey and Zavoina pseudo R-squared value, a goodness of fit measure shown to perform well with Tobit analysis (Veall and Zimmerman 2006).

measures to data available in the composite VSR data. We then combined the predicted values in the composite VSR data to generate national estimates of mean (predicted) values of the dependent variable. If the statistical models are valid, these national estimates should match closely to the nationally representative estimates of the mean of the dependent variables available from APEC and RORA data because the VSR data are a census of districts offering NSLP. As discussed in the next chapter, we find that the models are valid.

Although the model validation analysis provides an assessment of model performance for the time period on which the models were estimated, this analysis cannot assess the validity of the model in future years. If the underlying relationships between the certification error measures and LEA characteristics change over time, then the performance of the models may erode.[25] Thus, a key assumption in applying these models to future years of data within the monitoring tool is that these relationships change little over time. This point underscores the importance of attempting to select highly predictive explanatory variables whose theoretical relationship with certification error is strong, and avoiding explanatory variables whose predictive power is based on peculiar aspects of the sample or the time period during which the sample was drawn.

For each measure of certification error, we selected the model with the strongest validation performance as our preferred one. In analyzing results from the Tobit equations that comprise these preferred models, we focused primarily on identifying relationships that are statistically significant at the 5 percent level. However, we also classified relationships that are statistically significant at the 10 percent level (but not at the 5 percent level) as marginally significant.

[25] Assessment of model validity in future years will be possible only if a study such as APEC is conducted to provide an independent assessment of certification rates for comparison with model estimates.

III. MODELING RESULTS

This chapter describes the statistical models we developed to summarize the relationships between LEA characteristics and each of the available measures of certification error, namely, overall household reporting and administrative certification error from Application, Eligibility, and Certification (APEC), and administrative certification error from Regional Office Review of Applications (RORA). For each of these types of error, we present analysis that leads to the model specification that is most predictive of certification error, and we discuss the findings from this final specification.

Chapter Highlights

- The preferred statistical models of certification error perform well when applied to VSR data. Imputed certification error estimates generated by applying the models to VSR data match well with estimates from APEC and RORA data.
- The preferred model of APEC overall certification error is based on a disaggregated measure in which certification error is broken out into six subcomponents. For Free-certified-not-eligible (FCNE) error, which accounts for about half of overall certification error, the most important explanatory factors are related to verification results and enrollment. For districts not using random verification samples, higher rates of reduction or termination of benefits through verification are associated with higher FCNE error, as are higher rates of verification nonresponse.
- The preferred model of APEC household reporting certification error is also based on a disaggregated measure. As with overall certification error, reduction of benefits through verification has a strong relationship with the largest component of reporting error.
- The preferred model of APEC administrative certification error is based on a single, aggregated measure (i.e. the percent of all reimbursements subject to administrative error). As was the case with models of overall and household reporting error rates, we find verification results are significantly related to administrative certification error rates for districts not selecting random verification samples. We find no other factors included in the model have a statistically significant relationship with administrative error rates.
- The preferred model of RORA administrative certification error is based on a single, aggregated measure. Although the model produces validation estimates that match well with estimates from the RORA data, the only statistically significant coefficients in the model are ones associated with enrollment—districts with more students tend to have higher administrative error rates. Contrary to the findings for other types of certification error, verification results are not significantly associated with RORA administrative error rates.

A. APEC Overall Certification Error

The measure of overall certification error available in APEC provides an empirically sound, carefully executed estimate of national erroneous payments due to certification error. Therefore, the statistical model that is most predictive of this measure will form the basis of the monitoring tool. This section begins by presenting findings from analysis used to compare different model specifications and select a preferred specification. Next, we describe results from this preferred specification.

1. Specification for Certification Error Models

We explored a number of different specifications for the models of overall certification error. The main ways these specifications varied were based on (1) whether the models were based on aggregate overall certification error measures or disaggregated measures, (2) the number of variables added to the models in addition to the core variables, and (3) whether the additional variables came from the VSR only or from all data sources. We also investigated an alternative specification in which equations were estimated separately by enrollment category. As described in Chapter II, we evaluated these different specifications on the basis of model goodness of fit and results from validation analysis in which the models were applied to the census of school districts available in the VSR data.[26]

Table III.1 presents results from the validation analysis of each specification. The top panel of this table presents the nationally representative mean certification error rate for districts in the APEC data, along with the distribution of certification error rates. The remainder of the table shows analogous values imputed based on selected model specifications for the census of districts in the 2005 VSR. The results in Table III.1 illustrate that the preferred specification was selected to provide an imputed VSR error rate distribution that matches well with the APEC data. To simplify the presentation, these tables show a relatively small subset of the specifications that were estimated.[27]

In addition to the model validation analysis, we examined goodness of fit to assess model performance as discussed in the previous chapter. The results of the goodness of fit analysis, presented in Appendix A, support the conclusions drawn from the model validation analysis. Because model validity is more relevant to the use of models in the certification error monitoring tool, we focus the text of this chapter on the validation analysis.

[26] A full set of goodness of fit statistics are presented in Appendix A.

[27] For example, Table III.1 presents estimates based on specifications using different numbers of additional covariates for disaggregated error rate models. However, analogous specifications for aggregate error rate models were also estimated. The covariates for each Tobit regression equation within each specification was tailored to the dependent variable based on the automated process described in Chapter II. Therefore, Table III.1 represents the synthesis of 22 different model specifications, containing a total of 77 final Tobit regression equations, built on the basis of over 500 Tobit regressions estimated as a part of the automated variable selection process. Analogous tables relevant to RORA and VSR certification error measures synthesize an even larger set of information since specifications for these models can also vary based on the sample year from which the data are drawn. All specifications tested for certification error rates were also tested for levels of certification error.

Table III.1. Validation Results for Different Specifications of Tobit Models of APEC Overall Certification Error Rates (Percentages)

	Mean Error Rate	Percentile of Error Rate Distribution			
		25	50	75	90
APEC Estimates of Certification Error Rates					
Actual Distribution of Overall Certification Error Rate	9.4	5.6	6.1	11.8	17.5
Imputed VSR Estimates by Specification of Dependent Variable					
Disaggregated Error Rates	8.9	4.8	8.3	12.1	15.4
Aggregated Error Rate	10.2	8.5	10.5	12.2	14.0
Imputed VSR Estimates by Number of Additional Covariates					
Core Covariates Only	7.3	4.5	6.9	9.4	12.3
Change Preferred Number in Disaggregated Error Rate Models by:					
-2	7.3	4.5	6.9	9.4	12.3
-1	8.7	5.3	8.3	11.5	14.8
+1	13.9	8.2	13.3	18.7	23.9
+2	13.9	8.1	13.2	18.6	24.2
Imputed VSR Estimates for Other Alternate Specifications					
Include Covariates from All Data Sources:					
Disaggregated error rates	8.5	4.2	7.8	11.6	15.4
Aggregated error rate	10.2	8.5	10.5	12.2	14.0
Separate Models by Enrollment Category	19.8	15.7	20.3	24.2	27.0

Source: APEC and Verification Summary Report data, SY2005-06.

Note: Certification error rates refer to the percentage of total reimbursements with a given type of certification error. APEC estimates are weighted to account for sample design and nonresponse. Imputed error rates are derived by applying relevant certification error rate models estimated in APEC data to districts in the VSR data. Unless stated otherwise, covariates in relevant models come from the VSR only. Unless stated otherwise, covariates were added to all models until adding an additional variable would not result in a statistically significant coefficient.

Based on the validation analysis, the strongest overall certification error rate specification is based on disaggregated certification error rates and includes covariates in addition to the core covariates until additional covariates are no longer statistically significant at the five percent level. We find that there is little gain to including additional variables from sources other than the VSR and that other alternative specifications do not outperform the preferred one. These specification features are discussed in greater detail below.

Measures of Certification Error Rate. Models based on disaggregated certification error rate measures have stronger validation results than those based on a single aggregate measure. The validation analysis shows that in the 2005 VSR sample, the mean imputed error rate based on the disaggregated error rate models is similar to the observed national estimate (8.9 percent versus 9.4 percent). Importantly, the distribution of these imputed error rates and the distribution of the APEC estimates are similarly shaped. For example, the 25th and 75th percentiles of the imputed error rate distribution are 4.8 and 12.1 percent, whereas those of the APEC distribution are 5.6 and 11.8 percent. In contrast, imputed certification error rates based on the aggregated error rate model are

less similarly shaped, with higher values throughout the distribution—the 25th percentile of this distribution is 8.5. This pattern is important because when the distribution of imputed error rates more closely matches the actual distribution, we are better able to distinguish which districts are at risk of having high certification error. Thus, a monitoring tool based on a statistical model that leads to a more accurately shaped imputed error rate distribution should more accurately identify the districts at risk of certification error.

Number of Additional Covariates. As described in Chapter II, our default method for selecting covariates in addition to the core ones was to add covariates until the coefficient on an additional covariate was not statistically significant. For example, if the first three variables added to a model's core covariates are statistically significant but the fourth is not, the preferred number of additional variables for that model is three. We assessed the efficacy of this strategy by comparing validation results of models with the preferred number of additional variables to those of models with different numbers of additional variables. Results of the validation analysis are fairly similar for the specification with the preferred number of additional variables and models with fewer variables—the mean imputed error rates in the models with fewer variables are slightly lower and the distributions have similar shapes. However, the validation results for specifications with more additional variables are dramatically worse than those of the specifications with the preferred number—the mean error rate is nearly 50 percent larger than the mean APEC error rate. This finding suggests that adding too many additional covariates incorporates into the model some idiosyncratic characteristics of the APEC data that are not generalizable to other samples. Therefore, we conclude that the strategy of adding covariates until the coefficient on an additional covariate is not statistically significant is an appropriate one.

Additional Covariate Data Sources. There are advantages to making use of fewer data sources because the selected models will be used in generating risk scores in future years. Focusing on a smaller number of data sources will simplify the monitoring tool and reduce errors related to merging data files. However, if a larger set of data sources contains variables strongly related to certification error, the value of adding these sources could justify the additional burden. To assess whether this was the case, we compared specifications that draw additional covariates only from the VSR to specifications that draw covariates from all data sources.

We find little evidence of important gains from adding data sources other than the VSR. In general, validation performance is similar regardless of whether data sources other than the VSR are included. For example, the mean imputed error rate is 8.9 when covariates are drawn only from the VSR, slightly closer to the actual mean error rate of 9.4 than the 8.4 percent mean error rate when covariates from other data sources are included (Table III.1). One reason for this similarity is that variables from the VSR are often selected by the automated process even when variables from other data sources are available. For example, the automated process for selecting additional covariates yields the same set of covariates in models of FCNE certification error rates regardless of whether data from sources other than the VSR are available. Based on this analysis, we conclude that focusing on covariates drawn only from the VSR is appropriate. Findings are similar for other APEC and RORA certification error measures. To simplify presentation, we do not include results related to additional data sources in the discussion of these other measures.

Separate Specifications by Enrollment. We investigated whether model performance could be improved by estimating separate certification error rate equations based on whether districts had more than 10,000 students. This approach could be effective if different characteristics are associated with certification error for districts in different enrollment categories. However, we find that this approach leads to greatly overstated imputed values when applied to VSR data. The mean

imputed error rate is more than twice as large as the mean error rate in the APEC data (Table III.1). Therefore, this approach is not our preferred one. Findings are similar for other APEC and RORA certification error measures. To simplify presentation, we do not include results for separate enrollment specifications in the discussion of these other measures.

2. Results of Certification Error Models

Based on the analysis in the previous section, the final model of APEC overall certification error is based on the disaggregated measures of certification error rate. Explanatory variables all come from the VSR and were added to the core ones until the coefficient on an additional covariate is not statistically significant.

Because the final model of overall certification error is based on the disaggregated measures, it includes six Tobit regression equations. Estimates from these equations are presented in Table III.2. Estimates from the FCNE certification error rate regression equation are the most critical to the performance of the model as a whole. This is because FCNE error constitutes 42 percent of total erroneous payments for the NSLP, by far the largest percentage of any component of overall error (Table III.2). As a result, the following discussion of estimates from the model's regression equation focuses primarily on the FCNE error rate equation and summarizes results from other types of error more briefly. The following discussion is organized by type of explanatory variable.

Variables Related to Verification Results. As described in Chapter II, verification results may be related to a particular certification error rate, either because the verification process actually creates a rough estimate of the underlying error rate or because the process proxies for the extent to which the district's administration of the meal programs is designed to promote program integrity. Whatever the underlying reason for a relationship between verification results and certification error, it is possible that this relationship may differ depending upon whether a district selects a verification sample randomly or by other means. Thus, the model specification includes interaction terms to allow the estimated marginal effect—which is the change in certification error for a unit change in verification results— to differ depending on whether a district selects a verification sample randomly or not. Marginal effects of verification results on certification error for SFAs not using random verification samples are represented by the coefficients on covariates 2, 4, and 6 in Table III.2, while the marginal effects for SFAs using random verification samples are represented by the sum of each of these coefficients with the coefficients on the relevant interaction terms (the sums of covariates 2 and 3, 4 and 5, and 6 and 7, respectively).

The estimated relationship between verification results and FCNE error rates is stronger for districts not selecting random verification samples (most of these districts use error-prone sampling). Covariate (2) in Table III.2 indicates that a 10 point increase in the percentage of certified free applications changed to reduced-price or paid status during verification is associated with a 2.49 percentage point increase in the predicted value of FCNE error rate; this relationship is statistically significant at the one percent level. However, a similar 10 point increase for districts using random

Table III.2. Coefficient Estimates from Tobit Model of APEC Overall Certification Error Rate Related, by Error Subcomponent

		(1)	(2)	(3)	(4)	(5)	(6)
		Free Certified, Not Eligible (FCNE)	Free Certified, RP Eligible (FCRE)	RP Certified, Not Eligible (RCNE)	RP Certified, Free Eligible (RCFE)	Not Certified, Free Eligible (NCFE)	Not Certified, RP Eligible (NCRE)
	Percent of Overall Certification Error from Error Type	**42.0**	**10.5**	**27.4**	**7.5**	**6.7**	**5.8**
	Verification Variables						
(1)	Selected random verification sample	5.895	0.535	12.582	4.262	-0.831	-3.622
(2)	Percentage of verified applications that had benefits reduced or terminated during verification[a]	0.249***	0.002	1.232	-0.031	0.001	0.097
(3)	Interaction of (1) and (2)	-0.232**	-0.001	-0.676	-0.248	0.152	0.024
	Significance of (2)+(3)				††		
(4)	Percentage of verified applications that had benefits increased during verification			-0.033	-0.028		
(5)	Interaction of (1) and (4)			0.233	-0.082		
	Significance of (4)+(5)						
(6)	Percentage of applications selected for verification in which household did not respond to request for verification	0.119**	0.020*	0.006	0.078*	0.588**	0.099
(7)	Interaction of (1) and (6)	0.021	-0.008	-0.165	-0.038	-0.463	0.117
	Significance of (6)+(7)	†					
	Certification Variables						
(8)	Percentage of certified students that were certified categorically	-0.131	-0.033**	0.462	-0.218***	-0.631*	0.339
(9)	Percentage of certified students that were certified non-applicants	0.009	-0.023**	0.246	-0.081	-0.330	0.296
	Core SFA Characteristics						
(10)	Enrollment (in tens of thousands)	0.184***	-0.003	0.036	-0.002	-0.474	-0.141
(11)	Percentage of students certified eligible for free meals	-0.102**	-0.010	-0.211	0.028	0.653**	0.217
(12)	Percentage of students certified eligible for reduced-price meals	-0.216	0.215***	0.688	-0.090	-0.251	0.748
	Additional District Characteristics						
(13)	Public SFA	-18.653***			-7.902***		
(14)	Enrollment 5001 - 10,000	7.799***					
(15)	Enrollment 1001 - 5000	7.606***					

Table III.2 *(continued)*

		(1)	(2)	(3)	(4)	(5)	(6)
		Free Certified, Not Eligible (FCNE)	Free Certified, RP Eligible (FCRE)	RP Certified, Not Eligible (RCNE)	RP Certified, Free Eligible (RCFE)	Not Certified, Free Eligible (NCFE)	Not Certified, RP Eligible (NCRE)
(16)	Enrollment < 1,000		-2.934***				
(17)	# Provision 2/3 schools	-0.035**					
(18)	% Free students from non-base year Prov 2/3 schools		-0.033***				
(19)	% students reported free eligible from non-base year Prov 2/3 schools				-0.254***	-0.844**	
(20)	% RP students reported RP eligible from non-base year Prov 2/3 schools						0.231
(21)	Enrollment w/access to NSLP Prov 2/3 schools (in tens of thousands)			0.325	0.205***		
(22)	% all applications certified for RP meals				-0.170*		
(23)	% apps verified				0.232***		
(24)	No free apps were verified					50.748**	
(25)	No RP apps were verified		2.260***			.	
(26)	Constant	16.540**	0.494	-4.553	19.907***	-17.858	-31.501
	Observations	86	86	86	86	86	86
	Pseudo R-squared	0.425	0.389	0.116	0.321	0.344	0.154

Source: Verification Summary Reports and APEC study.

Note: Pseudo R-squared refers to the McKelvey and Zavoina pseudo R-squared.

[a]For columns (5) and (6) this independent variable is the percentage of all verified applications that changed to a different status during verification. See Table II.3 and related discussion.

*Coefficient is statistically significant at 10 percent level.
**Coefficient is statistically significant at 5 percent level.
***Coefficient is statistically significant at 1 percent level.
†Sum of coefficients is statistically significant at 10 percent level.
††Sum of coefficients is statistically significant at 5 percent level.
†††Sum of coefficients is statistically significant at 1 percent level.

verification sampling is associated with a 0.17 percentage point increase in the predicted value of FCNE error (2.49 – 2.32 = 0.17); this relationship is not statistically significant.[28]

The percentage of certified free applications changed to reduced-price or paid status during verification is not significant for any other error rate (see coefficient on covariate (2) in columns (2) through (6) in Table III.2) among districts not using random verification samples. However, the percentage of certified free applications changed to reduced-price or paid status in districts using randomly selected verification samples is associated with lower RCFE error rates: the sum of the coefficients on covariates (2) and (3) is significant in column (4).

For districts not using random verification samples, there is also a positive association between FCNE error rates and the percentage of certified free applications selected for verification in which the household did not respond (covariate 6 in Table III.2). For these districts, a 10 percentage point increase in nonresponse among free-certified verification households is associated with a 1.19 percentage point increase in FCNE error rates; this relationship is statistically significant at the five percent level. There are also positive, significant relationships between the percentage of certified free applications selected for verification in which the household did not respond and FCRE, RCFE, and NCFE error rates.

As with the districts not selecting verification samples through random sampling, those using random sampling to select verification samples show a positive association between FCNE error rates and the percentage of certified free applications selected for verification in which the household did not respond to the request for documentation. A 10 percentage point increase in free applicant nonresponse is associated with a 1.40 percentage point increase in FCNE error; this finding is marginally significant (p=0.052). However, this relationship is not statistically significant for any other type of overall certification error.

Variables Related to the Method of Certification. As discussed in Chapter 1, students may be certified eligible to receive free or reduced-price meals in several ways. They may be certified by application on the basis of family income and family size or on the basis of categorical eligibility (by reporting a SNAP, FDPIR, or TANF case number on their application). Students may be determined eligible for free meals without submitting an application through direct certification. Under direct certification, districts use information provided by SNAP-, FDPIR-, and TANF-administering agencies to identify students who are members of households participating in one of these programs and is thus automatically eligible to receive free meals. It is possible that different methods of certification are associated with different rates of erroneous payments. Districts that have higher percentages of students who are determined to be eligible for benefits categorically may have less error for two reasons. First, it is simpler for families to report program participation on their free/reduced-price meal applications than it is to report income, thus reducing reporting error. Second, determining the eligibility of these households is simpler for program administrators, thus reducing administrative error. Similarly, districts are able to eliminate reporting error entirely for those students who are certified without an application.

[28]This marginal effect is calculated by summing two relevant coefficients and multiplying by 10. In other words, we added the coefficient on the percentage of certified free applications changed to reduced-price or paid status during verification (0.249) and the coefficient on the interaction of this variable with whether the district selected a random verification sample (-0.232). We then multiplied this sum (0.017) by 10. Statistical significance of the marginal effect was determined using a Wald test of whether the sum of these two coefficients was equal to zero; results from these tests are reported below the relevant coefficient estimates in Table III.3.

A higher percentage of free applications approved on the basis of categorical eligibility is associated with a lower FCNE error rate. This association is not statistically significant, although the magnitude is fairly large. A 10 percentage point increase in this measure is associated with a 1.31 percentage point decline in the FCNE error rate. This suggests that in the NSLP, being approved for free meals based on a SNAP, FDPIR, or TANF case number may be associated with less certification error than is being approved based on household income. This conclusion is further supported by negative significant coefficients on the percentage of certified free applications approved through categorical eligibility in the FCRE, RCFE, and NCFE error equations.

The relationship between the percentage of certified students who are certified without an application (mainly through direct certification) and FCNE error rates is small and not statistically significant. This relationship is negative and statistically significant in the FCRE equation, but is not statistically significant for any other component of overall certification error.

Other District Characteristics. Three core characteristics were included in all error rate equations: (1) district enrollment, (2) the percentage of enrolled students certified for free meals, and (3) the percentage of enrolled students certified for reduced-price meals. Additional covariates were added to each model based on the strength of their relationship with the error rate. These additional covariates varied substantially across certification error rate subcomponents, with few variables selected for more than one regression equation. For FCNE error, the additional covariates are (1) whether the district is publicly operated, (2) whether enrollment is at least 5,000 and less than 10,000, (3) whether enrollment is at least 1,000 and less than 5,000, and (4) the number of non-base year Provision 2 or 3 schools in the district. For other error rate equations, the variables selected by the automated process were varied and typically specified differently for different equations.

The coefficients on enrollment-related variables indicate that enrollment has an important positive relationship with FCNE error. The inclusion of the two categorical variables related to enrollment indicate that this relationship is not linear—that is, the nature of the relationship between enrollment and FCNE error varies depending on how many students are enrolled in the district. Specifically, the results suggest that error rates are highest for districts with at least 1,000 and fewer than 10,000 students. This pattern may suggest that although larger districts tend to have higher rates of FCNE error, very large districts may be able to mitigate these differences through more efficient certification processes or other means. The relationship between enrollment and certification error is not typically present for other subcomponents of certification error. There is evidence that schools with fewer than 1,000 students have lower FCRE error, but otherwise there are no significant relationships between enrollment and other certification error types.

Whether the district is publicly operated is one of the strongest relationships identified in the FCNE error rate equation. Controlling for other factors, public districts have FCNE error rates that are nearly 19 percentage points lower than private districts. This difference is statistically significant at the one percent level. Whether the district is publicly operated also has a significant negative relationship with RCFE error. This variable was not statistically significant for other types of certification error.

Other variables with significant relationships with FCNE error are the percentage of students certified for free meals and the number of non-base year Provision 2 or 3 schools. A higher percentage of students certified for free meals is associated with lower FCNE error rates. A 10 percentage point increase in the percentage of students certified for free meals is associated with a one percentage point decrease in FCNE error rate. The number of non-base year Provision 2 or 3 schools also has a significant negative relationship with FCNE error rates, although the magnitude is

small. Each additional non-base year Provision 2 or 3 school is associated with a 0.035 decrease in FCNE error rate.

For types of error other than FCNE, there is little consistent pattern in the additional variables added through the automated process. Higher percentages of students reporting free meals from non-base year Provision 2 or 3 schools are associated with lower RCFE and NCFE error rates. Otherwise, no variables have significant relationships with more than one type of error.

B. APEC Household Reporting Certification Error

Reporting error occurs when parents do not report correct information about their household circumstances on their application. The APEC study estimated that this type of error constitutes nearly 70 percent of overall erroneous payments due to certification error nationwide (Ponza et al. 2007). This section describes the statistical models developed to summarize the relationship between household reporting error and district characteristics.

1. Specification for Household Reporting Certification Error Models

We explored a number of different specifications for the models of household reporting certification error and found that the strongest specification has the same form as the preferred specification identified for overall certification error. Specifically, the primary household reporting error specification is based on disaggregated certification error rates and adds covariates to the core ones until the coefficient on an additional covariate is no longer statistically significant.

Table III.3 shows validation results for different specifications of the household reporting error models. We find that compared to models based on aggregated household reporting error rates, models based on disaggregated error rates yield superior validation results. Comparing validation results for the aggregated and disaggregated error rate models shows that the shape of the imputed VSR household reporting error rate distribution based on the disaggregated error rate model more closely matches that of the APEC household reporting error rate distribution. The 25th and 75th percentiles of the APEC household reporting error rate distribution are 4.5 and 10.3 percent, whereas those of the imputed error rate distribution based on disaggregated error rates are 3.9 and 9.8 percent (Table III.3). The imputed error rate distribution based on aggregated error rates is less similar to the shape of these other two distributions, with 25th and 75th percentiles of 6.6 and 10.8 percent. Because of these findings, we use the specification based on the disaggregated error rates as our primary one.

Analysis of model validation findings also suggest that the strategy of adding covariates to the core equation until the coefficients on additional variables are no longer statistically significant is an appropriate one. Validation results are similar for specifications with fewer additional variables and substantially worse for those with more additional variables (Table III.3).

