Congestion in Public Elementary Schools

Michael M. Alba

1. Introduction

This note presents the results of a programming exercise that, using SY 2007-2008 data from the Basic Education Information System (BEIS) of the Department of Education (DepEd), estimates the number of public elementary school students who were underprovided with school inputs, the number of schools where underprovision prevailed, and the magnitudes of the implied resource gaps. This exercise was first undertaken by Honesto Nuqui for public high schools in a World Bank evaluation study of the the Education Services Contracting (ESC) scheme (World Bank, Forthcoming). Alba (Forthcoming) conducted a similar exercise (also for public high schools) using a slightly different set of assumptions.

As pointed out in Alba (Forthcoming), this exercise may be considered a complement of and adds value to traditional statistical analyses of school input ratios, since "an unsatisfying aspect [of such analyses] is that [they do] not provide a sense either of the extent of congestion in schools … or of the resources needed to address the problem." In addition, the exercise is "an example of an activity that DepEd planners and policy makers can do on a regular basis to improve the internal efficiency of the public school system (in the sense of aligning school inputs with the enrollment level)."

The rest of this paper is organized as follows: The next section briefly discusses the assumptions and features of the programming model. The third section describes the data set and variables used in the exercise. The fourth section presents the results. The fifth section concludes.

2. The programming model

Assume that a public elementary school can have at most two shifts. Let single-shift schools remain with one shift, and restrict all other schools to two shifts. Require each student to have a seat, i.e., a desk, armchair, or table-chair set. Consider the following as classrooms: academic classrooms, science laboratories, home economics rooms, industrial arts workshops, computer laboratories, and rooms not currently being used. Assume that each classroom can accommodate 36 students (as set by DepEd), and assign one teacher to each classroom (i.e, unlike in high school, subject specialization is not needed at the elementary level). For the high (low) estimate, count only (both) the nationally-funded (and locally-funded) teachers and exclude (include) rooms that are not currently in use.

Let capacity (in terms of number of students that can be accommodated) in school *i* be determined by

$$k_i^* = \min \{t_i^*, c_i^*, r_i^*\},$$

where t_i^*, c_i^*, and r_i^* are, respectively, the (different) enrollment levels implied by school *i*'s size of teaching staff, number of seats, and number of classrooms, given the number of school shifts it has. Specifically,

$$t_i^* = \delta_i n^t t_i, \qquad c_i^* = \delta_i c_i, \qquad \text{and} \qquad r_i^* = \delta_i n^r r_i,$$

where δ_i is the number of shifts school *i* has, t_i is the size of its teaching staff, r_i is the number of classrooms it has, and n^t and n^r are, respectively, the ideal student-teacher ratio and ideal class size. In effect, the capacity of a school is set to the lowest enrollment level that its resources can handle.

Define congestion by

$$d_i^e = \max\ \{n_i - k_i^*, 0\},$$

where n_i is the enrollment level in the *i*th school. That is, congestion is simply the number of students in excess of a school's capacity or zero, whichever is larger.

Finally, define shortage in each input by

$$s_{ij} = \max\ \{j_i^s - j_i^a, 0\} \quad \text{for } j = t\text{[eachers]}, c\text{[hairs], and } r\text{[ooms]},$$

where j_i^a is the actual number of inputs (i.e., teachers, seats, and classrooms) in school *i* and

$$j_i^s \equiv \begin{cases} t_i^s = \dfrac{n_i}{\delta_i n^t} & \text{for teachers} \\ c_i^s = \dfrac{n_i}{\delta_i} & \text{for seats} \\ r_i^s = \dfrac{n_i}{\delta_i n^r} & \text{for rooms.} \end{cases}$$

In other words, given the ideal student-teacher ratio and class size as well as its enrollment level n_i and number of shifts δ_i, a school's shortage in input *j* is simply the difference between the amount of resources needed and its actual resource count. (In the exercise, $n^t = n^r = 36$.)

