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AUTHOR O'Hora-Weir, M. Eileen; Ganopole, Selina
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ABSTRACT

The School Community Based Management (SCBM) process for the Hawaii public school system, legislated in 1989, elicits input from administrators, teachers, support staff, parents, students, and community members. SCBM shifts some of the decision making powers to the school and can be adopted by a school on a voluntary basis. This study develops a qualitative response model which attempts to explain an individual school's decision to adopt SCBM. The study applied a profit procedure using school-level characteristics and socioeconomic data for all of Hawaii's public schools. A subset of explanatory variables was identified as statistically significant in impacting the probability of adoption of SCBM. The variables that positively affected the choice to become an SCBM school included: (1) the percentage of students in attendance for the entire school year; and (2) the percentage of classrooms available relative to state requirements. The percentage of students receiving free lunches and the percentage of students scoring in the above-average stanine of the SAT scores in reading demonstrated a significant negative impact on the SCBM decision. The percentage of teachers remaining at the school longer than 5 years was also negatively correlated with the adoption of SCBM. Tests for goodness-of-fit found that the model provided a fairly good fit and that it was more successful in predicting nonadoption of SCBM. The model is deficient in its omission of leadership qualities and impacts of departmental policies. Five tables and two figures are included. (Contains 16 references.) (Author/LMI)

THE IMPACT OF SCHOOL LEVEL AND SOCIOECONOMIC VARIABLES ON THE ADOPTION OF SCHOOL COMMUNITY BASED MANAGEMENT IN HAWAII'S PUBLIC SCHOOLS

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Submitted by:
M. Eileen O'Hora-Weir
and
Selina Ganopole

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study develops a qualitative response model which attempts to explain an individual school's decision to adopt School Community Based Management (SCBM). SCBM, in effect, shifts some of the decision making powers to the school and, as legislated in the State of Hawaii in 1989, can be adopted by a school on a voluntary basis.

A probit procedure is applied using school level characteristics and socio-economic data for all of the State's public schools. A sub-set of explanatory variables are identified as statistically significant in impacting the probability of adoption of SCBM.

The variables that were found to positively affect the choice to become an SCBM school are; 1) the percentage of students in attendance for the entire school year and 2) the percentage of classrooms available relative to state requirements. Although not strictly significant, the level of education within the school's community was also positively correlated with the decision to adopt SCBM.

The percentage of students on free lunch, as well as the percentage of students scoring in the above average stanine of the SAT tests in reading, demonstrated a significant negative impact on the SCBM decision. The percentage of teachers remaining at the school longer than five years was also negatively correlated with the adoption of SCBM.

Tests for goodness of fit and prediction success rates were carried out on the probit model developed in this study. The analysis indicated that the model provided a fairly good fit and that it was more successful at predicting non-adoption of SCBM. A recognized deficiency in the model is the omission of leadership qualities and impacts of departmental policies. These variables play a substantial role in a school's decision to adopt SCBM.

M. Eileen O'Hora-Weir is a doctorate student in Resource Economics at the University of Hawaii. She is currently a research assistant on a project involving School/Community-Based Management which is sponsored by the Graduate Division at the University of Hawaii and the Evaluation Section of Hawaii's Department of Education.

Selina Ganopole is currently Associate Dean of Graduate Studies, Graduate Division, University of Hawaii and the principal investigator on the School/Community-Based Management project..

INTRODUCTION

This paper focuses on the School Community Based Management (SCBM) process for the public school system in Hawaii. As legislated in 1989, this management process requires input from the six role groups that comprise the school's community: administration, teachers, support staff, parents, students and community members. The SCBM Council, which represents the six role groups, is mandated to use consensus as the decision making process. Schools are given the option to adopt SCBM and must submit both a Letter of Intent and a Proposal to Implement in order to be approved by the Board of Education as an SCBM school. To date, all schools that have submitted proposals have been approved and as of March 1995, 93 of the State's 234 schools had adopted SCBM. As legislated, schools receive an initial endowment of $11,000 to implement SCBM, but no other budgetary allowance is provided. Formative evaluation of the SCBM process at each school is to be done internally during the first three years and a summative, external evaluation is conducted in the fourth year.