Table III.3. Validation Results for Different Specifications of Tobit Models of APEC Household Reporting Certification Error Rates (Percentages)

		Percentile of Error Rate Distribution			
	Mean Error Rate	25	50	75	90
APEC Estimates of Certification Error Rates					
Actual Distribution of Household Reporting Certification Error Rate	7.7	4.5	5.6	10.3	13.8
Imputed VSR Estimates by Specification of Dependent Variable					
Disaggregated Error Rates	7.2	3.9	6.7	9.8	12.7
Aggregated Error Rate	8.5	6.6	8.6	10.8	12.4
Imputed VSR Estimates by Number of Additional Covariates and Alternate Specifications					
Core Covariates Only	7.1	4.6	6.8	9.3	11.5
Change Preferred Number in Disaggregated Error Rate Models by:					
-2	7.3	4.9	7.1	9.5	11.7
-1	6.0	3.5	5.7	7.8	10.3
+1	5.4	2.7	4.7	7.3	10.3
+2	4.3	1.3	3.1	6.1	9.6
Separate Models by Enrollment Category	9.3	4.8	7.9	11.8	18.8
Covariates from Other Data Sources	11.2	5.4	9.5	15.2	21.7

Source: APEC and Verification Summary Report data, SY2005–06.

Note: Certification error rates refer to the percentage of total reimbursements with a given type of certification error. APEC estimates are weighted to account for sample design and nonresponse. Imputed error rates are derived by applying relevant certification error rate models estimated in APEC data to districts in the VSR data. Covariates in relevant models come from the VSR only. Unless stated otherwise, covariates were added to all models until adding an additional variable would not result in a statistically significant coefficient.

2. Results of Certification Error Models

The final model of household reporting certification error is based on the disaggregated measures of certification error rate. Explanatory variables all come from the VSR and were added to the core ones until the coefficient on an additional covariate is not statistically significant. Although the final model of overall certification error is based on six Tobit regression equations, we focus our discussion of the model on the regression equations for the percentage of reimbursements for students not eligible for either free or reduced-price meals but incorrectly certified for free meals due to household reporting error (FCNE error). This equation is most critical to the performance of the model as a whole because FCNE error constitutes more than 40 percent of total erroneous payments for the NSLP (Ponza et al. 2007). These estimates are presented in Table III.4. The following discussion of these estimates is organized by type of explanatory variable.

Table III.4. Coefficient Estimates from Tobit Models of APEC Household Reporting Certification Error Rate, by Error Subcomponent

		(1)	(2)	(3)	(4)	(5)	(6)
		Free Certified, Not Eligible (FCNE)	Free Certified, RP Eligible (FCRE)	RP Certified, Not Eligible (RCNE)	RP Certified, Free Eligible (RCFE)	Not Certified, Free Eligible (NCFE)	Not Certified, RP Eligible (NCRE)
	Percent of Reporting Error from Error Type	**39.2**	**12.2**	**30.5**	**9.1**	**4.0**	**5.1**
	Verification Variables						
(1)	Selected random verification sample	4.880	0.743	16.647	0.500	4.275	4.108
(2)	Percentage of verified applications that had benefits reduced or terminated during verification[a]	0.179**	0.015	0.669	-0.118	-0.273	0.145
(3)	Interaction of (1) and (2) *Significance of (2)+(3)*	-0.186*	-0.027	0.120	-0.157	-0.088	0.101
(4)	Percentage of verified applications that had benefits increased during verification			0.050	0.098		
(5)	Interaction of (1) and (4) *Significance of (4)+(5)*			0.123	-0.164		
(6)	Percentage of applications selected for verification in which household did not respond to request for verification	0.066	0.012	0.073	0.058	0.333*	0.243
(7)	Interaction of (1) and (6) *Significance of (6)+(7)*	-0.013	-0.002	-0.439	0.038	-0.329	-0.139
	Certification Variables						
(8)	Percentage of certified students that were certified categorically	0.017	-0.007	0.230	0.018	0.062	0.019
(9)	Percentage of certified students that were certified non-applicants	-0.104	0.039**	0.417	-0.018	0.395	-0.040
	Core SFA Characteristics						
(10)	Enrollment (in tens of thousands)	-0.022	0.000	-0.262	0.750***	-0.082	-0.049
(11)	Percentage of students certified eligible for free meals	-0.093**	-0.008	-0.270	0.064	0.100	0.201**
(12)	Percentage of students certified eligible for reduced-price meals	-0.040	0.010	0.983	-0.076	0.311	0.552
	Additional District Characteristics						
(13)	Public SFA	-14.531**			-1.259		
(14)	Enrollment 5001 - 10,000		0.805**				
(15)	Enrollment 1001 - 5000	6.366***					15.194
(16)	Enrollment > 10,000				-5.753***		

Table III.4 *(continued)*

		(1)	(2)	(3)	(4)	(5)	(6)
		Free Certified, Not Eligible (FCNE)	Free Certified, RP Eligible (FCRE)	RP Certified, Not Eligible (RCNE)	RP Certified, Free Eligible (RCFE)	Not Certified, Free Eligible (NCFE)	Not Certified, RP Eligible (NCRE)
(17)	Enrollment squared				-0.000***		
(18)	% students reported free eligible from non-base year Prov 2/3 schools				-0.203***		
(19)	% RP students reported RP eligible from non-base year Prov 2/3 schools			0.394			
(20)	% all apps certified for free meals based on income					0.594	
(21)	# Apps certified for Free meals based on income				-0.000**		
(22)	% Free apps certified based on income		0.049***				
(23)	% apps verified				0.345***		
(24)	Constant	14.409*	-3.561**	-7.704	1.394	-63.128**	-29.787**
	Observations	86	86	86	86	86	86
	Pseudo R-squared	0.312	0.278	0.160	0.350	0.203	0.193

Source: Verification Summary Reports and APEC study.

Note: Pseudo R-squared refers to the McKelvey and Zavoina pseudo R-squared.

[a]For columns (5) and (6) this independent variable is the percentage of all verified applications that changed to a different status during verification. See Table II.3 and related discussion.

*Coefficient is statistically significant at 10 percent level.
**Coefficient is statistically significant at 5 percent level.
***Coefficient is statistically significant at 1 percent level.
†Sum of coefficients is statistically significant at 10 percent level.
††Sum of coefficients is statistically significant at 5 percent level.
†††Sum of coefficients is statistically significant at 1 percent level.

Variables Related to Verification Results. We find that changes in benefit status through verification are related to FCNE household reporting error, but only for districts not selecting random verification samples. Nonresponse to verification is not related to FCNE household reporting error for districts conducting either type of verification sampling.

In districts not selecting random verification samples, those that have higher percentages of verified applications in which benefits are reduced or terminated based on the verification process tend to have higher FCNE household reporting error rates. In particular, a 10 point increase in the percentage of certified free applications changed to reduced-price or paid status during verification is associated with a 1.79 percentage point increase in the predicted value of FCNE error rate; this relationship is statistically significant at the five percent level. This finding is similar to the finding in the overall certification error analysis and is consistent with the notion that the verification process provides a measure of the underlying error rates among districts not conducting random sampling. However, for other types of certification error other than FCNE error, the rate of household nonresponse to verification, among those certified for free meals, is not statistically significant. NCFE error is the only household reporting error rate with a significant association with the rate of household nonresponse to verification; higher nonresponse is associated with higher NCFE error for districts not using random verification samples. For districts selecting verification samples using random sampling, the percentage of verified applications that had benefits reduced during verification is not significantly associated with any type of household reporting error rates. The relationship between FCNE error rates and the percentage of certified free applications selected for verification in which the household did not respond to the request for documentation is also not statistically significant for any subcomponent of household reporting error.

Variables Related to the Method of Certification. Neither the percentage of certified free applications that are approved by establishing categorical eligibility for free meals nor the percentage of certified participants without an application have a strong relationship with FCNE household reporting error or with most other types of household reporting error. The only statistically significant relationship between a variable related to method of certification and a component of household reporting error is a positive one between FCRE and the percentage of certified students without an application.

Other District Characteristics. The remaining variables include the core LEA characteristics and the covariates added to the core ones based on their strong correlation with each type of household reporting error. As with overall certification error, the additional covariates selected by the automated process varied considerably across the types of household reporting error. For FCNE household reporting error, these variables were: (1) whether the district is publicly operated and (2) whether enrollment is at least 1,000 and fewer than 5,000. For other types of household reporting error, few variables were selected in more than one error type equation.

Similar to findings in the overall certification error rate model, we find that FCNE household reporting error rates are highest for districts with at least 1,000 and fewer than 5,000 students. The coefficient on the continuous enrollment measure is not statistically significant; however the coefficient on the indicator for enrollment of at least 1,000 and fewer than 5,000 students is large, positive, and statistically significant at the one percent level. The relationship between enrollment and other types of household reporting error varies. There is evidence that FCRE error is highest for districts with between 5,001 and 10,000 students, while it appears that districts with between 1,001 and 5,000 students have the highest NCRE error rates. The relationship between RCFE error and enrollment is nonlinear and suggests that while larger districts tend to have higher rates of RCFE error, very large district may be able to mitigate these higher rates.

Whether a district is publicly operated is one of the strongest relationships identified in the FCNE household reporting error rate equation. Controlling for other factors, public districts have FCNE error rates that are nearly 15 percentage points lower than private districts' error rates. This difference is statistically significant at the five percent level. Public operation is not significantly related to other types of household certification error, controlling for other district characteristics. The percentage of students certified for free meals has a significant negative relationship with FCNE error rates. A 10 percentage point increase in the percentage of students certified for free meals is associated with about a one percentage point decrease in FCNE error rate. This variable has a significant positive relationship with NCRE error but is not significantly related to other types of household reporting error.

C. APEC Administrative Certification Error

Administrative error can occur for a number of reasons: (1) the number of household members from the application was not summed correctly, (2) household income reported on the application was not summed correctly, (3) reported income was incorrectly converted from the units in which it is reported (such as dollars per week) into the units used in the guidelines (such as dollars per month), (4) an error was made in translating the household size and monthly income into an eligibility status, or (5) an error was made in determining categorical eligibility. Administrative error is substantially less common than household reporting error (Ponza et al. 2007). This section describes the statistical models developed to summarize the relationship between household reporting error and district characteristics.

1. Specification for Administrative Certification Error Models

Developing a statistical model that generalizes to samples other than the one for which the model was estimated proved more challenging for administrative certification error than for overall or household reporting error. As with the other types of certification error, we explored a number of different specifications for the models of administrative certification error rates. Most of these specifications had high goodness of fit values, indicating that the models were able to explain a large portion of the variance in administrative certification error rates. However, the distribution of imputed administrative certification error rates derived by applying the models to the VSR tended to be very different than the distribution of administrative certification error rates observed in APEC. The model that performs best in validation analysis is one that is based on the aggregate administrative error rate and includes no additional covariates. That the strongest model is one that includes only the core variables is consistent with the notion that more inclusive models are capturing relationships between various factors and administrative error rates that are specific to the APEC sample and not generalizable to other samples.

As noted above, the imputed VSR administrative error rate estimates based on models of administrative error are typically a poor match to the administrative error rates observed in APEC. For example, in a model of the aggregate administrative error rate in which additional covariates are added to the core covariates until an additional covariate is no longer statistically significant, the mean imputed VSR administrative error rate is more than four times larger than the mean administrative error rate observed in APEC. Imputed error rates are similarly large for models of disaggregated error rates that include additional variables.

In contrast to models that include additional covariates, models of administrative error rates that include only the core covariates perform well in the validation analysis, particularly the model of the aggregate error rate. The mean imputed error rate based on this model is 1.1 percent, whereas

the 25th and 75th percentiles are 0.0 and 1.8 percent (Table III.5). These values compare favorably to the ones observed in the APEC data, where the mean error rate is 1.5 percent and the 25th and 75th percentiles are 0.0 and 1.4 percent. Based on these findings, our analysis focuses on the model of aggregate administrative error rates that includes only the core variables.

Table III.5. Validation Results for Different Specifications of Tobit Models of APEC Administrative Certification Error Rates (Percentages)

		Percentile of Error Rate Distribution			
	Mean Error Rate	25	50	75	90
APEC Estimates of Certification Error Rates					
Actual Distribution of Administrative Certification Error Rate	1.5	0.0	0.4	1.4	4.3
Imputed VSR Estimates by Specification of Dependent Variable					
Disaggregated Error Rates	6.1	1.8	6.6	9.6	11.3
Aggregated Error Rate	7.3	5.5	7.6	9.3	11.3
Imputed VSR Estimates by Number of Additional Covariates and Alternate Specifications					
Core Covariates Only	1.1	0.0	0.7	1.8	2.9
Change Preferred Number in Aggregate Error Rate Models by:					
-2	0.8	0.0	0.0	0.5	2.2
-1	5.2	0.9	5.0	8.9	10.8
+1	6.8	2.6	7.3	10.3	12.0
+2	6.9	2.8	7.4	10.5	12.2
Separate Models by Enrollment Category	9.4	6.5	9.7	13.2	14.4
Covariates from Other Data Sources	2.1	0.2	1.3	2.8	5.2

Source: APEC and Verification Summary Report data, SY2005-06.

Note: Certification error rates refer to the percentage of total reimbursements with a given type of certification error. APEC estimates are weighted to account for sample design and nonresponse. Imputed error rates are derived by applying relevant certification error rate models estimated in APEC data to districts in the VSR data. Covariates in relevant models come from the VSR only. Unless stated otherwise, covariates were added to all models until adding an additional variable would not result in a statistically significant coefficient.

2. Results of Certification Error Models

Unlike the final models of overall and household reporting certification error, the final model of administrative error is based on a single Tobit regression equation. As was the case with models of overall and household reporting error rates, we find verification results are related to administrative certification error rates for districts not selecting random verification samples. However, we find no other factors included in the model have a statistically significant relationship with administrative error rates.

In districts not selecting random verification samples, those that have higher percentages of verified applications in which school meal benefit status is changed based on the verification process tend to have higher FCNE household reporting error rates. A 10 point increase in the percentage of applications changed during verification is associated with a 0.73 percentage point increase in the predicted administrative error rate; this relationship is marginally significant (Table III.6). This

finding is similar to the findings in the overall and reporting certification error analysis and is consistent with the notion that the verification process provides a measure of the underlying error rates among districts not conducting random sampling.

For districts selecting applications for verification not using random sampling, there is also a positive association between FCNE error rates and the percentage of certified free applications selected for verification in which the household did not respond. For these districts, a 10 percentage point increase in nonresponse among verification households is associated with a 0.59 percentage point increase in administrative error rate; this relationship is statistically significant at the five percent level (Table III.6). These findings are consistent with the notion that certification error is high in districts with higher rates of nonresponse.

Table III.6. Coefficient Estimates from Tobit Model of APEC Administrative Certification Error Rate

Variable		Coefficient
	Verification Variables	
(1)	Selected random verification sample	3.480
(2)	Percentage of verified applications changed during verification	0.073*
(3)	Interaction of (1) and (2)	-0.072
	Significance of (2)+(3)	
(6)	Percentage of applications in which household did not respond to verification	0.059**
(7)	Interaction of (1) and (6)	-0.010
	Significance of (6)+(7)	
	Variable Related to Method of Certification	
(8)	Percentage of certified students that were certified non-applicants	-0.048
(9)	Percentage of certified students that were certified categorically	-0.079
	Other District Characteristics	
(10)	Enrollment (in tens of thousands)	0.037
(11)	Percentage of students certified eligible for free meals	0.012
(12)	Percentage of students certified for reduced-price meals	-0.130
(13)	Constant	-0.118
	Observations	86
	Pseudo R-squared	0.153

Source: FNS-742 Verification Summary Reports and APEC study.

Note: Robust standard errors in parentheses. Pseudo R-squared refers to the McKelvey and Zavoina pseudo R-squared.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.
†Sum of coefficients is statistically significant at 10 percent level.
††Sum of coefficients is statistically significant at 5 percent level.
†††Sum of coefficients is statistically significant at 1 percent level.

For districts selecting verification samples using random sampling, neither the percentage of certified applications changed during verification nor the percentage that did not respond to verification are significantly associated with FCNE household reporting error rates. This finding is consistent with findings in the overall and household reporting analysis and suggests that results of the verification process only reflect the underlying error rates among districts not conducting random sampling.

The administrative error rate model also included core covariates related to method of certification, enrollment, the percentage of students certified for free meals, and the percentage of students certified for reduced-price meals. None of these variables have significant associations with administrative error rates.

D. RORA Administrative Certification Error

As described in Chapter II, administrative certification error measures are also available in RORA data. Parallel to the APEC analysis, we examined a number of different models of RORA administrative error rates. Unlike APEC, the RORA data are available in multiple years. Therefore, the specification analysis also compared the performance of models based on the most recent year of RORA data to those based on data that are pooled across all available years. In making these comparisons, we examined model goodness of fit as well as model validation performance using data from the 2007 VSR. The results of this specification analysis and the findings from the preferred model specification are discussed below.

1. Specification for Administrative Certification Error Models

Based on the specification analysis, the primary specification of RORA administrative certification error rates used in our analysis is one that is based on the most recent available year of RORA data and that uses the aggregate administrative error rate. Table III.7 shows validation results for a selection of models estimated for RORA administrative error.

When examining the set of school years from which to draw the analysis sample, we find little difference in model validation performance for specifications based on 2007 RORA data and those based on RORA data pooled across years (Table III.7). When estimating an aggregate administrative error rate model, specifications based on 2009 RORA data yield imputed administrative error rate distribution with a mean of 1.7 while the specification based on pooled data yields a mean of 1.5 (Table III.7). Because the imputed error rate distribution based on 2009 data somewhat more closely matches that of the observed RORA administrative error rate distribution for 2009 than does the imputed distribution based on pooled data, the specification based on 2009 data is our preferred one.

We find that the specification based on aggregate administrative error rates performs similarly to the one based on disaggregated measures (Table III.7). In order to facilitate comparisons with the APEC administrative error model (which is based on aggregate error rates), the model based on the aggregate measure is the preferred one.

Model validation findings suggest that the strategy of adding covariates to the core equation until the coefficients are no longer statistically significant is an appropriate one. Validation results are similar for specifications with fewer or more additional variables (Table III.7).

Table III.7. Validation Results for Different Specifications of Tobit Models of RORA Administrative Certification Error Rates Applied to SY2009–10 VSR Data (Percentages)

		Percentile of Error Rate Distribution			
	Mean Error Rate	25	50	75	90
RORA Estimates of Administrative Certification Error Rates					
Actual Distribution of Administrative Certification Error Rate, SY2009–10	1.3	0.2	0.7	1.9	3.4
Imputed VSR Estimates by Year of Analysis Sample					
Model Based on Data from SY2009-10 Only	1.5	0.8	1.4	2.1	2.9
Model Based on All Available Data Pooled	1.7	1.3	1.7	2.1	2.5
Imputed VSR Estimates by Specification of Dependent Variable					
Disaggregated Error Rates	1.2	0.0	0.6	1.7	3.2
Aggregate Error Rates	1.5	0.8	1.4	2.1	2.9
Imputed VSR Estimates by Number of Additional Covariates and Alternate Specifications					
Core Covariates Only	1.2	0.6	1.1	1.7	2.4
Change Preferred Number in Aggregate Error Rate Models by:					
+1	1.8	0.8	1.6	2.6	3.5
+2	1.7	0.8	1.6	2.5	3.4
Separate Models by Enrollment Category	1.8	1.0	1.8	2.5	3.2
Covariates from Other Data Sources	1.9	1.5	2.0	2.4	2.8

Source: RORA and Verification Summary Report data, 2005 through 2009.

Note: Certification error rates refer to the percentage of total reimbursements with a given type of certification error. RORA estimates are not weighted. Imputed error rates are derived by applying relevant certification error rate models estimated in RORA data to districts in the VSR data. Covariates in relevant models come from the VSR only. Unless stated otherwise, covariates were added to all models until adding an additional variable would not result in a statistically significant coefficient. Unless stated otherwise, models are based on 2007 RORA data. The preferred number of additional variables in the aggregate error rate model is one; thus, reducing the number of additional variables results in the model based on core covariates only.

2. Results of Certification Error Models

Only one relationship between RORA administrative error and the factors included in the model is statistically significant. Contrary to the findings in the APEC model of administrative error rates, verification results are not significantly associated with RORA administrative error rates. These differences are likely related to differences in the ways in which APEC and RORA administrative error measures are constructed. Some key differences are that APEC includes directly certified students whereas RORA does not, the studies used different sampling designs, and the APEC sample includes more students certified by income (for whom administrative error is more common) than does RORA (Ponza et al. 2007).

The only statistically significant coefficients are the ones associated with enrollment. Districts with more students tend to have higher administrative error rates, although this relationship is partially mitigated by a marginally significant negative coefficient on a variable indicating that the district has more than 10,000 students (Table III.8).

Table III.8. Coefficient Estimates from Tobit Model of RORA Administrative Reporting Certification Error Rate

Variable		Coefficient
	Verification Variables	
(1)	Selected random verification sample	-0.964
(2)	Percentage of free applications changed to reduced-price or paid during verification	-0.032
(3)	Interaction of (1) and (2)	0.068
	Significance of (2)+(3)	
(4)	Percentage of free applications in which household did not respond to verification	-0.003
(5)	Interaction of (1) and (6)	-0.001
	Significance of (1)+(6)	
	Variable Related to Method of Certification	
(6)	Percentage of certified students that were certified non-applicants	-0.028
(7)	Percentage of certified students that were certified categorically	-0.075
	Core District Characteristics	
(8)	Enrollment (in tens of thousands)	0.039***
(9)	Percentage of students certified eligible for free meals	0.007
(10)	Percentage of students certified for reduced-price meals	-0.060
	Additional District Characteristics	
(11)	Enrollment is greater than 10,000	-1.157*
(12)	Constant	4.178
	Observations	54
	Pseudo R-squared	0.261

Source: FNS-742 Verification Summary Reports and RORA study.

Note: Robust standard errors in parentheses. Pseudo R-squared refers to the McKelvey and Zavoina pseudo R-squared.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

IV. DEVELOPMENT OF RISK ASSESSMENT MONITORING TOOL

This chapter describes the process for developing the certification error risk assessment tool that will be used annually to identify districts at risk for certification error. We begin by describing the purpose of the tool and how it categorizes districts' risk for certification error based on model parameters and data from the VSR. Next, we discuss the output of the tool. Finally, we discuss the strengths and weaknesses of the tool.

Chapter Highlights

- The monitoring tool identifies districts that meet FNS criteria for additional administrative reviews (AARs). These include: high level of verification non-response or termination; high claiming rates (over 90% free eligibles or 80% RP eligibles); and establishment of a Provision 2/3 base year.
- The monitoring tool categorizes districts' risk of certification error based on information from the VSR, parameters from the models for APEC overall certification error, and State-specific thresholds for high and medium certification error risk estimates.
- The risk categories used by the tool are well targeted. In 2009, the 16 percent of districts identified as high risk are estimated to account for 68 percent of national certification error.
- The model appears to be responsive to LEA characteristics that change over time; the model does not identify the same set of districts as high risk in every year. For the six-year period examined, most districts were never categorized as high risk, and it was relatively uncommon for districts to be categorized as high risk in every year.
- High- and medium-risk ranked districts have very different characteristics than low-risk districts. For example, districts in the high- and medium-risk categories are much larger and have less favorable verification characteristics (higher rates of eligibility change and higher verification nonresponse) on average compared to low-risk ranked districts.

A. Design and Development of Risk Assessment Tool

The Child Nutrition and WIC Reauthorization Act of 2004 requires State Child Nutrition agencies to conduct additional administrative reviews (AARs) with LEAs that have demonstrated a high level of, or a high risk for, certification error. A primary goal of this study is to provide a tool to help State agencies (SAs) identify LEAs for AARs. Mathematica Policy Research worked with Relyon Media to develop a web-based NSLP risk assessment tool. This tool incorporates the statistical modeling described in earlier chapters of this report, along with other AAR guidelines established by FNS, to help SAs identify districts at high-risk for certification error and appropriate for AARs.

1. Development of the Risk Assessment Tool

The web-based risk assessment tool was developed as a platform for annually analyzing VSR data and applying statistical model parameters to estimate LEA risk for certification error. The tool

was developed in ASP.NET with a SQL server database. The tool will generate reports for SAs based on the following data input by FNS administrators:

- Verification Summary Report (VSR)
- Department of Education, Common Core of Data (CCD)
- State NSLP meal counts from the FNS National Databank
- NSLP meal reimbursement rates
- Consumer Price Index

The tool includes multiple programming steps to accomplish the following:

- Match the uploaded VSR data to the known universe of LEAs from prior years (this provides a match of VSR to CCD and produces a discrepancy report to identify new or missing LEAs)
- Combine multiple VSR data items to construct new measures
- Apply model parameters to VSR data to calculate risk scores

The risk assessment tool displays VSR data and estimated risk scores in State-specific reports which highlight the SFAs that meet the criteria for AARs, as described below.

2. Risk Assessment Tool Criteria for Selecting SFAs for AARs

In order to fulfill the mandate to reduce certification error through AARs, FNS requires SAs to conduct a minimum number of AARs:

1. *1% of SFAs*: SAs must conduct AARs on a number of SFAs equivalent to no less than 1% of the SFAs in the State; and
2. *3% of total annual reimbursement*: SAs must conduct AARs on a number of SFAs comprising no less than 3% of the total statewide reimbursement.

According to FNS guidance (SP-48-2011), SAs must annually conduct AARs of selected SFAs that meet any of the following criteria:

1. Establishment of a new Provision 2/3 base year since the previous coordinated review effort was conducted.
2. Verification data indicating a high level (e.g., top 25% among SFAs within a State) of non-response or response-based terminations.
3. Consistently claiming over 90% free eligible or 80% reduced-price eligible.

The risk assessment tool makes it easy for SAs to select SFAs for AARs: SFAs that meet the first two criteria for selection are highlighted, and SA selections of SFAs are measured relative to

FNS size criteria for AARs.[29] In addition, the tool identifies SFAs with high risk of certification error based on statistical models described in previous chapters. This is important because the focus of the Child Nutrition and WIC Reauthorization Act of 2004 is on districts that have demonstrated a high level of certification error. Because it is not possible to measure accurately the certification error rates of each SFA each year, the tool provides annual estimates of certification error rates based on the statistical model developed in this study.