3. The data set

As mentioned above, the data for this exercise are culled from DepEd's BEIS for SY 2007-2008. The data set consists of 37,306 public elementary schools. But information on teachers, seats, and classrooms are inadvertently not encoded in the BEIS for 29 schools in School District Sibagat of Agusan Del Sur, Caraga Region. Hence, these schools are excluded from the analysis.

Of the 37,277 remaining schools, 36,486 are one-shift schools, 714 are two-shift schools, 74 are three-shift schools, two are four-shift schools, and one school has a missing value. Accordingly, in the exercise, 791 schools are treated as having two shifts.

Table 1 presents the national count as well as the regional distribution of enrollment, schools, teachers, seats, and classrooms for the 37,277 public elementary schools in the data set.

Table 1
Frequency Distribution of the Variables, SY 2007-2008

	Enrollment	Schools	Nationally Funded Teachers	Locally Funded Teachers	Seats	Classrooms	Rooms not used
National	12,199,744	37,277	337,063	81,218	7,143,376	318,083	6,279
NCR	1,199,560	511	26,988	1,348	538,124	15,048	125
Ilocos	608,364	2,366	20,924	2,520	470,086	21,761	184
CAR	210,482	1,467	7,621	641	158,141	7,651	144

Table 1
Frequency Distribution of the Variables, SY 2007-2008

	Enrollment	Schools	Nationally Funded Teachers	Locally Funded Teachers	Seats	Classrooms	Rooms not used
Cagayan Valley	424,402	2,164	14,342	1,353	284,370	14,958	234
Central Luzon	1,230,566	2,908	33,033	3,021	812,327	34,358	656
CALABARZON	1,432,416	2,685	33,997	1,762	930,282	32,684	357
MIMAROPA	436,431	1,785	12,233	1,112	224,545	11,963	166
Bicol	913,776	3,123	25,416	1,086	458,417	24,594	565
Western Visayas	980,603	3,380	31,912	1,961	724,948	32,091	542
Central Visayas	916,997	2,897	24,569	1,545	529,915	23,752	848
Eastern Visayas	668,803	3,591	21,136	1,031	447,198	20,098	549
Zamboanga Peninsula	532,498	2,039	15,619	58,195*	304,672	14,915	440
Northern Mindanao	607,014	2,049	17,228	439	308,833	16,409	369
Davao	590,382	1,617	16,150	942	320,951	15,359	341
SOCCSKARGEN	567,021	1,607	14,166	2,198	279,985	13,613	255
ARMM	619,471	2,035	13,675	1,593	195,199	11,587	416
Caraga	260,958	1,053	8,054	471	155,383	7,242	88

* This extreme value is due to the fact that Sapa Seco Elementary School (School ID 126171) in Manicahan School District of Zamboanga City is reported in the BEIS as having 57,533 LGU-funded teachers. Except for pushing out the teaching capacity of this one school in the low-estimate set of assumptions, this data point does not otherwise affect the results of the exercise.

4. The results

Table 2 provides a national summary of the results of the programming exercise. It shows that in SY 2007-2008 about 4.8 million students in 33.5 to 33.7 thousand public elementary schools were underprovided with school inputs. Put another way, about 40 percent of the 12.2 million elementary school students did not have the appropriate combination of teachers, seats, and classrooms, and 90 percent of public elementary schools could not provide their students with the right mix of these inputs. At the same time, however, 3.6 to 3.8 thousand schools were undersubscribed, with the empty seats summing up to 146.0 thousand to 154.5 thousand. It can thus be said that inefficiencies in the public elementary school system involved not only congestion in most schools but also underutilization of available resources in a few schools.