Since SCBM is a voluntary program, the qualitative choice model developed in this paper focuses on establishing a cause and effect relationship between indicators at the school level and the decision to adopt SCBM. This decision can be likened to the adoption of technology in neoclassical economic theory. Under this theoretical framework, context, process and outcome indicators, as well as socio-economic variables, serve to explain the choice between adoption or non-adoption of a new type of technology which will change the mode of production. Since the choice variable can be represented by a dichotomous dependent variable, 0 for non-adoption and 1 for adoption, a probit model is applied. This results in an estimate of the conditional probability that a school will adopt SCBM given the value of the explanatory variables.

Literature Review:

In the field of education, most of the literature concerning SCBM entails qualitative analysis aimed at developing methods for evaluating the effectiveness of the process once SCBM has been adopted. Such qualitative analysis in education involves identifying the objectives of various approaches to student learning and linking those objectives with activities that are intended to achieve desired results. It is then necessary to identify and collect measurable

indicators or data on the actual outcomes which result from implementation of specific educational techniques or programs. In Hawaii, a case study approach, utilizing the above qualitative analysis, has been applied to SCBM in an attempt to 1) evaluate the effectiveness of SCBM and 2) identify those common objectives and activities associated with the successful implementation of SCBM[1].

In the *Analysis of School/Community Input for SCBM Summative Evaluation,* perceptions on the expected outcomes of SCBM were reported (Ganapole, 1993). The report based its findings on the results of a questionnaire administered to 144 individuals including SCBM Council members, district education officers and resource teachers, SCBM district coordinators, members of the legislature, members of the State Board of Education, a representative of the Governor's Office and the Chair of the Commission on Performance Standards. Based on the responses to this questionnaire, ten categories were established to classify the perceived benefits from the of adoption of SCBM.[2] Identifying these ten categories has assisted in developing evaluation measures for SCBM and may also provide some insight into the reasons to adopt SCBM at a particular school.

Qualitative response models have been widely used in the field of education. Pindyck and Rubenfeld present examples of logit models used to analyze behavior relating to decisions concerning education (Pindyck, 1991). In one example, the voting behavior of Troy, Michigan residents on a school budget issue is modeled using demographic statistics as explanatory variables. In another example, a logit model is used to predict the likelihood that an individual will attend college based on family income, distance from home to campus, and sex.

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[1] Several qualitative studies have been conducted on SCBM schools in Hawaii. The *Evaluation of Implementation of School/Community-Based Management* in August 1992 conducted case studies on Wai`alae and Ma`ili Elementary Schools. In 1994 the Curriculum Research and Development Group (CRDG) of the Department of Education, University of Hawaii, conducted evaluations on nine of the SCBM schools in Hawaii. The method employed by CRDG in evaluating SCBM borrowed heavily from the *Evaluation of Implementation of the Special Needs Schools Program in the Molokai`i Complex 1992-93.*

[2] Autonomy/Sense of Empowerment
Academic Achievement
Attitudes toward School & Learning
Budgeting; Benefit/Cost Considerations
Satisfaction with SCBM and school climate
School Vision Outcomes
Instructional Innovations
Participation
Shared Decision Making
Student Behavior

Using a qualitative choice model to determine the tendency of a school to implement SCBM, is similiar to applying this type of model to firm-level production decisions concerning the adoption of a particular technology. In the case of SCBM, the behavioral choice is a management decision reached by consensus of the whole school community including parents and community members. The decision is expected to impact the process of school management through shared decision making, influence school climate through empowerment of all the role groups, and affect outcomes such as student achievement and behavior. It is within this context that the following econometric model is developed.

ECONOMETRIC MODEL

The decision to adopt SCBM is influenced by many factors and the model developed here does not express the effects of leadership qualities and departmental policies which may heavily influence both the adoption and the success of SCBM in Hawaii's public schools. The following model does attempt to identify those school and community level characteristics which appear to have a significant impact on the adoption of SCBM.

Probit Model:

The choice of a probit model was based on analysis of the data used and comparison of the behavior of other modeling techniques. A linear probability model may be used in situations where there are nearly equal representation of both choices (zero or one) and the ordinary least squares, (OLS), estimates of the coefficients will be unbiased (Greene, 1993). Unfortunately, due to the dichotomous nature of the dependent variables, the disturbance term will not be constant implying that the model is heteroscedastic. Thus, the standard hypotheses tests cannot be applied. This problem can be alleviated by developing a generalized least-squares (GLS) estimate based on the predictions from the OLS model. The statistics generated will be asymptotically valid, but the dependent variable will not be constrained to the interval [0,1]. A logit model may be applied to this data but, due to the similarity of the cumulative normal distribution and the logistic distribution which underlie the probit and logit methods respectively, the results will be nearly the same except in the tails (Maddala, 1988).

