“Still, reducing class size holds real appeal. It is one change that can be made without training, follow up, and continued maintenance.”

Slavin, 1990

INTRODUCTION
This chapter contains an analysis of the school-level dollar cost of CSR. The purpose of this analysis is to help policymakers understand the relationships between policy choices and costs. This analysis builds on existing literature with additional information on school-level costs and explores new combinations of policies and existing conditions and their cost implications. The policy choices being addressed are:

- The decision to implement or not implement CSR?

If CSR is implemented, how to structure the policy in terms of:

- What is the class size goal?
- How class size is measured?
- How many students should be affected by the policy?

The implications of these policy questions are summarized by four simple “rules of thumb” that can be used to estimate the school-level costs of CSR.

This chapter has four parts. It begins with a description of the data and methods used in the chapter and progresses through three sections. The first section uses a simple hypothetical model to gain a better understanding of the relationship between costs, existing conditions and policy choices. The second section uses simulations of CSR in seven Florida school districts to examine the cost implications of the five policy decisions outlined above with CSR implementation. This examination includes analysis of the effects of alternative space and staffing choices on the cost of CSR. The third section uses regression models to provide rules of thumb about the cost of CSR that can be applied to policy situations outside of the Florida sample.

DATA AND METHODS
A program’s costs are the resources consumed in implementation and are then unavailable to be used in other programs. The costs discussed here are those with a market price, and thus can be discussed in dollars. This is appropriate since there are markets and prices for most of the resources used in CSR (Drummond, O’Brien, Stoddart and Torrance 1997,
The largest component of CSR costs are teachers’ services, which are purchased with dollars paid in the teacher’s salary.

The goal of the Florida simulation is to provide the marginal cost of implementing a program. That is, it provides estimates of the additional resources used to implement the policy. These costs are the average marginal cost the schools in the sample districts.

To allow comparability among CSR policies, the additional effort needed to implement CSR is presented as cost per student in the grades to be reduced. A simple and widely applicable measurement of the marginal resources needed to implement CSR is the additional number of classrooms. In other words, the basic unit of cost in this analysis is the classroom. Classrooms may contain different bundles of ingredients, depending on district policies and circumstances on such matters as teacher salaries, the use of aides, and the cost of heating and cooling.

To calculate the cost per student for a policy, the number of classrooms needed to implement the policy is divided by the number of students sitting in the classrooms, resulting in the intermediate measure, classrooms per student. Classrooms per student is the cost measure used in the hypothetical model. Classrooms per student are multiplied by the total price of the resources needed for a classroom to reach the final cost per student.

A key issue for individual districts is the space used to for new CSR classrooms. This issue is complicated for individual districts by their available space, and future demands for classrooms associated with changes in enrollment. This space has some shadow price (i.e. non-market price) that is not discussed in this analysis. The costs reported in the rules of thumb assume the new classrooms are in leased relocatable classrooms. This assumption allows the rules of thumb to be a baseline price that schools and districts can modify according to their own circumstance. Price estimates for new classrooms and purchased relocatable space are provided (see Table 3.5 and Appendix 3) to facilitate consideration of alternative sources of new classroom space.

Data
The data described below were used in the Florida simulation. The data are drawn from a variety of sources, most from various offices inside the Florida Department of Education. Florida was selected for use in the simulation because of the availability of good school-level data on staffing, enrollment, facilities, and school performance.

As described in Nakib (1996, 1994), as well as Nakib & Herrington (1998), the Florida Education Finance Program (FEFP) is a comprehensive and detailed centralized funding system that was initially adopted in 1973. The FEFP and the associated accountability system require the state to maintain detailed information on school-level enrollment, staffing, and facilities. The data are maintained in three separate databases, with the staffing and enrollment databases becoming functional in 1992–93. Beginning in 1996–97,
the state also began publishing and releasing on the world wide web (web) Florida Indicators Reports (Indicators), which provide summary information on school enrollment, staffing, performance and expenditures. In 1997–98, the Florida Department of Education gathered data on the class size in K–3 classrooms by school in response to a legislative request. These five databases (enrollment, staffing, facilities, Indicators, and Florida Class-Size Reports), plus the Common Core of Educational Data, School-Level database are the sources of data for this work. Details on the data used here are contained in Appendix 1.

Because of the complex and time-consuming nature of merging data from these five different databases, a sample of Florida school districts was used. School districts in Florida are countywide. The school districts that were selected are Alachua, Broward, Dade, Hillsborough, Pinellas, Santa Rosa, and Wakulla. The districts were selected in consultation with database managers to be geographically and socio-economically diverse, as well as to contain districts that generally were reliable in providing input to the state databases. This sample includes four of the larger districts in the state (Dade, Broward, Hillsborough and Pinellas), a medium-sized district (Santa Rosa), and two smaller districts (Alachua and Wakulla).

During the summer of 1998, the Florida Department of Education provided detailed raw data from the staffing, enrollment, and facilities databases for all elementary schools for the seven school districts. Each (staff, enrollment, and facilities) consisted of text files, with different layouts. The enrollment and facilities data required extensive reformatting prior to the analysis.

Each of the five data sets contained a slightly different set of schools. The end result is a final data set of 535 schools with enrollment, staffing, and class size data. Details on how the data was merged and which schools were not included are in Appendix 2.

Prices
Initially estimate the marginal resources needed to meet the policy goals measured in classrooms per student. To show how variation in prices among districts can lead to large variation in costs between districts, prices for resources used in classroom are added. The resources used in this work for all new classrooms are teachers, substitutes, aides, a leased relocatable classroom, teacher furniture, utilities, and maintenance. The most appropriate price estimates are the marginal price of purchasing one more unit of each resource (Levin, 1983). In some instances, for example utilities and maintenance, the only price estimates available are the average cost of providing those services within the district.

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10 Prices are established in a market of buyers and sellers. The prices discussed here are for goods sold to school districts. Because there are few school districts in a given area, there are few buyers for the goods, and the market may not be perfectly competitive for goods that are not easily transportable. See Drummond, O’Brien, Stoddart & Torrance, 1997.
Details on how the prices were derived are contained in Appendix 3. Table 3.1 shows the prices used in the analysis.

<table>
<thead>
<tr>
<th>District</th>
<th>Teacher Salary &amp; Benefits</th>
<th>Aide Salary &amp; Benefits</th>
<th>Leased Relocatable Classroom</th>
<th>Operations, Maintenance &amp; Utilities Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alachua</td>
<td>$32,911</td>
<td>$1,791</td>
<td>$6,000</td>
<td>$3,601</td>
<td>$43,103</td>
</tr>
<tr>
<td>Broward</td>
<td>$38,570</td>
<td>$3,655</td>
<td>$6,000</td>
<td>$4,722</td>
<td>$51,747</td>
</tr>
<tr>
<td>Dade</td>
<td>$37,674</td>
<td>$11,069</td>
<td>$6,000</td>
<td>$6,378</td>
<td>$59,921</td>
</tr>
<tr>
<td>Hillsborough</td>
<td>$33,251</td>
<td>$4,533</td>
<td>$6,000</td>
<td>$3,824</td>
<td>$46,408</td>
</tr>
<tr>
<td>Pinellas</td>
<td>$33,117</td>
<td>$5,015</td>
<td>$6,000</td>
<td>$3,817</td>
<td>$46,749</td>
</tr>
<tr>
<td>Santa Rosa</td>
<td>$31,022</td>
<td>$4,894</td>
<td>$6,000</td>
<td>$2,997</td>
<td>$43,713</td>
</tr>
<tr>
<td>Wakulla</td>
<td>$33,782</td>
<td>$5,645</td>
<td>$6,000</td>
<td>$3,862</td>
<td>$48,089</td>
</tr>
</tbody>
</table>

The average costs used in this report is $53,000, which is a weighted (by school) average.

**Teacher Salaries**

The teacher salaries are expected to reflect the price districts would have to pay for new teachers to reduce class sizes. The cost of a teacher is the teacher’s salary and benefits package and can vary considerably based on a teacher’s experience and education levels. Details on the derivation of the teacher salaries used here are in Appendix 3.

