Forecasting Demand for California Credentialed Teachers

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Developing enough quality credentialed teachers to meet the needs of America's children is the paramount goal of teacher education programs and school districts across the country and, since 2001, required by the federal mandate, *No Child Left Behind* (U.S. Department of Education, Office of Elementary and Secondary Education, 2002). However, according to a 2002 report, "Rather than getting *closer* to a qualified teacher in every classroom, the data indicate that we are drifting farther from that objective as candidates in all fields are becoming more difficult to find" (American Association for Employment in Education, 2002, p.9). The research report further states that, due to early and routine retirement, our future holds an unprecedented turnover of existing credentialed teachers. Further, as every teacher education program staff member has become aware, exacerbating the problem of teacher turnover is the general disinterest by many future teachers in the field of teaching brought about by increasing governmental control over the craft of teaching pedagogy.

In a 2003 report, "No Dream Denied: A Pledge to America's Children," the National Commission on Teaching and America's Future indicated that, contrary to popular opinion in the field, teacher retirement is not

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the most damaging factor in teacher retention. The report argues that retiring teachers are outnumbered 3:1 by teachers leaving for other reasons after three years, and 5:1 after five years. Report after report reflects the same findings—the demand for credentialed teachers is simply greater than the supply (Esch, Chang-Ross, Guha, Tiffany-Morales, & Shields, 2004; McAuliffe, 2003). Even as student enrollment slows to what should be manageable levels, that is, 5% over the next 10 years, according to the National Center for Education Statistics (2003), the net difference between the demand for new credentialed teachers and our national ability to produce new teachers is increasing, leaving an even larger shortage of teachers. Obviously, simply producing more credentialed teachers is not the only solution, as evidenced in the 1990s, when the production of teachers was greater than the increase in student enrollments, yet the net of demand over supply still increased. In other words, the teacher shortage worsened.

Further complicating the question of future demand for credentialed teachers is Ingersoll's (2001) notion of "the leaking bucket." Ingersoll argues that increased supply alone will not solve the teacher shortage problem. He asserts that the attrition rate of new teachers, especially in the first five years of their careers, has increased to such a degree that, despite the number of new teachers, because trained teachers leave the profession at an alarmingly high rate, the shortage will continue. Ingersoll and others (American Association for Employment in Education, 2002; Bandeira de Mello & Broughman, 1996; National Commission on Teaching and America's Future, 2003) postulate that too much focus is put on teacher supply. Rather, they suggest, we should focus on teacher retention. As a result, any model attempting to forecast the demand for credentialed teachers over the next decade must include the complex situation of those leaving the teaching profession at high rates.

Another factor to consider when attempting to forecast teacher demand is the rate of retirement. While new teachers may be leaving the field, possibly due to discontent (National Commission on Teaching and America's Future, 2003), experienced teachers will be leaving at increased rates due to retirement, which at times is exacerbated by school districts' financial concerns resulting in the offering or tendering of early retirement incentives (e.g., golden or silver handshakes).

Interestingly, even in the midst of these bleak predictions of a shortage of qualified teachers, many are asking, is there really a teacher shortage in America? For example, California has been so effective in its policies designed to increase teacher supply that many are suggesting that California may have turned the corner and thus is facing a teacher surplus. The notion of a teacher surplus in California is not without some

logical foundation. To handle class size reduction (a late 1990s California policy to reduce primary grade class size), California and many other states have taken extraordinary measures to increase the supply of highly qualified teachers for its public schools (California Research Bureau, California State Library, 1998 and Esch, C.E., Chang-Ross, C.M., Guha, R., Tiffany-Morales, J., & Shields, P. M., 2004). Even with these attempts to increase supply, within the past decade, the demand for new teachers has skyrocketed, evidenced by a 400% increase in the demand for newly credentialed teachers from 1994 to 1997 (State of California, Commission on Teacher Credentialing, 2004).

California responded to this explosive need for new credentialed teachers through state policies designed to increase teacher supply (e.g., easing restrictions for out-of-state trained teachers to teach in California public schools, developing policy authorizing increased opportunity for school districts to train teachers, piloting initiatives for non-WASC accredited universities to train teachers for California certification). At the same time, existing teacher education programs ramped up for the additional demand for teachers, and the market responded through an influx of for-profit universities entering the California teacher education market.