The probit model is designed so that the dependent variable, the decision to adopt SCBM,

$(SCBM_i) = 1$, if $x_i'\beta_i > 0$ and $(SCBM_i) = 0$ if $x_i'\beta_i \leq 0$. In this formulation X' is the row vector of explanatory variables and β represents a column vector of the coefficients. Therefore, it is necessary to use a function which will compute the probability that $Y_i = 1$ given that the value of $x_i'\beta_i$ - $Pr(Y_i=1) = F(x_i'\beta_i)$ where $0 < F(x_i'\beta_i) < 1$. The probit model utilizes the cumulative normal probability function (F) to compute these probabilities where e is evaluated at $x_i'\beta_i$.[3] Therefore P_i is a non-linear function of the independent variables, x_i' (Amemiya, 1981). The maximum likelihood estimators are asymptotically normal implying that standard hypotheses testing is valid if sample size is sufficiently large (Durham, 1988).

The method used to estimate the probability of adoption is the likelihood function. The probit procedure estimates the values of β_i such that the values of $x_i'\beta_i$ will be high for schools that adopt SCBM and low for schools that do not adopt.[4]

Variables:

Data for this model includes school level data, as well as United States Census data which has been broken down to the school community level. The only socio-economic variable utilized from the Census data is:

- **HI_SCH** - % of community residents over age 18 with high school diplomas

The school level data was obtained for the school year 1990-91. This year was chosen as it represents the first year for the adoption of SCBM in Hawaii's public schools and thus provides a baseline for school characteristics before the influence of the SCBM process. Of the 238 schools in the State as of April 1995, 16 school were dropped due to insufficient data. Of

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$$P_i = F(x_i'\beta_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x_i'\beta_i} \exp(-0.5e^2)\, de$$

4 The likelihood function is maximized as follows:

$$L = \int_{i=1}^{T} F(x_i'\beta_i)^n [1 - F(x_i'\beta_i)]^{T-n}$$

the remaining 222 schools, 91 have adopted SCBM at some point between June, 1990 and April, 1995. SCBM schools are coded with one (1) and non-SCBM schools are coded as zero (0). Additionally, each school is coded by a number representing one of the State's seven school districts.

The school level variables are separated into three categories; context, process and outcome variables. This reflects the manner in which these variables are viewed by the State Department of Education as reported in *The Superintendent's Fifth Annual Report on School Performance and Improvement in Hawaii.* The variables are as follows:

Context Indicators:
- **STUD_Y** - % of Students Enrolled for the Entire School Year
- **FREE_L** - % of Students on Free Lunch

Process Indicators:
- **TEACH_R** - % of Teachers at the School for > 5 years
- **CLSRM** - % of Classrooms relative to Department of Education Standards

Outcome Indicators:
- **SATM** - % of Students Scoring in Above Average Stanine of the SAT in Mati

The above school level variables combined with the socio-economic variables constitute a data set of 6 explanatory variables with a total of 222 observations and represented an appropriate mix of context, process, and outcome variables.

METHODOLOGY

Using the SHAZAM computer program, a probit model was run in SHAZAM using the six explanatory variables described above and the results were compared to both an OLS and logit model. According to Amemiya, the probit and logit models should produce similar results except at the tails although the estimates of β are not directly comparable. He suggests multiplying the probit estimates (β) by a transformation constant of 1.6 in order to produce close approximations of the logit estimates (β_L) . He further recommends the probit estimates can be compared to linear probability estimates (β_{LP}) by multiplying β by 0.4 and adding 1.25 to the constant term (Amemiya, 1981). These calculations were performed on the probit, logit and OLS

estimates and the results, shown in Table 1, provide good approximations for the logit estimates. The OLS approximations are not as accurate especially for the constant term.