Table 3.2 shows the salary price ranges to be used in this work. Note that for several districts the low and median estimates are the same. This indicates that the distribution of salaries is skewed to the right. This skewness indicates that the mean and standard deviation would overstate the variation in the salary range of potential new teachers for these districts, because of the influence of outliers.
### TABLE 3.2 SALARY OF NEW TEACHERS IN THE SAMPLE

<table>
<thead>
<tr>
<th>District</th>
<th>25th Percentile Low</th>
<th>50th Percentile Median</th>
<th>75th Percentile High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alachua</td>
<td>$30,856</td>
<td>$32,911</td>
<td>$33,649</td>
</tr>
<tr>
<td>Broward</td>
<td>$38,038</td>
<td>$38,570</td>
<td>$48,957</td>
</tr>
<tr>
<td>Dade</td>
<td>$37,441</td>
<td>$37,674</td>
<td>$42,361</td>
</tr>
<tr>
<td>Hillsborough</td>
<td>$33,251</td>
<td>$33,251</td>
<td>$35,910</td>
</tr>
<tr>
<td>Pinellas</td>
<td>$33,117</td>
<td>$33,117</td>
<td>$35,777</td>
</tr>
<tr>
<td>Santa Rosa</td>
<td>$31,022</td>
<td>$31,022</td>
<td>$37,475</td>
</tr>
<tr>
<td>Wakulla</td>
<td>$30,743</td>
<td>$33,782</td>
<td>$36,801</td>
</tr>
</tbody>
</table>

**Operational Costs: Aides**

Costs for classroom personnel may also include an additional average cost per classroom for aides. While additional classrooms may require additional aides, based on school staffing decisions, it is assumed that additional classrooms do not require other administrative or support staff such as principals and counselors. This is based on the assumption that assignment of these personnel are based on enrollment or the existence of a school and not on the number of classrooms.

The initial cost of aides is estimated to maintain aide usage at the same intensity and salary level as was found in each district’s elementary schools in 1997–98. Later analysis will examine the effects of different policy decisions on aide staffing.

**Prices for Classroom Space**

Additional classroom spaces can come either from current space that is not used for classroom purposes or from new classrooms. The analysis contained in this chapter assumes leased relocatable or portable classrooms are the source of new space. Appendix 3 contains information on the cost leased space. It also contains information on purchased classrooms that can be used to calculate the cost of CSR if new permanent schools or classrooms are used\(^{11}\). The prices used here is $4,800 per year for leasing a relocatable plus an estimated $1,200 for teacher equipment.

**Utilities and Maintenance**

The Florida Department of Education collects district-level cost data for operations, maintenance and utilities of all facilities in each district. Operations costs are driven by custodial services. Upkeep and repair of rooms drive maintenance costs, and energy costs

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\(^{11}\) The decision whether new schools should be built is not addressed in this work. This decision is the function of many local factors that are beyond this work such as geography, demographics and development goals, and requires analysis more focused on local issues than this work.
are for lighting, heating and cooling. The cost data can be used in estimating the cost of operating new classrooms that are built for CSR.

**Methodology**
The key issue for estimating this cost marginal cost of CSR is determining the existing number of classrooms and the number of classrooms needed to reach the class size goal. The difference between the existing number of classrooms and the number needed to reach the class size goal is the additional number of classrooms needed to implement CSR. The cost of CSR is simply the additional number of classrooms times the price of a classroom.

Determining the number of classrooms is relatively straightforward using information on class size and enrollment. An important factor is that classrooms come in whole units, i.e., a school cannot add a fraction of classroom (or teacher) to reach a class size goal.

**The Ceiling and Target Class Size Measurement Options**
The methods used to determine the number of classrooms needed to reach a given class size goal for the hypothetical model and the simulations are the same. Two different policy options for measuring class size are used. The first will be called the ceiling option, and the second will be called the target option. These two options are similar to the “base” and “flexible” policies seen in Brewer et al. (1999).

The ceiling option simulates the California policy where the class size goal is a class size ceiling of what the largest size classes can be. The total number of classrooms needed to reach the class size goal using the ceiling option is determined by rounding the quotient of enrollment divided by class size goal up to the next whole number.

The target option simulates a more flexible policy where schools minimize the difference between their actual class size and the target class size. The target policy simulates the decision mechanism for allocating new teachers described by a superintendent in a small Florida district. In this district, principals were allocated funds to meet district-wide class size goals. If the sum of students above the class size target across a grade equaled 51% of the class size target for that grade, then the district would allocate another teacher to that school. For example, assume the class size goal is 20, and in year one a school has 40 students with two teachers. This would produce two classes that exactly meet the class size goal of 20 students in each class. Assume that in year two that same grade had 51 students. With two classrooms the sum of the students over the class size goal would be 11. Eleven students over the class size target would be 55% of the class size goal. This is past the 51% tipping point and the school would be allocated another teacher. The total number of classrooms needed to reach the class size goal using the target option is determined by rounding the quotient of enrollment divided by class size goal to the nearest whole number.

**The Existing Number of Classrooms in the Florida Simulation**

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Determining the existing number of K–3 classrooms in the sample of Florida schools proved to be a challenge. Several methods were attempted. The first method was to use teacher assignments from the staff database to determine the number of classrooms per grade. This method proved unworkable because of the lack of information on the number and grades taught by Title 1 teachers teaching regular classrooms and the grades taught by mixed-grade teachers.

A second potential approach was to use the reported average class size for schools found in the Indicators reports. The Indicators reports give the average class size for grades K–5 in a school. While this approach is reasonable, it was not optimal for several reasons. First, this methodology would lead to averaging class sizes across schools and would not capture grade-level variations in class size. Second, the definition of class size provided with the Indicators did not clearly exclude special education classes and other pull-out classes, which leads to suspicions that the methodology of determining class size could vary across schools or districts and would not reflect the class size experienced by the average student. Given the difficulty in measuring class size, as described in Chapter 1, it seemed likely that schools used different methodologies varying from using pupil-teacher ratios to actually counting the number of regular classrooms serving each grade. An interview with a school principal revealed that the mechanism for verifying accuracy in Indicators class size was parental complaints. The principal explained that if schools reported class sizes in the Indicator reports that were significantly different from what their children experienced, then parents would complain, leading to correction of class sizes.

This suspicion of inaccuracy in the Indicators class size was increased when the Indicators data was compared with the estimated minimum possible class size based on the staffing and enrollment data. A total number of potential regular K–5 teachers was estimated based on teacher assignments in the staffing data. This pool of total teachers includes Title 1 teachers, those assigned to mixed classes, and those with indeterminate assignments, but did not include special education or specialist (music, art and PE) teachers. Not all of these teachers are expected to be teaching in regular classrooms. Dividing the number of potential teachers into the K–5 enrollment produces an estimate of the minimum possible class size given the number of teachers assigned to a school. In 35% of schools, the Indicators class size was smaller than the minimum class size that was possible given the number of potential K–5 teachers. The difference between the Indicators class size and the estimated minimum possible class size was larger than one in 29% of the schools for the entire sample and 68% of the schools in Dade County.

There are multiple potential reasons for this difference. One is that the assignment of teachers to grades and schools in the staffing data could be incorrect. Clearly this is the case for one school in Dade County that had zero teachers assigned to it. Equally reasonable is that the Indicators class size was measured when enrollment was at a minimum for a school year, thus minimizing the reported class size. An extreme example was related by a principal whose enrollment fluctuates by 30% during the school year due
to farm worker migration. The number of teachers assigned to the school is relatively static, leading to large changes in the class size. Depending on when class size was measured in this school, the reported class size could vary by 20–30%. Equally probable cause is the use of special education, specialist and other non-regular teachers to calculate the Indicators class size. This would bias the Indicators class size down from the class size experienced by the majority of the students in a school. Regardless of the reason, the difference between the Indicators class size and the estimated minimum possible class size cast doubt on the accuracy of the Indicator class size.