Has California reached a point of equilibrium between the supply and demand for new credentialed teachers, or will the nation's trend of a teacher shortage (composed of supply problems, the "leaky bucket syndrome," and fewer potential teacher candidates) also continue to be the case in California? Possibly, with the sole exception of complying with *No Child Left Behind*, no greater force has necessitated state agencies, institutions of higher education, and even school districts to have a keen forecast of teacher demand than the recent shortage of teachers in California. Nevertheless, a report on California's teacher shortage by the Center for the Future of Teaching and Learning (Esch, Chang-Ross, Guha, Tiffany-Morales, & Shields, 2004) concludes that "policymakers report that they do not have access to data needed to make reliable projections of the magnitude of the teacher shortage in coming years" (p. 4).

The question, "Will the demand for new credentialed teachers continue over the next decade or not?" at first appears straight-forward. The answer, however, may be more elusive than many policy makers would like to believe. Shall new policies be implemented to encourage more out-of-state teachers to come to California? Shall additional legislation be passed for the creation of more streamlined teacher education programs? Shall the academy ramp up their teacher preparation programs or scale them down? Should the California Commission on Teacher Credentialing continue to support non-WASC accredited universities to recommend teaching credentials in California? Or are the

suspicions true? Has the trend reversed itself and will we now be in a market in which credentialed teachers will not be able to find employment or fewer people will be seeking teaching credentials? Equally important, how long will these trends last, whatever their direction? Clearly, the question of demand for new teachers in California is a product of many variables, such as future public school enrollment, attrition rate of new teachers, state policy changes affecting average class size, and districts' financial ability to maintain class size reduction, among others.

This current study attends directly to the question, "What is the future demand for credentialed teachers in California?" The authors have developed a dynamic-behavioral model for forecasting teacher demand in California. The model is more complex than some models that attempt to forecast teacher demand using a static-mechanical approach, which simply takes into account the net difference between the current number of active credentialed teachers less those who retire and those credentialed teachers entering the field. Such a static-mechanical model does have some value, but ignores what many national reports have indicated. Specifically, retirement rates alone will not provide for a robust forecast of teacher demand. Using static-mechanical models to forecast teacher demand can lead to poor policy decisions. That said, no model is likely to forecast teacher demand in a perfect manner. Some factors can be accurately quantified, while others require a range of possible outcomes. This results in a "what if" model in which several factors are held constant, such as enrollment growth and retirement rate, while others are varied, and they produce multiple projections, depending on certain assumptions of the factors, such as the exit rate of teachers.

Methodology

The authors have developed a model to forecast the demand for credentialed teachers in California through 2012. There are various ways to define teacher demand. Specifically, how teacher demand is defined within a forecasting model strongly influences the model's structure and its resulting accuracy. Simply stated, teacher demand is the total number of credentialed teachers needed by school systems.

As previously noted, no model is likely to perfectly forecast teacher demand, especially when data likely to produce the most robust projections of teacher demand either cannot be compared from one agency to the other or simply do not exist altogether. However, many factors can be accurately quantified, while others require a range of possible outcomes. The advantage of this current dynamic model is that, when exact data do not exist for a certain variable, such as attrition rate, the

model can produce a series of possible outcomes based on a likely range of possible values (see *Projected Attrition Rate* below for an example). This results in multiple projections to accommodate the range of possible outcomes. Thus, it is the consumer of the forecast who can overlay personal knowledge and experience of the forecasted variables to come to the most likely, in her opinion, outcome. The consumer of the forecast also can be attuned to the impact of various policy scenarios on the projections and thus make more informed decisions. The specific variables used in this current model, their sources and, when appropriate, their calculations are listed below.

K-12Enrollment (Actual and Projected)

Enrollment figures include all enrollments in public and private schools in K-12, including special education. The actual enrollments used in this study (1982-2003) were based on data provided by the Department of Finance, California State Department of Education (State of California, Department of Finance, 2003), as were the enrollment projections (2004-2012).

Enrollment per Teacher, AKA: Pupil-Teacher Ratio (Actual and Projected)

The actual enrollment per teacher, known in this study as pupil-teacher ratio, was calculated by dividing the actual K-12 enrollment for a given year by the total number of school employed credentialed teachers for that year. Projected enrollment per teacher was calculated by using the projected K-12 enrollment by the projected pupil-teacher ratio. In this current study, three pupil-teacher ratios were used: 20:1 (current), 23:1 (return to the 1990s level), and 21.5:1 (midpoint between the two scenarios). It should be noted that the pupil-teacher ratio includes all teachers, including those on special assignment, not only those in the classroom, thus the lower current ratio of 20:1. Pupil-teacher ratio, then, is not the same as class size.