TABLE 1: Comparison of Estimates of Probit, Logit and OLS

Coefficient	Probit	Logit	Log. Approx	OLS	OLS Approx
STUD_Y	4.3932	7.2170	7.02912	1.5346	1.75728
FREE_L	-0.76994	-1.3292	-1.2319	-0.2692	-0.307976
TEACH_R	-0.52625	-0.83248	-0.8420	-0.19807	-0.2105
SATR	-2.3552	-3.8967	-3.76832	-0.82083	-0.94208
CLSRM	1.3515	2.1961	2.1624	0.47850	0.5406
HI_SCH	1.3746	2.2689	2.19936	0.49113	0.54984
CONSTANT	-5.0518	-8.2699	-8.08288	-1.2777	-0.77072

The 6 explanatory variables were regressed on the SCBM dependent variable using all 222 observations. All of the explanatory variables indicated a reasonable level of significance and displayed the correct expected signs. FREE_L , a recognized indicator of poverty, also acts as a proxy for income. CLSRM serves as a proxy for capital expenditures on the school. STUD_Y is an indicator for student transiency which is a significant problem in particular schools, especially those that serve military communities. TEACH_R is an indicator of teacher retention and SATR represents student academic achievement levels. The socio-economic variable, HI_SCH, served to represent the impact of education on the SCBM choice.

Auxiliary regressions were then run on each of the explanatory variables and the results indicated that there were no problems with multicollinearity. As specified, the model produced acceptable results in terms of goodness of fit measures.

The observations were then split into two groups; Oahu school districts and the Outer Island school districts. The rationale behind dividing the data in this manner was to see how the model, as defined for all of the State's schools, performed on the sub-groups. It was hypothesized that the school level characteristics, as well as socio-economic considerations, would be similar for the four Oahu districts. Due to the small geographic size of Oahu, all districts are within commuting distance of Honolulu, the only large urban area in the state. The

rate of district exemptions is expected to be higher for Oahu than on the Outer Islands. Additionally, most of the State's private schools are situated on Oahu allowing for more alternatives in education than on the Outer Islands (Education Directory, 1994-95).

Oahu districts include Honolulu with 53 schools, Central with 39 schools, Leeward with 34 schools and Windward with 30 schools comprising a total of 156 schools. The Outer Islands include Hawaii with 31 schools, Maui with 23 schools, and Kauai with 12 schools. Since the probit method produces unbiased estimates and valid statistics asymptotically, the estimates from the Outer Islands, with only 66 schools, were not reliable and were not reported.

RESULTS

The tables that follow report the results from this model. Analysis will focus on three aspects of the model; 1) marginal effects and interpretation of coefficients, 2) goodness of fit measures, and 3) prediction success tables. The coefficients reported for the probit model are the linear parameters for the unobserved, underlying index function. As such, they do not represent the marginal effects generally associated with the coefficients of regression. Thus, the relevant statistic is the slope of the reported coefficient which is calculated using equation (1) evaluated at each value of the independent variables. Tables 2 and 3 report the results of the probit model from the All Districts and Oahu Districts.

TABLE 2: All Districts (222 Public Schools)

VARIABLES	COEFF	PSLOPE	STD ERR	T-VALUE	ELAST.
STUD_Y	4.3932	1.700434	1.4910	2.9465	3.3826
FREE_L	-0.76994	-0.298009	0.34038	-2.2620	-0.31802
TEACH_R	-0.52625	-0.203689	0.47875	-1.0992	-0.30995
SATR	-2.3552	-0.911592	1.0327	-2.2807	-0.45316
CLSRM	1.3515	0.5231198	0.51448	2.6270	1.3611
HI_SCH	1.3746	0.5320594	0.89798	1.5308	0.95474
CONSTANT	-5.0518	-1.955331	1.6820	-3.0035	-4.8536

TABLE 3: Oahu Districts (156 Public Schools)

VARIABLES	COEFF	PSLOPE	STD ERR	T-VALUE	ELAST.
STUD_Y	4.8454	1.84725	1.8594	2.6058	3.8575
FREE_L	-0.72645	-0.27695	0.4584	-1.5848	-0.29313
TEACH_R	-0.80525	-0.30699	0.60612	-1.3285	-0.50983
SATR	-2.9180	-1.11244	1.3628	-2.1412	-0.58369
CLSRM	1.4919	0.56877	0.65885	2.2644	1.5134
HI_SCH	1.4607	0.55685	1.2277	1.1897	1.0885
CONSTANT	-5.3788	-2.05058	2.1113	-2.5477	-5.3738

Analysis of Coefficients:

Analysis of the results for the All Districts model (Table 2) shows that the t-values for all the variables are greater than ±2, the approximate critical value, except TEACH_R and HI_SCH. Although not significant at the 5% significance level, the t-values which are 1.0992 and 1.5308 respectively, are large enough to indicate that these variables probably do influence the SCBM decision.