A more precise and accurate source of class size information is data gathered by the Florida Department of Education in response to a request from the Florida Legislature. The request was for a count of “regular” classrooms by grade and enrollment for grades K–3. There were two complications with these data. First, the request did not include mixed-grade classrooms and thus does not provide the true number of classrooms for schools that have mixed-grade classes. Second, the data were gathered in January 1998, and thus may have different enrollment information than what is contained in the Automated Student Information System, which was collected as of October 1, 1997. This data provided the class size and enrollment for some (or all based on potential use of mixed-grade classrooms) students in January, and the enrollment data provided a count of all students in October. To resolve this issue, an integer program optimization was applied that estimated a count of classrooms by grade by minimizing the difference between the class size reported in the legislative request and the estimated class size using the October enrollment data. The final number of classrooms by grade was assumed to be the larger of either the number estimated from the optimization or the number reported from the legislative request. As discussed above, the enrollment data from the Automated Student Information System was the final enrollment data used, unless the class size data reported enrollment for a grade that did not have enrollment in the Automated Student Information System.

**RESULTS SECTION ONE: HYPOTHETICAL MODEL**

This section uses a hypothetical model of the classrooms per student required to meet policy goals to provide a basic understanding of the CSR cost function. Classrooms per student are a universal measure of CSR costs and are simply the inverse of the actual class size. The final cost of CSR is simply the price of a classroom times the classrooms per student.

Figure 3.1 shows the classrooms per student required to maintain three different class sizes (15, 17, and 20) using the target method of enforcement.
This figure illustrates three intuitive points about the relationship between costs and class size, where classrooms per student represents costs. The most obvious point is that the number of classrooms needed increases as class size decreases. The average number of classrooms per student needed to maintain a class size of 20 is about .05, while the number of classrooms needed to maintain a class size of 15 is closer to .067.

Second, costs cycle from a high cost (at an enrollment level that is one plus some multiple of the class size goal) down to a low level (at the next multiple of the class size goal). This reflects the simple relationship that when enrollment reaches some “tipping point,” an additional classroom is needed. This additional classroom is averaged across all students. An increase of 1 student can move costs over a tipping point from the lowest costs to the highest costs. In the case of a class size goal of 20, an increase of 1 student from 80 to 81 students required the addition of another teacher and increased costs by 24% when classrooms per student moved from a low of .05 to a high of .062.

A final, related, observation is that as enrollment increases, variation decreases. Increasing the number of students spreads the costs of an additional classroom across more students. With a class size goal of 15 using the ceiling method, when enrollment moves from 15 to 16, a school must add another teacher and the cost of each teacher is spread over 8 students. The next tipping point is at 31, when the school must have 3 teachers. Here
the cost of each is spread over 10 students, which is a 25% reduction in classrooms per student compared to an enrollment of 16 students.

The oscillating cost across enrollment form a cost distribution. Figures 3.2 and 3.3 show summaries of the cost distribution for the target method and the ceiling method to reach a class size of 17. The policy goal class size of 17 is used to illustrate issues seen for all class sizes. Each point represents a portion of the distribution across a range of 50 students. Three points are shown for each enrollment range, quartile 1 (25th percentile), median (50th percentile), and quartile 3 (75th percentile).

![Figure 3.2 Distribution of Classrooms Per Student for a Class Size Goal of 17 Using the Target Method](image)

There are several key points to note about the distributions shown in Figures 3.2 and 3.3. First, the median number of classrooms for the target method is constant at under .059 across all enrollment ranges while the median for the ceiling method declines continuously. The ceiling median starts at .065 classrooms per student and asymptotically approaches the minimum number of classrooms, which is .059. This means that the median of the ceiling distribution (Figure 4.3) is continually higher than the target. In fact, ceiling quartile 1 almost exactly overlaps target quartile 3. The differences between the ceiling and target distributions quickly become small. At enrollments of between 250 and 300, the difference between the two medians is about .002 classrooms per student (using Florida prices, this difference is about $100 per student).
Finally as noted above the distribution of costs is larger for smaller enrollments. That is, the range of potential expenditures to maintain a given class size is larger for smaller enrollments. For enrollments in the range of 200 to 250, the difference in costs between the median and minimum or maximum is no more than plus or minus 4% of the median cost for each enforcement method. But for the smallest enrollment range, costs can be up to 15% higher or lower than the median cost using the ceiling method. Equally important, the ceiling distribution is not symmetrical, while the target distribution is. Using the ceiling method, the minimum and maximum costs are not equal distances from the median. If enrollment levels are evenly distributed within each enrollment range, then a school or grade implementing CSR has an equal probability of falling within any two adjacent lines. Under the target method of enforcement, the range of potential costs is an equal amount above and below the median cost of maintaining a class size. But for the ceiling method, the highest cost can be 18% of the median, while the lowest costs are 10% below the median.

The focus of this work is on the school-level costs of CSR. Over a district with many schools, costs will average out to the median for the target method and to higher than the median using the ceiling method. But the costs at any one school or a district with just a few schools can be higher or lower than the median. In these situations the cost difference
can be very significant. If schools or small districts are funded at a fixed amount that is either the average or median cost for a given enrollment range, schools will face costs that are significantly higher or lower than the reimbursement. Of course, schools are not directly funded at this point, but this funding scheme is part of decentralization reforms discussed in the previous chapter.

This simple hypothetical simulation has provided some key insights into how policy choices affect the costs of CSR that will be repeatedly borne out and quantified in the remaining sections of this chapter. First, smaller class sizes cost more. Second, costs using the ceiling methods are generally higher than the target method, but these differences decrease as enrollment increases. When enrollment reaches about 300, these differences are relatively small. Finally, costs at the school level oscillate as enrollment grows, with the highest costs at lower enrollments. This results in a larger distribution of costs for small enrollments. Costs can be between 12% and 16% higher or lower for schools with enrollments between 50 and 100. This distribution is not symmetrical for the ceiling method, but instead is skewed higher. This means that costs can be much higher using the ceiling method than the target method. The highest costs for the ceiling method are 15% higher than the highest costs for the target method.

RESULTS SECTION TWO: THE FLORIDA SIMULATION
This section describes the results of a simulation of the cost of CSR across seven different school districts in Florida. The hypothetical simulation made it clear that school-level conditions are directly related to school-level costs. This finding makes it important to understand the conditions at the schools before implementing CSR. Figures 3.4 and 3.5 show class size and enrollment distributions at the school level for the schools in the sample. The school-level class size is an average across grades K–3, when mixed-grade classes are allowed. Details are provided in Appendix 4.

Each figure shows the average, minimum, and maximum levels for each district and the average across the sample. The minimum and maximum levels are shown in bar form. The averages are shown as lines. The sample average is a straight line across each chart, while the district average changes with each district.
Schools and districts implementing CSR have relatively large variation in conditions. The average class size across the sample is 24.1, with district averages ranging from 20.5 in Santa Rosa County to 26.4 in Dade County. The conditions at the school level vary even more. The largest differences within a district are seen in Broward County, where the largest class size is 45.0 and the smallest is 14.4.

As seen in Figure 3.5, conditions at schools also vary in terms of enrollment. The average K–3 enrollment for the sample school is 523, with the district average ranging from 386 in Alachua to just under 600 in Broward, a difference of over 50%. Within districts, conditions vary even more. The county-wide districts serve many different communities. In Santa Rosa, the range of enrollments is from 120 to over 1000, a difference of over eight times.

The conditions in schools vary considerably across and within districts, and this variation will lead to huge differences across schools and districts in terms of the cost of implementing CSR. The next portion begins a discussion of the costs of CSR, how these costs vary with school-level conditions, and how policy choices increase or decrease these costs.
Policy Choices and the Cost of Implementing CSR

The first choice regarding CSR is simply whether to implement it or not. A key first step in this evaluation is to compare the costs of CSR with the costs of other reforms.