Table 2
National Estimates, SY 2007-2008

	High Estimate	Low Estimate
Excess students	4,829,511	4,791,358
Oversubscribed schools	33,685	33,478
Empty seats	146,041	154,516
Undersubscribed schools	3,592	3,799

Figure 1 presents the regional distribution of these excess students. It shows that the regions with the highest number of such students were the National Capital Region (NCR), Central Luzon, CALABARZON, Bicol, Central Visayas, and the Autonomous Region for Muslim Mindanao (ARMM), whereas the regions with the least number were Ilocos, Cordillera Autonomous Region (CAR), Cagayan Valley, and Caraga.

Figure 1
Regional Distribution of Excess Students, SY 2007-2008

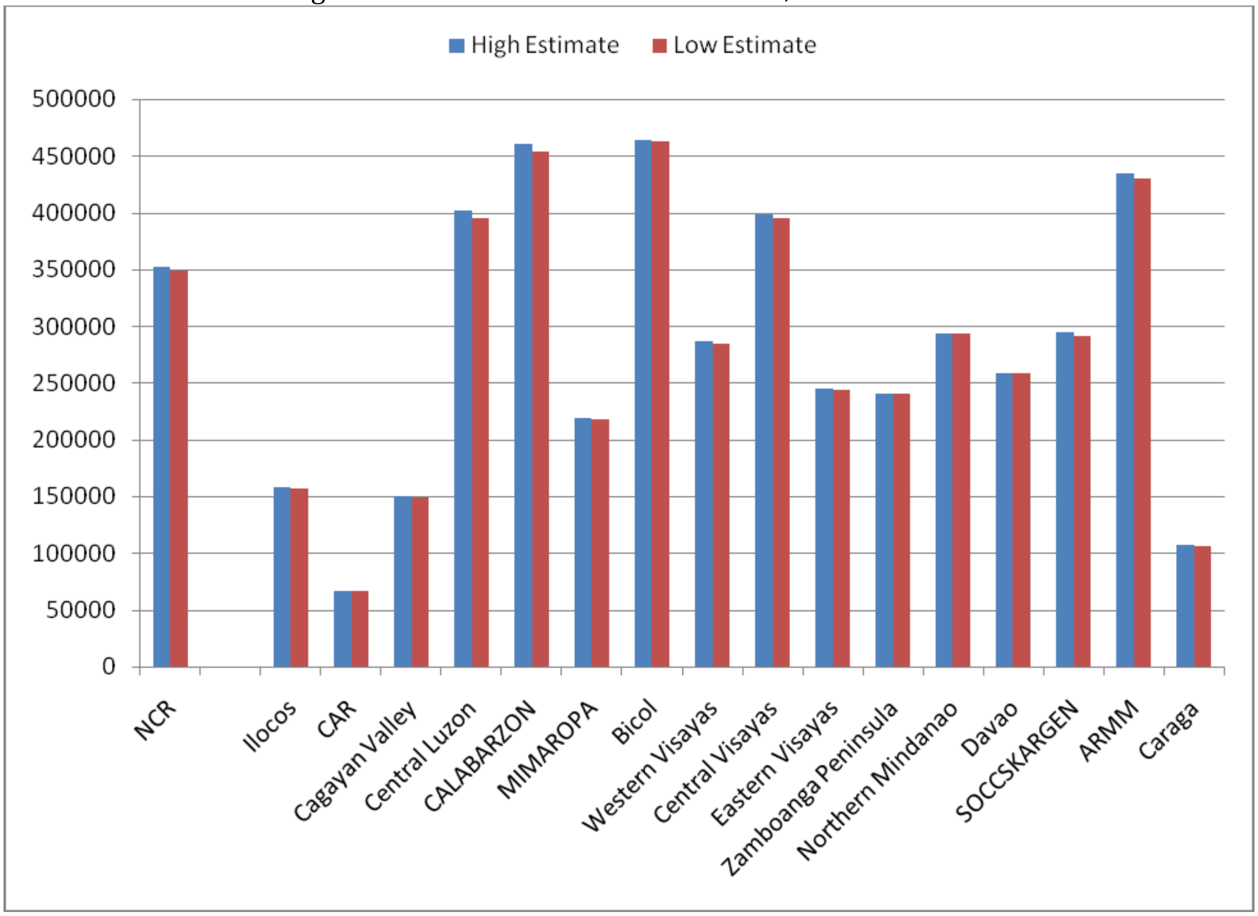
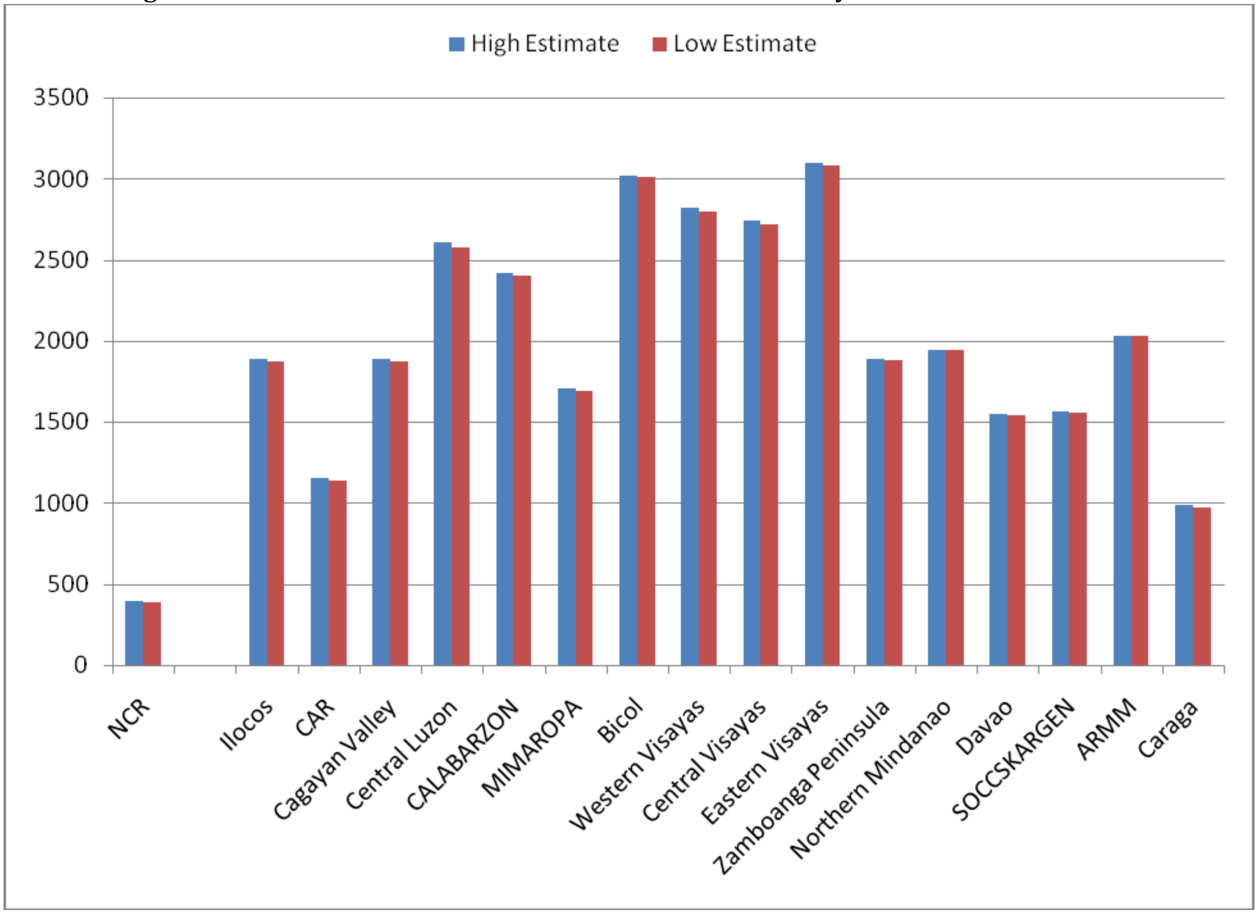


Figure 2 shows the regional distribution of oversubscribed schools. Regions with the most number of these schools turned out to be Central Luzon, CALABARZON, Bicol, Western Visayas, Central Visayas, and Eastern Visayas, while regions with the least number of these schools were NCR, CAR, and Caraga.