The final models developed for overall certification error provide estimates of district certification error that hold up well in validation analysis. There are a number of ways that these estimates could be used to categorize district risk of certification error. The next section describes the development and implications of the certification error risk definitions used by the monitoring tool.

3. Thresholds for High and Medium-Risk of Certification Error

The tool is most useful to SAs if it clearly identifies SFAs at high risk of certification error. A definition of "risk for certification error" should have the following attributes:

- **Simple**. Straightforward to incorporate into the monitoring tool and easy to understand by tool users
- **Targeted.** Identifies a set of districts accounting for a disproportionate share of national erroneous payments due to certification error
- **Responsive to time-variant characteristics**. Does not identify the same set of districts as high-risk in every year

This section describes the definitions of certification error risk utilized in the monitoring tool and the extent to which these definitions are consistent with these desirable attributes.

Definition of Risk Categories. The statistical models described in this report provide model parameters that can be used to impute rates of overall certification error (the percentage of NSLP applications certified in error due to all causes). The risk assessment tool imputes these overall certification error rates for each SFA each year. Imputed error rates are applied to SFA reimbursements to calculate estimated erroneous payments (dollars) due to certification error. The tool then compares the imputed amount of erroneous payments due to certification error to State-specific thresholds defining medium and high certification error risk. Finally, the imputed *rate* of erroneous payments is compared to a rate floor, or a minimum rate at which districts can be categorized as high-risk. A rate floor is applied because it ensures that districts with very low error rates are not the focus of State administrative reviews.

Thus, the tool imputes each SFA's certification error dollar amount using a three-step process:

1. Apply the parameters of the APEC overall certification error model to district characteristics. This involves combining the model estimates of error rate relationships

[29] Data that would identify consistent claiming of over 90% free eligible or 80% reduced-price eligible are not available nationally. Therefore, this criterion is not incorporated into the risk assessment tool. SFAs meeting this criterion must be identified using State records.

with district characteristics to calculate the six imputed certification error rates for each district.[30]

2. Multiply each of the disaggregated error rates by the appropriate estimate of district National School Lunch Program (NSLP) reimbursements. For example, the percentage of reimbursements made to students certified for NSLP-free who are estimated to be not eligible (FCNE) is multiplied by the district's estimated free meal reimbursements. This gives an imputed estimate of the dollar amount of certification error related to FCNE students.
3. Sum the dollar amount estimates across the six types of disaggregated certification error to get an estimate of overall erroneous payments due to certification error. We convert this estimate to 2005 dollars using the consumer price index available from the Bureau of Labor Statistics. [31]

Next, the imputed certification error estimates are compared with State-specific thresholds for high and medium-risk of certification error, provided in Appendix B. The State-specific thresholds were developed to adjust for the median district enrollment in each State. Without this adjustment, States with larger than average districts would have a disproportionately high number of high-risk SFAs, while States with smaller than average districts would have a disproportionately small number of high-risk SFAs. State-specific thresholds for risk are used so that SFA risk is measured relative to other districts in the same State.[32]

The threshold for classification as high-risk is defined as $50,000 (roughly the 85th percentile of the national imputed certification error distribution) multiplied by the ratio of State median enrollment to national median enrollment. The threshold for classification as medium-risk is defined as $25,000 (roughly the 65th percentile of the national imputed certification error distribution) multiplied by the ratio of State median enrollment to national median enrollment. These thresholds were selected on the basis of the criteria identified above. As an example, the threshold for classification as high-risk in Florida (where the median enrollment is nearly 11,000 students) is $537,000; the threshold for classification as high-risk in North Dakota (where the median enrollment is about 200 students) is $10,000.

The final step in categorizing districts' certification error risk is to compare their certification error rate to a rate floor, or a minimum rate at which districts can be categorized as high-risk. This rate floor was included in the definition for high-risk in order to avoid classifying as high-risk any large districts with low rates of erroneous payments but high levels of erroneous payments (due to the districts' large levels of reimbursements). This approach implicitly recognizes that it might be unrealistic to expect error rates to be lower than some minimum threshold, and therefore large

[30] The six certification error rate equations in the model have the statistical form represented by Equation II.1. The coefficients in these equations, which represent the relationship between certification error rate measures and different district characteristics, are presented in Table III.2. The six disaggregated error rates are discussed in section II.B.2.

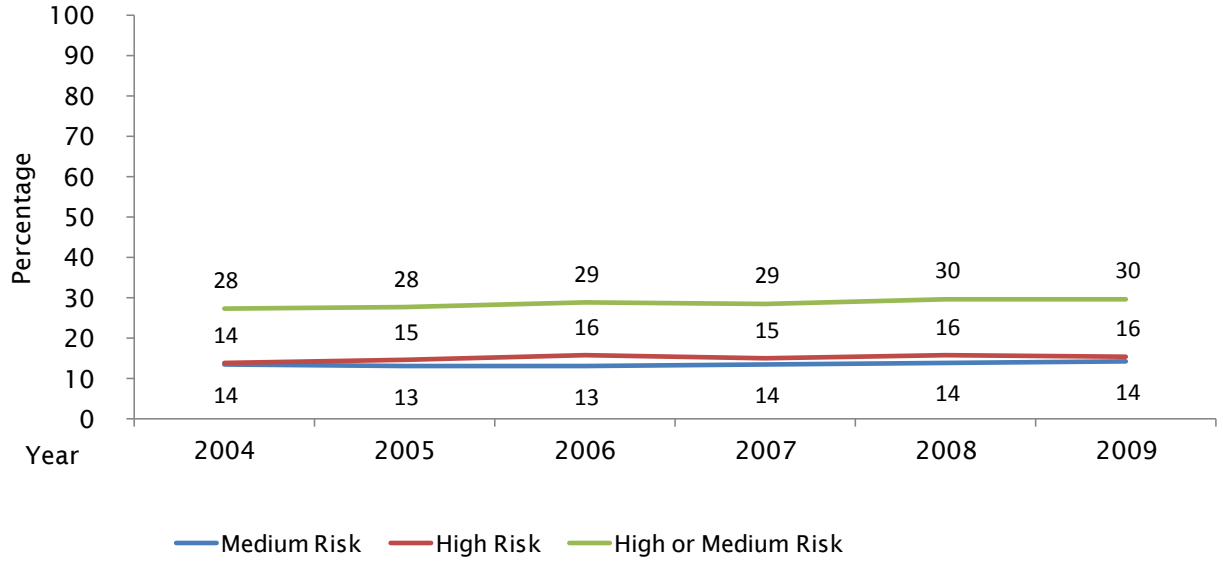
[31] National estimates calculated in this way compare favorably to those estimated as a part of the APEC study. For example, using imputed erroneous payments from the 2005 VSR, we find total erroneous payments of $727 million out of total reimbursements of $7.8 billion. These amounts are similar to those reported in APEC, which are $758 million in erroneous payments out of $8.1 billion in total reimbursements (Ponza et al. 2007).

[32] While State-specific threshold adjustment accounts for differences in district size *across* states, it is still true that large districts *within* a State are more likely to be identified as high risk than a small district with the same error rate. This is because more reimbursement dollars are at risk in larger districts.

districts with very low error rates may not be a good place to focus additional monitoring effort. The monitoring tool was designed to provide FNS with flexibility to adjust the rate floor for determining high certification error risk. The properties of different rate floors are discussed in the next section.

The tool categorizes a district as high-risk if their imputed estimate of certification error amount is greater than or equal to the State-specific threshold for high-risk and their imputed certification error rate is greater than or equal to the rate floor. LEAs are medium-risk if their estimated dollar amount of certification error is higher than the State-specific threshold for medium- risk, regardless of certification error rate. (Medium-risk includes LEAs that would be high-risk based on estimated dollars in error, but have error rates below the high-risk rate floor.) LEAs are categorized as low-risk if their estimated dollar amount of certification error is lower than the State-specific threshold for medium-risk. With a rate floor of five percent, this process categorizes about one in six districts as high-risk and one in six as medium-risk during school years 2004 through 2009. The percentage of high-risk ranked districts varies little over time, ranging from 14 percent to 16 percent (Figure IV.1). Similarly, the percentage of medium-risk ranked districts is about 14 percent in each school year.

Figure IV.1. Percentage of VSR Districts Classified as High or Medium-Risk of Certification Error, 2004-2009



Note: This figure uses a certification risk definition with a rate floor of five percent.

Targeted Risk Categories. Risk categories are well targeted if districts ranked as high-risk have substantially higher levels of imputed erroneous payments than those not ranked as high- risk. Ideally, well-targeted risk categories should identify a small number of districts contributing the most toward total national erroneous payments.

Targeting also implies that we should observe large differences in average erroneous payments between the low-, medium-, and high-risk ranked groups. The degree to which this is true, however, could depend on the definition of risk categories. Moreover, depending on the number and distribution of districts in each group, we may or may not find the risk categorization to be well targeted, in the sense that high and medium-risk ranked districts account for a large share of national total erroneous payments.

As shown in Table IV.1, average imputed amounts of erroneous payments are drastically different for districts categorized as high, medium or low-risk for certification error. For example in 2008, districts categorized as high, medium, and low-risk had average imputed erroneous payments of about $214,000, $53,000, and $9,000, respectively. Certification error rates are also higher for medium- and high-risk ranked districts on average; about 10 percent of reimbursements are subject to imputed certification error for medium- and high-risk ranked districts, compared with 5 percent for low-risk ranked districts (Table IV.1).

Table IV.1. Average Dollar Amount and Rate of Imputed Erroneous Payments for Districts in the 2009 VSR, by Certification Error Risk Category

	Low-Risk	Medium-Risk	High-Risk
Amount of Erroneous Payments ($)			
Overpayments	7,679	54,686	178,351
Underpayments	1,610	11,430	35,591
Total Erroneous Payments	9,289	66,116	213,941
Rate of Erroneous Payments (%)			
Overpayments	4.6	9.3	10.3
Underpayments	1.6	1.3	1.5
Total Erroneous Payments	6.2	10.6	11.9
Number of Districts	**10,344**	**2,104**	**2,303**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of overall certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and a five-percent rate floor. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

High- and medium-risk ranked districts are responsible for a disproportionate share of imputed erroneous payments nationwide. High-risk ranked districts represent about 16 percent of all districts and account for 68 percent of national total erroneous payments ($728 million) (Table IV.2). The sum of imputed erroneous payments for districts in both the low- and medium-risk categories is about $100 million, even though there are five times as many districts in the low-risk category as in the medium-risk category. These findings suggest that the chosen risk categorization definitions are well targeted.

Table IV.2. Sum Total Dollar of Imputed Erroneous Payments Across Districts in the 2009 VSR, by Certification Error Risk Category (In Millions of Dollars)

	Low-Risk	Medium-Risk	High-Risk
Total Amount of Imputed Erroneous Payments			
Overpayments	79	115	411
Underpayments	17	24	82
Total Erroneous Payments	96	139	493
Number of Districts	**10,344**	**2,104**	**2,303**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of overall certification error rates estimated based on APEC data to districts in the 2008 VSR. Risk categorization was determined using State-specific thresholds and a five-percent rate floor. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

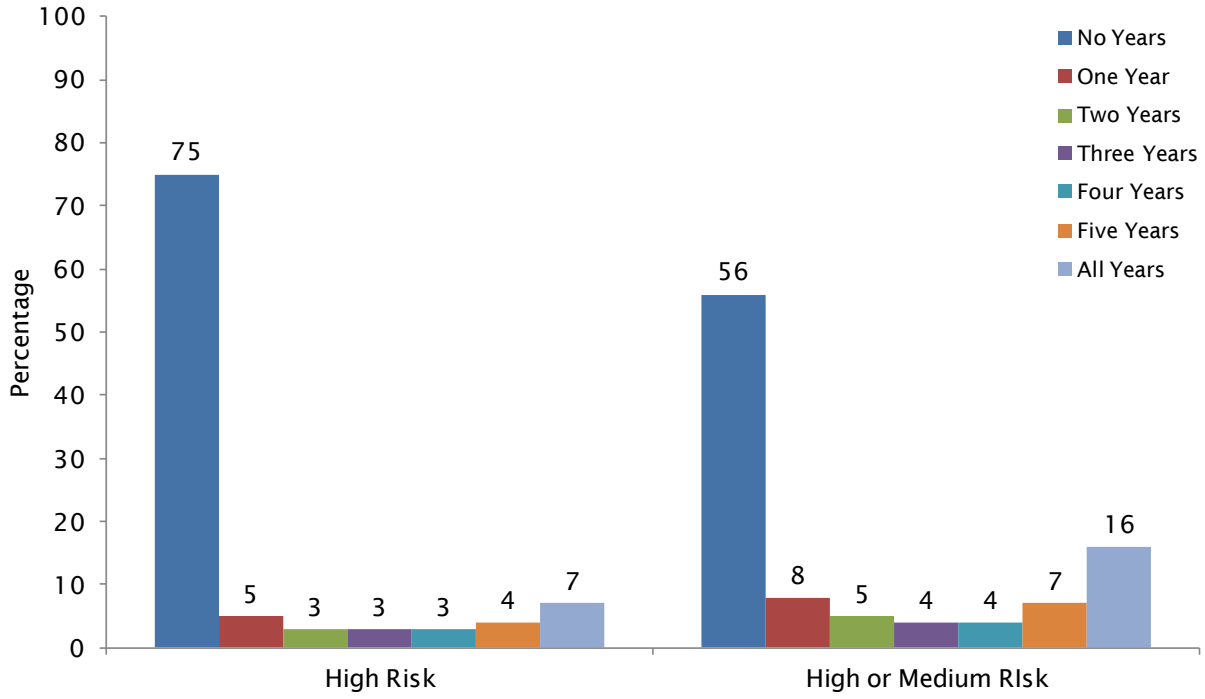
Variation over Time in Districts Identified as at Risk. One concern with the risk categorization system is that the set of districts identified as high-risk may not vary substantially from year to year. This should not be surprising because underlying fundamentals must change to cause a change in risk category. However, the categorization may not be useful if the same largest

districts dominate the high-risk category every year simply because risk categories are defined by dollar amounts of error.

We applied the risk definitions to VSR data for six school years and examined the number of times each district was identified as high or medium-risk. Although only about 25 percent of districts are ranked as high-risk in any year, it is more common for districts to be high-risk in some years than in all years (Figure IV.2). Thus, despite year-to-year stability in the percentage of districts identified as high or medium-risk, we do find some variation in the set of districts identified as high or medium-risk for certification error.

Responsiveness of Risk Definition to Different Rate Floors. In future years, the rate floor incorporated into the monitoring tool will be adjusted according to FNS priorities. The choice of rate floor used in the risk category definitions has important effects on targeting of the risk categories and the extent to which districts are identified as high-risk in multiple years.

Figure IV.2. Number of Years VSR Districts Identified as High or Medium-Risk for Certification Error, 2004-2008



Note: Includes districts present in at least five of the six VSR years between 2004 and 2009.

As shown in Table IV.3, the targeting of the high-risk category erodes as the error rate floor increases. With no rate floor, we categorize 17 percent of districts as highrisk and they account for 73 percent of national erroneous payments. With a rate floor of five percent, we categorize 16 percent of districts as highrisk and they account for 68 percent of national erroneous payments. Moving the rate floor above 5 percent significantly reduces the percentage of dollar error captured in the high-risk category. With a rate floor of 10 percent, we categorize 9.8 percent of districts as high-risk and they account for only 37 percent of national erroneous payments.

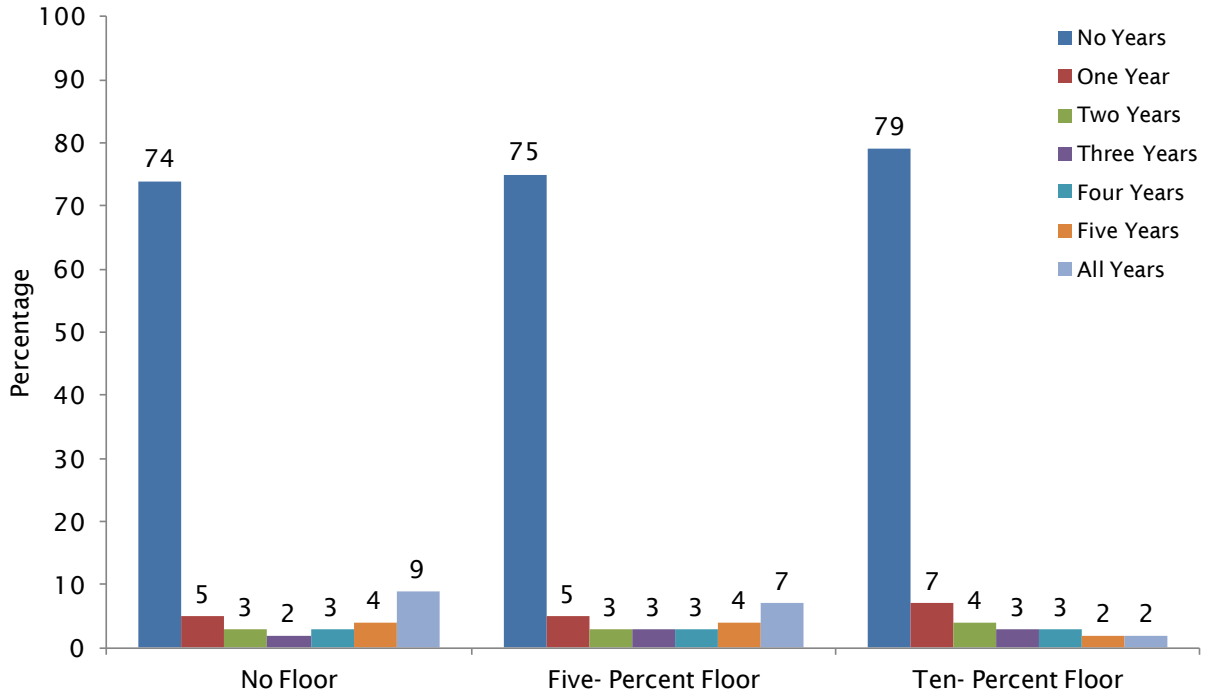
Table IV.3. Targeting in the 2009 VSR for Certification Error Risk Definitions Based on Certification Error Levels, State-Specific Thresholds, and Different Certification Error Rate Floors

Minimum Required Certification Error Rate (Error Rate Floor)	Percent of LEAs Identified as High-Risk	Percent of Estimated National Certification Error from High-Risk LEAs
None (Definition Used in Report)	16.9	72.7
3 Percent	16.6	71.7
5 Percent	15.6	67.7
7 Percent	14.0	59.2
10 Percent	9.8	37.0

Note: Districts are categorized as high-risk if their estimated dollar amount of certification error is higher than the State-specific threshold and their certification error rate is higher than the error rate floor.

As shown in Figure IV.3, with higher rate floors, the number of LEAs that are never identified increases while the number of LEAs that are identified as high-risk in all years decreases. For example, with no rate floor 9 percent of districts are high-risk in all years and 74 percent are never high-risk. By comparison, with a ten percent rate floor, 2 percent of districts are high-risk in all years and 79 percent are never high-risk.

Figure IV.3. Number of Years VSR Districts Identified as High or Medium-Risk for Certification Error for 2004-2008, by Risk Definition Rate Floor



Note: Includes districts present in at least five of the six VSR years between 2004 and 2009.

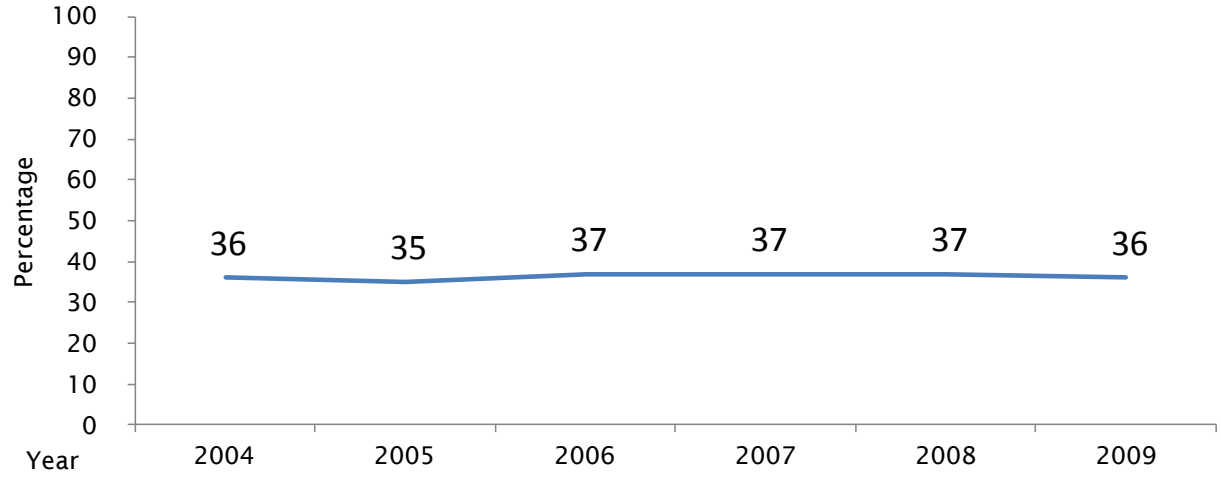
Definition and Interpretation of Risk Score. In addition to generating a district risk category based on the State-specific thresholds and the imputed error amount, the monitoring tool provides a risk score for each district. The score provides a way to assess the degree of risk among high-risk districts. It does not determine the estimated risk category nor is it intended to be used for districts other than those at high-risk. Rather, it reflects how high erroneous payments are relative to the threshold for high-risk, accounting for the distribution of district erroneous payments within the State.

The risk score is a function of estimated dollar amount of erroneous payments, the State threshold for high-risk, and the dispersion of district erroneous payments in the State. This score is constructed on a scale of 0 to 100 such that all scores higher than 50 result in a categorization of high-risk.[33] These scores are normalized on a scale of 1 to 100 so that they can be compared over time and across States, and will provide tool users a simple measure of the degree of certification error risk. The scores are calculated as:

$$Risk\ Score = \Phi\left(\frac{Estimated\ Dollar Amount\ In\ Error - State\ Threshold\ for\ High\ Risk}{St andard.Deviation\ of\ Estimated\ State\ Dollar\ Amount\ In\ Error}\right)*100$$

where Φ is the cumulative density function of the standard normal distribution.[34] This risk score has an average value of about 36 during school years 2004 through 2009 (Figure IV.4).

Figure IV.4. Certification Error Risk Score for VSR Districts, 2004-2009



[33] It is possible for a district with a score higher than 50 to be classified as medium-risk if their estimated error rate is below the rate floor.

[34] The cumulative density function for the standard normal distribution does not have a closed form solution. Our calculations are based on the approximation developed by Bowling et al. (2009).

The interpretation of the score is similar to that of percentiles in a bell shaped distribution, such as that of a standardized academic achievement test. A given change in the estimated dollars of erroneous payments that occurs near the threshold for high-risk will result in a larger change in the score than the same change in erroneous payment dollars that occurs a higher level. An example is provided in Table IV.4. In State A of this table, an increase of $25,000 from the State threshold for high-risk would change the risk score by 19 points, from 50 to 69. Meanwhile, a change from $50,000 above the threshold to $75,000 above the threshold would change the risk score by 9 points, from 84 to 93. Using the analogy to a standardized achievement test, this property of the risk score can be thought of in the same way that a student "passes" more of their peers in the test score distribution (i.e. increasing their percentile by more) if a given test score change occurs near the average than if the same change occurs near the top of the distribution.

A given change in erroneous payments that takes place in a State with a less dispersed distribution of erroneous payments will result in a larger change in the score than the same change in erroneous payment dollars that occurs in a State with a more dispersed erroneous payment distribution. For example, as shown in Table IV.4, in a State in which the standard deviation of erroneous payments is $50,000 (State A), an increase of erroneous payments of $50,000 from the State threshold for high-risk would increase the score from 50 to 84. The same change in a State in which the standard deviation of erroneous payments is twice as high (State B) would increase the score from 50 to 69. Using the analogy to a standardized achievement test, this property of the risk score can be thought of in the same way that a student "passes" more of their peers in the test score distribution (i.e. increasing their percentile by more) if a given test score change occurs when test scores are more tightly grouped around the mean than if they are more spread out.

The risk score is most useful for assessing the degree of risk among high-risk districts. The risk score is less useful in assessing risk for districts that are not categorized as high-risk, particularly in States in which there is a high standard deviation of estimated dollar amount in error. Each state has a minimum possible risk score, achieved by districts with no estimated erroneous payments:

$$Minimum\ Risk\ Score = \Phi\left(\frac{0 - State\ Threshold\ for\ High\ Risk}{Standard.Deviation\ of\ Estimated\ State\ Dollar\ Amount\ In\ Error}\right) * 100$$

As the standard deviation of dollar amount in error increases, the minimum risk score increases as well. Most States have minimum risk scores of 21 or lower. However in ten States, the minimum risk score is greater than 40. In these States, the risk score does not provide meaningful information about districts not categorized as high-risk. Although it could be useful to have information on the degree of risk among districts not categorized as high-risk, alternative formulations for the risk score that lower the minimum risk score also increase the number of districts that receive the maximum score.[35] Therefore, these alternate risk scores provide less information about the degree of risk among high-risk districts and provide States with less information that is useful in selecting SFAs for AARs.

[35] Alternative formulations include using different values in the denominator of the risk score equation, such as the national standard deviation of dollar amount in error or the State inter-quartile range of erroneous payments.