The sign of STUD_Y is positive indicating that the lower the student transiency level, the greater is the propensity for a school to adopt SCBM. This is in keeping with expectations since highly transient populations are not likely to commit the time and energy needed to implement SCBM.

The percentage of students on FREE_L has a negative correlation with adoption of SCBM. Since FREE_L is an indicator of poverty, the less endowed the school's community the less likely is the adoption of SCBM. This serves as a better indicator of the impact of family income on the SCBM choice since higher income families have more educational options than poverty level households.

The negative correlation between SCBM and TEACH_R helps to identify the tendency of long term staff to resist change. SCBM not only involves changes to decision making practices and curriculum planning but, the essence of SCBM is to broaden the involvement of all of the school's community. This involves an 'open' classroom approach which may be

unacceptable to many long term educational professionals.

SATR presents the percentage of students scoring in the above average stanine of the SAT (Stanford Achievement Test) in Reading. When this percentage is high, the school already has reached a desirable level of scholastic achievement and the there is little impetus to change. Therefore, it is expected that the sign on this indicator will be negative.

CLSRM gives the percentage of classrooms available relative to the amount deemed necessary by the Department of Education given the size of the student body. This variable demonstrates a strong positive correlation with the adoption of SCBM. As such, it represents the community's perception of capital expenditure on the school facility. The better the facilities, the more likely that all of the school's community will choose to invest effort in school improvement activities as embodied in the SCBM process.

The variable HI_SCH represents the percentage of individuals in the community, age 18 or older, that completed high school. As such, it is an indicator of the level of education within the community, is expected to be positively correlated with SCBM adoption.

Since the probit method reports the coefficients of the underlying index, Pindyck suggests it is the relative magnitude of the individual coefficients that is important. This relative magnitude can be compared to other model estimates to judge the performance of the different models (Pindyck, 1991). Referring back to Table 1, the relative magnitude of the coefficient for STUD_Y (4.3932) in the probit model estimate is 3.25 times the magnitude of the coefficient for CLSRM (1.3515). The ratio of these two coefficients in the logit model is 3.28 and for the OLS the ratio is 3.2. Therefore, the model, as specified, demonstrates consistency in the relative magnitudes of coefficients with different regression procedures.

The relative magnitude of the estimates of the probit coefficients in the All Districts model (Table 2) was compared to the Oahu Districts model (Table 3). The magnitude of STUD_Y relative to the other explanatory variables is shown below for the two models:

	ALL DISTRICTS	OAHU DISTRICTS
FREE_L	5.7	6.67
TEACH_R	8.35	6.0
SATR	1.86	1.66
CLSRM	3.25	3.24
HI_SCH	3.19	3.3

The Oahu model returns relative magnitudes for the coefficients which are quite similar to the All Districts model. The ratios are especially close for those estimates which have significant t-values in both models (STUD_Y, SATR, AND CLSRM).

As noted before, the relevant statistic for describing the marginal effects of the explanatory variables on the propensity to adopt SCBM is the PSLOPE estimate which was computed at the mean of the underlying index. From Table 2, we can see that 1% increase in the level of the variable CLSRM for a particular observation or school would increase the probability estimate of the underlying index by 0.523 percent. The elasticity estimate, which is computed at the mean of the data, implies that a 1% increase in level of the variable CLSRM would increase the probability of adoption by 1.36%. From examination of the elasticities reported in Table 2, it is apparent that the level of the percentage of students at the school all year (ϵ=3.38) and the level of the percentage of required classrooms (ϵ=1.36) both have a strong positive effect on the probability of adoption of SCBM.

Analysis of Goodness of Fit Measures:

FIGURE 1: GOODNESS OF FIT MEASURES FOR ALL DISTRICTS

Log-Likelihood Function = -137.96
Log-Likelihood (0) = -150.26
Likelihood Ratio Test = 24.5987 with 6 D.F.

FIGURE 2: GOODNESS OF FIT MEASURES FOR OAHU DISTRICTS

Log-Likelihood Function = -95.927
Log-Likelihood (0) = -104.40
Likelihood Ratio Test = 16.9387 with 6 D.F.

