Appendix B

Methodology of Analysis

There are four basic steps to the analysis for this report. Each answers a specific question:

1) Are urban schools different?

2) Are high poverty schools different?

3) Are urban schools different after taking into account the poverty concentration of the school?

4) Are urban high poverty schools different than predicted? Is there something about these schools that puts the students at particular risk for poor educational outcomes and experiences?

Four models that correspond to these four questions can be calculated. Each of the models uses the following notation:

Y_i = the score on a particular outcome measure for the ith student

$X1_i$ and $X2_i$ = a set of contrast-coded variables representing the urbanicity of the ith student's school where:

$X1_i$ = 2 if suburban and -1 otherwise

$X2_i$ = 2 if rural and -1 otherwise

$X3_i$, $X4_i$, and $X5_i$ = a set of contrast-coded variables representing the poverty concentration of the ith student's school where:

$X3_i$ = 3 if the school has 0 to 5 percent poverty concentration and -1 otherwise

$X4_i$ = 3 if the school has 6 to 20 percent poverty concentration and -1 otherwise

$X5_i$ = 3 if the school has 21 to 40 percent poverty concentration and -1 otherwise

$X6_i$, $X7_i$, $X8_i$, $X9_i$, $X10_i$, and $X11_i$ = a set of variables representing various aspects of the interaction between urbanicity and poverty concentration where:

$$X6_i = X1_i * X3_i$$
$$X7_i = X1_i * X4_i$$
$$X8_i = X1_i * X5_i$$
$$X9_i = X2_i * X3_i$$
$$X10_i = X2_i * X4_i$$
$$X11_i = X2_i * X5_i$$

Model 1 estimates:

$$\hat{Y}_i=\beta_0+\beta_1X_1+\beta_2X_2$$

A joint test of $\beta_1+\beta_2$ tests the overall effect of urbanicity. If the overall test is significant, then a test that $\beta_1=0$ tests the difference between students in rural and urban schools on Y, while the test that $\beta 2 = 0$ tests the contrast between students in suburban and urban schools.

Model 2 estimates:

$$\hat{Y}_i =\beta_0+\beta_3 X_3+\beta_4 X_4+\beta_5 X_5$$

A joint test of $\beta_3+\beta_4+\beta_5$ tests the overall effect of poverty concentration. If the overall test is significant, then a test that $\beta_3=0$ tests the difference on Y between students in schools with 0 to 5 percent poverty concentration and students in schools with over 40 percent poverty concentration; a test that $\beta_4=0$ tests the difference on Y between students in schools with 6 to 20 percent poverty concentration and students in schools with over 40 percent poverty concentration; and a test that $\beta_5=0$ tests the difference on Y between students in schools with 21 to 40 percent poverty concentration and students in schools with over 40 percent poverty concentration.

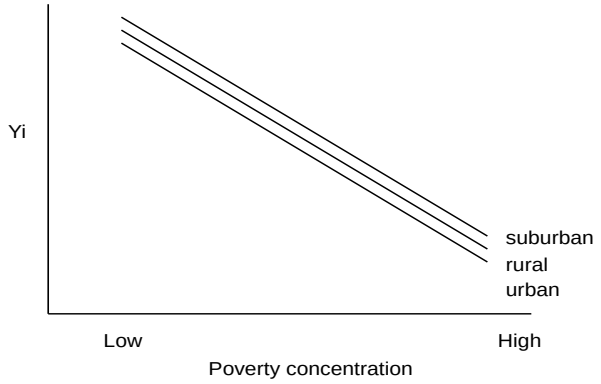
Model 3 estimates:

$$\hat{Y}_i =\beta_0+\beta_1 X_1+\beta_2 X_2+\beta_3 X_3+\beta_4 X_4+\beta_5 X_5$$

A joint test of $\beta_1+\beta_2$ tests the overall effect of urbanicity (controlling for poverty concentration). If the overall test is significant, then a test that $\beta_1=0$ tests the difference between students in rural and urban schools on Y (controlling for poverty concentration), while the test that $\beta_2=0$ tests the contrast between students in suburban and urban schools (controlling for poverty concentration). Model 3 tests whether figure 1 or figure 2 holds for the data.

