Immigration and Spending on Public Education: California, 1970-2000*

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Comments welcome.

Abstract

The evolution of education spending in California has received plenty of attention by both academics and practitioners after this state's education finance reform of the 1970's. The impact on public education spending of the demographic trends associated with immigration has not been thoroughly analyzed, instead. This paper quantifies the contribution of immigration to the relative decline in elementary and secondary public education spending per student in California in the period 1970 to 2000. A simple quantitative model of school choice and voting over public education is used to perform the counterfactual experiment of interest. The model allows for household heterogeneity in income, number of school-age children, citizenship and immigration status, and preference for education. The results indicate that immigration played a quantitative important role in accounting for the relative decline in education spending in California, especially after 1990. In the year 2000, the model predicts that education spending per student in California would have been 24 percent higher than in reality if U.S. immigration had been restricted to its 1970 level.

Keywords: Immigration, Public Education, Private Education, Education Finance Reform, California.

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1 Introduction

In this paper I study the impact of immigration on spending on elementary and secondary public education in California over the period 1970-2000. In doing so, the paper contributes to the debate on two important issues that have attracted much attention from policy makers and academics alike. The first debate concerns the effects of immigration on the well-being and economic outcomes of natives. The effect of immigration on the labor market outcomes of natives has been extensively analyzed in the economics literature (see Borjas, 2003 and Ottaviano and Peri, 2008 for two different views on this issue). Less attention has been devoted to analyze the interaction of immigrants and natives that occurs through government spending and taxes. In particular, spending on public education is one of the most important items on the budget of state and local governments.

The second debate concerns the significant decline in public education spending per student that occurred in California - the main immigrant-receiving state in the U.S. - relative to the rest of the country since the early 1970's. While the economics literature has emphasized the role played by education finance reform from a foundation system to a state system (see, e.g., Silva and Sonstelie, 1995 and Fernandez and Rogerson, 1999), relatively little attention has been paid to the underlying demographic trends that took place over this period. According to the 2000 U.S. Census of Population, school-age children from households whose head had immigrated to the U.S. after 1970 accounted for about 40 percent of total enrollment in elementary and secondary school (Table 2). The corresponding figure for the rest of the U.S. was 13 percent. In all Census years, California households whose head had immigrated to the U.S. after 1970 had, on average, more school-age children than native households, and more than twice as many in 1990 and 2000. These households accounted for about 30 percent of all households in California in 2000 (Table 2), while the corresponding figure for the rest of the U.S. is only 8 percent.

The paper develops a quantitative political-economy model of education spending to answer the following counterfactual question: "what would have been the level of education spending per student in California in 1980-2000 if U.S. immigration had been restricted to its 1970 level?" The main result of the paper is that immigration has played a quantitatively important role in the decline in education spending per student in California. Specifically, I estimate that in the academic year

1999-2000 education spending per student in California was about $1,459 (in 1999 dollars) lower than it would have been if U.S. immigration had been restricted to its 1970 level. This represents about 24 percent of actual education spending per student in California in 2000. For sake of comparison, education finance reform in California is commonly believed to have decreased education spending per student by about 10-15 percent (see e.g. Fernandez and Rogerson, 1999 and Hoxby, 2001).

In order to answer the counterfactual question above, I employ a political-economy model where California's households who are U.S. citizens vote over expenditures on public education in a state-wide voting round. The latter setting is consistent with the institutional setup of education finance in California where, since the early 1980's, current spending for elementary and secondary public education has been virtually equalized across students, reducing the scope for Tiebout mobility.[1] In the model, households are assumed to be heterogeneous with respect to their income, number of school-age children, immigration status, citizenship status, and the weight they attach to education relative to consumption in their utility function. Households with school-age children choose between private and public education.