Number of Teachers (Actual and Projected)

The actual number of credentialed teachers was taken from the California Department of Education (State of California, Department of Education, Educational Demographics Unit, 2004). Projected number of teachers was calculated by dividing K-12 enrollment for a given year (State of California, Department of Finance, 2003) by the projected enrollment per teacher.

Change in Demand for Teachers (Actual)

Actual change in demand for credentialed teachers was calculated by subtracting the actual number of teachers from year *y* from year *y-1* (i.e., change in demand for 1985 equals the actual number of credentialed teachers in 1985 minus actual number of teachers from 1984).

Projected Change in Demand for Teachers

Projected change in demand for credentialed teachers was calculated by adding the projected attrition, projected retirement, and change in demand for teachers for any given year.

Projected Attrition Rate

Attrition rate is the percentage of the entire workforce permanently leaving the field minus retirement rate. It is an estimated figure that takes into account the high rates of attrition within the first five years of beginning teachers (from 14% during the first year to 46% in the fifth year) (Ingersoll, 2001), the lower attrition rates in California as compared to the rest of the nation, and the fact that attrition decreases greatly after a teacher has been in the field for some time. The 5-7% range is an estimate, but reflects the foregoing conditions.

Projected Retirement Rate

The current retirement rate is reported to be 1.7%, projected to peak in 2007-08 at 5.0% and then decline to 3.7% by 2011-12. Other years are interpolated. (State of California, Department of Finance, 2003, California State Teachers' Retirement System, 2004).

Credentials Issued

Actual credentials issued (1982-2002) came from the California Commission on Teacher Credentialing (State of California, Commission on Teacher Credentialing, 2004).

Demand for Credentialed Teachers

Projected credentials (2003-12) equals total projected change in demand x 80%. Twenty percent is estimated to be filled by out-of-state (15%) and credentialed teachers reentering the teacher workforce (5%).

Using the more operationalized variables above, the following model can be derived:

$$D_y = [ct_{y-1} - (ct_{y-1}a_x + r_p) + (n_z + rf)]$$

where:

D = demand
ct = current teachers
a = teachers leaving the field through attrition
r = teachers leaving the field through retirement
n = new teachers entering the field
rf = teachers returning to the field
$_y$ = forecast year
$_p$ = the projected rate of retirement
n_z = change in new teachers, using class sizes of 20, 21.5, and 23
a_x = attrition rates of 5%, 6%, and 7%

As can be seen, the above formula will yield teacher demand for a given year ($_y$) across various class size estimates (n_z) and attrition rates (a_x).

Results

As noted earlier, one can project teacher demand by dividing total pupil enrollment in California (Figure 1) by the number of pupils per teacher (Figure 2). Since pupil enrollment projections are provided by the California Department of Education through the year 2012, this simple analysis then can be developed with three assumptions for that same time period:

Figure 1.
K-12 enrollment in California public schools (actual and projected). Source: Actual enrollment (1982-2003) from California Department of Education. Projected enrollment (2004-12) from Demographic Research Unit, California Department of Finance (State of California, Department of Finance, 2003).

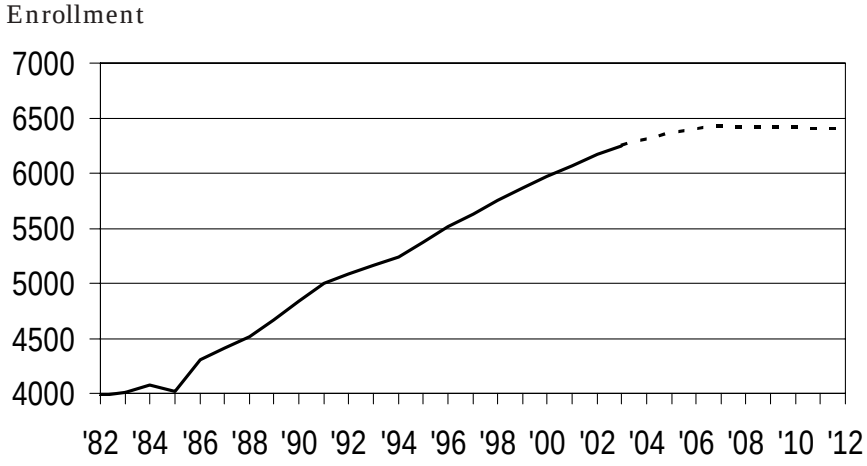


Figure 2.
Enrollment per teacher in California public schools, projecting three scenarios. Source: Actual (1982-2002) equals enrollment (Figure 1), number of teachers (Figure 3) (State of California, Department of Finance, 2003). Projected (2003-12) to remain constant at 20 and return to the 1990s levels.