Table IV.4. Examples of Risk Scores for Different Estimated Erroneous Payment Amounts and Different State Distributions of Erroneous Payments

	State A: $50,000 Standard Deviation		State B: $100,000 Standard Deviation	
	EP Dollars Greater than High-Risk Threshold	Risk Score	EP Dollars Greater than High-Risk Threshold	Risk Score
Erroneous Payments Equal to State Threshold for High-Risk Plus:				
0	$0	50	$0	50
0.5 standard deviations	$25,000	69	$50,000	69
1.0 standard deviation	$50,000	84	$100,000	84
1.5 standard deviations	$75,000	93	$150,000	93
2.0 standard deviations	$100,000	98	$200,000	98

3. Characteristics of Districts by Risk Category

It is important to assess the characteristics of districts identified as having different levels of risk by the monitoring tool. In general, we find large differences in the characteristics of districts in different risk categories. High-risk ranked districts tend to have less favorable verification results and much larger average enrollment.[36] These findings are discussed in greater detail below by type of characteristic.[37]

Verification results. Findings from the statistical models indicate that verification-related variables, particularly nonresponse to verification, are important factors associated with overall certification error. Because the imputed erroneous payments used in the risk category definitions are based on these models, it is not surprising that there are important differences in verification results based on district risk category. Namely, districts in the high- and medium-risk categories have less favorable verification characteristics on average than do low-risk ranked districts. The rate of nonresponse for low-risk ranked districts is 12 percent, while that of medium-risk ranked districts is nearly twice as high, 22 percent, and that of high-risk ranked districts is nearly three times as high, 31 percent (Table IV.4). The percentage of sampled applications that changed during verification is also significantly higher for the high- and medium-risk ranked groups (29 and 27 percent) compared to the low-risk ranked group (16 percent).

[36] These differences are even larger in comparisons of districts that were identified as high-risk in all years to districts that were never categorized as high-risk.

[37] We examined district characteristics for districts with different levels of estimated risk for household reporting and administrative certification error (Appendix F). Districts with high and medium-risk of household reporting and administrative error risk are similar to those with high and medium risk for overall error. Districts in the high- and medium-risk categories are much larger and have less favorable verification characteristics (higher rates of eligibility change and higher verification nonresponse) on average compared to low-risk ranked districts. This pattern is also present when examining characteristics of districts with different levels of risk of overall, household reporting, and administrative certification error separately by region. The results by region are also presented in Appendix F.

Table IV.5. Average Characteristics of Districts in the 2009 VSR, by Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	11.8	21.8***	31.2***
Error Rate	16.0	26.8***	28.9***
Percentage of Certified Students			
Categorically Eligible	12.5	10.0***	9.3***
Not Subject to Verification	28.4	33.9***	33.6***
District Demographic Characteristics			
Enrollment			
Number of Students	996	5,121***	11,935***
Number of Students Is:			
Less Than 1,000	71.2	9.2***	0.8***
At Least 1,000, Less Than 5,000	26.9	66.8***	45.9***
At Least 5,000, Less Than 10,000	1.3	12.1***	28.3***
At Least 10,000	0.5	11.9***	25.1***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	49.1	47.8**	49.0
Number of Districts	**10,344**	**2,104**	**2,303**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of overall certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Method of certification. We find that districts with higher risk of certification error tend to certify fewer students categorically (Table IV.4). This finding is consistent with theoretical expectations and with the estimates from the model upon which the imputed overall certification error estimates are based. We hypothesized that districts that certify more students who are categorically eligible for benefits would have lower levels of certification error because this method of certification offers fewer opportunities for reporting or administrative error. Multivariate models of certification error indicated that certification through categorical eligibility has a moderately large negative relationship with FCNE certification error that is not statistically significant. This translates into lower rates of certification through categorical eligibility for higher-risk ranked districts—the percentages of certified students eligible categorically for low-, medium-, and high-risk districts are 13, 10, and 9 percent, respectively (Table IV.4).

We also find that districts with higher risk of certification error tend to certify more students who are not subject to verification (Table IV.4). This finding is inconsistent with expectations, since this type of certification does not involve an application and thus offers no opportunity for

reporting or administrative error. In addition, this finding does not come directly from the model upon which the imputed overall certification error estimates are based. This model indicates that, controlling for other factors, there is no strong relationship between certification of students not subject to verification and overall certification error rates. The fact that there is a strong relationship between certification of students not subject to verification and overall certification error rates when not controlling for other factors but no significant relationship when other factors are controlled for indicates that certification of students not subject to verification must be correlated with other factors that are related to certification error. For example, districts with more than 10,000 students have significantly higher rates of certification of students not subject to verification than do smaller districts. The statistical models control for the inter-relationships between these variables.

Enrollment. Average enrollment increases sharply with certification error risk category. Low-risk districts have an average enrollment of 996 students; nearly three-quarters of low-risk districts have fewer than 1,000 students and less than one percent have more than 10,000 students. Medium-risk districts have an average enrollment of 5,121. High-risk districts have an average enrollment of 11,935; less than one percent of high-risk districts have fewer than 1,000 students and 25 percent of high-risk districts have more than 10,000 students. Another way of viewing the relationship between size and risk is that 65 percent of districts with more than 10,000 students are identified as high-risk, and about 30 percent of these large districts were identified as high-risk in all VSR years available for this study. On the other hand, 13 percent of small districts (fewer than 10,000 students) were identified as high-risk. The implications of these findings are discussed in greater detail in the next section.

4. Relationship of District Size to Chosen Risk Definitions

The risk categories utilized by the certification error monitoring tool do a good job identifying districts that contribute most to national erroneous payments. However, these definitions have some disadvantages. Most important among these is the tendency for very large districts to be consistently identified as high-risk.

The high probability of identifying large districts as at risk of certification error is largely a function of the focus on levels of certification error rather than rates. Because their levels of reimbursements are necessarily high, large districts can have high levels of error even if they have low rates of certification error. There are two ways to view this pattern. On the one hand, large districts are the ones contributing the most to certification error nationally. Moreover, a small change in the certification error rate in a large district would result in a much larger dollar reduction in erroneous payments due to certification error than would a similar error rate change in a smaller district. For these reasons, it may be appropriate that larger districts are much more likely to be identified as high-risk by the monitoring tool. On the other hand, large districts with low certification error rates may regard their selection as unfair if they view it as being related to a factor that cannot be changed. Moreover, repeated selection of large districts for review of certification practices may result in diminishing opportunities for improvement of certification error rates in those districts.

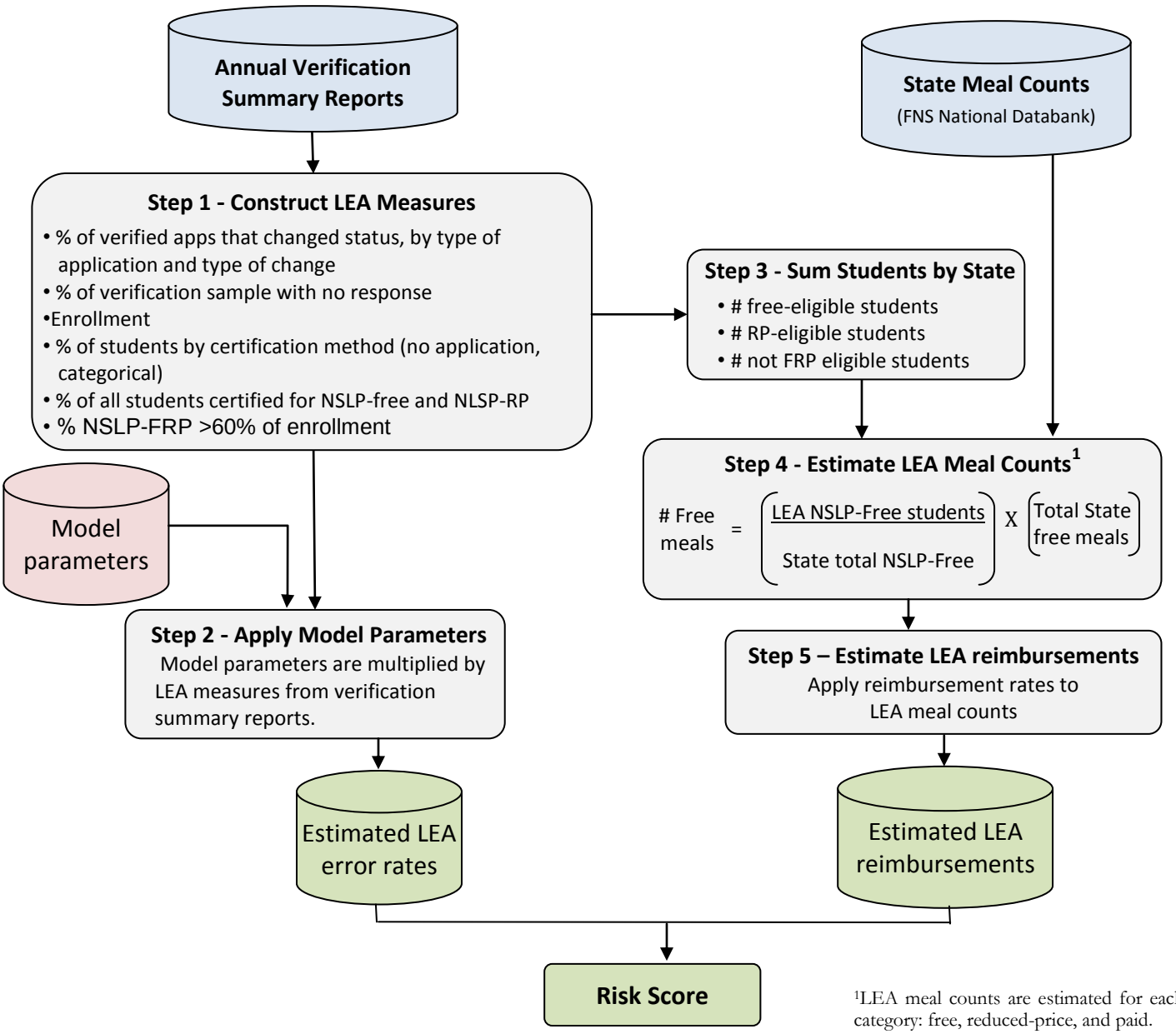
It is difficult to reduce the probability of identifying large districts while focusing on levels of certification error, although the selection of districts with very low rates is eliminated by applying an error rate floor. An alternative focus on certification error rates, rather than certification dollar error, for assigning risk categories was not adopted because risk categories based on certification error rates tend to be poorly targeted. For example, districts in the top 20 percent of the imputed certification error rate distribution account for only about 30 percent of the national sum of

erroneous payments due to certification error. This figure is dramatically lower than the targeting achieved by the categorization based on certification error levels (as noted above, the 16 percent of districts categorized as high-risk account for 68 percent of national erroneous payments).

B. Operation and Reporting of the Monitoring Tool

Every year FNS will generate new estimates of district certification risk by uploading fresh data into the monitoring tool. As a part of this process, FNS will load three sets of data into the monitoring tool: (1) the latest verification summary reports (VSR) data, (2) State meal counts, and (3) reimbursement rates for the prior school year. Exhibit IV.1 illustrates how the tool uses these data.

Exhibit IV.1. Process Used by the Monitoring Tool to Generate Annual District Certification Error Risk Estimates



[1]LEA meal counts are estimated for each category: free, reduced-price, and paid.

In Step 1 of Exhibit IV.1, data from the verification summary reports are processed to construct measures of LEA characteristics used in the statistical models. Key characteristics include verification results (percent of households that did not respond to verification, and percent of verified applications that changed status, by type of application and type of change), certification characteristics (percent of certified students that were certified without applications, and percent that were certified categorically), and other LEA characteristics (such as enrollment, percent of students certified free, and percent certified reduced price).

Step 2 applies model parameters to the verification summary report data to estimate the six disaggregated certification error rates.

Step 3 calculates the total number of students certified for free and reduced price meals in each State, and the total not certified for free or reduced price meals.

Step 4 estimates LEA meal counts by multiplying State meal counts by the LEA-to-State ratio of NSLP students.

Step 5 estimates LEA reimbursements, equal to estimated meal counts multiplied by current reimbursement rates. State Child Nutrition Directors may choose to upload actual LEA meal counts to improve the accuracy of the meal counts and reimbursements.

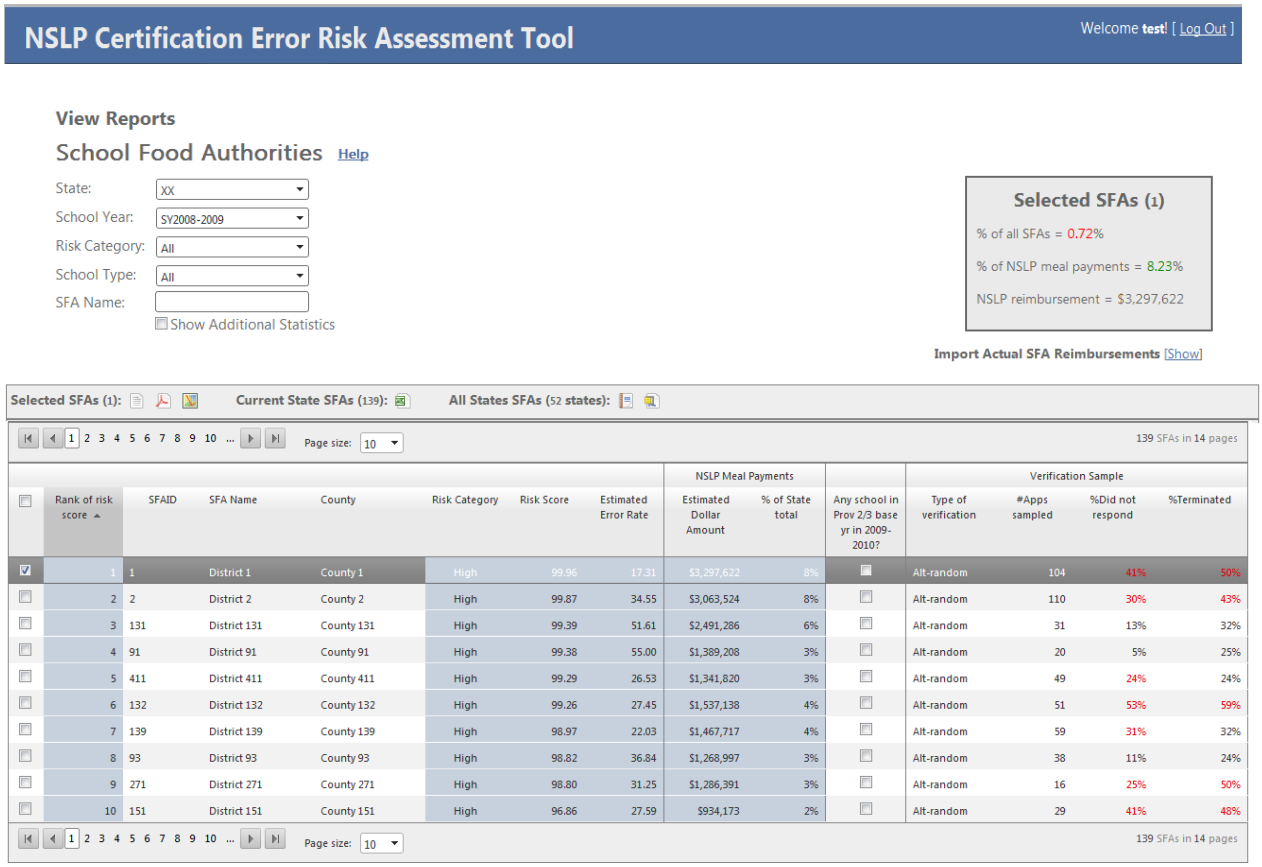
Steps 1-5 provide six estimates of LEA error rates. Results from the six models are combined with estimates of reimbursements to estimate the dollar amount of certification error. These dollar amount estimates are then used to categorize each district's certification error risk, as high, medium, or low-risk. After completing these five steps, the monitoring tool prepares a set of reports that present estimated district certification error risk categories along with other characteristics that may be used as criteria for selecting districts for AARs. The next section illustrates how these reports are set up and how they can be used.

1. Reporting in the Monitoring Tool

The most important output generated by the tool is a dynamic report that synthesizes the model-based certification error estimates and other LEA information to provide a platform for consistent application of AAR selection criteria. A screenshot of this report is provided in Exhibit IV.2. The report displays estimated certification error risk and FNS criteria for selecting districts for AARs—the percent of households selected for verification that did not respond, and the percent of verification applications that had benefits terminated. For these latter two items, districts in the top 25 percent within their State are displayed in red to indicate that they meet FNS criteria for AAR selection.[38] State Child Nutrition Directors may also indicate (by checkbox) the SFAs with schools operating a provision 2/3 base year, and use this information along with other selection criteria.

[38] The tool is currently being revised in response to FNS comments in order to incorporate additional information related to these criteria.

Exhibit IV.2. Screenshot of the Primary Report Generated by the Monitoring Tool



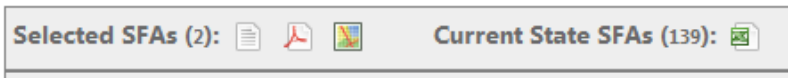
There are four ways to control the display of information in the report:

1. Filters (drop-down boxes) at the top of the page on:
   - School year – years from SY2008-2009
   - Risk Category – All, Low, Medium, or High
   - School Type –All, Public, or Private
   - SFA Name – type an SFA name to display only that SFA
2. **Show Additional Statistics –** Users can check the box to display four additional columns of information about SFAs: (a) number of applications approved for NSLP FRP, (b) number of students approved for NSLP FRP, (c) percent of all students approved for Free-NSLP, and (d) percent of all students approved for RP-NSLP.
3. **Sort the report** – Users can click a column header to sort the report by that column. Click the column header a second time to sort in reverse order.
4. **Select the page size –** Users can select the number of rows to display on a page using the selector at the top or bottom of the page.

SAs can use this reporting page to identify and select SFAs for AARs. Selections are made by clicking checkboxes in the report's first column. As districts are selected, the "Selected SFAs" box at the top of the screen updates dynamically to indicate to SAs whether they have selected sufficient

districts to meet FNS requirements for a minimum number of AARs ("% of all SFAs" and "% of NSLP meal payments" statistics change color from red to green when requirements are met).

After selecting districts for AARs, SAs can obtain more detailed information about the selected districts (number selected shown in parentheses) or all districts (number shown in parentheses) using the icons above the table:

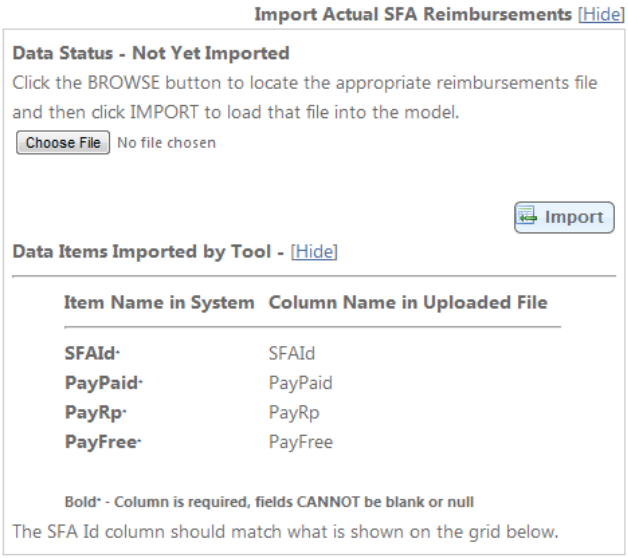


The first two icons produce reports, in HTML and PDF format, with four types of information for each selected SFA:

1. Verification Summary Report information for the prior school year (enrollment, NSLP applications, NSLP eligible students)
2. Verification results from the prior school year
3. Trends in verification statistics, including the percentage of FRP students subject to verification, and verification results (displayed for all years from SY2008-2009 to present)
4. Results of the modeling of risk assessment
5. Prior year selection of the district for AAR

The third icon produces a map of selected SFAs, intended to help SAs determine the feasibility of conducting AARs within their travel and time budgets. The last icon provides a downloadable Excel file with statistics for all SFAs.

A final capability of the tool allows SAs to overcome one of the limitations of the risk scores presented in this report. As described in this report, SFA reimbursements used in risk calculations were imputed based on information in the FNS national data file. The monitoring tool provides an option for SAs to upload actual reimbursement data for SFAs, and to recalculate risk scores based on actual reimbursement data. SAs can view instructions for the upload by clicking the link for "Import Actual State Reimbursements [Show]" whereby the link expands and changes to "[Hide]."



C. Strengths and Weaknesses of the Monitoring Tool

This section discusses the strengths and limitations of the monitoring tool. Strengths of the monitoring tool include:

- ***The monitoring tool is based on statistical models that are highly predictive of certification error.*** When applied to national data from the VSR, these models produce a distribution of estimated certification error that closely mirrors the actual distribution of certification error measured in the APEC study. Strong validation performance based on a single data source (the VSR) contributes to the monitoring tool's accuracy and ease of use.
- ***The monitoring tool synthesizes a substantial amount of information in an intuitive, user-friendly way.*** The selection of districts for AARs is based on a number of criteria. The monitoring tool collects information related to these criteria in a single location and allows for sorting and filtering of this information. The tool's intuitive interface should allow SAs to make more informed decisions about the districts that would most benefit from AARs.

Despite these strengths, the tool has some important limitations:

- ***The statistical models used by the monitoring tool are based on a single school year.*** Although the statistical models perform well in validation analysis, this analysis only provides an assessment of model performance for the time period on which the models were estimated. It is not possible to assess the validity of the model in future years. If the underlying relationships between the certification error measures and LEA characteristics change over time, then the performance of the models may erode. Thus, a key assumption in applying these models to future years of data within the monitoring tool is that these relationships change little over time. It will not be possible to assess the performance of the models over time until another national study of certification error, such as APEC, is completed.
- ***The monitoring tool identifies a disproportionate number of large districts as high-risk.*** This pattern is appropriate in the sense that large districts are the ones contributing the most to certification error nationally. On the other hand, large districts with low certification error rates may regard their selection as unfair if they view it as being related to a factor that cannot be changed. Moreover, repeated selection of large districts for review of certification practices may result in diminishing opportunities for improvement of error rates in those districts. The certification risk definition used by the tool accounts for these possibilities by including an "error rate floor" in the assignment of LEAs to the high-risk category.
- ***Imputed meal counts are used to calculate reimbursements and dollar amounts of certification error.*** There is no available source of nationwide data on district meal counts. As a result, the monitoring tool imputes meal counts, which are used to estimate total reimbursements and dollar amounts of certification error. These imputations likely introduce error into district error estimates and risk classification. However, the tool allows SAs to upload actual meal counts, which should reduce this type of error.

Overall, the strengths of the risk assessment tool outweigh the current limitations. The tool provides a platform for consistent application of criteria by SAs when selecting LEAs for AARs.

The tool provides historical information from VSR since SY 2008-2009, and the tool stores SA selections for AARs for review and consideration in future years. The limitations discussed above should be taken into consideration as the tool is used in future years, and as opportunities arise for evaluating tool performance relative to newly acquired data about LEA certification error rates.

This page has been left blank for double-sided copying.

V. CONCLUSION

This study is intended to facilitate further efforts to combat certification error by providing FNS and SAs information about where problems exist and where they are most severe. In particular, the study's objectives are to:

- Develop an econometric model, based on APEC data and findings, to identify indicators of LEAs with high risk of certification error.
- Provide a web-based monitoring tool that will apply the model parameters to Verification Summary Report (FNS-742) data annually, and publish results for access by State Child Nutrition (CN) agencies.

This chapter discusses the ways in which the study achieved these objectives, as well as limitations to the study's approach.

A. Study Achievements

- ***The study includes modeling that is based on high quality data and results in informative and technically appropriate results.***

A key step in developing the certification error monitoring tool is to estimate statistical models of certification error. These models summarize the relationship between LEA characteristics and each type of certification error (household reporting, administrative, and overall).

One strength of the modeling effort is the quality of the data upon which the models are based. The models dependent variables come from the APEC and RORA studies. Thus, they are based on independent, high quality studies of certification error. The LEA characteristics considered as explanatory variables in the models are drawn from a broad set of datasets, including Verification Summary Report (VSR), Common Core of Data (CCD), Census Small Area Income and Poverty Estimates (SAIPE), and Bureau of Labor Statistics Local Area Unemployment Survey (LAUS). The datasets allowed us to examine the relationship of certification error to a wide range of different LEA characteristics and identify a set of characteristics that can explain variation in the district's certification error rates and that can be easily incorporated into the monitoring tool to provide estimates of certification error risk in future years.

Another strength of the statistical modeling is that it is technically sound and based on an extensive set of specification and robustness checks. To develop the statistical models, we tested alternative model specifications and selected final models based on predictive power and good fit to the data. We tested different estimation strategies (Tobit and OLS regressions), different specifications of the dependent variables (aggregated and disaggregated measures of both certification error rates and levels), different combinations of explanatory variables (variables selected based on policy relevance and selected automatically based on correlation; variables drawn from all datasets or from VSR alone), and estimation sample (full sample and samples based on enrollment subgroups). This thorough consideration of alternative estimation strategies helps ensure that the final models achieve a high level of performance in predicting certification error.

- ***The statistical models developed in the study perform well in validation analysis, indicating that they are good predictors of certification error.***

We assessed model performance by comparing the distributions of error rates reported in APEC and RORA with the distribution of predicted error rates obtained by applying model parameters to VSR data. For all types of certification error examined in this study, predicted certification error estimates from VSR data match well with estimates from APEC and RORA data.

The strong correspondence between national estimates of certification error and estimates imputed by the statistical models suggests that the models do a good job in producing valid estimates of certification error.