The cost of CSR is compared with two school-based reforms identified in the Educators Guide to Schoolwide Reform (Herman et. al., 1999)\(^{12}\). After reviewing 24 approaches to schoolwide reform, Herman identified two elementary reforms that have “strong” evidence of positive effects on student achievement\(^{13}\): “Success for All”\(^{14}\) and “Direct Instruction.” The costs for these reforms are the ongoing operational costs. That is, they exclude the start-up costs that occur in the first three years when some additional

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\(^{12}\) For evaluations of the cost effectiveness of CSR see Levin, Glass & Meister (1987), Darling-Hammond (1998), and Grissmer, Flanagan, Kawata & Williamson (2000). The first two articles argue CSR is not cost effective, while Grissmer and his colleagues find that CSR is a cost-effective state-level reform.

\(^{13}\) Herman defined “strong” evidence as having three rigorous studies showing “educationally (or statistically) significant” effects (pp. 3).

\(^{14}\) Success for All uses reduced size classrooms for targeted instruction in specific subjects.
resources are required to implement the reform.\textsuperscript{15} The per student costs of these reforms are provided in Table 3.3 below.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|}
\hline
Reform & Average start-up costs (first 3 years), no additional personnel & Operational costs, (after first 3 years), no additional personnel\textsuperscript{16} & Operational Cost with additional personnel \\
\hline
Direct Instruction & $216 & $125 & $225 \\
Success for All & $80 & $40 & $320-$1,292 \\
\hline
\end{tabular}
\caption{PER STUDENT COST OF ELEMENTARY SCHOOL BASED REFORMS WITH “STRONG” EVIDENCE OF EFFECTIVENESS}
\end{table}

Source: Herman et al. (1999)

Each reform has higher costs during the first three years of implementation as teachers are trained. After teachers are trained, costs to maintain the program are significantly lower. These operational expenses are mainly for materials. Costs increase dramatically when additional personnel are needed to implement the reform. The need for additional personnel is a factor of the number of existing staff at the school, the ability of school management to reassign personnel, and the qualifications (classified vs. certified) of the additional personnel hired. This is similar to CSR where costs are directly related to the number and qualifications of personnel (teachers and aides) hired for implementation.

“Success for All” includes smaller classes for reading, which is usually achieved by reallocating resources within schools during reading instruction. Precursors to “Success for All,” which included subject- and ability-specific reduced class sizes, were recommended by Odden (1990) as a less costly alternative to class size reduction.

Figure 3.6 shows the average cost per student at the district level of reducing class size to 20 in four grades with three other reforms. The additional reform shown here is simply increasing regular expenditures by 10%.\textsuperscript{17} The first issue to note is the extreme variation by district in the average cost of CSR, from a low of $115 per student in Alachua to a high of $733 in Dade. This variation in costs is a function of the existing class sizes as shown above in Figure 3.4 and variation in costs shown in Appendix 5. Dade has the largest average class size of 26.4 and the highest estimated cost of a classroom at just over

\textsuperscript{15} The costs drop significantly to $40 per student for “Success for All” and $125 per student for “Direct Instruction” when additional personnel are not required.

\textsuperscript{16} Costs are provided for a 500-student school with a student to teacher ratio of between 20:1 to 25:1. The year of the nominal dollar value for the estimates was not provided. The report was published in 1999.

\textsuperscript{17} Regular expenditures do not include expenditures on exceptional, at-risk or vocational education students.
$61,000. For three of the districts, CSR is less expensive than either “Direct Instruction” or “Success for All.” This is due to the existing small class sizes in many schools so that few schools actually require additional classrooms to reach the policy goal. For example, only 57% of Alachua schools require additional classrooms to meet the policy goal shown below.

Finally note that except for the two largest districts in the sample, Broward and Dade, CSR represents less than a 10% increase in operational costs for these districts.

The information presented here can be a first step in helping policymakers decide whether to implement CSR. The total cost of CSR depends on several important policy decisions that can dramatically affect the costs of CSR. The next portion addresses the relationship between policy decisions and CSR costs. As discussed in Chapter 2, state-level policymakers may find CSR attractive given the ability to mandate a reform that can be implemented quickly. Bodilly (1998) found school-based reforms to be dependent on schools’ ability to freely choose a reform model. The implementation rate she found was slower than CSR’s implementation rate. In her sample of 33 schools, after two years of
reform 54% were implementing or fulfilling the vision of the reforms\(^\text{18}\). This can be compared to the CSR experience in California, where after two years nearly 100% of grades 1–2 and nearly 70% of kindergarten and third grade classrooms had been reduced (Bohrnstedt & Stecher, 1999). The pace and lack of control over school-based reforms may make CSR more attractive to state-level policymakers than school-based reforms, despite the potentially higher cost of CSR implementation.

**Policy Decisions Regarding CSR Implementation**

Assuming state-level policymakers choose to implement CSR, several important decisions remain regarding the class size goal, the number of students to be affected by the policy, and the class size measurement method. This portion makes some general observations on the cost behavior, building on what was seen in the hypothetical model. These general observations are later enumerated in the “rules of thumb.” To begin the discussion, Table 3.4 shows the average cost of CSR in the sample, using leased relocatable classrooms for all of the new classes.

| TABLE 3.4 AVERAGE COST OF CSR PER STUDENT, USING LEASED RELOCATABLE CLASSROOMS |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                             | Ceiling Method  | Target Method   |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Single Grade                | $1,522          | $1,106          | $648            | $1,313          | $895            | $463            |
| K–3                         | $1,363          | $950            | $488            | $1,310          | $891            | $440            |

Source: FEFP & FL Class-Size Reports

The class size goal is the first policy decision to be considered. Table 3.9 shows that the average cost of CSR in K–3 increases a relatively constant amount between the three class size goals considered here. The cost to reduce to 17 is approximately double the cost to reduce to 20, and the cost to reduce to 15 is approximately triple the cost to reduce to 20. The cost to reduce at the grade level as compared to the school level is approximately the same using the target method. But the ceiling method is approximately $150 more expensive at the grade level than at the school level. This indicates that costs for the ceiling method decline as the number of students sitting in reduced classrooms increases. However, the target method costs are approximately the same at both enrollment levels. This is not surprising given what was seen in the hypothetical model where the median (and average) number of classrooms per student was constant for all enrollment ranges.

\(^{18}\) It is also not clear that reform designers can quickly scale-up to support statewide reform implementation. During this two-year scale-up period evaluated by Bodilly (1998), roughly 410 schools worked to implement one of seven different school-based designs. This can be compared to the total number of elementary schools in Florida, which was 1,548 in 1997–98.
How costs vary across districts, and policy choices, must also be explored. Figure 3.7 shows the average cost to reduce class size for grades K–3 across all schools in each district, for the goal sizes of 15 and 20, using both the target and ceiling method of enforcement. The goal size of 17 was not included to make the figure easier to read. The method of enforcement does not significantly affect the cost of CSR when implemented across K–3 at once. Also, the difference in cost when the goal decreases are fairly constant is around $400 per student. A key point is the large variation in cost across the districts. The difference between the average cost in Dade County (the most expensive district) and Alachua (the least expensive district) ranges from $602 to $960. The average difference between Dade and Alachua is $790, which is comparable to the difference between the cost of reducing to 15 and 20 (which is $792).
Finally, policymakers must decide how many students should be affected by CSR. This question involves three issues. First, are mixed-grade classes allowed? If mixed-grade classes are not allowed, then the cost differences between reducing one grade or all of K–3 are not found. Allowing mixed grades effectively increases the number of students affected by the policy. The number of students sitting in reduced classrooms interacts with the second issue, measurement method, to affect the cost of CSR. As shown in Table 3.9, costs for reducing a single grade using the ceiling method are about $150 more expensive than when using the target method. This difference is reduced to between $40 and $60 for reduction of grades K–3 with mixed-grade classes. In other words, if the number of students to sit in reduced classrooms is around 130 (the average single-grade enrollment), costs are significantly higher using the ceiling method. As enrollment grows, this different decreases, so by enrollment of 500 (the average K–3 combined enrollment), the difference is between $40 and $60.
Finally while the cost per student may decrease when CSR is targeted towards more students, the total costs increase. Table 3.10 shows the total cost to implement CSR in the entire sample in any one grade and in all four grades. The first issue that policymakers will address is simply the amount of resources available for reduction. This issue is beyond the analysis here. Table 3.5 shows the total cost (in thousands) for implementing CSR in the sample. It makes clear the obvious point that resources required for reduction in a single grade are much less than what is required for K–3 together.