Figure 2
Regional Distribution of Oversubscribed Public Elementary Schools, SY 2007-2008



Note that an implication of the finding that NCR has among the most number of excess students (from Figure 1) and the fewest number of oversubscribed schools (from Figure 2) is that these oversubscribed schools must be highly congested or must have very large resource gaps.

The regional distribution of empty seats is presented in Figure 3. It shows that NCR had by far the most number of empty seats. This may be because, having more fiscal resources from the internal revenue allotments (IRAs) and the Special Education Fund (SEF) (which is set by law to be one percent of the real estate taxes collected by the local government), cities and municipalities in NCR are able to allocate more resources to public schools. That there remained many excess students (about 350,000) in 391 to 393 of NCR's 511 public elementary schools—even as there were at least 40,000 empty seats in the 118 to 120 other schools—implies that the distribution of resources was highly uneven and skewed in favor of a quarter of all schools.

Figure 3
Regional Distribution of Empty Seats, SY 2007-2008

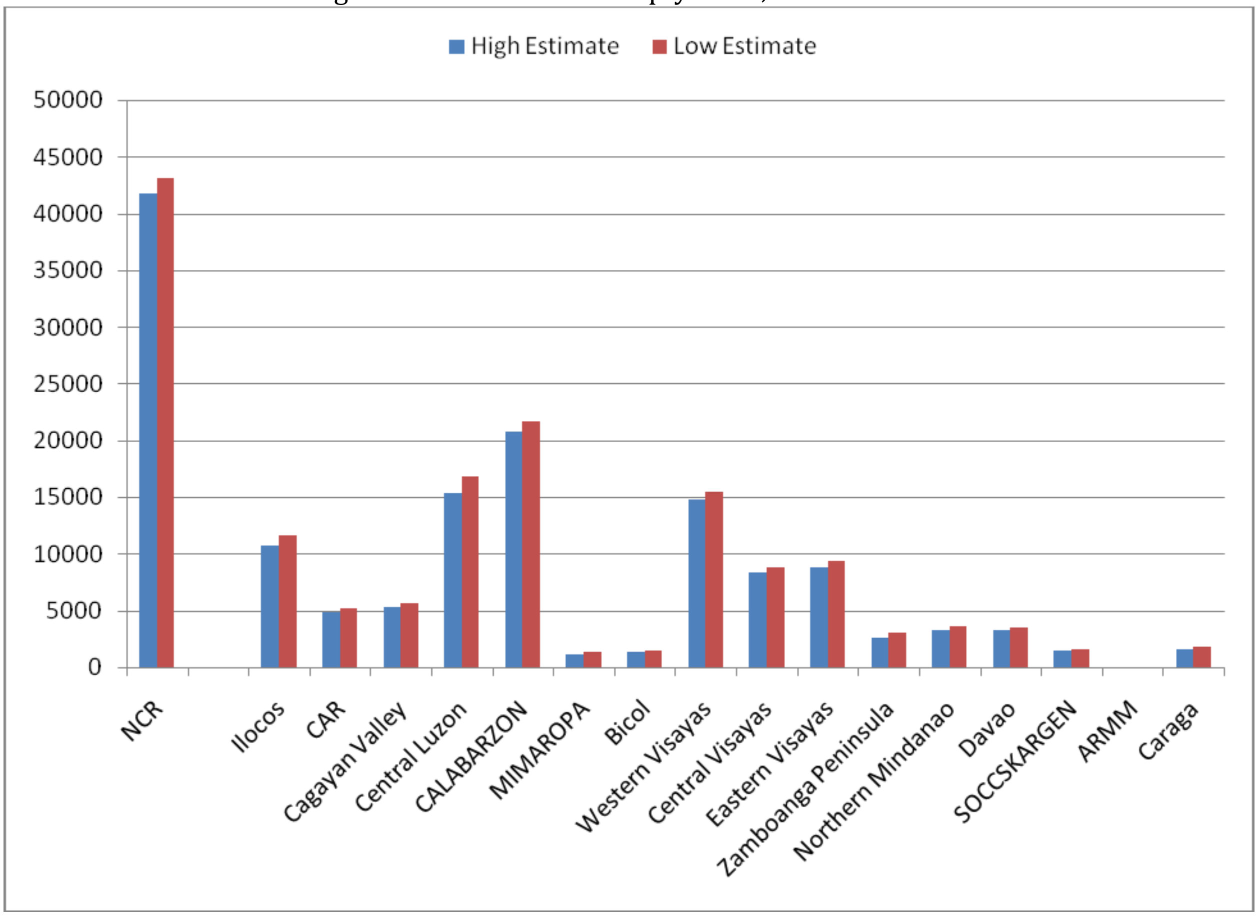


Figure 4 shows that the regions with the most number of undersubscribed schools included Ilocos, Western Visayas, and Eastern Visayas. That there are significant numbers of excess students in these regions (see Figure 1) implies that the extent of congestion in elementary schools can be eased by aligning the allocation of school inputs with school enrollments.