- ***The statistical models identified important relationships between certification error and LEA characteristics.***

Verification results are strongly associated with certification error. For all three measures of certification error available in the APEC data, there is a significant relationship between certification error and verification results for districts not using random verification samples; the relationship between certification error and verification is not significant for RORA administrative error. Additional significant relationships are discussed briefly below.

APEC Overall Certification Error. The final model of APEC overall certification error is based on a disaggregated measure in which certification error is broken out into six subcomponents. Therefore, there are six separate regression equations in the APEC overall certification error model. For Free-certified-not-eligible (FCNE) error, which accounts for about half of overall certification error, some important explanatory variables are related to verification results and enrollment. For districts not using random verification samples, higher rates of reduction or termination of benefits through verification are associated with higher FCNE error, as are higher rates of verification nonresponse. Enrollment also has a positive relationship with FCNE error. Districts with higher percentages of students certified for free meals and districts that are publicly operated tend to have lower FCNE error rates. This model was selected for the monitoring tool, over alternative models discussed below, based on predictive power and good fit to the data.

APEC Household Reporting Certification Error. The final model of APEC certification error due to household reporting is also based on a disaggregated measure. As with overall certification error, reduction of benefits through verification has a strong positive relationship with FCNE reporting error (the largest component of household reporting error) for districts not using random verification samples. Unlike overall certification error, verification nonresponse does not have a significant relationship with household reporting error. Districts with higher percentages of students certified for free meals and districts that are publicly operated tend to have lower FCNE reporting error rates.

APEC Administrative Certification Error. The final model of APEC administrative certification error is based on a single, aggregated measure. As was the case with models of overall and household reporting error rates, we find verification results are significantly related to error rates for districts not selecting random verification samples. We find no other factors included in the model have a statistically significant relationship with administrative error rates.

RORA Administrative Certification Error. The final model of RORA administrative certification error is based on a single, aggregated measure. The only statistically significant coefficient is the one associated with enrollment—districts with more students tend to have higher administrative error rates. Contrary to the findings for other types of certification error, verification results are not significantly associated with RORA administrative error rates.

- ***The statistical models produce overall certification error estimates that can be used by the monitoring tool to categorize district certification risk in a way that is simple, targeted, and responsive to time-varying LEA characteristics.***

Risk of certification error is defined by the estimated dollar amounts of NSLP benefits approved or denied in error. Therefore, the monitoring tool applies the statistical model to VSR data to estimate LEAs' certification error rates, and then applies these rates to total NSLP reimbursements for each LEA. The estimated erroneous payments are then assigned to a risk category (low, medium, and high-risk). We use State-specific thresholds when assigning risk categories and only categorize districts as high-risk if their certification error rate is above a certain error rate floor.

The risk categories used in the monitoring tool are well targeted in the sense that they identify a set of districts accounting for a disproportionate share of national erroneous payments due to certification error. As shown in Figure ES.1, in 2009, the 16 percent of districts identified as high-risk are estimated to account for 68 percent of national certification error.

The statistical models appear to be responsive to LEA characteristics that change over time. For example, the FCRE error rate (free certified, RP eligible) decreases as the percentage of students categorically certified or certified without application rises. Moreover, the model does not identify the same set of districts as high-risk in every year, confirming its responsiveness to factors that change over time. For the six-year period examined, most districts were never high-risk, but it was relatively uncommon for districts to be high-risk in every year.

- ***The monitoring tool provides an intuitive, user-friendly way for FNS to provide SAs with the information they need to make informed decisions about district AAR selection.***

The selection of districts for AARs is based on a number of criteria. The monitoring tool collects information related to these criteria in a single location and allows for sorting and filtering of this information. The tool's intuitive interface should allow SAs to make more informed decisions about the districts that would most benefit from AARs.

B. Limitations of the Study

- ***Statistical models are estimated using cross-sectional data. Their validity in future years is limited by the degree to which the relationships between certification error and LEA characteristics are stable over time.***

Although the statistical models perform well in validation analysis, this analysis provides an assessment of model performance only for the time period on which the models were estimated. The models use relationships between districts' characteristics and their error rates at a point in time to infer error rates in the future, when LEA characteristics may change. It is not unusual to use a

cross-sectional model to make inferences about outcomes in future periods, however, we would ideally like to estimate a model which considered how districts' error rates changed over time as their characteristics changed. If the underlying relationships between the certification error measures and LEA characteristics change over time, then the performance of the models may erode. Thus, a key assumption in applying these models to future years of data within the monitoring tool is that these relationships change little over time. It will not be possible to assess the performance of the models over time until another national study of certification error, such as APEC, is completed.

- ***The statistical models do not perfectly predict certification error.***

As noted above, the explanatory variables in the model explain a reasonably large amount of the variation in districts' error rates. However, there is also a substantial amount of variation that remains unexplained by the models. In other words, there are unobserved factors that cause certification error rates to be higher in some districts than in others. To the extent that changes in these unobserved factors also lead to changes in error rates (and, consequently, erroneous payments) in future years, the monitoring tool will not capture these changes.

- ***Certification error estimates require imputed values for district meal counts.***

In order to predict the dollar amount of certification error, the monitoring tool must use estimates of district meal counts. Meal counts are available at the State level. District counts of meals (free, reduced-price, and paid) are estimated to be proportional to the district's share of the state's students in that meal price category. These estimates are likely to be accurate on average, but in any given district the estimated value of a particular meal count might differ substantially from its actual value. (The tool includes an optional function by which SAs may upload actual meal counts.)

C. Conclusion

The statistical models and monitoring tool developed as a part of this study make a valuable contribution to efforts to reduce certification error. The statistical models are the result of a thorough investigation of high quality data. As a result, they successfully identify important LEA characteristics associated with certification error and produce valid estimates of certification error in national samples other than the ones for which the models were estimated.

It is not possible to assess the validity of the models in future years without additional studies. It is likely that the models will provide reasonable estimates of certification error in the short run, but they may be limited if the relationships between certification error and LEA characteristics are not stable over time. In the longer term, it will be important to update the tool with statistical models that incorporate information from future national studies of certification error.

The web-based monitoring developed by this study provides a platform for consistent application of criteria by SAs when selecting LEAs for AARs. The tool provides historical information from VSR since SY 2008-2009, and the tool stores SA selections for AARs for review and consideration in future years. The limitations discussed above should be taken into consideration as the tool is used in future years, and as opportunities arise for evaluating tool performance relative to newly acquired data about LEA certification error rates.

REFERENCES

Bowling, Shannon, Mohammade Kasawneh, Sittichai Kaewkuekool, and Byun Rae Cho. "A Logistic Approximation to the Cumulative Normal Distribution." *Journal of Industrial Engineering and Management*, vol. 2, no. 1, 2009.

Carlson, Barbara L., Brenda G. Cox, and Linda S. Bandeh. "SAS' Macros Useful in Imputing Missing Survey Data." *Proceedings of the 1995 SAS Users' Group International Conference*, 1995.

Cole, Nancy and Christopher Logan. *Data Matching in the National School Lunch Program: 2005 Volume 1: Final Report*. Final report submitted to the U.S. Department of Agriculture, Food and Nutrition Service. Cambridge, MA: Abt Associates, Inc., February 2007.

Gleason, Philip. "Direct certification in the national school lunch program expands access for children." *Journal of Policy Analysis and Management,* vol. 27, no. 1, Winter 2008.

Lee, Kang In and John J. Koval. "Determination of the best significance level in forward stepwise logistic regression." *Communications in Statistics*, vol. 26, no. 2, 1997.

Ponza, Michael, Philip Gleason, Lara Hulsey, and Quinn Moore. *NSLP/SBP Access, Participation, Eligibility, and Certification Study, Erroneous Payments in the NSLP and SBP, Volume I: Findings*. Final report submitted to the U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis, Nutrition, and Evaluation. Princeton, NJ: Mathematica Policy Research, Inc.**,** October 2007.

Seastrom, Marilyn M. "NCES Statistical Standards." National Center for Education Statistics, October 2002.

Shtatland, Ernest, Ken Kleinman, and Emily Cain. "Stepwise Methods in Using SAS Proc Logistic and SAS Enterprise Miner for Prediction." *Proceedings of the 2003 SAS Users' Group International Conference*, 2003.

Veall, Michael R. and Klaus F. Zimmerman. "Pseudo-R squared measures for come common limited dependent variable models." *Journal of Economic Surveys*, vol. 10, no. 3, September 1996.

This page has been left blank for double-sided copying.

APPENDIX A

GOODNESS OF FIT MEASURES FOR CANDIDATE MODELS

This page has been left blank for double-sided copying.

Table A.1. Goodness of Fit for Different Specifications of Tobit Models of APEC Overall Certification Error Rates (Percentages)

		Disaggregated Error Rates					
	Aggregated Error Rate	FCNE	FCRE	RCFE	RCNE	NCFE	NCRE
By Specification of Dependent Variable							
Disaggregated Error Rates	—	0.425	0.389	0.321	0.116	0.344	0.154
Aggregated Error Rate	0.198	—	—	—	—	—	—
By Number of Additional Covariates							
Change Preferred Number in Disaggregated Error Rate Models by:							
-2	—	0.350	0.199	0.291	0.077	0.280	0.132
-1	—	0.404	0.243	0.311	0.077	0.332	0.132
+1	—	0.462	0.410	0.332	0.269	0.389	0.390
+2	—	0.474	0.440	0.348	0.790	0.399	0.362
By Data Source							
Models Including Covariates from All Data Sources and Based on:							
Disaggregated error rates	—	0.425	0.446	0.311	0.077	0.280	0.132
Aggregated error rate	0.198	—	—	—	—	—	—

Source: APEC and Verification Summary Report data, SY2005–06.

Note: Goodness of fit is represented by McKelvey and Zavoina pseudo R-squared value, a goodness of fit measure shown to perform well with Tobit analysis (Veall and Zimmerman 2006). Certification error rates refer to the percentage of total reimbursements with a given type of certification error. Unless stated otherwise, covariates in relevant models come from the VSR only. Unless stated otherwise, covariates were added to all models until adding an additional variable would not result in a statistically significant coefficient.

Table A.2. Goodness of Fit for Different Specifications of Tobit Models of APEC Household Reporting Certification Error Rates (Percentages)

		Disaggregated Error Rates					
	Aggregated Error Rate	FCNE	FCRE	RCFE	RCNE	NCFE	NCRE
By Specification of Dependent Variable							
Disaggregated Error Rates	—	0.312	0.278	0.350	0.160	0.203	0.193
Aggregated Error Rate	0.146	—	—	—	—	—	—
By Number of Additional Covariates							
Core Covariates Only	—	0.154	0.112	0.109	0.128	0.146	0.100
Change Preferred Number in Disaggregated Error Rate Models by:							
-2	—	0.154	0.112	0.109	0.307	0.146	0.100
-1	—	0.264	0.167	0.109	0.347	0.146	0.100
+1	—	0.328	0.278	0.857	0.373	0.242	0.827
+2	—	0.352	0.280	0.859	0.373	0.243	0.848

Source: APEC and Verification Summary Report data, SY2005–06.

Note: Goodness of fit is represented by McKelvey and Zavoina pseudo R-squared value, a goodness of fit measure shown to perform well with Tobit analysis (Veall and Zimmerman 2006). Certification error rates refer to the percentage of total reimbursements with a given type of certification error. Unless stated otherwise, covariates in relevant models come from the VSR only. Unless stated otherwise, covariates were added to all models until adding an additional variable would not result in a statistically significant coefficient.

Table A.3. Goodness of Fit for Different Specifications of Tobit Models of APEC Administrative Certification Error Rates (Percentages)

		Disaggregated Error Rates					
	Aggregated Error Rate	FCNE	FCRE	RCFE	RCNE	NCFE	NCRE
By Specification of Dependent Variable							
Disaggregated Error Rates	—	0.804	0.199	0.265	0.647	0.383	0.258
Aggregated Error Rate	0.440	—	—	—	—	—	—
By Number of Additional Covariates							
Core Covariates Only	0.153	—	—	—	—	—	—
Change Preferred Number in Disaggregated Error Rate Models by:							
-2	0.374	—	—	—	—	—	—
-1	0.427	—	—	—	—	—	—
+1	0.465	—	—	—	—	—	—
+2	0.489	—	—	—	—	—	—

Source: APEC and Verification Summary Report data, SY2005–06.

Note: Goodness of fit is represented by McKelvey and Zavoina pseudo R-squared value, a goodness of fit measure shown to perform well with Tobit analysis (Veall and Zimmerman 2006). Certification error rates refer to the percentage of total reimbursements with a given type of certification error. Unless stated otherwise, covariates in relevant models come from the VSR only. Unless stated otherwise, covariates were added to all models until adding an additional variable would not result in a statistically significant coefficient.

Table A.4. Goodness of Fit for Different Specifications of Tobit Models of RORA Administrative Certification Error Rates (Percentages)

		Disaggregated Error Rates					
	Aggregated Error Rate	FCNE	FCRE	RCFE	RCNE	NCFE	NCRE
By Year of Analysis Sample							
Model Based on Data from SY2009 Only	0.261	—	—	—	—	—	—
Model Based on All Available Data Pooled	0.179	—	—	—	—	—	—
By Specification of Dependent Variable							
Disaggregated Error Rates	—	0.520	0.175	0.900	0.561	0.627	0.481
Aggregated Error Rate	0.261	—	—	—	—	—	—
By Number of Additional Covariates							
Core Covariates Only	0.201	—	—	—	—	—	—
Change Preferred Number in Disaggregated Error Rate Models by:							
+1	0.281	—	—	—	—	—	—
+2	0.290	—	—	—	—	—	—

Source: RORA and Verification Summary Report data, 2005 through 2009.

Note: Goodness of fit is represented by McKelvey and Zavoina pseudo R-squared value, a goodness of fit measure shown to perform well with Tobit analysis (Veall and Zimmerman 2006). Certification error rates refer to the percentage of total reimbursements with a given type of certification error. Unless stated otherwise, covariates in relevant models come from the VSR only. Unless stated otherwise, covariates were added to all models until adding an additional variable would not result in a statistically significant coefficient.

APPENDIX B

STATE-SPECIFIC THRESHOLDS FOR CERTIFICATION ERROR RISK CATEGORIZATION

This page has been left blank for double-sided copying.

Table B.1. Median SFA Enrollment and Certification Risk Thresholds, by State

State	Median SFA Enrollment	Threshold for High- Risk	Threshold for Medium- Risk
Alabama	3,052	$161,311	$80,655
Alaska	311	$16,411	$8,206
Arizona	401	$21,168	$10,584
Arkansas	935	$49,419	$24,709
California	1,571	$83,007	$41,504
Colorado	587	$31,025	$15,513
Connecticut	2,305	$121,829	$60,914
Delaware	2,241	$118,446	$59,223
District of Columbia	326	$17,230	$8,615
Florida	1,876	$99,128	$49,564
Georgia	2,781	$146,987	$73,494
Hawaii	218	$11,522	$5,761
Idaho	641	$33,879	$16,940
Illinois	752	$39,746	$19,873
Indiana	1,742	$92,045	$46,023
Iowa	630	$33,298	$16,649
Kansas	524	$27,696	$13,848
Kentucky	2,397	$126,665	$63,332
Louisiana	4,027	$212,844	$106,422
Maine	629	$33,245	$16,623
Maryland	16,433	$868,525	$434,263
Massachusetts	1,629	$86,099	$43,050
Michigan	1,123	$59,355	$29,678
Minnesota	596	$31,501	$15,751
Mississippi	2,284	$120,719	$60,359
Missouri	536	$28,330	$14,165
Montana	202	$10,677	$5,338
Nebraska	344	$18,182	$9,091
Nevada	446	$23,573	$11,786
New Hampshire	1,521	$80,391	$40,196
New Jersey	1,066	$56,316	$28,158
New Mexico	438	$23,124	$11,562
New York	1,468	$77,590	$38,795
North Carolina	3,813	$201,533	$100,766
North Dakota	195	$10,307	$5,153
Ohio	1,062	$56,131	$28,066
Oklahoma	413	$21,802	$10,901
Oregon	908	$47,992	$23,996
Pennsylvania	1,755	$92,759	$46,379
Rhode Island	2,441	$128,991	$64,495
South Carolina	4,441	$234,699	$117,349
South Dakota	286	$15,116	$7,558
Tennessee	3,572	$188,795	$94,397
Texas	792	$41,860	$20,930
Utah	1,018	$53,806	$26,903
Vermont	220	$11,628	$5,814
Virginia	3,558	$188,055	$94,027
Washington	1,007	$53,224	$26,612
West Virginia	3,826	$202,220	$101,110
Wisconsin	900	$47,542	$23,771
Wyoming	871	$46,036	$23,018

Note: The threshold for high-risk is $50,000 multiplied by the ratio of State median enrollment to national median enrollment. The threshold for medium-risk is $25,000 multiplied by the ratio of State median enrollment to national median enrollment.

This page has been left blank for double-sided copying.

APPENDIX C

ADDITIONAL RESULTS FROM STATISTICAL MODELS:

APEC OVERALL REPORTING ERROR

This page has been left blank for double-sided copying.

This appendix includes the results of the models that were estimated as part of the process of selecting final models to include in the final report and the monitoring tool. These models are Tobit regressions estimated for overall certification error as measured in APEC. Overall certification error refers to the total of household reporting error and administrative error.

The regression results are organized in two sets of tables:

- Table Set 1 (Tables C.1 – C.7) includes regressions using only explanatory variables from the VSR. These regressions were the basis for the final models presented in the body of the report and used in the monitoring tool. The final models are highlighted in these tables.
- Table Set 2 (Tables C.8 – C.14) includes regressions using explanatory variables drawn from all available data sets. These models were not used as the final ones presented in the body of the report, although the report does show validation results for them.

Each table set includes seven tables, one for *aggregate* overall certification error and one for each of the six types of *disaggregate* overall certification error. These disaggregate error types include estimated erroneous payments made to students who are:

- Free-Certified, Not Eligible (FCNE)
- Free-Certified, Reduced-Price-Eligible (FCRE)
- Reduced-Price-Certified, Free-Eligible (RCFE)
- Reduced-Price -Certified, Not Eligible (RCNE)
- Not Certified, Free-Eligible (NCFE)
- Not Certified, Reduced-Price-Eligible (NCRE)

Each table has seven columns corresponding to seven regression specifications with different numbers of explanatory variables. All columns include the core explanatory variables that were selected based on policy relevance or theoretical relationship to certification error (see Table II.3 and related discussion). These variables are related to verification results, NSLP application characteristics, and district demographic and administrative characteristics.

An automated process was used to identify the "preferred" model specification. This automated process identified explanatory variables that are correlated with certification error. At each step of the automated process, one additional explanatory variable (with the highest correlation) was added to the existing set of explanatory variables.

The column labeled "Model 1" has results from a regression of the certification error rate on the core explanatory variables and one additional variable. The column labeled "Model 2" has results from the regression in which two additional variables are added based on the automated process. The column labeled "Model 3" has three additional variables, the column labeled "Model 4" has four additional variables, and so forth. At each step, the additional variable was included in the model based on the observed correlation with certification error.

We tested the model performance and validity of models that include different numbers of additional explanatory variables. For all of the final APEC overall certification error models we

added variables to the core set until the coefficient on the next additional variable was no longer statistically significant at the five percent level. As noted in the report, this inclusion rule is consistent with the literature on automated variable selection and led to models with strong performance. We have highlighted the final model selected in each table in Table Set 1.

Table Set 2 includes variables from all available data sources as candidate explanatory variables. These results are often identical or very similar to regression results from Table Set 1, which includes only variables from the VSR as candidate explanatory variables. This is because variables from the VSR are often selected by the automated process even when variables from other data sources are available. Consequently, model validation performance is similar regardless of whether data sources other than the VSR are included. We use this finding as support for focusing on covariates drawn only from the VSR. The primary advantage of focusing on a smaller number of data sources is that it simplifies the monitoring tool and reduces errors related to merging data files in future years.

Table Set 1: Models with Covariates from VSR Only

Table C.1. Coefficient Estimates from Tobit Model of APEC Certification Error - Free Certified, RP Eligible (FCRE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	0.567	0.043	0.535	0.765	1.183	1.156	1.320
% Free Apps Changed Through Verification	0.011	0.012	0.002	0.005	0.011	0.009	0.010
% Free Apps W/ No Response	0.023*	0.023*	0.020	0.022*	0.024*	0.025*	0.028*
% Free Apps Changed Through Verification (X Random Sampling)	-0.012	-0.003	-0.001	-0.004	-0.012	-0.012	-0.013
% Free Apps W/ No Response (X Random Sampling)	-0.005	0.001	-0.008	-0.011	-0.016	-0.017	-0.022
% FRP Students Certified Not Subject to Verification	-0.026*	-0.020	-0.023*	-0.023*	-0.025*	-0.024*	-0.026*
% FRP Students Certified Based on Categorical Eligibility	-0.031	-0.029*	-0.033*	-0.033*	-0.035*	-0.038*	-0.041*
Enrollment (10,000s)	-0.004	-0.002	-0.003	-0.003	-0.004	-0.006	-0.018*
% Students Certified for Free Meals	-0.005	-0.006	-0.010	-0.010	-0.010	-0.010	-0.008
% Students Certified for RP Meals	0.108*	0.146*	0.215*	0.224*	0.176*	0.156*	0.148*
% Free Students from Non-Base Year Prov 2/3 Schools	-0.033*	-0.032*	-0.033*	-0.033*	-0.031*	-0.031*	-0.044*
No RP Apps Were Verified		1.545*	2.260*	2.232*	2.111*	2.051*	1.964*
Enrollment < 1,000			-2.934*	-3.626*	-4.124*	-3.701*	-3.701*
Public SFA				-0.917	-0.784	-0.677	-0.671
No Free Apps Were Verified					2.802	2.707	2.870
% Apps Verified						-0.048*	-0.052*
# RP Students Reported for Non-Base Year Prov 23 Schools							0.000
Intercept	0.889	0.346	0.494	1.086	1.187	1.484	1.519

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report and used in the monitoring tool.

*Coefficient is statistically significant at 5 percent level.

Table C.2. Coefficient Estimates from Tobit Model of APEC Certification Error - Free Certified, Not Eligible (FCNE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	7.033	6.149	6.225	5.895	2.530	1.187	2.726
% Free Apps Changed Through Verification	0.193*	0.200*	0.251*	0.249*	0.242*	0.229*	0.218*
% Free Apps W/ No Response	0.081	0.082	0.120*	0.119*	0.115*	0.092	0.091*
% Free Apps Changed Through Verification (X Random Sampling)	-0.235*	-0.234*	-0.231*	-0.232*	-0.170	-0.161	-0.171*
% Free Apps W/ No Response (X Random Sampling)	-0.007	0.014	0.007	0.021	0.059	0.101	0.077
% FRP Students Certified Not Subject to Verification	0.022	0.027	0.016	0.009	0.041	0.058	0.057
% FRP Students Certified Based on Categorical Eligibility	-0.053	-0.066	-0.123	-0.131	-0.120	-0.097	-0.093
Enrollment (10,000s)	0.055	0.076	0.102	0.184*	0.198*	0.332*	0.311*
% Students Certified for Free Meals	-0.119*	-0.115*	-0.104*	-0.102*	-0.106*	-0.118*	-0.126*
% Students Certified for RP Meals	-0.084	-0.166	-0.237	-0.216	0.038	0.059	0.197
Public SFA	-13.555*	-15.429*	-18.196*	-18.653*	-17.044*	-17.443*	-19.624*
Enrollment 5001 - 10,000		5.139*	7.542*	7.799*	7.126*	7.777*	12.732*
Enrollment 1001 - 5000			7.321*	7.606*	7.258*	7.695*	12.330*
# Provision 2/3 Schools				-0.035*	-0.037*	-0.030*	-0.030*
No RP Apps Were Verified					9.548	10.065*	11.063*
Enrollment Cubed						-0.000	-0.000
Enrollment > 10,000							5.943*
Intercept	15.720*	16.802*	16.304*	16.540*	12.454*	12.704*	8.740

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report and used in the monitoring tool.

*Coefficient is statistically significant at 5 percent level.

Table C.3. Coefficient Estimates from Tobit Model of APEC Certification Error - RP Certified, Free Eligible (RCFE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	3.255	3.579	3.421	4.471	4.236	3.471	2.198
% RP Apps Changed to Free	-0.017	-0.037	-0.047	-0.039	-0.031	-0.038	-0.011
% RP Apps Changed to Paid	-0.039	-0.026	-0.027	-0.029	-0.028	0.004	0.009
% RP Apps W/ No Response	0.075	0.082	0.077	0.084	0.078	0.099*	0.085
% RP Apps Changed to Free (X Random Sampling)	-0.300	-0.298	-0.307	-0.244	-0.248	-0.238	-0.288
% RP Apps Changed to Paid (X Random Sampling)	-0.053	-0.064	-0.062	-0.082	-0.082	-0.093	-0.084
% RP Apps W/ No Response (X Random Sampling)	-0.037	-0.037	-0.030	-0.046	-0.038	-0.027	-0.003
% FRP Students Certified Not Subject to Verification	-0.045	-0.087	-0.094	-0.084	-0.081	-0.078	-0.102
% FRP Students Certified Based on Categorical Eligibility	-0.148	-0.213*	-0.203*	-0.222*	-0.218*	-0.250*	-0.283*
Enrollment (10,000s)	-0.001	0.012	0.026	0.002	-0.002	0.007	0.010
% Students Certified for Free Meals	0.055	0.088*	0.089*	0.027	0.028	0.033	0.075
% Students Certified for RP Meals	-0.304	-0.325	-0.234	-0.077	-0.090	-0.186	-0.324
Public SFA	-8.152*	-7.924*	-7.230*	-7.931*	-7.902*	-7.923*	-7.176*
% Students Reported Free Eligible from Non-Base Year Prov 2/3 Schools		-0.247*	-0.253*	-0.220*	-0.254*	-0.249*	-0.198*
% Apps Verified			0.235*	0.227*	0.232*	0.211*	0.246*
% All Applications Certified for RP Meals				-0.171*	-0.170*	-0.184*	-0.142
Enrollment W/Access to NSLP Prov 2/3 Schools					0.000*	0.000*	0.000*
Enrollment > 10,000						-2.559	-3.114
% RP Students Reported RP Eligible from Non-Base Year Prov 2/3 Schools							-0.069
Intercept	15.716*	16.132*	13.939*	19.904*	19.907*	21.545*	21.131*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report and used in the monitoring tool.