The most important statistic in analyzing the overall fit of the probit model is the likelihood ratio test (LRT).[5] The LRT is similar to the F test in that the null hypothesis is that all the coefficients are equal to zero. For 6 degrees of freedom (D.F.). the ChiSquare critical value is 12.59 at a 5% significance level. Both the All Districts model (LRT=24.6) and the Oahu Districts Model (LRT=16.9) result in rejection of the null hypothesis indicating a good overall fit of the model.

[5]This test statistic is computed using the formula: $LR = -2[\ln L_0 - \ln L]$ where L_0 and L are the log-likelihood function estimates evaluated using only β_0 and using all β_i's respectively (Greene, 1993).

Analysis of Prediction Tables:

TABLE 4: PREDICTION SUCCESS TABLE FOR ALL DISTRICTS

		ACTUAL	
		0	1
	0	110.	58.
PREDICTED	1	21.	33.

# of Right Predictions = 143.
% of Right Predictions = 0.64414

TABLE 5: PREDICTION SUCCESS TABLE FOR OAHU DISTRICTS

		ACTUAL	
		0	1
	0	78.	39.
PREDICTED	1	17.	22.

# of Right Predictions = 100.
% of Right Predictions = 0.64103

Since interpretation of the pseudo R^2 measures associated with the probit regression procedure is controversial (Greene, 1993), the above prediction tables provide a better measure of the reliability of the models. In the case of the All Districts model, the number of predictions at the value of zero (0), or non-adoption, is 110 while the actual number is 131. This means that 84% are correctly predicted when the decision is not to adopt SCBM. The number of predictions at the value of one (1), or adoption, is 33 while the actual number is 91. This means that in terms of predicting adoption of SCBM, 58 prediction were wrong giving a success rate of only 36%. In probit models where the dichotomous dependent variable is not represented in a balanced manner, it is generally the case that the model will predict the dominant outcome more successfully. In the case of the All Districts model, only 41% of the schools have adopted SCBM, thus the model does a better job of predicting non-adoption. Combining the two predictions gives an overall success of predictions at 64.4%.

The Oahu Districts model has nearly the same predictions of success for both choices as the All District model due to the fact that 39% of the schools on Oahu have adopted SCBM.

CONCLUSION

The analysis finds that certain school level indicators and community characteristics significantly effect the decision to adopt SCBM in the State's public schools. The probability of

adoption increases when the percentage of students in attendance all year increases and when adequate facilities are in place. Furthermore, the positive effect of a higher level of education on the adoption of SCBM cannot be ruled out. The probability of adoption decreases as the percentage of students below poverty level increases and when the percentage of students with high academic achievement levels increases. Although not highly significant, an increase in the percentage of teachers at the school longer than five years negatively impacts the decision to adopt SCBM.

Although the relationship between the explanatory variables and the response is not an excellent fit, both the All Districts and Oahu Districts models pass the likelihood ratio or goodness of fit test. Analysis of the prediction of success demonstrates that the models are much better at predicting non-adoption than they are at predicting adoption of SCBM.

As mentioned before, this model is limited in expressing all of the characteristics impacting the decision to adopt SCBM. As with most management decisions, an underlying factor is the attitudes of the leadership at the school and the personal qualities of that leadership. In the case of SCBM, the leadership underlying the decision to adopt is generally provided by the school's administration. In some cases, due to the process of establishing SCBM and the emphasis on inclusion of the school's entire community, that leadership may also come from one of the other components of SCBM such as a dedicated and motivated parent or teacher. Once there is committed leadership to spearhead the implementation of SCBM, a critical number of concerned individuals is needed to carry the process through.

Another aspect of SCBM adoption which does not formally enter the model is the Department of Education's influence on the adoption process. Current policy encourages adoption in a move toward self-governance. The problem with this policy is that full self-governance would involve budgetary autonomy and complete control over curriculum decisions. This is not the case however, and the resulting process can only impart a sense of empowerment without really shifting control away from the central authority.

The above exclusions could be considered omitted variables in the currently specified model and might help to explain the lack of an exceptionally good fit. As is the case with all methods that attempt to model human behavior, the simplification necessary to reduce the behavior to a regression format does not always capture all of the elements that describe the behavior.

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