The grade-level cost in the first row is an average of the cost of reducing any single grade. Comparing the first row with the second two illustrates how the cost of reduction of one grade is much less expensive using the target method and how this difference is reduced when the number of students increases. The cost of reducing class size for all four grades without mixed-grade classrooms shown in the second row is simply the single grade cost multiplied by four. The final row shows the cost of CSR in four grades allowing mixed-grade classes.

<table>
<thead>
<tr>
<th>TABLE 3.5 COMPARISON OF TOTAL COSTS FOR CSR IN ONE GRADE AND IN K–3 TOGETHER</th>
<th>Ceiling Method</th>
<th>Target Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Single Grade</td>
<td>$115,527</td>
<td>$87,060</td>
</tr>
<tr>
<td>K–3 with Mixed-Grade Classes</td>
<td>$399,837</td>
<td>$282,185</td>
</tr>
</tbody>
</table>

Source: FEFP & FL Class-Size Reports

Allowing mixed-grade classes using the ceiling method reduces costs by about $40 million regardless of the class size goal. Using the target method, costs are essentially the same with or without mixed-grade classes. The educational costs and benefits of mixed-grade classrooms are not addressed here, only the relative dollar costs.

Another issue that is not addressed here is overall school size. The literature fairly consistently finds smaller elementary schools are associated with better student performance (Fowler, 1991).
“Efficiency” of Different Measurement Methods
Costs for the ceiling method are between 4% and 18% higher than for the target method. The largest differences between the ceiling and target method are at lower enrollments. As enrollments get larger, the difference in cost between the two methods gets smaller. The difference in costs at the lower enrollments is a product of differences in efficiency in implementation. Efficiency, in this case, is the difference between the policy goal and actual class size. In other words, efficiency measures the ability of policies to achieve the class size policy goal. Figure 3.8 shows the average class size after reduction for different enrollment ranges.

The higher costs for the ceiling method relative to the target method are directly related to the smaller class sizes after implementation. For the ceiling method, average class sizes are significantly smaller than the policy goal for enrollment ranges of 0 to 50 and remain below the policy goal for all enrollment ranges. For example, with the policy goal of 20, the average class size for enrollment between 50 and 100 is 19.4 for the target method and 18.1 for the ceiling method. This difference between actual and policy goal class sizes at low enrollments drives costs higher in small schools. At enrollment levels above 150, class sizes using the target method are essentially stable within .2 of the policy goal for all

Source: FEFP & FL Class-Size Reports
class size goals. This indicates that at enrollments higher than 150, the cost of class size reduction is at or close to minimum for the target method. At the same time, class sizes for the ceiling method decline continuously and approach the policy goal throughout the enrollment range of 50 to 750. Just as was seen in the hypothetical model, costs for the ceiling methods are expected to slowly, but continuously, decline.

The target method is clearly more efficient at meeting the policy goal than the ceiling method. At lower enrollments, both methods produce average class sizes that are different from the policy goal. The target method class sizes are closer to the policy goal than the ceiling methods, and target method class sizes more quickly approach the policy goal as enrollment increases.

**Policy Decisions: What Is Included in a Classroom?**

**Aides**

Personnel costs for teachers and aides make up the largest component of new classroom costs. Districts can choose whether to include aides as members of new classrooms and have some control over the salary paid to the teachers who fill new classrooms. As discussed in the beginning of this chapter, the baseline cost of a new classroom includes:

- a teacher at the median salary and benefits for new teachers to the district in 1997–98,
- aides’ salaries and benefits to maintain the aides to regular teachers ratio seen in a district previously, and
- the cost of a leased relocatable classroom including furniture, operations and maintenance.

CSR policy may include changing the number of classroom aides as class sizes are reduced. As discussed in Chapter 2, Project STAR found no difference in student performance between regular-sized (22–25) classrooms with aides and without aides (Word et. al., 1990). It is possible that reduced classes will not require aides. The estimated costs of aides per classroom are shown in Table 3.11. There is large variation among districts on expenditures for teacher aides. The largest costs are in Dade County, which expends $11,000 per classroom. These high costs are driven by both high numbers of aides and high salaries. This is relative to the low intensity of use and salaries seen in Alachua, which spent about $1,800 per classroom on aides.

If aides were dropped from all reduced grades, there would be considerable cost savings. In some districts, these savings are comparable to the cost of reducing classrooms. Table 3.6 shows the estimated cost of CSR per student (without aides) and the total expenditures per student on aides, as well as the total cost of reducing classrooms (without aides). In Pinellas and Santa Rosa, the expenditures on aides is more than the cost of CSR. In these districts, dropping classroom aides could free enough resources to implement CSR. In the other districts, the savings from dropping aides ranges from a low of 31% (of the cost of CSR in Broward County) to a high of 93% (of the cost in
Dropping aides in all classrooms would cover about 65% of the total cost of CSR to 20 in this sample of districts.

### TABLE 3.6 COMPARISON OF ESTIMATED EXPENDITURES ON CLASSROOM AIDES AND COST OF CSR WITHOUT AIDES

<table>
<thead>
<tr>
<th></th>
<th>Per Student Cost of Reducing to 20 Using the Target Method</th>
<th>Total Cost of CSR To 20 Using the Target Method in K–3 (in thousands)</th>
<th>Estimated Per Student Expenditures on Aides Without CSR</th>
<th>Estimated Total District Expenditures on K–3 Aides (in thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alachua</td>
<td>$111</td>
<td>$1,020</td>
<td>$87</td>
<td>$765</td>
</tr>
<tr>
<td>Broward</td>
<td>$464</td>
<td>$33,420</td>
<td>$150</td>
<td>$10,472</td>
</tr>
<tr>
<td>Dade</td>
<td>$600</td>
<td>$66,319</td>
<td>$421</td>
<td>$45,781</td>
</tr>
<tr>
<td>Hillsborough</td>
<td>$207</td>
<td>$11,200</td>
<td>$210</td>
<td>$10,376</td>
</tr>
<tr>
<td>Pinellas</td>
<td>$172</td>
<td>$6,011</td>
<td>$232</td>
<td>$7,798</td>
</tr>
<tr>
<td>Santa Rosa</td>
<td>$111</td>
<td>$880</td>
<td>$252</td>
<td>$1,458</td>
</tr>
<tr>
<td>Wakulla</td>
<td>$313</td>
<td>$436</td>
<td>$241</td>
<td>$339</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$119,286</strong></td>
<td></td>
<td><strong>$76,989</strong></td>
</tr>
</tbody>
</table>

Source: FEFP & FL Class-Size Reports

Of course, replacing aides with classrooms to reduce class size can be difficult and have some unintended consequences. Many of the aides are paid by Title 1 funds from the federal government. The 1994 reauthorization of Title 1 made schoolwide programs much easier for schools with a large proportion of low-income students (Palmaffy, 1999). In those schools that qualify for schoolwide programs, districts may be able to replace Title 1 aides with teachers for reduced size classrooms. In schools that do not qualify for a schoolwide Title 1 program, this transition may be difficult. School officials may also resist loss of aides in grades K–3 if the aides’ activities are more valuable than reduced class sizes. For example, in those classrooms that are already below the class size goal, removal of aides would represent a net reduction in classroom resources. The loss of the aides may be small since districts with small existing class sizes are also those that expend little on aides but would surely be noticed as the aides’ duties are reassigned. Finally, the aides themselves could resist job loss and make it politically difficult to completely replace them with classroom teachers.