*Coefficient is statistically significant at 5 percent level.

Table C.4. Coefficient Estimates from Tobit Model of APEC Certification Error - RP Certified, Not Eligible (RCNE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	12.576	19.466	23.919	22.723	14.951	11.478	15.580
% RP Apps Changed to Free	1.231	1.080	0.802	0.733	0.351	0.458	0.548
% RP Apps Changed to Paid	-0.033	-0.092	-0.057	-0.038	-0.038	-0.118	0.003
% RP Apps W/ No Response	0.006	0.060	0.183	0.075	0.017	0.050	0.119
% RP Apps Changed to Free (X Random Sampling)	-0.676	-0.436	-0.260	-0.054	0.316	-0.158	-0.230
% RP Apps Changed to Paid (X Random Sampling)	0.233	0.365	0.315	0.246	0.253	0.381	0.262
% RP Apps W/ No Response (X Random Sampling)	-0.165	-0.344	-0.464	-0.380	-0.271	-0.207	-0.227
% FRP Students Certified Not Subject To Verification	0.246	0.567*	0.460	0.426	0.352	0.408	0.076
% FRP Students Certified Based on Categorical Eligibility	0.462	2.555*	2.378*	2.220*	2.004*	1.003	0.895
Enrollment (10,000s)	0.036	0.058	0.123	0.921*	0.923*	0.922*	0.951*
% Students Certified for Free Meals	-0.211	-0.460*	-0.423*	-0.332	-0.291	-0.731*	-0.958*
% Students Certified for RP Meals	0.688	1.350	1.550	1.471	0.869	1.096	1.397
% RP Students Reported RP Eligible from Non-Base Year Prov 2/3 Schools	0.325	0.786*	0.891*	0.869*	0.805*	0.880*	0.939*
% Free Applications Certified Categorically		-1.500*	-1.466*	-1.254*	-1.199*	-1.076*	-1.069*
Enrollment W/Access to NSLP Prov 2/3 Schools			-0.001	-0.003	-0.003	-0.002	-0.002
# Applications Certified Free Categorically				-0.001	-0.001	-0.001	-0.001
Enrollment 5001 - 10,000					9.697	11.880	14.364
% Students Certified Free Categorically						2.000*	2.414
% Students Certified Free Without An Application							0.805
Intercept	-4.549	-1.098	-3.173	-5.643	4.685	15.465	11.997

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. In the case of RCNE error, only one additional variable was added to the core set of variables because the coefficient on that one additional variable was not statistically significant. Validation results using core variables only and no additional variables are provided in Table III.1. See page 24 for a discussion of automated model selection. Highlighted column indicates the final model presented in the final report and used in the monitoring tool.

*Coefficient is statistically significant at 5 percent level.

Table C.5. Coefficient Estimates from Tobit Model of APEC Certification Error - Not Certified, Free Eligible (NCFE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	-2.617	-0.831	-1.185	1.162	1.221	0.997	2.777
% Sampled Apps Changed Through Verification	-0.047	0.001	-0.078	-0.079	-0.078	-0.081	-0.046
% Sampled Apps W/ No Response	0.550*	0.588*	0.525*	0.530*	0.531*	0.527*	0.523*
% Sampled Apps Changed Though Verification (X Random Sampling)	0.151	0.152	0.278	0.218	0.217	0.223	0.126
% Sampled Apps W/ No Response (X Random Sampling)	-0.424	-0.463	-0.524	-0.534	-0.534	-0.529	-0.507
% FRP Students Certified Not Subject to Verification	-0.310	-0.330	-0.412	-0.400	-0.403	-0.414	-0.381
% FRP Students Certified Based on Categorical Eligibility	-0.567	-0.631	-0.701	-0.744*	-0.763	-0.826	-2.987*
Enrollment (10,000s)	-0.465	-0.474	-0.484	-0.515	-0.513	-0.563	-0.646*
% Students Certified for Free Meals	0.651*	0.653*	0.625*	0.521*	0.520*	0.528*	0.594*
% Students Certified for RP Meals	0.838	-0.251	-0.759	-0.451	-0.445	-0.504	-0.692
% Students Reported Free Eligible from Non-Base Year Prov 2/3 Schools	-0.871*	-0.844*	-0.833*	-0.782*	-0.789	-0.919	-0.892
No Free Apps Were Verified		50.748*	88.283*	89.125*	89.057*	89.748*	106.130*
Public SFA			30.636	30.628	30.650	31.032	45.707*
% All Applications Certified for RP Meals				-0.329	-0.347	-0.387	-0.735
% All Apps Certified for Free Meals Based on Income					-0.018	-0.074	0.032
Enrollment W/Access to NSLP Prov 2/3 Schools						0.000	0.000
% Free Certified Students Certified Free Categorically							1.731*
Intercept	-24.651	-17.858	-34.870	-24.863	-23.130	-17.771	-32.074

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report and used in the monitoring tool.

*Coefficient is statistically significant at 5 percent level.

Table C.6. Coefficient Estimates from Tobit Model of APEC Certification Error - Not Certified, RP Eligible (NCRE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	-3.622	10.578	9.652	0.452	-3.454	2.893	3.297
% Sampled Apps Changed Through Verification	0.097	0.139	0.164	0.060	-0.023	-0.221	-0.214
% Sampled Apps W/ No Response	0.099	0.192	0.145	0.150	0.108	0.011	0.033
% Sampled Apps Changed Though Verification (X Random Sampling)	0.024	-0.283	-0.294	-0.086	-0.036	-0.047	-0.054
% Sampled Apps W/ No Response (X Random Sampling)	0.117	0.012	0.072	0.170	0.236	0.149	0.160
% FRP Students Certified Not Subject to Verification	0.296	0.747*	0.101	-0.371	-0.469	-0.377	-0.387
% FRP Students Certified Based on Categorical Eligibility	0.339	1.929*	1.712*	0.626	0.474	0.759	0.735
Enrollment (10,000s)	-0.141	-0.285	-0.278	-0.220	-0.214	-0.314	-0.131
% Students Certified for Free Meals	0.217	-0.304	-0.432	-0.997*	-1.087*	-1.106*	-1.164*
% Students Certified for RP Meals	0.748	2.733*	2.265	2.203	3.342*	4.317*	4.537*
% RP Students Reported RP Eligible from Non-Base Year Prov 2/3 Schools	0.231	0.705*	0.658*	0.733*	0.727*	0.762*	0.834*
% All Apps Certified for Free Meals Based on Income		1.588*	1.455*	1.321*	1.266*	1.286*	1.286*
% Students Certified Free Without an Application			1.130	2.065	2.280*	2.158*	2.202*
% Students Certified Free Categorically				2.074	2.401*	2.230*	2.338*
No Free Apps Were Verified					-176.1	-193.4	-192.4
Enrollment > 10,000						15.256	14.869
# Provision 2/3 Schools							-0.082*
Intercept	-31.5	-154.5	-132.3	-98.1*	-96.5*	-109.6	-111.3

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report and used in the monitoring tool.

*Coefficient is statistically significant at 5 percent level.

Table C.7. Coefficient Estimates from Tobit Model of APEC Overall Certification Error

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	2.549	2.724	1.897	2.567	3.014	5.185	7.435
% Sampled Apps Changed Through Verification	0.019	0.045	0.057	0.124	0.118	0.110	0.123
% Sampled Apps W/ No Response	0.061	0.080	0.083*	0.129*	0.137*	0.134*	0.158*
% Sampled Apps Changed Though Verification (X Random Sampling)	-0.023	-0.040	-0.041	-0.049	-0.049	-0.095	-0.128
% Sampled Apps W/ No Response (X Random Sampling)	-0.029	-0.021	0.000	-0.013	-0.027	-0.043	-0.073
% FRP Students Certified Not Subject to Verification	-0.046	-0.034	-0.029	-0.041	-0.038	-0.026	-0.003
% FRP Students Certified Based on Categorical Eligibility	-0.184*	-0.177*	-0.188*	-0.233*	-0.242*	-0.261*	-0.233*
Enrollment (10,000s)	0.050	0.049	0.065	0.081*	0.071*	0.039	0.036
% Students Certified for Free Meals	-0.024	-0.016	-0.012	0.000	0.001	-0.071	-0.108*
% Students Certified for RP Meals	0.344	0.335	0.256	0.152	0.111	0.333	0.470
% Free Students from Non-Base Year Prov 2/3 Schools	-0.202*	-0.204*	-0.197*	-0.204*	-0.207*	-0.171*	-0.214*
Public SFA		-4.736	-6.389	-8.594*	-8.962*	-9.081*	-9.637*
Enrollment 5001 - 10,000			4.349*	6.286*	6.138*	5.702*	5.228*
Enrollment 1001 - 5000				5.371	5.405	4.731	4.297
% Apps Verified					-0.158*	-0.163*	-0.207*
% All Applications Certified for RP Meals						-0.202	-0.243*
% RP Students Reported RP Eligible from Non-Base Year Prov 2/3 Schools							0.067*
Intercept	9.326*	11.72*	12.52*	11.26*	12.56*	19.34*	19.15*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. The model presented in the report is based on disaggregated household reporting certification error; see highlighted columns of Tables C.1 through C.6.

*Coefficient is statistically significant at 5 percent level.

Table Set 2: Models with Covariates from VSR and Other Sources

Table C.8. Coefficient Estimates from Tobit Model of APEC Certification Error - Free Certified, RP Eligible (FCRE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	0.567	0.043	0.535	0.434	0.256	0.460	0.678
% Free Apps Changed Through Verification	0.011	0.012	0.002	-0.008	-0.010	-0.006	-0.007
% Free Apps W/ No Response	0.023*	0.023*	0.020	0.010	0.011	0.014	0.014
% Free Apps Changed Through Verification (X Random Sampling)	-0.012	-0.003	-0.001	-0.004	0.001	-0.002	-0.001
% Free Apps W/ No Response (X Random Sampling)	-0.005	0.001	-0.008	-0.004	-0.003	-0.005	-0.011
% FRP Students Certified Not Subject to Verification	-0.026*	-0.020	-0.023*	-0.023	-0.027	-0.027	-0.025
% FRP Students Certified Based on Categorical Eligibility	-0.031	-0.029*	-0.033*	-0.027	-0.029	-0.029	-0.021
Enrollment (10,000s)	-0.004	-0.002	-0.003	-0.001	-0.000	-0.000	-0.001
% Students Certified for Free Meals	-0.005	-0.006	-0.010	-0.013	-0.012	-0.012	-0.006
% Students Certified for RP Meals	0.108*	0.146*	0.215*	0.215*	0.207*	0.215*	0.220*
% Free Students from Non-Base Year Prov 2/3 Schools	-0.033*	-0.032*	-0.033*	-0.032	-0.033	-0.033	-0.029
No RP Apps Were Verified		1.545*	2.260*	2.153*	2.123*	2.104*	2.243*
Enrollment < 1,000			-2.934*	-3.288*	-3.162*	-3.740*	-4.061*
# LEA Administrators Per Student (CCD)				-527.74	-535.19	-509.69	-479.28
% Schools in Rural Location (CCD)					0.682	0.742*	0.874*
Public SFA						-0.807	-0.976
Unemployment Rate (BLS)							-0.189*
Intercept	0.889	0.346	0.494	1.610	1.696	2.148	2.867*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process.

*Coefficient is statistically significant at 5 percent level.

Table C.9. Coefficient Estimates from Tobit Model of APEC Certification Error - Free Certified, Not Eligible (FCNE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	7.033	6.149	6.225	5.895	2.530	1.944	1.411
% Free Apps Changed Through Verification	0.193*	0.200*	0.251*	0.249*	0.242*	0.233*	0.244*
% Free Apps W/ No Response	0.081	0.082	0.120*	0.119*	0.115*	0.105*	0.113*
% Free Apps Changed Through Verification (X Random Sampling)	-0.235*	-0.234*	-0.231*	-0.232*	-0.170	-0.159	-0.155
% Free Apps W/ No Response (X Random Sampling)	-0.007	0.014	0.007	0.021	0.059	0.054	0.053
% FRP Students Certified Not Subject to Verification	0.022	0.027	0.016	0.009	0.041	0.044	0.054
% FRP Students Certified Based on Categorical Eligibility	-0.053	-0.066	-0.123	-0.131	-0.120	-0.109	-0.067
Enrollment (10,000s)	0.055	0.076	0.102	0.184*	0.198*	0.211*	0.237*
% Students Certified for Free Meals	-0.119*	-0.115*	-0.104*	-0.102*	-0.106*	-0.115*	-0.091*
% Students Certified for RP Meals	-0.084	-0.166	-0.237	-0.216	0.038	0.020	-0.012
Public SFA	-13.56*	-15.43*	-18.20*	-18.65*	-17.04*	-16.79*	-18.25*
Enrollment 5001 - 10,000		5.139*	7.542*	7.799*	7.126*	7.132*	5.991*
Enrollment 1001 - 5000			7.321*	7.606*	7.258*	7.422*	6.238*
# Provision 2/3 Schools				-0.035*	-0.037*	-0.037*	-0.042*
No RP Apps Were Verified					9.548	9.558	8.483
% Students Who are Migrants (CCD)						41.885	49.570*
% Schools in Urban Location (CCD)							-4.292*
Intercept	15.720*	16.802*	16.304*	16.540*	12.454*	12.807*	14.448*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process.

*Coefficient is statistically significant at 5 percent level.

Table C.10. Coefficient Estimates from Tobit Model of APEC Certification Error - RP Certified, Free Eligible (RCFE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	3.255	3.579	3.421	4.471	4.714	4.412	4.699
% RP Apps Changed to Free	-0.017	-0.037	-0.047	-0.039	-0.034	0.002	-0.013
% RP Apps Changed to Paid	-0.039	-0.026	-0.027	-0.029	-0.013	-0.016	-0.026
% RP Apps W/ No Response	0.075	0.082	0.077	0.084	0.098*	0.083	0.092*
% RP Apps Changed to Free (X Random Sampling)	-0.300	-0.298	-0.307	-0.244	-0.259	-0.279	-0.240
% RP Apps Changed to Paid (X Random Sampling)	-0.053	-0.064	-0.062	-0.082	-0.101	-0.105	-0.095
% RP Apps W/ No Response (X Random Sampling)	-0.037	-0.037	-0.030	-0.046	-0.047	-0.029	-0.050
% FRP Students Certified Not Subject to Verification	-0.045	-0.087	-0.094	-0.084	-0.101	-0.095	-0.116*
% FRP Students Certified Based on Categorical Eligibility	-0.148	-0.213*	-0.203*	-0.222*	-0.238*	-0.223*	-0.239*
Enrollment (10,000s)	-0.001	0.012	0.026	0.002	0.025	-0.001	0.041
% Students Certified for Free Meals	0.055	0.088*	0.089*	0.027	0.020	0.013	0.031
% Students Certified for RP Meals	-0.304	-0.325	-0.234	-0.077	-0.070	-0.047	-0.076
Public SFA	-8.152*	-7.924*	-7.230*	-7.931*	-6.000*	-5.521*	-5.547*
% Students Reported Free Eligible from Non-Base Year Prov 2/3 Schools		-0.247*	-0.253*	-0.220*	-0.221*	-0.222*	-0.267*
% Apps Verified			0.235*	0.227*	0.228*	0.235*	0.216*
% All Applications Certified for RP Meals				-0.171*	-0.173*	-0.179*	-0.176*
Avg # Students Per School					-0.006	-0.007	-0.007
# LEA Support Staff (CCD)						0.003	0.006*
# LEA Administrators (CCD)							-0.032*
Intercept	15.716*	16.132*	13.939*	19.904*	21.829*	21.796*	22.533*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process.

*Coefficient is statistically significant at 5 percent level.

Table C.11. Coefficient Estimates from Tobit Model of APEC Certification Error - RP Certified, Not Eligible (RCNE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	18.091	19.265	16.460	20.702	22.342	26.783	22.539
% RP Apps Changed to Free	1.202	1.273	1.104	1.322	1.249	0.944	0.832
% RP Apps Changed to Paid	-0.137	-0.247	-0.317	-0.151	-0.135	-0.007	0.004
% RP Apps W/ No Response	-0.088	-0.122	-0.218	-0.105	-0.056	0.167	0.183
% RP Apps Changed to Free (X Random Sampling)	-1.332	-1.480	-1.221	-1.339	-1.126	-0.676	-0.606
% RP Apps Changed to Paid (X Random Sampling)	0.181	0.189	0.329	0.272	0.276	0.197	0.249
% RP Apps W/ No Response (X Random Sampling)	-0.130	-0.193	-0.194	-0.289	-0.349	-0.527	-0.473
% FRP Students Certified Not Subject to Verification	0.081	0.094	0.152	0.184	0.292	0.173	0.102
% FRP Students Certified Based on Categorical Eligibility	0.107	0.164	0.228	0.158	0.350	0.318	0.290
Enrollment (10,000s)	0.078	0.147	0.017	-0.046	-0.050	-0.133	-0.125
% Students Certified for Free Meals	-0.353	-0.469*	-0.428*	-0.386	-0.461	-0.307	-0.281
% Students Certified for RP Meals	1.296	1.509	1.406	1.267	1.492	1.545	1.403
% Students Black (CCD)	0.443*	0.525*	0.508*	0.491	0.429	0.211	0.189
% Students Who are Migrants (CCD)		252.05*	217.92*	251.90*	238.04*	400.75*	414.17*
Avg # Students Per School			0.033*	0.043	0.044	0.052	0.052
# LEA Administrators Per Student (CCD)				9118.00	8926.50	8977.41	8603.75
% RP Students Reported RP Eligible from Non-Base Year Prov 2/3 Schools					0.225	0.533	0.544
% Students Enrolled in Prov 2/3 Schools						-3.370	-3.552*
% Schools in Rural Location (CCD)							10.168
Intercept	3.11	4.65	-10.97	-34.57	-41.30*	-52.58*	-50.68*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process.

*Coefficient is statistically significant at 5 percent level.

Table C.12. Coefficient Estimates from Tobit Model of APEC Certification Error - Not Certified, Free Eligible (NCFE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	-4.415	-0.943	-0.574	0.996	-1.309	-3.418	-4.158
% Sampled Apps Changed Through Verification	-0.025	-0.011	0.089	0.017	-0.018	-0.041	-0.047
% Sampled Apps W/ No Response	0.462*	0.544*	0.473*	0.388*	0.390*	0.331*	0.333*
% Sampled Apps Changed Though Verification (X Random Sampling)	0.019	-0.014	-0.159	-0.257	-0.151	-0.181	-0.179
% Sampled Apps W/ No Response (X Random Sampling)	-0.336	-0.404	-0.344	-0.249	-0.258	-0.207	-0.194
% FRP Students Certified Not Subject to Verification	-0.217	-0.390	-0.318	-0.208	-0.128	-0.150	-0.167
% FRP Students Certified Based on Categorical Eligibility	-0.296	-0.579	-0.452	-0.399	-0.311	-0.254	-0.248
Enrollment (10,000s)	-0.453	-0.466	-0.598	-0.521	-0.495	-0.562	-0.541*
% Students Certified for Free Meals	0.524*	0.642*	0.523*	0.045	0.116	0.019	-0.024
% Students Certified for RP Meals	1.029	1.040	0.181	0.967	1.063	1.074	1.121
LEA Support Staff Per Student (CCD)	2893.95	2984.56	3443.93	2766.97	2015.68	2554.01	2496.04
% Free Students from Non-Base Year Prov 2/3 Schools		-0.601*	-0.733*	-0.616*	-0.560*	-0.559*	-0.565*
% Students Hispanic (CCD)			0.382	0.612*	0.556*	0.662*	0.667*
% Students Black (CCD)				0.470*	0.478*	0.565*	0.561*
% Schools in Suburban Location (CCD)					11.099	10.908	10.736
% Students Asian (Ccd)						0.210	0.223
Food Services Spending Per Student (CCD)							0.016
Intercept	-34.15	-33.23	-32.61	-32.25	-39.25*	-39.69*	-43.27

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process.

*Coefficient is statistically significant at 5 percent level.

Table C.13. Coefficient Estimates from Tobit Model of APEC Certification Error - Not Certified, RP Eligible (NCRE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	-6.264	-5.268	-4.964	-1.402	-7.828	-13.275	-15.586
% Sampled Apps Changed Through Verification	-0.067	-0.188	-0.161	-0.111	-0.106	-0.105	-0.114
% Sampled Apps W/ No Response	0.047	0.062	0.041	-0.025	0.002	-0.036	-0.135
% Sampled Apps Changed Though Verification (X Random Sampling)	0.040	0.262	0.156	0.036	0.165	0.197	0.118
% Sampled Apps W/ No Response (X Random Sampling)	0.208	0.223	0.251	0.292	0.372	0.509	0.597*
% FRP Students Certified Not Subject to Verification	0.185	0.137	0.114	-0.942	-1.371*	-1.470*	-1.523*
% FRP Students Certified Based on Categorical Eligibility	0.053	0.198	0.197	-0.012	-0.129	-0.111	-0.007
Enrollment (10,000s)	-0.124	-0.173	-0.187	-0.187	-0.158	-0.370	-0.441*
% Students Certified for Free Meals	0.019	-0.088	-0.056	-0.412	-0.494	-0.578*	-0.791*
% Students Certified for RP Meals	1.526	3.920*	3.927*	3.290*	2.899*	2.954*	2.990*
% Students Black (CCD)	0.420	0.581*	0.516*	0.564*	0.558*	0.550*	0.506*
Enrollment < 1,000		-194.254	-20506.6	-15400.8	-1018.06	-11958.2	-198.429
LEA Support Staff Per Student (CCD)			2022.45	1865.40	1743.56	1908.85	2060.28
% Students Certified Free Without an Application				1.951	2.551*	2.802*	2.920*
% Schools in Rural Location (CCD)					18.294*	20.453*	20.314*
# LEA Administrators (CCD)						0.080	0.087
% Students White (CCD)							-0.205
Intercept	-24.90	-40.49*	-45.58*	-21.57	-13.18	-11.43	10.16

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process.

*Coefficient is statistically significant at 5 percent level.

Table C.14. Coefficient Estimates from Tobit Model of APEC Overall Certification Error

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected Random Verification Sample	2.549	2.724	1.897	2.567	2.429	2.923	3.027
% Sampled Apps Changed Through Verification	0.019	0.045	0.057	0.124	0.098	0.092	0.096
% Sampled Apps W/ No Response	0.061	0.080	0.083*	0.129*	0.113*	0.122*	0.122*
% Sampled Apps Changed Though Verification (X Random Sampling)	-0.023	-0.040	-0.041	-0.049	-0.027	-0.027	-0.041
% Sampled Apps W/ No Response (X Random Sampling)	-0.029	-0.021	0.000	-0.013	-0.017	-0.032	-0.030
% FRP Students Certified Not Subject to Verification	-0.046	-0.034	-0.029	-0.041	-0.015	-0.011	-0.017
% FRP Students Certified Based on Categorical Eligibility	-0.184*	-0.177*	-0.188*	-0.233*	-0.220*	-0.229*	-0.229*
Enrollment (10,000s)	0.050	0.049	0.065	0.081*	0.053	0.042	0.039
% Students Certified for Free Meals	-0.024	-0.016	-0.012	0.000	0.009	0.010	0.010
% Students Certified for RP Meals	0.344	0.335	0.256	0.152	0.151	0.109	0.119
% Free Students from Non-Base Year Prov 2/3 Schools	-0.202*	-0.204*	-0.197*	-0.204*	-0.217*	-0.222*	-0.230*
Public SFA		-4.736	-6.389	-8.594*	-11.609*	-12.097*	-12.245*
Enrollment 5001 - 10,000			4.349*	6.286*	6.421*	6.271*	6.103*
Enrollment 1001 - 5000				5.371	6.388*	6.461*	6.621*
Avg # Students Per School					0.009*	0.009*	0.010
% Apps Verified						-0.169*	-0.183*
LEA Support Staff Per Student (CCD)							327.833
Intercept	9.326*	11.718*	12.517*	11.256*	8.607	9.903	8.868

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process.

*Coefficient is statistically significant at 5 percent level.

APPENDIX D

ADDITIONAL RESULTS FROM STATISTICAL MODELS:

APEC HOUSEHOLD REPORTING ERROR

This page has been left blank for double-sided copying.

This appendix includes Tobit regressions estimated for household reporting certification error as measured in APEC. Seven table sets are included:

- Tables D.1 – D.7 are regressions using only explanatory variables from the VSR. These regressions were the basis for the final models presented in the body of the report.

Each table set includes seven tables, one for *aggregate* household reporting error and one for each of the six types of *disaggregate* household reporting error. These disaggregate error types include estimated erroneous payments made to students who are:

- Free-Certified, Not Eligible (FCNE)
- Free-Certified, Reduced-Price-Eligible (FCRE)
- Reduced-Price-Certified, Free-Eligible (RCFE)
- Reduced-Price -Certified, Not Eligible (RCNE)
- Not Certified, Free-Eligible (NCFE)
- Not Certified, Reduced-Price-Eligible (NCRE)

Each table has seven columns corresponding to seven regression specifications with different numbers of explanatory variables. All columns include the core explanatory variables that were selected based on policy relevance or theoretical relationship to certification error (see Table II.3 and related discussion). These variables are related to verification results, NSLP application characteristics, and district demographic and administrative characteristics.