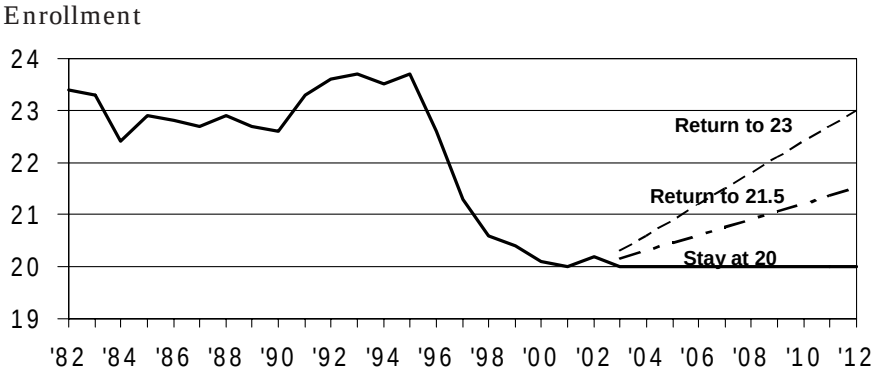
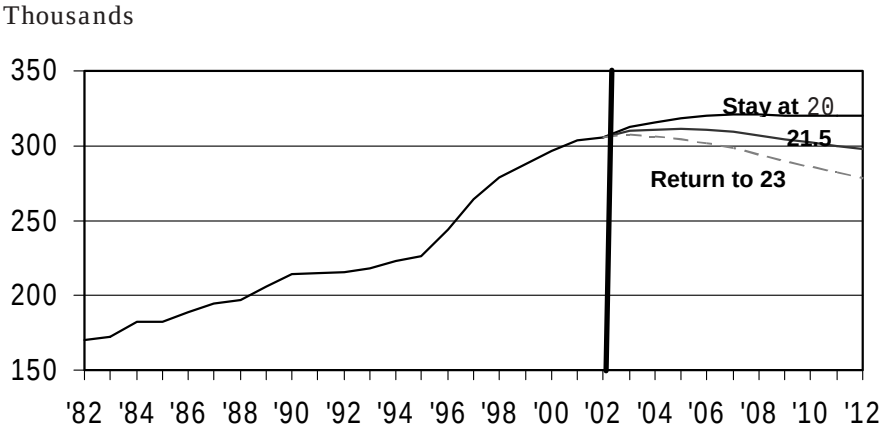


Figure 3.
Actual number of teachers in California public school and projections controlling for pupil-teacher ration. Source: Actual number of teachers (1982-2002) from California Department of Education (State of California, Department of Finance, 2003). Projected number of teachers (2003-12) equals enrollment divided by pupils per teacher.



(a) a pupil-teacher ratio at its current level (20:1); (b) at a level that would return the pupil-teacher ratio back to its early 1990s pre-class size reduction levels (23:1); or (c) a midpoint between the steady state of 20:1 and a return to the 1990s level of 23:1, resulting in a third scenario of 21.5:1.

Figure 3 presents a possible range of outcomes in this simple projection, from a slight increase in teacher demand under the steady state scenario to a significant decrease in teacher demand, back to 1997-98 levels, should the pupil-teacher ratio return to 23:1. However, this basic analysis, as the reader will soon see, does not prove to be a reliable prediction.

Perhaps the best method for ascertaining the true demand for credentialed teachers in California over the past 20 years and over the next decade, using this basic model, can be gained by viewing Figure 4. Each bar represents the number of credentialed teachers needed for that given year and is calculated by subtracting the current year's demand for teachers from the previous year's demand. One can easily see the significant increase in demand from 1995 to 1996, the demand continuing for several years, and then tapering off in the future. Figure 5 presents the projected time period from 2003 through 2012, using a 20:1 ratio. Figures 6 and 7 present pupil-teacher ratios of 21.5:1 and 23:1, respectively. The reader should note that these data only represent change in teacher demand in its most basic sense.

For the purposes of this study, teacher turnover (teachers who leave the field) is defined as a combination of retirement rate and teacher

Figure 4.
Change in demand for teachers in California public schools as a result of enrollment change. Source: From Figure 3 (current year minus previous year).