Figure 4
Regional Distribution of Undersubscribed Schools, SY 2007-2008

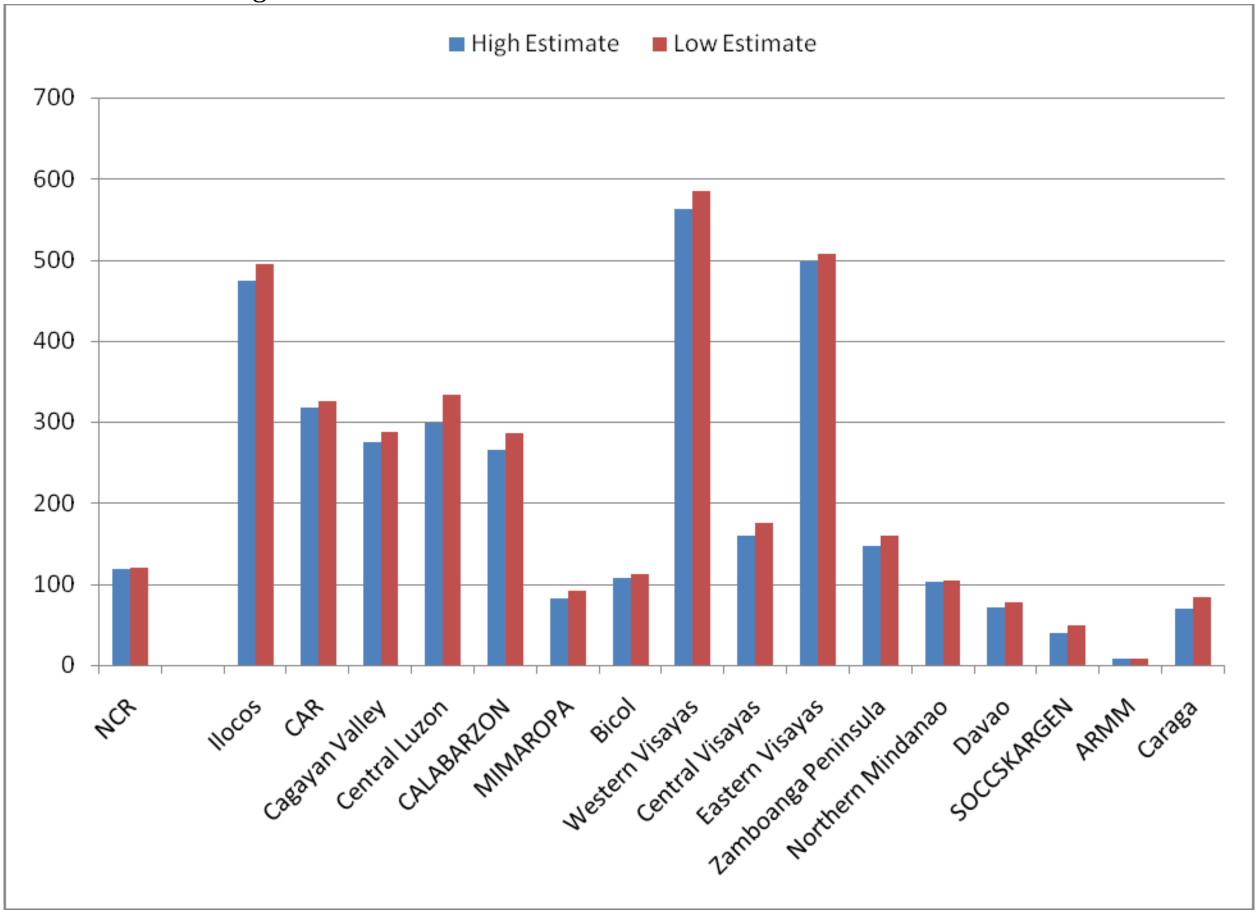


Table 3 classifies schools by the types of binding constraints they face. The programming exercise suggests that under the high (low) estimate 2,184 (946) of the schools had a binding teacher constraint, 2,526 (2,532) had a binding classroom constraint, and 30,044 (30,686) had a binding seat constraint.[1] But some schools faced a combination of binding constraints: 577 (351) schools did not have enough teachers and rooms for their enrollment size, 84 (20) did not adequately provide enough teachers and seats, 186 (271) did not have enough classrooms and seats, and 111 (22) had insufficient teachers, classrooms, and seats.

Based on these results, it can thus be inferred that public elementary schools are predominantly plagued by a seat constraint.

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[1] The reason why a larger number of schools have a binding classroom or seat constraint in the low-estimate scenario than in the high-estimate setting is that the inclusion of locally funded teachers in the teacher count pushes out the teacher constraint of the low-estimate scenario. Since the teacher constraint is less likely to bind as a result, it is the other constraints that become more likely to restrict the enrollment capacity of the schools.

Table 3
Public High Schools, by Type of Binding Constraint, SY 2007-2008

	High Estimate	Low Estimate
Teachers	2,184	946
Rooms	2,526	2,532
Seats	30,044	30,686
Ties		
Teachers and rooms	577	351