Figure 1 indicates an effect of poverty concentration but not of urbanicity when poverty concentration is held constant. That is, the differences between urban and other schools are explained by the higher concentration of poor students in urban schools. The difference between urban and other schools with high poverty concentrations is the same as it is at schools

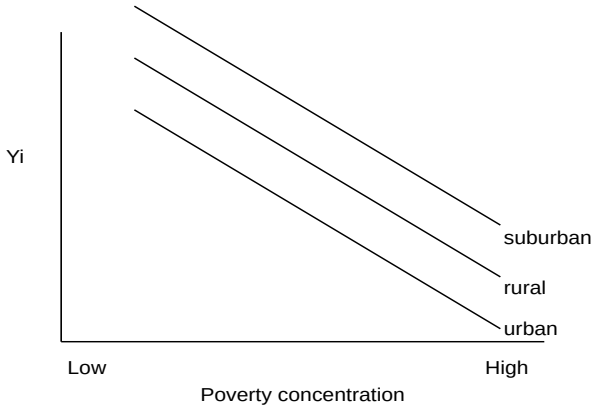
Figure 1



with low poverty concentrations; therefore, urban high poverty schools are no different than predicted.

Figure 2 indicates both an effect of poverty concentration and of urbanicity above and beyond the effect of poverty concentration. That is, significant differences between urban and other schools remain after accounting for the higher concentration of poverty in urban schools. Since the difference between urban and other schools with high poverty concentrations is the same as it is at low poverty concentrations, urban high poverty schools are no different than predicted.

Figure 2



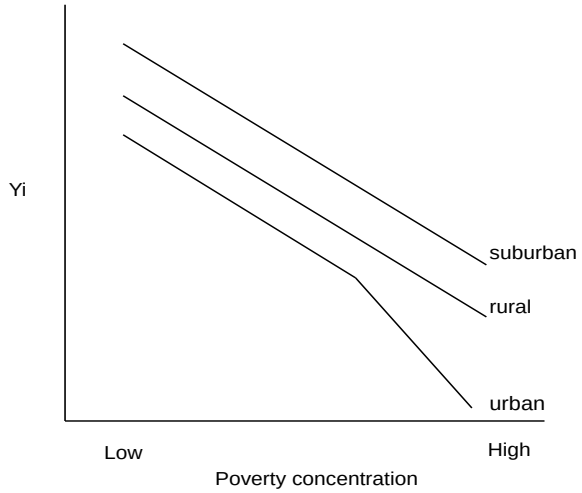
Model 4 estimates:

$$\hat{Y}_i=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}$$

A joint test that $\beta_6+\beta_7+\beta_8+\beta_9+\beta_{10}+\beta_{11}=0$ tests the overall effect of the interaction between urbanicity and poverty concentration. If the overall test is significant, each term in the interaction tests a different aspect of the interaction. Specifically, the test of $\beta_6=0$ tests whether the difference between rural and urban schools with 0 to 5 percent poverty concentration is the same as the difference between rural and urban schools with over 40 percent poverty concentration. The test of $\beta_9=0$ tests whether the difference between suburban and urban schools with 0 to 5 percent poverty concentration is larger or smaller than the difference between suburban and urban schools with over 40 percent poverty concentration. And this pattern continues for β_7 and β_8 through β_{10} and β_{11}.