An automated process was used to identify the "preferred" model specification. This automated process identified explanatory variables that are correlated with certification error. At each step of the automated process, one additional explanatory variable (with the highest correlation) was added to the existing set of explanatory variables.

The column labeled "Model 1" has results from a regression of the certification error rate on the core explanatory variables and one additional variable. The column labeled "Model 2" has results from the regression in which two additional variables are added based on the automated process. The column labeled "Model 3" has three additional variables, the column labeled "Model 4" has four additional variables, and so forth. At each step, the additional variable was included in the model based on the observed correlation with certification error.

We tested the model performance and validity of models that include different numbers of additional explanatory variables. We added variables to the core set until the coefficient on the next additional variable was no longer statistically significant at the five percent level. As noted in the report, this inclusion rule is consistent with the literature on automated variable selection and led to models with strong performance. We have highlighted the final model selected in each table.

Table D.1. Coefficient Estimates from Tobit Model of APEC Household Reporting Error - Free certified, not eligible (FCNE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	4.376	4.880	3.532	3.196	2.553	5.795	4.369
% free apps changed through verification	0.136	0.179*	0.180*	0.175*	0.188*	0.163*	0.154*
% free apps w/ no response	0.033	0.066	0.065	0.074	0.081	0.076	0.071
% free apps changed through verification (x random sampling)	-0.188	-0.186	-0.156	-0.146	-0.142	-0.163	-0.134
% free apps w/ no response (x random sampling)	0.002	-0.013	-0.002	-0.004	0.010	-0.039	-0.025
% F/RP students certified not subject to verification	0.028	0.017	0.011	-0.015	-0.013	-0.024	-0.003
% F/RP students certified based on categorical eligibility	-0.059	-0.104	-0.084	-0.122	-0.134	-0.126	-0.114
Enrollment (10,000s)	-0.037	-0.022	-0.006	-0.001	0.022	0.008	0.012
% Students certified for free meals	-0.103*	-0.093*	-0.043	-0.017	-0.014	-0.009	-0.024
% students certified for RP meals	-0.012	-0.040	-0.175	-0.209	-0.276	-0.086	0.116
Public SFA	-12.85*	-14.53*	-14.33*	-14.78*	-16.41*	-21.19*	-21.08*
Enrollment 1001 - 5000		6.366*	6.558*	6.541*	8.007*	17.616*	19.111*
% all applications certified for RP meals			0.150	0.164	0.171	0.226	0.209
% Students enrolled in Prov 2/3 schools				-0.097	-0.091	-0.110	-0.106
Enrollment 5001 - 10,000					3.677	13.981*	15.547*
Enrollment > 10,000						12.138	14.286*
No RP apps were verified							5.810
Intercept	15.325	14.409	9.330	9.926	10.212	1.340	-1.732

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report.

*Coefficient is statistically significant at 5 percent level.

Table D.2. Coefficient Estimates from Tobit Model of APEC Household Reporting Error - Free certified, RP eligible (FCRE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	0.704	0.743	0.743	0.578	0.752	1.079	1.158
% free apps changed through verification	0.021	0.015	0.015	0.015	0.017	0.012	0.012
% free apps w/ no response	0.016	0.012	0.012	0.012	0.014	0.011	0.013
% free apps changed through verification (x random sampling)	-0.026	-0.027	-0.027	-0.023	-0.026	-0.029	-0.029
% free apps w/ no response (x random sampling)	-0.000	-0.002	-0.002	0.000	-0.002	-0.006	-0.008
% F/RP students certified not subject to verification	-0.015	-0.007	-0.007	-0.006	-0.002	0.002	-0.001
% F/RP students certified based on categorical eligibility	-0.020	0.039*	0.039*	0.038*	0.052	0.066*	0.060*
Enrollment (10,000s)	-0.000	0.000	0.000	0.001	0.001	-0.003	-0.003
% Students certified for free meals	-0.008	-0.008	-0.008	-0.008	-0.011	-0.015*	-0.014*
% students certified for RP meals	0.011	0.010	0.010	0.024	0.034	0.074	0.079
Enrollment 5001 - 10,000	0.852*	0.805*	0.805*	0.775*	0.758*	1.256*	1.254*
% Free applications certified categorically		-0.049*	-0.049*	-0.047*	-0.055*	-0.058*	-0.056*
Public SFA			0.004	0.073	-0.049	-0.197	-0.271
No RP apps were verified				0.472	0.487	0.720	0.723
% RP students reported RP eligible from non-base year Prov 2/3 schools					0.007	0.010	0.013
Enrollment > 10,000						0.899	0.962
% Students enrolled in Prov 2/3 schools							-0.012
Intercept	0.781	1.347	1.345	1.133	1.020	0.334	0.299

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report.

*Coefficient is statistically significant at 5 percent level.

Table D.3. Coefficient Estimates from Tobit Model of APEC Household Reporting Error - RP certified, free eligible (RCFE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	2.981	3.269	1.907	0.292	0.202	0.500	-0.072
% RP apps changed to free	-0.048	-0.064	-0.073	-0.078	-0.131	-0.118	-0.136
% RP apps changed to paid	0.075	0.083	0.135	0.127	0.096	0.098	0.096
% RP apps w/ no response	0.046	0.052	0.083	0.056	0.056	0.058	0.053
% RP apps changed to free (x random sampling)	-0.222	-0.224	-0.214	-0.201	-0.136	-0.157	-0.180
% RP apps changed to paid (x random sampling)	-0.164	-0.171	-0.190	-0.178	-0.154	-0.164	-0.160
% RP apps w/ no response (x random sampling)	-0.017	-0.017	0.003	0.050	0.038	0.038	0.049
% F/RP students certified not subject to verification	0.029	-0.004	0.001	0.025	0.014	0.018	-0.009
% F/RP students certified based on categorical eligibility	0.042	-0.009	-0.054	-0.019	-0.019	-0.018	-0.130
Enrollment (10,000s)	0.061	0.071	0.089*	0.395*	0.745*	0.750*	0.779*
% Students certified for free meals	0.024	0.050	0.064	0.049	0.061	0.064	0.100*
% students certified for RP meals	0.043	0.030	-0.141	-0.112	-0.072	-0.076	-0.142
% apps verified	0.327*	0.339*	0.309*	0.343*	0.351*	0.345*	0.329*
% students reported free eligible from non-base year Prov 2/3 schools		-0.191*	-0.192*	-0.166*	-0.203*	-0.203*	-0.281*
Enrollment > 10,000			-4.012*	-5.135*	-5.754*	-5.753*	-5.251*
Enrollment squared				-0.000	-0.000	-0.000	-0.000
# Apps certified for Free meals based on income					-0.000	-0.000	-0.000
Public SFA						-1.259	-0.352
% all apps certified for free meals based on income							-0.133
Intercept	-1.425	-1.002	0.792	0.702	0.591	1.394	9.298*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report.

*Coefficient is statistically significant at 5 percent level.

Table D.4. Coefficient Estimates from Tobit Model of APEC Household Reporting Error - RP certified, not eligible (RCNE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	16.647	21.130	16.362	16.530	25.790	23.872	20.476
% RP apps changed to free	0.669	0.303	0.141	0.113	0.186	0.010	-0.008
% RP apps changed to paid	0.050	0.120	0.130	0.184	0.126	0.189	0.277
% RP apps w/ no response	0.073	0.191	0.208	0.173	0.223	0.218	0.235
% RP apps changed to free (x random sampling)	0.120	0.320	1.218	1.605	0.948	1.026	0.320
% RP apps changed to paid (x random sampling)	0.123	0.042	0.191	0.154	0.127	0.059	0.171
% RP apps w/ no response (x random sampling)	-0.439	-0.475	-0.497	-0.526	-0.671*	-0.620*	-0.598*
% F/RP students certified not subject to verification	0.230	0.096	0.036	-0.014	0.284	0.314	0.389
% F/RP students certified based on categorical eligibility	0.417	0.241	0.275	0.395	1.863*	1.880*	3.115*
Enrollment (10,000s)	-0.262	0.049	-0.007	0.484	0.377	0.394	0.284
% Students certified for free meals	-0.270	-0.219	-0.291	-0.154	-0.290	-0.291	0.257
% students certified for RP meals	0.983	1.427	1.936	1.727	1.698	1.459	0.033
% RP students reported RP eligible from non-base year Prov 2/3 schools	0.394	0.665*	0.690*	0.643*	0.868*	0.867*	0.856*
% Free students from non-base year Prov 2/3 schools		-4.673*	-4.617*	-7.404*	-7.682*	-7.005*	-5.990*
Enrollment < 1,000			-25.072	-31.969	-9.871	-4.751	-0.403
# Applications certified free categorically				-0.003	-0.003	-0.002	-0.002
% Free applications certified categorically					-1.064*	-1.089*	-1.936*
Enrollment 5001 - 10,000						7.781	7.844
% all applications certified for RP meals							1.494*
Intercept	-7.70	-11.39	-10.86	-12.22	-9.89	-10.13	-56.25*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report.

*Coefficient is statistically significant at 5 percent level.

Table D.5. Coefficient Estimates from Tobit Model of APEC Household Reporting Error - Not certified, free eligible (NCFE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	4.274	4.945	-1.635	-1.205	-0.600	-0.600	0.207
% sampled apps changed through verification	-0.273	-0.312	-0.312	-0.306	-0.305	-0.305	-0.383
% sampled apps w/ no response	0.333	0.339	0.305	0.305	0.297	0.297	0.380
% sampled apps changed though verification (x random sampling)	-0.088	-0.082	0.039	0.029	0.036	0.036	0.078
% sampled apps w/ no response (x random sampling)	-0.329	-0.366	-0.311	-0.315	-0.329	-0.329	-0.392
% F/RP students certified not subject to verification	0.062	0.068	0.153	0.153	0.131	0.131	0.355
% F/RP students certified based on categorical eligibility	0.395	0.303	1.109	1.144	1.344	1.344	1.770
Enrollment (10,000s)	-0.082	-0.135	-0.080	-0.084	-0.072	-0.072	1.275
% Students certified for free meals	0.100	0.111	0.323	0.334	0.408	0.408	0.538
% students certified for RP meals	0.311	-0.012	-0.648	-0.648	-0.746	-0.746	-0.704
% all apps certified for free meals based on income	0.594	0.540	1.289	1.293	0.442	0.442	0.901
% apps verified		-1.072	-0.855	-0.855	-0.796	-0.796	-0.668
% all applications certified for RP meals			1.259	1.256	0.701	0.701	1.123
% Students certified free categorically				-0.067	-0.391	-0.391	-0.682
% Free applications certified categorically					-0.682	-0.682	-0.486
% Free apps certified based on income						0.000	0.000
% Free apps not verified							-0.001
Intercept	-63.13*	-51.38	-140.76	-141.59	-65.30	-65.30	-123.12

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report.

*Coefficient is statistically significant at 5 percent level.

Table D.6. Coefficient Estimates from Tobit Model of APEC Household Reporting Error - Not certified, RP eligible (NCRE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	4.108	3.844	-3.073	-3.086	-3.241	-3.078	-6.989
% sampled apps changed through verification	0.145	0.059	-0.052	-0.052	-0.054	-0.055	-0.012
% sampled apps w/ no response	0.243	0.220	0.225	0.225	0.221	0.223	0.229
% sampled apps changed though verification (x random sampling)	0.101	0.217	0.381	0.381	0.382	0.380	0.415
% sampled apps w/ no response (x random sampling)	-0.139	-0.138	-0.067	-0.066	-0.065	-0.063	0.014
% F/RP students certified not subject to verification	0.019	0.003	-0.001	-0.005	0.156	0.017	-0.119
% F/RP students certified based on categorical eligibility	-0.040	0.058	-0.576	-0.579	-0.592	0.204	0.581
Enrollment (10,000s)	-0.049	-0.077	-0.063	-0.063	-0.060	-0.061	-0.500
% Students certified for free meals	0.201*	0.185	-0.066	-0.068	-0.080	-0.094	-0.197
% students certified for RP meals	0.552	1.528	1.811*	1.808*	1.900	1.988	1.861
Enrollment 1001 - 5000	15.194	11.868	10.996	11.000	11.127	11.250	12.333
Enrollment < 1,000		-101.141	-107.501	-107.426	-107.929	-109.581	-109.663
% Students certified free categorically			1.349*	1.353*	1.382*	1.188	1.258
% Students certified free without an application				0.009	-0.026	0.025	0.230
% Free certified students certified without an application					-0.120	-0.032	0.002
% Free certified students certified free categorically						-0.570	-0.919
Total number of apps certified							0.000
Intercept	-29.79*	-33.89*	-22.98	-22.84	-22.86	-22.89	-18.24

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. Highlighted column indicates the final model presented in the final report.

*Coefficient is statistically significant at 5 percent level.

Table D.7. Coefficient Estimates from Tobit Model of APEC Household Reporting Error

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	2.360	2.419	1.965	2.318	2.184	2.380	4.392
% sampled apps changed through verification	0.051	0.075	0.105	0.084	0.081	0.078	0.087
% sampled apps w/ no response	0.042	0.059	0.077	0.065	0.075	0.081	0.098
% sampled apps changed though verification (x random sampling)	-0.010	-0.020	-0.022	-0.022	-0.016	-0.014	-0.040
% sampled apps w/ no response (x random sampling)	-0.075	-0.069	-0.057	-0.064	-0.067	-0.075	-0.104
% F/RP students certified not subject to verification	0.028	0.034	0.032	0.070	0.050	0.047	0.093*
% F/RP students certified based on categorical eligibility	-0.070	-0.071	-0.098	0.173*	0.123	0.091	0.253*
Enrollment (10,000s)	0.003	0.003	0.019	0.021	0.021	0.013	0.013
% Students certified for free meals	-0.061*	-0.052	-0.043	-0.047	-0.034	-0.032	-0.065*
% students certified for RP meals	0.306*	0.285	0.189	0.209	0.200	0.169	0.284
Enrollment 1001 - 5000	4.009	4.599	6.436*	5.797*	5.850*	5.902*	5.305*
Public SFA		-3.820	-5.788	-7.609	-7.866*	-7.995*	-9.314*
Enrollment 5001 - 10,000			3.868*	3.664*	3.583*	3.480*	3.049*
% Free applications certified categorically				-0.215*	-0.196*	-0.178*	-0.266*
% Students enrolled in Prov 2/3 schools					-0.067	-0.073	-0.090*
% apps verified						-0.105*	-0.126*
% RP students reported RP eligible from non-base year Prov 2/3 schools							0.074*
Intercept	4.460	6.380	6.649	10.254*	10.661*	11.388*	10.840*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. The model presented in the report is based on disaggregated household reporting certification error; see highlighted columns of Tables D.1 through D.6.

*Coefficient is statistically significant at 5 percent level.

APPENDIX E

ADDITIONAL RESULTS FROM STATISTICAL MODELS:

APEC ADMINISTRATIVE ERROR

This page has been left blank for double-sided copying.

This appendix includes Tobit regressions estimated for administrative certification error as measured in APEC. Seven table sets are included:

- Tables E.1 – E.7 are regressions using only explanatory variables from the VSR. These regressions were the basis for the final models presented in the body of the report.

Each table set includes seven tables, one for *aggregate* administrative error and one for each of the six types of *disaggregate* administrative error. These disaggregate error types include estimated erroneous payments made to students who are:

- Free-Certified, Not Eligible (FCNE)
- Free-Certified, Reduced-Price-Eligible (FCRE)
- Reduced-Price-Certified, Free-Eligible (RCFE)
- Reduced-Price -Certified, Not Eligible (RCNE)
- Not Certified, Free-Eligible (NCFE)
- Not Certified, Reduced-Price-Eligible (NCRE)

Each table has seven columns corresponding to seven regression specifications with different numbers of explanatory variables. All columns include the core explanatory variables that were selected based on policy relevance or theoretical relationship to certification error (see Table II.3 and related discussion). These variables are related to verification results, NSLP application characteristics, and district demographic and administrative characteristics.

An automated process was used to identify the "preferred" model specification. This automated process identified explanatory variables that are correlated with certification error. At each step of the automated process, one additional explanatory variable (with the highest correlation) was added to the existing set of explanatory variables. We added variables to the core set until the coefficient on the next additional variable was no longer statistically significant at the five percent level. As noted in the report, this inclusion rule is consistent with the literature on automated variable selection and led to models with strong performance.

The column labeled "Model 1" has results from a regression of the certification error rate on the core explanatory variables and one additional variable. The column labeled "Model 2" has results from the regression in which two additional variables are added based on the automated process. The column labeled "Model 3" has three additional variables, the column labeled "Model 4" has four additional variables, and so forth. At each step, the additional variable was included in the model based on the observed correlation with certification error.

We tested the model performance and validity of models that include different numbers of additional explanatory variables. As discussed in Chapter III, the model of APEC administrative error that performs best in validation analysis is one that is based on the aggregate administrative error rate and includes the core covariates with no additional covariates. Parameters from that model are presented in Table III.6. This appendix presents estimates from models that do include additional covariates.

Table E1. Coefficient Estimates from Tobit Model of APEC Administrative Error - Free certified, not eligible (FCNE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	33.684*	39.047*	32.713*	30.756*	30.119*	32.007*	57.720*
% free apps changed through verification	0.725*	0.800*	0.699*	0.659*	0.683*	0.726*	1.038*
% free apps w/ no response	0.474*	0.552*	0.428*	0.395*	0.404*	0.444*	0.667*
% free apps changed through verification (x random sampling)	-0.772*	-0.885*	-0.810*	-0.780*	-0.740*	-0.752*	-1.183*
% free apps w/ no response (x random sampling)	-0.238	-0.289	-0.165	-0.135	-0.123	-0.140	-0.393
% F/RP students certified not subject to verification	-0.104	-0.072	-0.021	-0.034	0.005	-0.079	-0.140
% F/RP students certified based on categorical eligibility	-0.147	-0.249	-0.172	-0.165	-0.145	-0.491	-0.708
Enrollment (10,000s)	0.146*	0.038	-0.103	-0.163*	-0.175	-0.253*	-0.377*
% Students certified for free meals	-0.005	-0.268*	-0.313*	-0.311*	-0.305*	-0.295*	-0.404*
% students certified for RP meals	-1.348	-0.293	-0.104	0.063	0.438	0.492	1.509
Enrollment 5001 - 10,000	15.029*	14.726*	14.337*	13.543*	12.347*	12.466*	30.882*
% all applications certified for RP meals		-0.896*	-0.936*	-0.922*	-0.883*	-1.134*	-1.556*
Number of RP applications verified			0.016*	0.023*	0.025	0.032	0.037*
Enrollment w/access to NSLP Prov 2/3 schools				-0.000	-0.000	-0.001	-0.001
No RP apps were verified					7.586	9.173	22.016*
% all apps certified for free meals based on income						-0.282	-0.419
Enrollment > 10,000							23.808*
Intercept	-36.82*	-15.61	-9.15	-7.63	-14.32	10.37	-12.89

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. The final model of administratve error presented in the report is based on aggregated administrative error and includes the core covariates with no additional covariates.

*Coefficient is statistically significant at 5 percent level.

Table E2. Coefficient Estimates from Tobit Model of APEC Administrative Error - Free certified, RP eligible (FCRE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	-0.320	-0.072	0.066	0.066	0.162	0.154	0.208
% free apps changed through verification	0.003	-0.002	-0.004	-0.004	-0.003	-0.003	-0.004
% free apps w/ no response	0.014	0.012	0.010	0.010	0.011	0.011	0.012
% free apps changed through verification (x random sampling)	0.004	0.003	0.000	0.000	-0.003	-0.003	-0.004
% free apps w/ no response (x random sampling)	-0.002	-0.006	-0.008	-0.008	-0.008	-0.008	-0.009
% F/RP students certified not subject to verification	-0.007	-0.007	-0.002	-0.002	-0.002	-0.001	-0.001
% F/RP students certified based on categorical eligibility	-0.003	0.002	0.035	0.035	0.029	0.029	0.023
Enrollment (10,000s)	-0.003	-0.006	-0.007	-0.007	-0.008	-0.008	-0.010
% Students certified for free meals	-0.009	-0.010	-0.010	-0.010	-0.015	-0.014	-0.015
% students certified for RP meals	0.036	0.059	0.062	0.062	0.075	0.075	0.070
No free apps were verified	3.259*	3.026*	3.040*	3.040*	3.076*	3.070*	3.175*
Enrollment > 10,000		0.497	0.546	0.546	0.519	0.515	0.497
% Free apps certified based on income			0.026	0.000	0.000	0.000	0.000
% Free applications certified categorically				-0.026	-0.006	-0.003	0.003
% all apps certified for free meals based on income					0.022	0.022	0.026
% all apps certified for free meals categorically						-0.004	-0.004
% apps verified							-0.022
Intercept	-0.702	-1.060	-3.501*	-0.940	-2.476	-2.535	-2.690

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. The final model of administratve error presented in the report is based on aggregated administrative error and includes the core covariates with no additional covariates.

*Coefficient is statistically significant at 5 percent level.

Table E3. Coefficient Estimates from Tobit Model of APEC Administrative Error - RP certified, free eligible (RCFE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	5.064	7.797	7.214	7.214	7.417	8.817	10.887
% RP apps changed to free	0.217	0.278	0.281	0.281	0.282	0.385	0.433
% RP apps changed to paid	-0.517*	-0.505*	-0.495*	-0.495*	-0.504*	-0.536*	-0.497*
% RP apps w/ no response	0.131	0.144	0.137	0.137	0.141	0.168	0.198*
% RP apps changed to free (x random sampling)	-0.711	-0.841	-0.814	-0.814	-0.807	-0.836	-0.786
% RP apps changed to paid (x random sampling)	0.559*	0.466*	0.447*	0.447*	0.454*	0.498*	0.461*
% RP apps w/ no response (x random sampling)	-0.192	-0.183	-0.167	-0.167	-0.170	-0.207	-0.247
% F/RP students certified not subject to verification	-0.125	-0.030	-0.044	-0.044	-0.060	0.031	0.097
% F/RP students certified based on categorical eligibility	0.154	0.239	0.108	0.108	0.066	0.278	0.381
Enrollment (10,000s)	-0.105	-0.071	-0.071	-0.071	-0.069	-0.105	-0.065
% Students certified for free meals	-0.168*	-0.188*	-0.214*	-0.214*	-0.210*	-0.275*	-0.360*
% students certified for RP meals	-0.366	0.108	0.223	0.223	0.198	0.273	0.550
% all apps certified for free meals based on income	0.490*	0.501*	0.610*	0.610*	0.564*	0.586*	0.648*
Public SFA		-11.64*	-10.77*	-10.77*	-11.11*	-10.63*	-9.43*
% Free applications certified categorically			0.167	0.167	0.041	0.019	0.080
% Free apps certified based on income				0.000	0.000	0.000	0.000
% all apps certified for free meals categorically					0.160	0.066	-0.005
% Students enrolled in Prov 2/3 schools						0.148*	0.341*
Enrollment w/access to NSLP Prov 2/3 schools							-0.000
Intercept	-22.23*	-19.28*	-27.90	-27.90	-23.84	-28.32	-37.75*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. The final model of administratve error presented in the report is based on aggregated administrative error and includes the core covariates with no additional covariates.

*Coefficient is statistically significant at 5 percent level.

Table E4. Coefficient Estimates from Tobit Model of APEC Administrative Error - RP certified, not eligible (RCNE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	16.129	8.454	9.370	9.312	10.114	13.732	12.390
% RP apps changed to free	1.918*	1.833*	1.658*	1.662*	1.646*	1.703*	1.591*
% RP apps changed to paid	-0.031	-0.164	-0.201	-0.195	-0.192	-0.245	-0.286
% RP apps w/ no response	-0.013	-0.018	-0.003	-0.005	0.011	-0.006	-0.030
% RP apps changed to free (x random sampling)	-2.908*	-3.481*	-3.352*	-3.346*	-3.330*	-3.584*	-3.511*
% RP apps changed to paid (x random sampling)	-0.037	0.122	0.143	0.141	0.136	0.074	0.091
% RP apps w/ no response (x random sampling)	0.215	0.339	0.305	0.302	0.283	0.281	0.289
% F/RP students certified not subject to verification	0.117	0.146	0.120	0.100	0.092	0.492	0.475
% F/RP students certified based on categorical eligibility	0.437	-0.567	-0.617	-0.612	-0.625	0.278	0.301
Enrollment (10,000s)	0.648*	0.726*	0.566*	0.549*	0.526	0.530	0.437
% Students certified for free meals	0.038	-0.427	-0.404	-0.371	-0.376	-0.783	-0.753
% students certified for RP meals	-0.400	-0.148	-0.674	-0.711	-0.698	0.410	0.211
Number of students free from Prov 2/3 schools	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.001
% Students certified free categorically		2.173*	2.089*	2.018	2.022	2.429*	2.361*
% apps verified			-2.630	-2.389	-2.544	-2.352	-2.731
% of students reported RP eligible from non-base year Prov 2/3 schools				-1.225	-8.036	-4.002	14.234
% RP students reported RP eligible from non-base year Prov 2/3 schools					0.516	0.345	-0.849
% all apps certified for free meals based on income						0.956	1.010
# Provision 2/3 schools							-0.719
Intercept	-40.46*	-19.82	-3.66	-4.37	-3.89	-76.20	-73.91

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. The final model of administratve error presented in the report is based on aggregated administrative error and includes the core covariates with no additional covariates.