Teachers and seats	84	20
Rooms and seats	186	271
Teachers, room, and seats	111	22

Table 4 shows the resources that were required to completely solve the congestion problem in public elementary schools in SY 2007-2008. Needed were 67,038 nationally-funded teachers or 63,215 teachers, 87,348 or 85,923 classrooms, and 4,418,402 seats.

Table 4
Resources Required to Solve the Congestion Problem

	High Estimate	Low Estimate
Teachers	67,038	63,215
Rooms	87,348	85,923
Seats	4,418,402	4,418,402

5. Conclusion

This note presents the results of the congestion analysis in terms of the numbers of (a) excess public elementary school students, (b) schools with these students, (c) empty seats in schools with excess capacity, (d) undersubscribed schools, and (e) the implied resource gaps. The results, however, are more detailed than these estimates. Indeed, they can identify whether each school is congested, how many students are affected, what resource constraints effectively bind in each school, what resources are needed to solve a school's congestion problem. The programming model is therefore most useful as a tool, not for analysts but for DepEd planners and policy makers in the allocation of scarce education resources. It is to hoped that this model will soon be adopted by DepEd in its planning exercises.

References

Alba, Michael M. Forthcoming. "Basic education: All's still not well." In *Updates in Philipine Human Development Issues: 1994–2005*. Quezon City, Philippines: Human Development Network.

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