**Teachers**

Another classroom component districts have some influence over is the teacher who occupies a classroom. Teacher salaries are generally a function of teacher experience and education. School districts can implement policies that attempt to fill classrooms with teachers who are either more experienced or more educated (and higher priced). If
districts are concerned about costs, they can put in policies that select teachers who are less experienced or educated, and are thus less expensive. However, district choices are constrained by state policies that set minimum education levels for teachers and by the teachers available in the labor market.

The distribution of salaries for new teachers in the sample districts was shown earlier in Table 3.3. It gives some indication of the availability of teachers of varying qualifications and costs. There is little or no difference between the 25th percentile and the median salaries. This indicates that districts are generally hiring a substantial number of teachers near the bottom end of the salary scale. Given the fact that districts are already hiring many teachers near the bottom of the salary scale, they may have little flexibility in finding more lower salary teacher than they are currently hiring. Salaries at the 75th percentile are noticeably higher. For example, salaries in Broward at the 75th percentile are 129% of the 25th percentile. For the remaining districts, the difference between lower and higher salary new teachers is between 8% and 21%. Taken together this suggests that districts may have the ability to use higher salary teachers for reduced classrooms, but less ability to find lower salary teachers for new classrooms.

During implementation of CSR, it may be difficult for school districts to raise entrance qualifications because it will reduce the pool of applicants at the same time that CSR increases the demand for new teachers. Ballou and Podgursky (1995) argue that raising entrance qualifications of teachers will reduce the pool of potential teachers. Findings on changes in teacher qualifications discussed in Chapter 5 indicate that the teacher labor market became very tight during CSR implementation in California. The end result is that many of the teachers hired during this period had lower qualifications (i.e., uncertified and minimum education levels).

School districts in Florida may not have much flexibility in the salary levels they pay during CSR implementation. Most new teachers in the sample are hired near the bottom of the salary schedule, and the teacher labor pool in Florida may not have enough higher qualified (and more expensive) teachers to fill new reduced classrooms.

Capital Costs
Capital costs are the costs for additional classroom space. Decisionmakers at schools have several options for finding this space, including building new classrooms, adding relocatable classrooms, displacing other school functions in favor of classrooms, or developing some mixture of these options. In this portion, the relative short-term capital costs are evaluated for several different policy options:

- leased relocatable classrooms for all new classes,
- use of any existing classrooms not currently assigned to teachers for new classes, and
- use of non-instructional space for new classes.
The first issue is how many classrooms need to be added to reach the policy goals. Table 3.7 shows the median number of added classrooms per school for the various CSR policies. For example, to reach a class size of 15 at the school level, the median number of added classrooms is 12 using the target method. The estimated cost of a leased relocatable classroom is $6,000 per year including furniture. Added to this are operations and maintenance costs that average $4,930 in the sample. Using relocatable classrooms increases the cost of CSR above personnel costs by between 25 and 28%.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Ceiling method</th>
<th>Target method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Grade</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>K–3</td>
<td>13</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: FEFP & FL Class-Size Reports

Very few schools in this sample appear to have existing classroom space that is not being used as classrooms. Of the 535 schools in the sample, a large majority, 447, have relocatable classrooms with an average of six relocatable classrooms per campus. About 10% of all classrooms in the sample are relocatable classrooms. The presence of relocatable classrooms implies that all available space is being used for classrooms. Of the remaining schools that do not have relocatable classrooms, 33 have “extra” classroom space. The median number of extra classrooms is four. Use of this extra space at these schools would reduce the number of classrooms needed by four per school for reduction of grades K–3, and two classrooms per school for reduction of any single grade. Use of this extra space produces relatively small cost savings. For example, for the entire sample, the cost of leasing relocatable classrooms to reduce class size to 20 for grades K–3 is just over $16 million. The savings from using extra space are estimated to be under $700,000 or about 4%. For the different class size goals and enforcement mechanisms, the savings from using extra space is between 2 and 6%.

Non-Classroom Space Available at the School Level

If necessary, rooms in schools that are currently used for other purposes can be converted to classrooms. These rooms include specialist classrooms (i.e., music, art and computer laboratories), libraries, gymnasiums, and non-instructional space such as lounges and auditoriums. Use of these spaces for classrooms eliminates their availability for their intended use. Table 3.8 shows the number of schools that have different types of space and the median number of classrooms that could be created. For example, of the 535 schools in the sample, 400 have specialist classrooms and 488 have libraries that are large enough to be converted into classrooms. Each has approximately three specialist classrooms, and conversions of the libraries to classrooms would create approximately two classrooms per school.
Use of this space for new classrooms can produce large cost savings. The amount of money saved is related to the number of rooms needed to reach the classroom goal and the supply of rooms from conversion. The cost savings from using each of the different groups of space for new classrooms are detailed in Appendix 6. The largest source of potential classrooms is libraries and specialist classrooms. Conversion of either type of space into classrooms will reduce the costs for classroom space by 14–46% if implementing in grades K–3 and 46–83% when reducing in one grade. Of course conversion of this space replaces the current use with classroom use. The cost savings must be balanced with the cost of lost libraries, music classes, PE classes, and auditoriums. Conversion of all these rooms to classrooms will meet only about two-thirds of the classroom needs for reduction of K–3 to 20.

The key question is if the dollars saved from using the existing space, or conversion, is worth the cost of displacing the current function with a reduced classroom. This is a difficult decision to make without more information on what the space is currently being used for. The best information on current space usage is at the school level. Those at the school level are well aware of the cost of lost activities from space converted to classrooms. The lost space could be a room converted from storage use to classroom use, or playground space lost when a portable classroom is added. Those at the school level do not often pay the cost of purchasing or building new classroom space. This makes those at the school very aware of the costs of losing existing space for new classrooms but not aware of the dollar cost of leasing new classrooms.

The converted space may be used to temporarily reduce the demand for new classrooms. This may be useful during a temporary shortage of relocatable classroom space or while new permanent buildings are being constructed.
SECTION THREE: RELATIONSHIP BETWEEN EXISTING CONDITIONS AT SCHOOLS AND CSR COSTS

The previous section contained observations about the cost of CSR in the sample of Florida schools. In this final section, the “rules of thumb” about the cost of CSR are created for use by policymakers outside of Florida. The rules of thumb show the cost ramifications of policy decisions, and in Chapter 4 will be shown to be an effective method for estimating reimbursements for CSR implementation.

The rules of thumb are translations of the results from multivariable regressions into plain language. The regression methodology is described first, followed by a discussion of the regression results culminating with the rules of thumb.

Regression Methodology
To make the results more generalizable, the regressions were run using classrooms per student as the cost measure. The regressions were run on a data set that contained the cost estimates of CSR in each individual grade and K–3. Each school provided five observations, one per grade and the sum of all four grades together, for a total of 2,634 observations.

The regression was only run for schools and grades that did not already meet the policy goal. Thus these predictions only hold for schools and grades that do not meet the policy goals before implementation. Using only grades and schools that require additional classrooms makes these findings more applicable to other schools and districts. If schools and grades that did not require additional classrooms were used, then these findings would be more dependent on the distribution of class sizes in the sample and less applicable to other districts with different class size distributions.