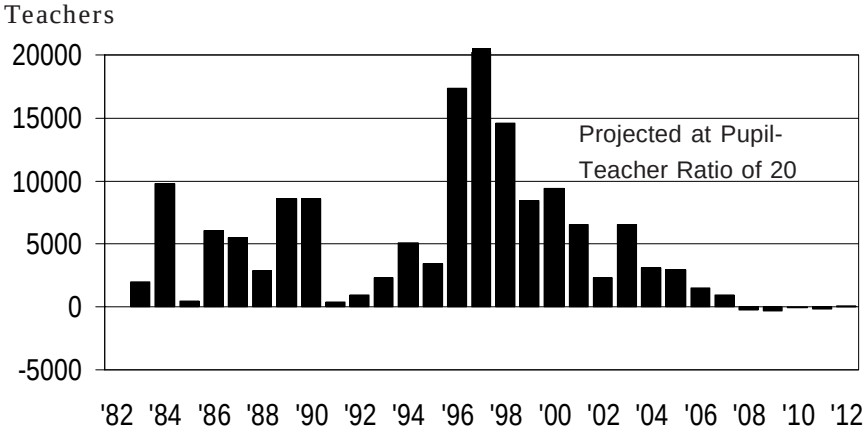


Figure 5.
Change in demand for teachers as a result of enrollment change (stay at 20). Source: From Figure 3 (current year minus previous year).

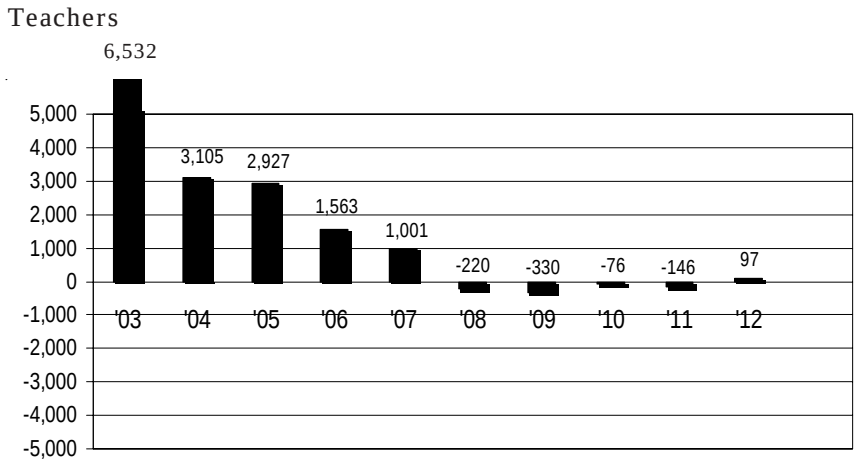


Figure 6.
Change in demand for teachers as a result of enrollment change (21.5). Source: From Figure 3 (current year minus previous year).

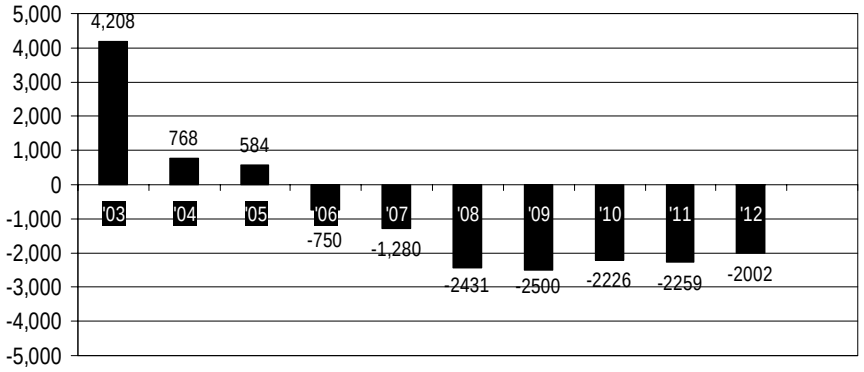


Figure 7.
Change in demand for teachers as a result of enrollment change (return to 23). Source: From Figure 3 (current year minus previous year).