The model's parameters are estimated using micro data from the 1980 U.S. Census and data on public education spending from the National Center for Education Statistics (NCES). The estimated model accounts well for the evolution of education spending in California in the subsequent Census years 1990 and 2000. The counterfactual exercise is performed by conditioning the joint distribution of household income, number of children, and citizenship status on households whose head is either a native or had immigrated to the U.S. prior to 1970. Given this joint conditional distribution, the model is then used to compute counterfactual tax rates and private school enrollment rates for 1980, 1990, and 2000. The model predicts increasingly higher levels of spending per student from 1980 to 2000 in the counterfactual economy, culminating with the gain of about $1,459 per student cited above. The estimated preferences are also used to compute the cost of immigration for native households, expressed as an equivalent variation. The estimated costs are about 70 percent larger than those obtained by keeping the level of education spending per capita constant in the economy with restricted immigration and simply reducing the tax burden on native households. The latter approach is commonly used in computing the fiscal cost of immigration (e.g. National Research

[1] See Sonstelie et al. (2000) for an informative account of education finance reform in California.

Council, 1997).

As already mentioned above, this paper is related to both the literature on the impact of immigration on native workers and households and the literature on education finance reform. While a large part of the immigration literature focuses on the labor market interactions between immigrants and natives (see Borjas, 1999 for a review), some researchers have asked whether immigrants tend to participate in the U.S. welfare system more than natives (Borjas and Hilton, 1996), while others have, more generally, attempted to compute the sign and size of the net fiscal transfer from natives to immigrants including both government spending as well as taxes (see Clune, 1998 and Garvey and Espenshade, 1998). This line of research takes an "accounting" perspective by computing the fiscal costs and benefits of immigration, given the existing system of transfers, government spending, and taxes. As argued by the National Research Council (1997 page 259) panel: "The assumption of exogenous fiscal policies provides useful short-term estimates for state and local government effects. Future work in this area could examine how much immigration affects fiscal policies ... and incorporate such endogenous effects into the modeling exercise." This paper represents a first step in this direction.

While the relationship between immigration and spending on public education in California has been largely ignored in the academic literature, some political commentators have emphasized this point before.[2] For example, the journalist Peter Schrag (1998, page 277) writes in his book *Paradise Lost* that "...the new California economy sits atop such a large immigrant population...whose presence, at least in the short run, not only depresses wage scales at the lower end but reduces the incentive to provide infrastructure and public services that would probably have been offered as a matter of course to groups considered genuinely "American"." One of the themes of Schrag's book is that the relative drop in spending per student in California is due to the lack of political representation of immigrants that, due to their lower incomes and higher number of children would be the primary beneficiaries of additional spending in public education. My analysis confirms that increasing the political weight of immigrants by allowing them to vote in the political-economy model results in higher equilibrium spending per student. However, this lack of political representation only

[2]Silva and Sonstelie (1995) do consider enrollment growth as a possible reason for the decline in public education spending per student in the 1980's. However, they restrict themselves to a model in which all households have the same number of children. Thus, in their model, the tax price of education spending does not change in response to an inflow of households.

accounts for a relatively small share of the observed drop in education spending per student.

The literature on the effects of states' education finance reform on education spending levels is relatively large. California represents the most prominent example of a shift from local to state level funding. This shift began in 1971 with the first *Serrano* ruling by which the California Supreme Court declared the education finance system unconstitutional and continued with the passage of Proposition 13 in 1978. By the early 1980's public education spending per student had been largely equalized within the state of California.[3] The consequence of California's reform have been widely studied in the literature. Silva and Sonstelie (1995), Fernandez and Rogerson (1999), and Hoxby (2001) point to this reform as the main explanation for the observed decline in education spending per pupil in California in the 1980's and early 1990's. Murray, Evans, and Schwab (1998), instead, estimate a positive effect of education finance reform on average spending per pupil using panel data on U.S. states. The purpose of this paper is not so much to dispute the importance of education finance reform in accounting for some of the observed drop in education spending per student in California. Instead, the paper tries to quantify the contribution of immigration. My empirical results suggest that education finance reform was slightly more important than immigration in explaining the drop in spending per student in California in 1980 and 1990, but that by the year 2000 immigration had become a much more important factor.