Figure 3 displays an instance in which students in urban schools with a high poverty concentration are at particular risk for less desirable experiences or outcomes. The difference between urban and other schools with high poverty concentrations is greater than it is at schools with low poverty concentrations; therefore, urban high poverty schools are different than predicted. The combination of an urban and high poverty setting interact so that the outcomes and experiences of

Figure 3



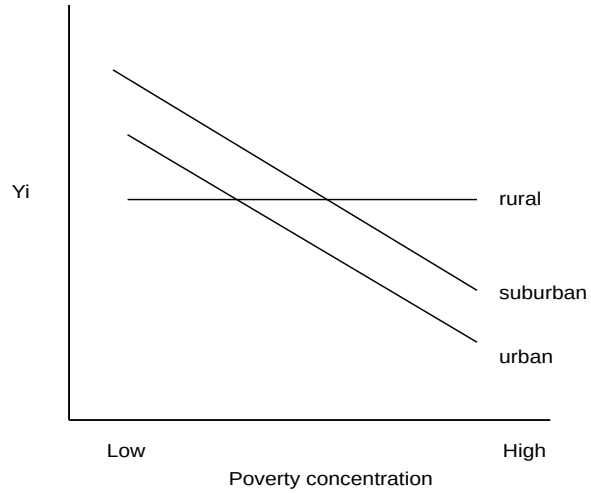
students in those settings are different than predicted. Also, students in urban high poverty schools are different from students in other high poverty schools.

Of course, the actual data do not behave as simply as the data in figures 1, 2, and 3, and the patterns can be quite complicated. In fact, sometimes the atypical group is the advantaged urban students.

In addition, there is another simple pattern that occurs in the data—one that is not explicitly tested in models 1 through 4. This pattern is shown in figure 4.

In this case, there is an interaction between urbanicity and poverty concentration, but not the one explicitly looked for in model 4. In fact, what is interesting is the lack of an overall effect of poverty concentration on rural schools as compared with a quite marked effect for urban and suburban schools. That is, what is of interest here is the overall effect of poverty concentration for rural schools, rather than the simple contrast between high poverty concentration and low poverty concentration schools. One can hypothesize that the slopes of the lines defining the poverty concentration are different for students in urban, suburban, and rural schools and that the slope for the students in rural schools is, in fact, not different from zero. For example, assume we ran the following model:

Figure 4



$$\hat{Y}_i=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5$$

where:

$X1_i$ and $X2_i$ = a set of contrast-coded variables representing the urbanicity of the ith student's school

where:

$X1_i$=2 if suburban and -1 otherwise
$X2_i$=2 if rural and -1 otherwise
$X3_i$=poverty concentration expressed as a continuous variable (in most cases percent of free and reduced price lunch);

$X4_i$ and $X5_i$ = a set of variables representing the interaction of urbanicity and poverty concentration with:

$X4_i = X1_i * X3_i$
$X5_i = X2_i * X3_i$

A joint test of $\beta_4+\beta_5$ is now an overall test of the interaction. Simple substitution of appropriate values for X_1 through X_5 results in the following simple regression equations for students in urban, rural, and suburban schools:

$$\hat{Y}_{urban}=\beta_0+\beta_1(-1)+\beta_2(-1)+\beta_3(PCLNCH)+\beta_4(-1*PCLNCH)+\beta_5(-1*PCLNCH)$$

where:

$(\beta_3-\beta_4-\beta_5)$*PCLNCH represents the poverty concentration slope for urban schools;

$$\hat{Y}_{rural}=\beta_0+\beta_1(2)+\beta_2(-1)+\beta_3(PCLNCH)+\beta_4(2*PCLNCH)+\beta_5(-1*PCLNCH)$$

where:

$(\beta_3+2\beta_4-\beta_5)$*PCLNCH represents the poverty concentration slope for rural schools; and

$$\hat{Y}_{suburban}=\beta_0+\beta_1(-1)+\beta_2(2)+\beta_3(PCLNCH)+\beta_4(-1*PCLNCH)+\beta_5(2*PCLNCH)$$

where:

$(\beta_3-\beta_4+2\beta_5)$*PCLNCH represents the poverty concentration slope for suburban schools.

After calculating the appropriate standard errors (combining terms from the coefficients' variance/covariance matrix), one can test whether the simple slopes for urban, rural, and suburban schools differ from one another, or whether they differ from zero.