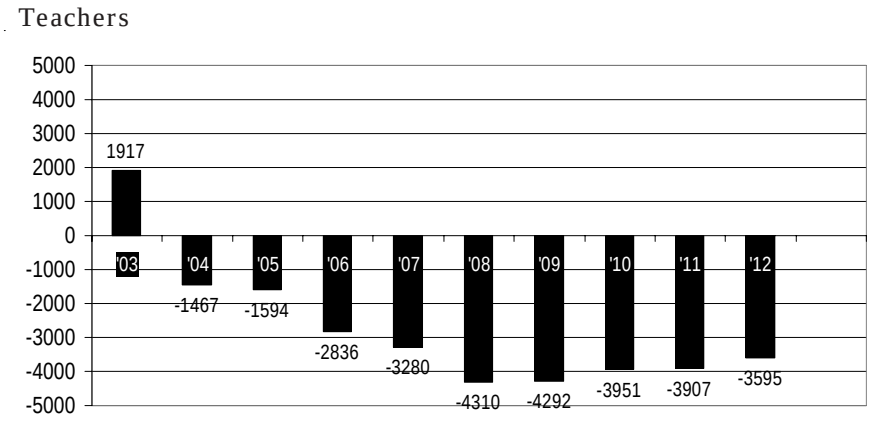
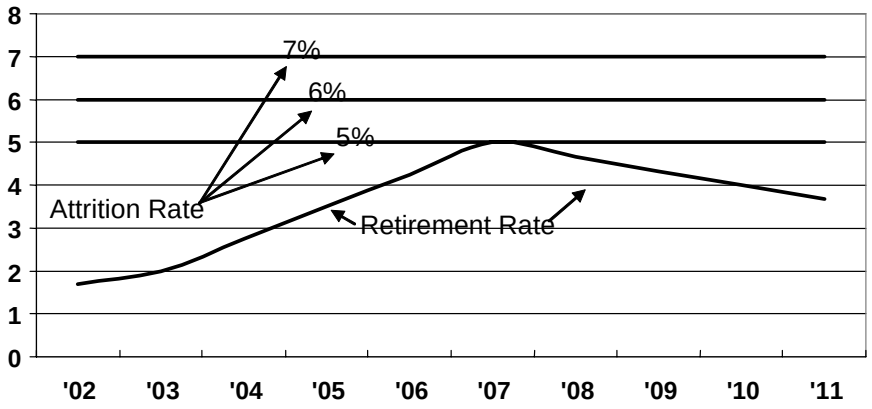


Figure 8.
Projected attrition plus retirement rates. Source: *Teacher Workforce Projection* from various sources. Current retirement rate is reported to be 1.7%, projected to peak in 2007-08 at 5.0% and then decline to 3.7% by 2010-11. Other years are interpolated.



attrition for reasons other than retirement. Retirement rate varies over time, from a current rate of 1.7%, peaking at 5% by 2007 and then returning to 3.7% by 2011; the same trend was used in all the scenarios in this forecasting model. Attrition rate, in comparison, is presented using three scenarios. An estimated current rate of 5% was used as the first case scenario, with 7% attrition being the highest estimated level, with a midpoint of 6% (Figure 8).

Taking the basic prediction model outlined above and incorporating two additional variables, retirement and attrition rate, the model will provide a much stronger forecast. For example, using the retirement trend data, we can fix the pupil-teacher ratio at its steady state of 20:1 and use the teacher attrition rate of 5% to develop our first scenario using the more complex model. The results are presented in Table 1. For any given year, the model begins with the projected change in enrollment and the credentialed teachers lost to attrition plus those who are expected to retire. The sum results in the total demand for teachers in the given year.

Figures 9, 10, and 11 present nine possible scenarios of teacher demand in California. Each presents the same fixed conditions (retirement rate and projections of pupil enrollments), but is reliant upon a specific set of "what if" circumstances. For example, if no major policy or school district financial constraints affect the pupil-teacher ratio in California, we can assume that it will stay at 20:1. If we also assume that teacher attrition will be approximately 5%, then by viewing Figure 9, we can project that there will be a small dip in teacher demand in 2004-05, then increasing greatly through 2007, and settling back to the 2003-04

Table 1
Projected Change in Demand for Teachers As a Result of Enrollment, Attrition (5%) and Retirement Assuming a Pupil-Teacher Ratio of 20

Year	Enrollment Change (1)	Attrition (2)	Retirement (3)	Total Change in Demand (4)
2003	6,532	15,615	6,246	28,393
2004	3,105	15,771	8,674	27,550
2005	2,927	15,917	11,142	29,986
2006	1,563	15,995	13,596	31,154
2007	1,001	16,045	16,045	33,091
2008	-220	16,034	14,976	30,790
2009	-330	16,018	13,871	29,559
2010	-76	16,014	12,811	28,749
2011	-146	16,007	11,749	27,610
2012	97	16,012	11,752	27,861