Last, the results of this paper are related to and consistent with the empirical evidence in Poterba (1997) and Fernandez and Rogerson (2001). Using panel data on U.S. states these authors show that for given level of aggregate income, and controlling for state fixed-effects, the elasticity of education spending per student with respect to changes in the number of students enrolled in school is close to -1. Differently from this exclusively empirical work, I endogenize the choice of education spending and school choice and I identify and focus on a specific demographic shock - immigration.

The rest of the paper is organized as follows. Section 2 presents the basic trends about education spending in California and the rest of the U.S. starting in 1970. Section 3 describes the model economy. Section 4 discusses the estimation of the model's parameters. Section 5 develops the counterfactual exercise, while Section 6 uses the model to compute the fiscal costs of immigration.

[3] When the *Serrano* plaintiffs returned to court in 1983, the judge wrote, rejecting their case, that "It is this court's view that the proper standard for testing compliance with the judgement is whether the Legislature has done all that is reasonably feasible to reduce disparities in per-pupil expenditures to insignificant differences. As is discussed, the state has met this standard and surpassed it." (cited by Sonstelie et al., 2000, page 55).

Section 7 considers a host of extensions of the basic framework of Section 3. Last, Section 8 concludes. A description of the data is contained in the Appendix

2 Empirical Evidence

2.1 Decomposition of Spending per Pupil over Time

The key variable of interest in this study is current education spending per student enrolled in public elementary and secondary school in California.[4] In this section I consider the evolution of this variable over time for California relative to the rest of the U.S. and decompose its evolution in different components. To fix ideas, it is convenient to denote aggregate nominal spending for public elementary and secondary education in location k at time t by E_k^t, where the index k equals CA (California) or US$^-$ (the U.S. excluding California). Let H_k^t denote the total number of households in k at time t, and let N_k^t stand for enrollment in public schools. Last, Y_k^t is a measure of total nominal income in k at time t.

By definition, log spending per student in CA relative to the rest of the US at time t can be decomposed in the following way:

$$\log \frac{E_{CA}^t/N_{CA}^t}{E_{US^-}^t/N_{US^-}^t} = \log \frac{E_{CA}^t/Y_{CA}^t}{E_{US^-}^t/Y_{US^-}^t} + \log \frac{Y_{CA}^t/H_{CA}^t}{Y_{US^-}^t/H_{US^-}^t} + \log \frac{H_{CA}^t/N_{CA}^t}{H_{US^-}^t/N_{US^-}^t}, \tag{1}$$

or, in words, as the sum of (log) relative education spending per unit of income, plus relative income per household, and relative number of households per student enrolled in public schools. I am interested in the evolution of these variables starting from a given point in time. Data availability does not allow me to start earlier than the school year 1969-70.[5] This initial date, however, works well because the resurgence of large-scale immigration to the U.S. dates back to the *Immigration and Nationality Act Amendments* of 1965 which facilitated immigration for family unification purposes. Also, the major education reform that equalized spending per student in California occurred in the 1970's.

[4] The NCES defines current expenditures as "The expenditures for operating local public schools, excluding capital outlay and interest on school debt. These expenditures include such items as salaries for school personnel, fixed charges, student transportation, school books and materials, and energy costs."

[5] As a convention, in what follows I refer to the school year 1969-70 as 1970.

Taking the difference between equation (1) in year t and its equivalent in 1970 provides the basis for the analysis of the determinants of the evolution of spending per student in California relative to the rest of the U.S. and relative to the year 1970:[6]

$$\begin{aligned}\Delta \log \frac{E^t_{CA}/N^t_{CA}}{E^t_{US^-}/N^t_{US^-}} &= \Delta \log \frac{E^t_{CA}/Y^t_{CA}}{E^t_{US^-}/Y^t_{US^-}} + \Delta \log \frac{Y^t_{CA}/H^t_{CA}}{Y^t_{US^-}/H^t_{US^-}} \\ &\quad + \Delta \log \frac{H^t_{CA}/N^t_{CA}}{H^t_{US^-}/N^t_{US^-}}.\end{aligned} \tag{2}$$

I implement the decomposition in equation (2) empirically using both yearly and decennial data. Figure 1 represents the decomposition with yearly data for the period 1970-2005. Data on current spending in public elementary and secondary education and fall enrollment are from the National Center for Education Statistics (NCES). Data on household income and the number of households is derived from the Current Population Survey (Annual Social and Economic Supplements). Figure 2 represents the same decomposition at intervals of ten years. The public education expenditures data are again from the NCES. Data on enrollment in elementary and secondary public schools, number of households, and household income are from the decennial Census of Population, 1970-2000.