Many different model specifications were examined. The independent variables used in the models reflect the intuition gathered from the hypothetical model; i.e., the relationship between enrollment and cost is non-linear, the relationship between class size and cost is linear, and costs are higher at small enrollments. Given these general lessons, the model that was used maximizes the variation explained for all the six different options (ceiling and target for 15, 17 and 20) and maintains simplicity. The model explained at least 80% of the cost variation for each of the different policy options. Table 3.9 lists the independent variables used in the model. The regression coefficients are found in Appendix 7.
TABLE 3.9 COEFFICIENTS FOR MODEL DESCRIBING THE COST OF CSR

<table>
<thead>
<tr>
<th></th>
<th>Existing class size</th>
<th>Enrollment</th>
<th>Enrollment squared</th>
<th>Enrollment less than 49</th>
<th>Enrollment between 50 &amp; 99</th>
<th>Enrollment over 250</th>
</tr>
</thead>
</table>

Regression Results

Table 3.10 provides predicted cost estimates using the regression coefficients. These can provide a baseline for comparisons. These cost estimates are significantly higher than the ones shown in Table 3.4 because they only include schools that need to add classrooms to reach the policy goal. The appropriate comparison is with the averages shown in Tables 7 and 8 of Appendix 5, which are higher than these predictions. The largest differences in the estimated costs and the actual costs seen in the sample are with the class size goal of 20. The predicted cost for the target method at the grade level is 33% lower than the average costs in the Florida simulation. This difference is within the margin of error of the estimation model. The difference is caused by the fact that the predicted costs are for grades of average size, controlling for costs at lower enrollments, while the averages are increased by several extremely high costs at relatively low enrollments. A secondary reason is that the average costs are weighted by grade while the costs used in the regression are weighted by classroom. If average costs are weighted by classroom, the difference between the average and the regression estimates is slightly reduced.

TABLE 3.10 ESTIMATED COST OF CSR BASED ON THE REGRESSION MODEL

<table>
<thead>
<tr>
<th>Measurement Mechanism</th>
<th>20</th>
<th>17</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ceiling</td>
<td>Target</td>
<td>Ceiling</td>
</tr>
<tr>
<td>Enrollment 130</td>
<td>$668</td>
<td>$501</td>
<td>$1,098</td>
</tr>
<tr>
<td>Enrollment 500</td>
<td>$488</td>
<td>$463</td>
<td>$955</td>
</tr>
</tbody>
</table>

Source: FEFP & FL Class-Size Reports

The regression results provide a key insight on the quantification of the higher costs associated with the lower enrollment levels. Remember that the costs are the average for schools that do not already meet the policy goal. Thus these are not the average costs for all schools, just for schools that need to add classrooms to meet the policy goals. The coefficients for the dummy variables “Enrollment less than 49” and “Enrollment between
50 and 99\textsuperscript{"} are all positive. Table 3.11 uses the results of the regression to estimate the increase in costs when enrollment is fewer than 99 and fewer than 49. Clearly these results show costs increase significantly as enrollment moves below 100 and below 50. The increases in costs for enrollment under 50 are very large, up to double the cost per student for enrollments of 130 at the same class size. The increases in costs for enrollments between 50 and 100 are much smaller.

<table>
<thead>
<tr>
<th>Enforcement Mechanism</th>
<th>20</th>
<th>17</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling</td>
<td>15%</td>
<td>*16%</td>
<td>*10%</td>
</tr>
<tr>
<td>Target</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average increase in cost changing enrollment from 130 to under 100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased cost moving enrollment from 130 to 45</td>
<td>*118%</td>
<td>*154%</td>
<td>*39%</td>
</tr>
</tbody>
</table>

* Indicates significant coefficient at the .05 level

Source: FEFP & FL Class-Size Reports

Many schools with low enrollments had small class sizes. The average class size for enrollment under 50 is 20.0, 4.3 students per classroom smaller than the entire sample. In this analysis, those schools with small enrollment and smaller class size are dropped. For those that did need to add classrooms, the costs are very high. These costs are higher because the base number of students this cost is spread over is small. For example, compare two schools with a class size of 22.5, one with 45 students and two classrooms and another with 90 students and four classrooms. Each needs to add an additional classroom to reach a class size goal of 20. The cost per student for the small school would be $1,191 compared to the larger school where the costs are roughly half at $595.

The next issue is the general relationship between cost and class size. All of the coefficients on class size are significant and relatively similar from .00125 to .00166.\textsuperscript{19} When converted to dollars, these coefficients indicate that for each change of existing class size by one student, the cost of CSR changes by $70 for reduction to 20, $84 for reduction to 17, and $89 for reduction to 15, for an average of $80 per student.

The hypothetical model indicated that, above small enrollments, the relationship between cost and enrollment is relatively flat for the target method and ceiling costs approach those of the target method. The relationship for smaller enrollments was described earlier. Figure 3.9 shows the estimated cost of CSR for enrollment ranging from 100 to 700 holding class size constant at 24.

\textsuperscript{19} They are not statistically the same at the .05 level.
The data presented in Figure 3.9 confirm some relationships among enrollment, measurement method, and cost seen in the hypothetical model. The costs for the target method are basically unchanged as enrollment changes. Several models were used that introduced non-linear enrollment terms, which did not affect the final relationships.

The differences between the ceiling and target methods are fairly similar for all class size targets. At enrollment of 130, the difference ranges from $165 to $196. All of these differences hit a minimum level at enrollment around 500. The differences decline along a non-linear path. It declines quickly at lower enrollments and then less rapidly as enrollment increases. The minimum difference is between $23 and $40 with an average of $33. The increasing differences above 600 are small and are most likely a product of the enrollment-squared term and not accurate representations of the behavior of costs. The breaks in the lines at enrollment of 250 are a product of the fixed-effects portion of the model that was employed to capture differences between medium enrollments of 100 to 250 and large enrollments above 250.
Rules of Thumb

The basic relationships between the cost of CSR and school-level conditions have been discussed above. Costs increase by a relatively constant amount as the class size goal moves from 20 to 17 and 15. Costs change by about $80 for each increase or decrease of one from the existing class size of 24. Costs are higher for smaller enrollments. Costs are higher when using the ceiling method. The difference between the ceiling and target methods declines as enrollment increases.

The only remaining issue needed to complete the rules of thumb is to approximate the changes in costs for the ceiling method as enrollment decreases. The difference between the target and ceiling methods declines at a non-linear rate. The difference declines quickly at lower enrollments and then less rapidly at enrollments above 300. A simple linear approximation of this difference is $240 at enrollment of 100. The “ceiling penalty” declines at a rate of $.75 for each student when enrollment increases over 100, until the difference hits $40 at an enrollment of 367. From this point on, the difference remains at $40. This approximation overestimates the penalty at low enrollments (100 to 275) and underestimates the penalty at higher enrollments (367 to 500).

The rules of thumb essentially provide an average cost per student for a given enrollment range and existing class size. Note that these rules are for estimating the cost per student in schools that need to add classrooms to meet policy goals. They are provided in dollar terms but can be converted to rooms per student by dividing by $53,000 (the cost of a staffed, relocatable classroom). Their range of applicability is for class sizes between 20 and 32, and enrollments between 50 and 750.

1. **Base Cost:** Costs for the target method increase in $435 increments. To reduce from a class size of 24 to a class size of 20 costs approximately $435 per student; to reduce to 17 costs double this or $870; and to reach 15 costs $1,305 (3 x $435) per student.

2. **Class Size Cost:** For existing class size, each change of one student above or below 24 add (for an additional student) or subtract (for each reduction of one student) $80 from the base amounts listed above.

3. **Ceiling Penalty:** Costs are higher for the ceiling method and are related to enrollment. The additional cost can be estimated by adding $240 to the sum of the base and class size costs described above for enrollment of 100. This penalty is reduced by $.75 for each additional student above 100 up to enrollment of 367, where the difference of $40 per student should be maintained for all higher enrollments.

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20 Estimates for existing class sizes above 32 overestimated the costs seen for the Florida sample by between $158 and $185 using the ceiling method, and about $85 for the target method for goals of 15 and 17, and $166 for a goal of 20.

21 Estimates were made for the Florida sample for enrollments up to 1350 and were no less accurate than estimates for lower enrollment levels. But the sample size for these larger enrollments was relatively small and thus estimates for this enrollment range are harder to support. Costs vary dramatically at enrollments under 50, making estimates very inaccurate.
4. **Low-Enrollment Penalty:** Costs are significantly higher for enrollments under 100 for all methods. These differences are summarized in Table 3.12 below. The base cost calculated using the first three steps above multiplies by these additional cost factors to reach the final cost estimate.