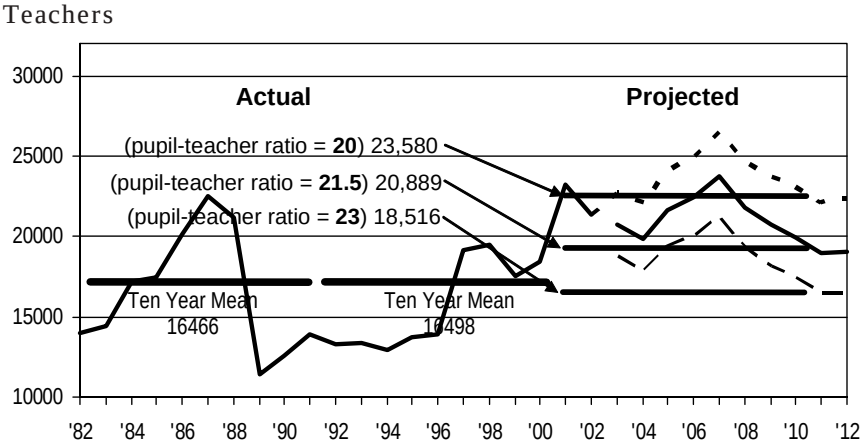
levels by 2012. Looking again at Figure 9, one can see the negative effect of a pupil-teacher ratio increasing to 23:1, assuming a 5% attrition rate. In fact, such a scenario would result in a serious drop in teacher demand, thrusting teacher demand back into late 1990s levels.

Investigating other scenarios, it becomes obvious that a higher attrition rate (teachers leaving the field) results in a greater teacher demand. The lower the pupil-teacher ratio, the higher the demand. This can best be seen in Table 2, which presents the number of needed (or surplus) teachers in California given each of the nine scenarios.

Discussion

The teacher demand model presented here does not offer the reader a simple yes/no response to the question of teacher demand in California over the next decade. Rather, it does something much more vital. The model offers the reader a framework for decision-making about California's future demand for credentialed teachers. The answer to the question we posed earlier in this article, "What is the future demand for credentialed teachers in California?" becomes a relative response. It is relative to how many teachers leave the profession due to dissatisfaction, which is an

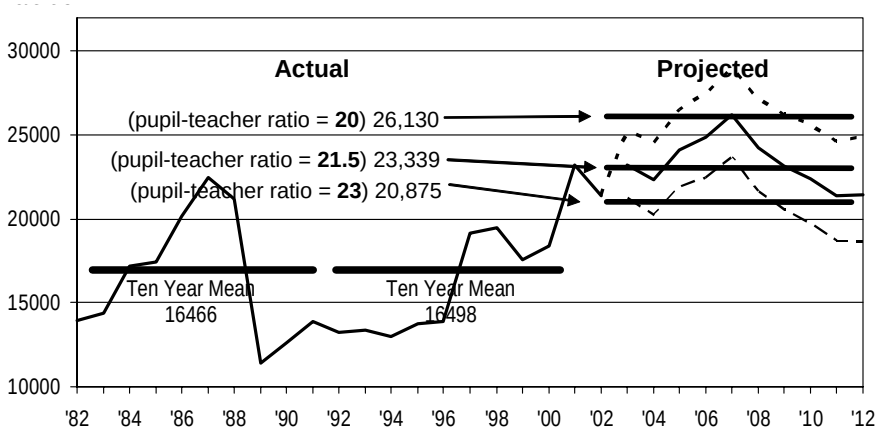
Figure 9.
Credentials issued from CSU, UC, and independents (1982-2002) and demand for credentialed teachers (2003-12), assuming a 5% attrition rate. Source: Actual credentials (1982-2002) from CCTC. Projected credentials (2003-12) equals total change in demand (Figure 7) x 80%. 20% is estimated to be filled by out-of-state (15%) and teachers reentering (5%).



allegedly growing number. It is relative to the accuracy of the enrollment projections of the Department of Education and highly relative to fluctuations in the pupil-teacher ratio. Additionally, changes in state policy in relation to teacher education can almost immediately affect teacher demand. A single policy change, such as the removal of class size reduction in primary grades, can, by itself, produce a severe teacher surplus in a matter of a couple of years, as happened in the reverse case in the late 1990s. Severe financial constraints faced by school districts would have a similar impact on teacher demand because districts could be forced to decrease their commitment to lowering or maintaining class size, resulting in the hiring of fewer teachers.

Overall, if pupil-teacher ratio and teacher attrition rates stay constant with the 2003 levels, the demand for credentialed teachers is projected to increase through 2007 and then return to 2004 levels by 2012. The most conservative scenario (Figure 9, with a 23:1 ratio) is that in which the model considers a case in which the pupil/teacher ratio returns to the 1990s levels (23:1) and attrition is stable at 5%. This scenario indicates a mean increase in demand of 23%, increasing from a 10-year mean of 16,498 during the 1993-2003 period to a mean of 20,238 through 2012. Deconstructing this increase over the eight-year forecasted period

Figure 10.
Credentials issued from CSU, UC, and independents (1982-2002) and demand for credentialed teachers (2003-12), assuming a 6% attrition rate. Source: Actual credentials (1982-2002) from CCTC. Projected credentials (2003-12) equals total change in demand (Figure 7) x 80%. 20% is estimated to be filled by out-of-state (15%) and teachers reentering (5%).