*Coefficient is statistically significant at 5 percent level.

Table E5. Coefficient Estimates from Tobit Model of APEC Administrative Error - Not certified, free eligible (NCFE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	-0.412	4.704	9.819	8.624	7.872	7.768	8.191
% sampled apps changed through verification	0.232	0.282	0.326	0.309	0.274	0.282	0.262
% sampled apps w/ no response	0.263*	0.316*	0.394*	0.379*	0.361*	0.376*	0.351*
% sampled apps changed though verification (x random sampling)	-0.024	-0.094	-0.156	-0.136	-0.117	-0.112	-0.088
% sampled apps w/ no response (x random sampling)	-0.162	-0.225	-0.300	-0.284	-0.278	-0.286	-0.305
% F/RP students certified not subject to verification	-0.226	-0.142	-0.199	-0.204	-0.202	-0.193	-0.220
% F/RP students certified based on categorical eligibility	-0.152	-0.021	-0.111	-0.127	-0.120	-0.130	-0.155
Enrollment (10,000s)	-0.197	-0.180	-0.207	-0.250	0.072	0.086	0.096
% Students certified for free meals	0.339*	0.253*	0.267*	0.278*	0.291*	0.284*	0.275*
% students certified for RP meals	-0.791	-0.525	-0.368	-0.437	-0.437	-0.433	-0.457
% apps verified	0.915*	0.841*	0.807*	0.813*	0.840*	0.825*	0.855*
% RP students reported RP eligible from non-base year Prov 2/3 schools		0.140	0.224	0.207	0.211	0.224	0.210
% students reported free eligible from non-base year Prov 2/3 schools			-0.385	-0.429	-0.435	-0.429	-0.421
Enrollment w/access to NSLP Prov 2/3 schools				0.000	0.000	0.000	0.000
Number of free applications verified					-0.007	0.018	0.016
Number of applications verified						-0.019	-0.018
Public SFA							7.813
Intercept	-23.36*	-29.69*	-32.45*	-30.81*	-30.09*	-30.19*	-34.72*

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. The final model of administratve error presented in the report is based on aggregated administrative error and includes the core covariates with no additional covariates.

*Coefficient is statistically significant at 5 percent level.

Table E6. Coefficient Estimates from Tobit Model of APEC Administrative Error - Not certified, RP eligible (NCRE)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Selected random verification sample	5.932	-9.091	4.413	11.527	17.705	18.207	21.330
% sampled apps changed through verification	0.045	0.048	0.136	-0.195	-0.144	-0.167	-0.160
% sampled apps w/ no response	0.294	0.141	0.352	0.152	0.245	0.227	0.236
% sampled apps changed though verification (x random sampling)	0.118	0.204	0.082	0.086	-0.249	-0.283	-0.384
% sampled apps w/ no response (x random sampling)	-0.070	0.367	0.120	0.006	0.015	0.022	0.032
% F/RP students certified not subject to verification	0.617	-1.376	-1.180	-1.067	0.135	0.245	0.132
% F/RP students certified based on categorical eligibility	-0.423	-0.771	-0.894	-0.855	1.693*	1.752*	1.781*
Enrollment (10,000s)	-0.192	-0.194	-0.092	-0.186	-0.305	-0.304	-0.326
% Students certified for free meals	-0.145	-1.129	-0.933	-0.819*	-1.185*	-1.211*	-1.289*
% Students certified free without an application	.	3.872*	3.092*	2.765*	1.595	1.474	1.649
% students certified for RP meals	1.462	1.759	2.288	3.031*	4.950*	5.067*	4.919*
% RP students reported RP eligible from non-base year Prov 2/3 schools	0.614	0.701	2.909*	2.857*	2.646*	2.584*	2.582*
% of students reported RP eligible from non-base year Prov 2/3 schools			-29.37	-29.09*	-20.63*	-19.49*	-19.32*
Enrollment > 10,000				20.740	12.254	10.278	7.770
% all apps certified for free meals based on income					2.137*	2.184*	2.345*
Enrollment 1001 - 5000						-7.233	-6.299
No RP apps were verified							-17.629
Intercept	-64.74	-14.32	-27.13	-33.84	-199.37	-200.61	-203.81

Source: Verification Summary Reports and APEC study.

Note: Model number refers to the number of explanatory variables added to the core variables using the automated variable selection process. The final model of administratve error presented in the report is based on aggregated administrative error and includes the core covariates with no additional covariates.

*Coefficient is statistically significant at 5 percent level.

This page has been left blank for double-sided copying

APPENDIX F

CHARACTERISTICS OF DISTRICTS BY CATEGORY OF RISK FOR HOUSEHOLD REPORTING ERROR AND ADMINISTRATIVE ERROR

This page has been left blank for double-sided copying.

Table F.1. Average Characteristics of Districts in the 2009 VSR, by Household Reporting Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	12.7	24.8***	27.6***
Error Rate	16.7	26.9***	31.1***
Percentage of Certified Students			
Categorically Eligible	12.4	10.1***	8.9***
Not Subject to Verification	28.6	33.8***	33.7***
District Demographic Characteristics			
Enrollment			
Number of Students	1,201	8,759***	9,281***
Number of Students Is:			
Less Than 1,000	68.7	6.6***	1.0***
At Least 1,000, Less Than 5,000	27.0	57.0***	61.6***
At Least 5,000, Less Than 10,000	3.4	17.1***	17.2***
At Least 10,000	0.9	19.3***	20.2***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	48.8	49.8*	47.9
Number of Districts	**10,777**	**2,429**	**1,545**
Percent of Districts	**73.1**	**16.5**	**10.5**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.2. Average Characteristics of Districts in the 2009 VSR, by Administrative Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	High or Medium-Risk
Verification Results and Method of Certification		
Verification Results		
Nonresponse Rate	15.0	42.7***
Error Rate	19.2	27.0***
Percentage of Certified Students		
Categorically Eligible	11.8	8.2***
Not Subject to Verification	30.0	29.4
District Demographic Characteristics		
Enrollment		
Number of Students	2,010	29,984***
Number of Students Is:		
Less Than 1,000	53.9	0.1***
At Least 1,000, Less Than 5,000	36.8	8.4***
At Least 5,000, Less Than 10,000	6.4	21.7***
At Least 10,000	2.9	69.7***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	48.6	54.8***
Number of Districts	**14,075**	**676**
Percent of Districts	**95.4**	**4.6**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of administrative certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. High and medium-risk districts are combined for the purposes of this table because the number of districts categorized as high-risk is very small. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.3. Average Characteristics of Mid-Atlantic Region Districts in the 2009 VSR, by Overall Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	16.3	25.5***	36.9***
Error Rate	19.9	26.6***	25.9***
Percentage of Certified Students			
Categorically Eligible	11.3	10.0**	8.9***
Not Subject to Verification	29.8	35.5***	32.1
District Demographic Characteristics			
Enrollment			
Number of Students	1,843	5,147***	14,706***
Number of Students Is:			
Less Than 1,000	48.2	1.3***	0.0***
At Least 1,000, Less Than 5,000	46.7	67.7***	33.3***
At Least 5,000, Less Than 10,000	3.0	21.7***	39.5***
At Least 10,000	2.1	9.3***	27.2***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	36.7	39.8*	44.8***
Number of Districts	**1,091**	**226**	**162**
Percent of Districts	**73.8**	**15.3**	**11.0**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.4. Average Characteristics of Mid-Atlantic Region Districts in the 2009 VSR, by Household Reporting Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	17.3	27.6***	35.3***
Error Rate	20.0	27.5***	26.6**
Percentage of Certified Students			
Categorically Eligible	11.1	10.3	8.2***
Not Subject to Verification	30.3	33.1**	33.6
District Demographic Characteristics			
Enrollment			
Number of Students	2,170	6,494***	19,385***
Number of Students Is:			
Less Than 1,000	45.3	1.2***	0.0***
At Least 1,000, Less Than 5,000	45.6	61.5***	49.3
At Least 5,000, Less Than 10,000	6.3	24.6***	17.3***
At Least 10,000	2.8	12.7***	33.3***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	36.8	42.2***	44.5**
Number of Districts	**1,160**	**244**	**75**
Percent of Districts	**78.4**	**16.5**	**5.1**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.5. Average Characteristics of Mid-Atlantic Region Districts in the 2009 VSR, by Administrative Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	High or Medium-Risk
Verification Results and Method of Certification		
Verification Results		
Nonresponse Rate	18.8	48.6***
Error Rate	21.6	21.1
Percentage of Certified Students		
Categorically Eligible	11.0	8.3**
Not Subject to Verification	30.9	30.8
District Demographic Characteristics		
Enrollment		
Number of Students	2,835	27,172***
Number of Students Is:		
Less Than 1,000	37.2	0.0***
At Least 1,000, Less Than 5,000	50.0	7.1***
At Least 5,000, Less Than 10,000	8.8	37.5***
At Least 10,000	4.0	55.4***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	37.5	52.6***
Number of Districts	**1,423**	**56**
Percent of Districts	**96.2**	**3.8**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of administrative certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. High and medium-risk districts are combined for the purposes of this table because the number of districts categorized as high-risk is very small. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.6. Average Characteristics of Mid-West Region Districts in the 2009 VSR, by Overall Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	11.2	20.9***	28.5***
Error Rate	15.9	26.3***	30.1***
Percentage of Certified Students			
Categorically Eligible	16.2	11.8***	11.1***
Not Subject to Verification	31.1	37.0***	37.1***
District Demographic Characteristics			
Enrollment			
Number of Students	904	4,785***	6,559***
Number of Students Is:			
Less Than 1,000	69.2	3.4***	0.0***
At Least 1,000, Less Than 5,000	29.9	80.1***	50.0***
At Least 5,000, Less Than 10,000	0.8	7.9***	37.3***
At Least 10,000	0.1	8.6***	12.7***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	48.2	42.8***	44.8***
Number of Districts	**2,705**	**583**	**416**
Percent of Districts	**73.0**	**15.7**	**11.2**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.7. Average Characteristics of Mid-West Region Districts in the 2009 VSR, by Household Reporting Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	11.9	21.9***	25.6***
Error Rate	16.1	26.6***	33.2***
Percentage of Certified Students			
Categorically Eligible	16.1	11.6***	10.4***
Not Subject to Verification	31.3	37.8***	35.5***
District Demographic Characteristics			
Enrollment			
Number of Students	1,050	5,459***	5,757***
Number of Students Is:			
Less Than 1,000	67.3	1.4***	0.4***
At Least 1,000, Less Than 5,000	30.2	72.8***	65.0***
At Least 5,000, Less Than 10,000	2.0	16.2***	22.9***
At Least 10,000	0.5	9.6***	11.8***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	47.8	43.9***	44.8***
Number of Districts	**2,799**	**625**	**280**
Percent of Districts	**75.6**	**16.9**	**7.6**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.8. Average Characteristics of Mid-West Region Districts in the 2009 VSR, by Administrative Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	High or Medium-Risk
Verification Results and Method of Certification		
Verification Results		
Nonresponse Rate	14.3	36.0***
Error Rate	19.0	31.9***
Percentage of Certified Students		
Categorically Eligible	15.0	8.3***
Not Subject to Verification	32.7	33.7
District Demographic Characteristics		
Enrollment		
Number of Students	1,767	27,578***
Number of Students Is:		
Less Than 1,000	51.9	0.0***
At Least 1,000, Less Than 5,000	40.6	1.8***
At Least 5,000, Less Than 10,000	5.7	23.6***
At Least 10,000	1.8	74.5***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	46.9	50.8
Number of Districts	**3,649**	**55**
Percent of Districts	**98.5**	**1.5**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of administrative certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. High and medium-risk districts are combined for the purposes of this table because the number of districts categorized as high-risk is very small. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.9. Average Characteristics of Mountain-Plains Region Districts in the 2009 VSR, by Overall Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	6.6	12.2***	23.0***
Error Rate	13.5	29.9***	28.5***
Percentage of Certified Students			
Categorically Eligible	8.1	8.0	8.8
Not Subject to Verification	25.5	28.7***	32.6***
District Demographic Characteristics			
Enrollment			
Number of Students	401	2,422***	6,772***
Number of Students Is:			
Less Than 1,000	95.4	38.9***	1.8***
At Least 1,000, Less Than 5,000	4.5	53.1***	66.1***
At Least 5,000, Less Than 10,000	0.1	1.1***	16.8***
At Least 10,000	0.0	6.9***	15.2***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	46.7	42.2***	42.7***
Number of Districts	**1,752**	**262**	**387**
Percent of Districts	**73.0**	**10.9**	**16.1**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.10. Average Characteristics of Mountain-Plains Region Districts in the 2009 VSR, by Household Reporting Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	7.0	15.0***	20.8***
Error Rate	14.1	26.7***	29.2***
Percentage of Certified Students			
Categorically Eligible	8.1	8.3	8.8
Not Subject to Verification	25.3	30.1***	32.8***
District Demographic Characteristics			
Enrollment			
Number of Students	412	4,917***	5,412***
Number of Students Is:			
Less Than 1,000	95.0	30.0***	2.3***
At Least 1,000, Less Than 5,000	4.7	48.7***	73.6***
At Least 5,000, Less Than 10,000	0.3	7.0***	13.2***
At Least 10,000	0.0	14.3***	10.9***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	46.5	43.6**	42.7***
Number of Districts	**1,780**	**273**	**348**
Percent of Districts	**74.1**	**11.4**	**14.5**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.11. Average Characteristics of Mountain-Plains Region Districts in the 2009 VSR, by Administrative Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	High or Medium-Risk
Verification Results and Method of Certification		
Verification Results		
Nonresponse Rate	8.9	35.5***
Error Rate	17.2	31.2***
Percentage of Certified Students		
Categorically Eligible	8.3	6.0**
Not Subject to Verification	26.8	30.9**
District Demographic Characteristics		
Enrollment		
Number of Students	1,013	18,352***
Number of Students Is:		
Less Than 1,000	77.0	1.1***
At Least 1,000, Less Than 5,000	19.9	13.6
At Least 5,000, Less Than 10,000	1.9	29.5***
At Least 10,000	1.2	55.7***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	45.6	45.3
Number of Districts	**2,313**	**88**
Percent of Districts	**96.3**	**3.7**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of administrative certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. High and medium-risk districts are combined for the purposes of this table because the number of districts categorized as high-risk is very small. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.12. Average Characteristics of Northeast Region Districts in the 2009 VSR, by Overall Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	14.0	24.1***	27.8***
Error Rate	17.7	27.8***	34.2***
Percentage of Certified Students			
Categorically Eligible	13.9	12.0**	10.0***
Not Subject to Verification	25.6	29.0***	36.6***
District Demographic Characteristics			
Enrollment			
Number of Students	1,373	4,373***	13,235***
Number of Students Is:			
Less Than 1,000	54.2	10.2***	4.1***
At Least 1,000, Less Than 5,000	42.5	66.2***	51.5***
At Least 5,000, Less Than 10,000	2.9	15.7***	32.2***
At Least 10,000	0.4	7.9***	12.3***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	29.9	35.5***	42.7***
Number of Districts	**1,343**	**216**	**171**
Percent of Districts	**77.6**	**12.5**	**9.9**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.13. Average Characteristics of Northeast Region Districts in the 2009 VSR, by Household Reporting Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	14.7	25.5***	23.2***
Error Rate	18.0	27.5***	38.8***
Percentage of Certified Students			
Categorically Eligible	13.7	12.3*	9.1***
Not Subject to Verification	25.6	30.5***	38.0***
District Demographic Characteristics			
Enrollment			
Number of Students	1,488	10,619***	5,366***
Number of Students Is:			
Less Than 1,000	52.5	10.8***	1.8***
At Least 1,000, Less Than 5,000	42.6	57.8***	70.2***
At Least 5,000, Less Than 10,000	4.6	19.7***	17.5***
At Least 10,000	0.4	11.7***	10.5***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	29.7	40.2***	42.0***
Number of Districts	**1,393**	**223**	**114**
Percent of Districts	**80.5**	**12.9**	**6.6**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.14. Average Characteristics of Northeast Region Districts in the 2009 VSR, by Administrative Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	High or Medium-Risk
Verification Results and Method of Certification		
Verification Results		
Nonresponse Rate	16.2	53.2***
Error Rate	20.6	18.3***
Percentage of Certified Students		
Categorically Eligible	13.3	8.0**
Not Subject to Verification	27.0	30.2
District Demographic Characteristics		
Enrollment		
Number of Students	1,996	71,492***
Number of Students Is:		
Less Than 1,000	44.3	0.0***
At Least 1,000, Less Than 5,000	46.9	8.7***
At Least 5,000, Less Than 10,000	7.1	30.4***
At Least 10,000	1.7	60.9***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	31.5	59.1***
Number of Districts	**1707**	**23**
Percent of Districts	**98.7**	**1.3**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of administrative certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. High and medium-risk districts are combined for the purposes of this table because the number of districts categorized as high-risk is very small. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.15. Average Characteristics of Southeast Region Districts in the 2009 VSR, by Overall Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	12.9	20.9***	29.5***
Error Rate	21.2	32.6***	34.4***
Percentage of Certified Students			
Categorically Eligible	9.2	7.3***	6.8***
Not Subject to Verification	38.9	43.7***	40.8***
District Demographic Characteristics			
Enrollment			
Number of Students	2,035	7,487***	27,950***
Number of Students Is:			
Less Than 1,000	33.3	0.0***	0.0***
At Least 1,000, Less Than 5,000	61.4	52.3***	12.1***
At Least 5,000, Less Than 10,000	3.4	27.7***	34.8***
At Least 10,000	1.9	20.0***	53.1***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	65.4	59.5***	54.9***
Number of Districts	**702**	**285**	**207**
Percent of Districts	**58.8**	**23.9**	**17.3**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.16. Average Characteristics of Southeast Region Districts in the 2009 VSR, by Household Reporting Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	15.2	22.2***	26.3***
Error Rate	21.5	35.6***	41.0***
Percentage of Certified Students			
Categorically Eligible	8.9	7.4***	5.1***
Not Subject to Verification	39.5	42.0**	43.4*
District Demographic Characteristics			
Enrollment			
Number of Students	2,855	15,190***	32,654***
Number of Students Is:			
Less Than 1,000	28.4	0.0***	0.0***
At Least 1,000, Less Than 5,000	54.3	49.8	15.4***
At Least 5,000, Less Than 10,000	13.6	17.4	15.4
At Least 10,000	3.6	32.8***	69.2***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	64.2	59.1***	52.1***
Number of Districts	**823**	**293**	**78**
Percent of Districts	**68.9**	**24.5**	**6.5**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.17. Average Characteristics of Southeast Region Districts in the 2009 VSR, by Administrative Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	High or Medium-Risk
Verification Results and Method of Certification		
Verification Results		
Nonresponse Rate	16.4	38.3***
Error Rate	25.9	31.8**
Percentage of Certified Students		
Categorically Eligible	8.4	7.6
Not Subject to Verification	40.4	39.8
District Demographic Characteristics		
Enrollment		
Number of Students	4,503	62,049***
Number of Students Is:		
Less Than 1,000	20.8	0.0***
At Least 1,000, Less Than 5,000	53.8	0.0***
At Least 5,000, Less Than 10,000	15.2	5.8***
At Least 10,000	10.2	94.2***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	62.7	53.6***
Number of Districts	**1,125**	**69**
Percent of Districts	**94.2**	**5.8**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of administrative certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. High and medium-risk districts are combined for the purposes of this table because the number of districts categorized as high-risk is very small. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.18. Average Characteristics of Southwest Region Districts in the 2009 VSR, by Overall Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	11.8	24.1***	35.2***
Error Rate	12.0	19.2***	25.1***
Percentage of Certified Students			
Categorically Eligible	10.7	8.7***	9.2***
Not Subject to Verification	26.4	30.7***	32.8***
District Demographic Characteristics			
Enrollment			
Number of Students	580	5,741***	9,810***
Number of Students Is:			
Less Than 1,000	88.5	11.3***	0.7***
At Least 1,000, Less Than 5,000	11.0	66.8***	58.8***
At Least 5,000, Less Than 10,000	0.4	5.8***	19.5***
At Least 10,000	0.1	16.1***	21.0***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	64.0	60.8***	54.8***
Number of Districts	**1,430**	**292**	**452**
Percent of Districts	**65.8**	**13.4**	**20.8**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.19. Average Characteristics of Southwest Region Districts in the 2009 VSR, by Household Reporting Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	12.8	27.2***	32.7***
Error Rate	12.1	21.2***	25.8***
Percentage of Certified Students			
Categorically Eligible	10.7	8.9***	8.9***
Not Subject to Verification	26.4	31.6***	33.1***
District Demographic Characteristics			
Enrollment			
Number of Students	724	9,784***	6,881***
Number of Students Is:			
Less Than 1,000	86.4	6.8***	0.3***
At Least 1,000, Less Than 5,000	11.8	54.1***	74.5***
At Least 5,000, Less Than 10,000	1.4	14.1***	11.8***
At Least 10,000	0.5	25.0***	13.3***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	63.9	60.0***	53.5***
Number of Districts	**1,476**	**368**	**330**
Percent of Districts	**67.9**	**16.9**	**15.2**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.20. Average Characteristics of Southwest Region Districts in the 2009 VSR, by Administrative Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	High or Medium-Risk
Verification Results and Method of Certification		
Verification Results		
Nonresponse Rate	16.2	44.2***
Error Rate	15.2	22.8***
Percentage of Certified Students		
Categorically Eligible	10.3	8.1***
Not Subject to Verification	28.3	28.2
District Demographic Characteristics		
Enrollment		
Number of Students	1,500	24,071***
Number of Students Is:		
Less Than 1,000	64.7	0.0***
At Least 1,000, Less Than 5,000	29.7	12.9***
At Least 5,000, Less Than 10,000	3.7	22.7***
At Least 10,000	1.9	64.4***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	62.1	57.0***
Number of Districts	**2,011**	**163**
Percent of Districts	**92.5**	**7.5**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of administrative certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. High and medium-risk districts are combined for the purposes of this table because the number of districts categorized as high-risk is very small. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.21. Average Characteristics of West Region Districts in the 2009 VSR, by Overall Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	13.3	27.6***	35.9***
Error Rate	15.8	25.9***	28.4***
Percentage of Certified Students			
Categorically Eligible	13.9	11.0***	9.4***
Not Subject to Verification	25.0	27.7*	2.6***
District Demographic Characteristics			
Enrollment			
Number of Students	782	5,964***	14,312***
Number of Students Is:			
Less Than 1,000	81.1	5.8***	0.4***
At Least 1,000, Less Than 5,000	17.1	66.3***	31.5***
At Least 5,000, Less Than 10,000	1.1	11.3***	29.7***
At Least 10,000	0.8	16.7***	38.4***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	58.8	55.2**	53.4***
Number of Districts	**1,321**	**240**	**508**
Percent of Districts	**63.8**	**11.6**	**24.6**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.22. Average Characteristics of West Region Districts in the 2009 VSR, by Household Reporting Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	Medium-Risk	High-Risk
Verification Results and Method of Certification			
Verification Results			
Nonresponse Rate	14.1	33.3***	31.4***
Error Rate	15.5	25.6***	32.5***
Percentage of Certified Students			
Categorically Eligible	13.9	10.5***	8.8***
Not Subject to Verification	24.6	28.5***	29.8***
District Demographic Characteristics			
Enrollment			
Number of Students	933	11,209***	12,378***
Number of Students Is:			
Less Than 1,000	79.3	4.2***	0.9***
At Least 1,000, Less Than 5,000	17.4	42.7***	43.4***
At Least 5,000, Less Than 10,000	2.3	22.1***	22.5***
At Least 10,000	1.0	31.0***	33.1***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	58.2	56.7	52.5***
Number of Districts	**1,346**	**403**	**320**
Percent of Districts	**65.1**	**19.5**	**15.5**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of household reporting certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

Table F.23. Average Characteristics of West Region Districts in the 2009 VSR, by Administrative Certification Error Risk Category (Percentage Unless Otherwise Noted)

	Low-Risk	High or Medium-Risk
Verification Results and Method of Certification		
Verification Results		
Nonresponse Rate	17.6	45.0***
Error Rate	19.1	28.1***
Percentage of Certified Students		
Categorically Eligible	12.8	9.3***
Not Subject to Verification	26.3	24.9***
District Demographic Characteristics		
Enrollment		
Number of Students	2,148	25,977***
Number of Students Is:		
Less Than 1,000	58.9	0.0***
At Least 1,000, Less Than 5,000	28.6	7.7***
At Least 5,000, Less Than 10,000	8.3	17.6***
At Least 10,000	4.3	74.8***
Percentage of Enrolled Students Certified for Free or Reduced-Price Meals	56.9	58.5
Number of Districts	**1,847**	**222**
Percent of Districts	**89.3**	**10.7**

Source: VSR 2009

Note: Risk category and imputed erroneous payments were derived by applying the model of administrative certification error rates estimated based on APEC data to districts in the 2009 VSR. Risk categorization was determined using State-specific thresholds and five-percent rate floors. High and medium-risk districts are combined for the purposes of this table because the number of districts categorized as high-risk is very small. District reimbursements were imputed based on information in the FNS national data file and the district's number of students in each meal benefit certification category. Rate of erroneous payments refers to districts' erroneous payments as a percentage of their total reimbursements.

*Significantly different from zero at the .10 level.
**Significantly different from zero at the .05 level.
***Significantly different from zero at the .01 level.

This page has been left blank for double-sided copying.

MATHEMATICA
Policy Research, Inc.

www.mathematica-mpr.com

Improving public well-being by conducting high-quality, objective research and surveys

Princeton, NJ ■ Ann Arbor, MI ■ Cambridge, MA ■ Chicago, IL ■ Oakland, CA ■ Washington, DC