The figures represent the percent difference between the value of a variable - for example spending per student - in California relative to the rest of the U.S. in a given year and its value in 1970. They show a remarkable deterioration in California's relative spending per student. The latter declines by more than 20 percent between 1970 and 2005, reaching a low point in the mid-1990's. These figures also suggest that this drop cannot be accounted for by a decline in the fraction of income spent on public education in California relative to the rest of the U.S. According to Figure 1, in 2005 California was spending almost the same fraction of its income in public education relative to the rest of the U.S. as in 1970. Figure 2 instead shows a small decline in this indicator. However, the reason for this decline is the fact that relative income per household in California grew faster according to the U.S. Census measure of income than according to the CPS measure of income. In fact, when considering education spending *per household*, as opposed to *per student* enrolled, California does not seem to gain or lose relative to the rest of the U.S. between 1970 and 2005. The reason why per student spending exhibits such a large decline, instead, is mainly the increase in the student to

[6] The operator Δ is such that $\Delta x_t = x_t - x_{1970}$.

household ratio in California relative to the rest of the U.S. For example, in 1970 there were 1.40 and 1.35 households in California and in the rest of the U.S., respectively, for each student enrolled in public school. In 2005, there were 2.34 households per student in the rest of the U.S., but only 1.97 in California. Notice how the cumulative change in the relative ratio E/N between 1970 and 2005 is almost identical to the cumulative trend followed by the relative ratio H/N.

It is also interesting to notice from those figures that the demographic shift that led to lower relative H/N ratios in California in 2005 did not start until about 1980. Figure 1 also shows how the ratio of education spending to income declined quickly in California between the mid-1970's and the early 1980's, remaining constant until the mid 1990's and then exhibiting an upward trend. Figure 2, which uses data from the U.S. Census to compute the income measure shows a further decline in spending relative to income for California until 1990. However, this decline is simply the counterpart of faster growth in income per household in the 1980's in California than in the rest of the U.S. as recorded by the Census, suggesting that education spending per household was actually fairly constant during the 1980's also according to the Census data. It is fair to interpret these trends as suggesting that the effect of the *Serrano* ruling on education spending relative to income emphasized by Fernandez and Rogerson (1999) had already fully taken place by the early 1980's.

Table 1 represents the *levels* of the main statistics about education spending, household income, and school enrollment in the different Census years for California and the rest of the U.S.

2.2 Immigration

What role did immigration play in generating the trends emphasized in Figures 1 and 2? To answer this question, in this section I present results from a simple statistical counterfactual exercise. Specifically, I generate a new series for the logarithm of relative (California vs the rest of the U.S.) spending per capita in public education replacing the term H_k^t/N_k^t in equation (1) with the ratio of the number of households headed by either a U.S. native individual or an individual who immigrated to the U.S. before 1970 to the number of children living in such households and enrolled in elementary and secondary public schools. To construct the counterfactual series, I use the Census data, which contains information about an individual's birthplace and allows me to distinguish between households headed by native and households headed by foreign-born individuals. Figure 3 reports

the actual data series (solid line) of relative spending in public education per school-age child and the corresponding counterfactual series (dashed line). As the figure shows, relative education spending per student in California would have been about the same in 2000 as it was in 1970 if the ratio of households per public-school student in California had been equal to the value computed for native and pre-1970 immigrant households only.

As Table 2 shows, immigrant headed households in California have on average significantly more school-age children than native households and the fraction of immigrant-headed households has increased dramatically over time. The table shows that immigrant headed households are both more likely to have some school-age children than native households and, among households with children, they tend to have more school-age children, on average. The fraction of school children from immigrant-headed households has increased by about 40 percentage points in the period 1970-2000, a remarkable demographic shock.