(2004-2012), one can observe an immediate decrease in demand from 2003 to 2005, when a steady increase in demand should continue until a peak in 2007. Demand should then undergo a moderate decrease to the 18,000 range by 2011 and 2012, which is approximately at the year 2000 level.

Suggestions for Future Research

The current model views California credentialed teachers as a single group, in contrast to looking at variance across geographic regions and types of credentials. Whereas some school districts report a great need for teachers, other districts have a teacher surplus. The same is true for the type of credentials. Class size reduction, for example, affects the demand for the multiple subject credentialed (elementary school) teachers far more than any other group. Additionally, some credential areas seem to be in constant need, almost impervious to market and policy conditions. Special education, for example, has been a high demand area for many years and most districts see this need continuing for an indefinite period. Thus, a model considering credential type and regional variations would provide additional information for policy and decision makers.

Also greatly needed is a model that connects teacher demand with

Figure 11.
Credentials issued from CSU, UC, and independents (1982-2002) and demand for credentialed teachers (2003-12), assuming a 7% attrition rate. Source: Actual credentials (1982-2002) from CCTC. Projected credentials (2003-12) equals total change in demand (Figure 7) x 80%. 20% is estimated to be filled by out-of-state (15%) and teachers reentering (5%).

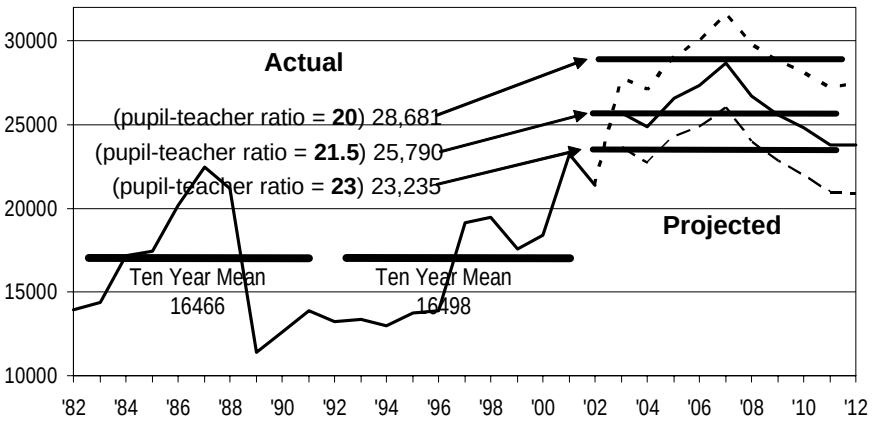


Table 2
Teacher Demand Across Nine Model Scenarios Comparing Difference of Actual 2002-03 to Mean Projections for 2003-2012

	Pupil-Teacher Ratio		
Attrition Rate	20:1	21.5:1	23:1
5%	+2,216	-475	-2,848
6%	+4,766	+1,975	-489
7%	+7,317	+4,426	+1,871

Note. In each cell above, the figure projects how many more credentialed teachers will be needed (+ or -) in each scenario over the baseline average of the 2002-03 year (21,364).

authentic measures of teacher quality. As an example, to be able to demonstrate the relationship between teacher quality indicators and teacher persistence in the field would provide decision makers with a tool to measure the exact effect of, for example, teacher rewards on retention, union issues aside. If such a relationship were measurable (and, in fact, exists), additional rewards directly to credentialed teachers might decrease the high and costly teacher turnover problem.

Conclusion

The authors present this current model as a tool to facilitate decision and policy makers as they attempt to create a system of balance between the supply and demand of quality credentialed teachers in California and the nation. Without such a model, decision makers have very limited tools to help support their actions and to increase the chance that such actions will lead to the desired outcomes. With the proper decision support tools, decision- and policy-makers can continually update the model as conditions change and adjust their decisions accordingly. Developing stronger decision support models, such as the one presented here, and creating a system that allows for multiple sources of data to be compatible with one another, will highly increase the probability that California and the entire nation can achieve a balance between its demand for credentialed teachers and the system's ability to strategically supply teachers with the specific talents needed, when and where they are needed.

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