<table>
<thead>
<tr>
<th>Class Size Goal</th>
<th>Enforcement Mechanism</th>
<th>20</th>
<th>17</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplication factor if enrollment is between 50 and 100</td>
<td>Ceiling</td>
<td>Target</td>
<td>Ceiling</td>
<td>Target</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10%</td>
<td>10%</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Fit of the Rules of Thumb**

To learn more about the accuracy and precision of the rule of thumb estimates, they were compared to the costs from the original simulation. There is large variance in costs especially at low enrollments. For example the standard deviation in cost estimates for enrollment between 50 and 100 ranges from $185 to $222. This makes precise cost estimates at lower enrollments more difficult since these predictions are basically of average costs for an enrollment range. When costs vary extremely, predictions using the rules of thumb will be less accurate.

One way to examine the relative precision of the rules of thumb is to segment the sample into different enrollment ranges in increments of 50 students (i.e., 0–50, 51–100, 101–150, etc.) and examine the average and standard deviation of the difference between the rule of thumb estimates and simulated cost. The average difference between the estimated cost using the rules of thumb and the simulated cost is largest for the ceiling method. Figure 3.10 shows the average difference and standard deviation of this difference between the rules of thumb cost estimate and the simulated cost estimate for reduction of K–3 to 20 using the ceiling method.
The average difference ranges from negative $54 to $16, with most differences within plus or minus $20. The standard deviation of the difference is very large at lower enrollments, and quickly falls to under $100 for enrollments over 150. The standard deviations are indicators of the precision of the rules of thumb. The distribution of difference between the simulated and rule of thumb estimated costs are generally normally distributed.\textsuperscript{22} This indicates that about 70\% of the actual costs are within plus or minus one standard deviation of the estimated costs using the rules of thumb.

\textsuperscript{22} The Shapiro-Wilk test indicates that the difference between the estimated cost using the rules of thumb and the simulated cost are normally distributed for all policy options and for enrollment groupings under 300 at the .1 level except class size goals of 17 and 20 using the target method. For enrollment groupings over 300, the sample sizes are smaller and the majority of the differences are not normally distributed.
The standard deviations for enrollment under 50 are approximately $400, moving to $200 for enrollment between 50 and 100, and approximately $150 for enrollments between 100 and 200. For enrollments over 200, the standard deviation ranges from $25 to $91 with an average of about $75.

In other words, at small enrollments, the rules of thumb are not very accurate, but as enrollment increases the accuracy of the rules of thumb estimates increase. At enrollments over 200, the rules of thumb are within $75 of actual cost the majority of the time.

CONCLUSIONS
The aim of this chapter was to provide state and federal policymakers with information about the cost ramifications of CSR implementation policy decisions. This information should help them as they contemplate important decisions regarding whether to implement CSR, the CSR class size goal, the number of students to sit in reduced classrooms, the class size measurement mechanism, and reimbursement strategies. The chapter proceeded through three sections to get a complete understanding of the cost of CSR. The first section used a hypothetical model to understand the basic behavior of the cost function. The second used a simulation of CSR in seven Florida school districts to understand how CSR would affect real schools and districts. The final section used regression analysis to quantify the cost of CSR in “rules of thumb” that generalize the cost of CSR beyond the Florida sample.

The hypothetical model outlined key features of the CSR cost function. These features include:

- larger cost variation at low enrollments,
- much higher costs for ceiling method at low enrollments, with decreasing, but constantly higher, costs as enrollments increase to 750, and
- higher cost as class size goals decrease.

The next section used a cost simulation in seven Florida school districts to make the cost of CSR more concrete. In this sample, the average cost of CSR was generally higher than the operational cost of two school-based reforms that have been identified as having “strong” evidence of effectiveness. In all but the largest districts, CSR was less than or equal to a 10% increase in operational expenditures.

The simulation showed that higher costs at lower enrollments and using the ceiling method are caused by differences between the actual class sizes and the policy goals. For example, at enrollments between 50 and 100, the average class size when reducing to 20 is 18.1 using the ceiling method and 19.4 using the target method. The ceiling method is less efficient than the target method in that class sizes with the ceiling method are farther from the goal than class sizes using the target method.
The next issue addressed was the flexibility that Florida policymakers may have in changing classroom components. The new teacher salary distribution showed that most new teachers were being hired at the low end of the salary schedule. This implied that districts would have little flexibility in lowering teacher salary costs for CSR. The data are not adequate to inform the question of whether districts could find higher paid teachers to implement CSR. While districts did hire some more experienced and better educated teachers (as well as higher paid), it is not clear if the supply of the better qualified teachers is adequate to fill extra classrooms created by CSR. Reallocation of funds spent on aides to CSR could provide about 65% of the total cost of reduction to 20, covering the entire cost in districts that already had smaller classes.

In the sample there was little indication that schools had available space for extra classrooms. Most of the schools in these districts already had relocatable classrooms, indicating there was little existing “extra” classroom space. In the 88 schools that did not have relocatables, only 33 had more classrooms than teachers. Use of these classrooms would reduce the classroom costs by about 4% (for reduction to 20 using the target method). Most schools did have specialist classrooms, libraries, gymnasiums and other space that could be converted to classroom space. Use of this space would fill about two-thirds of the classroom demands of CSR to 20.

Through a multivariant regression, the simulation results were used to create four simple rules of thumb that related the cost of CSR to existing conditions and policy choices. They highlight how much school-level conditions interact with policy decisions to vary costs. These rules are:

1. **Base Cost:** There is a base cost of about $435 per student for reduction from 24 to 20 using the target method. This base cost doubles for reduction to 17 and triples for reduction to 15.

2. **Class Size Cost:** Each increase or decrease of existing class size above or below 24 adds or subtracts $80 to the base cost. This class size cost is about 20% of the base cost for reduction to 20.

3. **Ceiling Penalty:** Using the ceiling method adds about $240 to the base cost for enrollment of 100. The ceiling penalty declines in a (roughly) linear fashion as enrollment increases to about 370. Above 370 the penalty is a constant $40.

4. **Low-Enrollment Penalty:** Cost are higher for schools with low enrollments, 10% above the sum of base cost, class size cost, and ceiling penalty for reduction to 20 and 5% higher for reduction to 17.

The rules of thumb were calculated using $53,000 as the cost of a new classroom. These rules of thumb can easily be applied to areas with different classroom costs. First, divide the amount in the rule of thumb by $53,000, and then multiply by the new classroom cost.
cost. For example, using the estimated classroom cost in Santa Rosa of $48,000 reduces the Base Cost from $435 to $394, and the Class Size Cost from $80 to $72.  

Policy choices clearly matter for the costs of implementing CSR. The rules of thumb are expected to meet education policymakers’ need for information on the cost implications of CSR implementation decisions. These choices are not just whether or not to implement CSR, but for which groups of students, to what size, and which enforcement mechanism to use.

Several points are clear. Obviously, lower target class sizes increase the costs. Using the target method from a class size of 24 costs double when the class size goal increases to 17 from 20 and triple when going to 15. Second, the cost of reduction is higher, on average, in smaller schools regardless of the measurement method. Finally, using the ceiling method of enforcement significantly increases costs because actual class sizes are much smaller than the policy goal. In other words, the ceiling method is not an efficient way of enforcing class size targets.

The issue of higher costs in smaller schools may be a particular problem for rural districts. In the Florida sample, the average K–3 enrollment of rural schools was 330, about 200 students less than all other schools in the sample. While this average was above the enrollment where the “rules of thumb” suggest costs are higher, rural schools may warrant special attention. As was discussed, the high costs in smaller schools occur when a school has a small number of students above the “tipping” point that requires an additional teacher to meet the policy requirements. In urban areas, districts may have some flexibility in reassigning a small number of students to other schools to move the enrollment in that school below the tipping point, and thus avoid the higher costs. But rural schools, or any area with few neighboring schools, will have less flexibility in reassigning students, and as shown here face higher costs.

\[ \text{Cost} = \frac{\text{Base Cost}}{53,000} \times 48,000 \]

23 $394=(435/53,000)*48,000, $72=(80/53,000)*48,000