2.3 Private Schools

Downes and Schoeman (1998) have argued that California's school finance reform of the 1970's has led to a significant increase in enrollment into private schools. A similar argument can be made regarding the reaction of native households to California's immigration wave. Betts and Fairlie (2003) use Census data to document the existence of a negative relationship between immigrant inflow in a metropolitan area and enrollment rates in private schools. It is therefore informative to use the Census data to evaluate the evolution of private school enrollment in elementary and secondary education in California relative to the rest of the U.S. Figure 4 plots the evolution of private school enrollment rates for California relative to the rest of the U.S., distinguishing between enrollment rates of children of households headed by natives and foreigners. The figure shows a remarkable increase in private school enrollment rates among native households in the 1970's, and a smaller increase in the 1980's. Since 1990, private school enrollment rates for native households have stayed constant or declined. For households headed by a foreign-born individual private school relative enrollment rates have remained fairly constant between 1970 and 2000. For California as a whole private school enrollment rates have increased in the 1970's, but declined since then. This is due to a composition effect, as the share of school-age immigrant children has increased, and the latter are more likely to

attend public than private school.

3 Model

In this section I introduce a simple political-economy model of spending on public education and household choice of public vs private education. The model is then calibrated to the data and used to interpret the trends in public education spending per student.

The economy (California) is populated by a measure one of households with preferences defined over a composite private good different from education, denoted by c for consumption, per-student spending on public education, denoted by e, and per child spending on private education, z. A household's utility function is assumed to take the following form:[7]

$$u(c,e,z,n,\lambda) = \frac{c^{\alpha}}{\alpha} + \begin{cases} \gamma\lambda e^{\alpha}/\alpha + \lambda e^{\alpha}/\alpha \text{ if } n>0 \text{ and children attend public school} \\ \gamma\lambda e^{\alpha}/\alpha + \lambda z^{\alpha}/\alpha \text{ if } n>0 \text{ and children attend private school} \\ \gamma\lambda e^{\alpha}/\alpha \text{ if } n=0 \end{cases} \tag{3}$$

where n denotes the household's number of school-age children and $\alpha < 1$, γ, and λ are parameters. The functional form in equation (3) is a generalization of the one adopted by Fernandez and Rogerson (1999, 2003). There are three dimensions in which the preferences considered here are more general than the ones used by Fernandez and Rogerson. First, I allow households with children to choose private instead of public education. By assumption, households cannot consume both public and private education services. Second, I explicitly consider households without school-age children.[8] The latter kind of household and households with children in private school are assumed to care about

[7] This class of preferences exhibits a unit income elasticity of education spending relative to income. This is consistent with the empirical evidence in Fernandez and Rogerson (2001). In assuming that households care about public education spending per student, I am implicitly postulating a constant returns to scale technology in the provision of education, in which marginal and average production costs coincide.

[8] While in most models of education spending in the local public finance literature (see Epple and Nechyba, 2004 for a review) all households are assumed to have one child, this assumption is less appropriate to study the consequences of immigration by households with a large number of children relative to native households. According to the Census data, in any given year, about 70 percent of households have no children enrolled in primary or secondary school, both in California and in the rest of the U.S. Moreover, Poterba (1997) has shown how support for public education is lower in U.S. states with a higher percentage of population over 65 years old. Bergstrom, Rubinfeld and Shapiro (1982) document, using survey data, that individuals with school-age children prefer significantly higher levels of per student school expenditures.

public education spending per student to a different extent relative to households with school-age children enrolled in public school. The parameter γ determines the extent of these differences in preferences. The last dimension in which the utility function differs from the one adopted by Fernandez and Rogerson is that there is also unobserved heterogeneity about the intensity of preferences for education among households. The latter is captured by the household-specific parameter $\lambda \in (0, \infty)$.

Spending on public education is financed through a linear tax s on household income y. Spending on public education equals tax revenue per-child attending public schools:

$$e = \frac{s\overline{y}}{\overline{n}_p}, \tag{4}$$

where $\overline{y}$ denote average household income in the economy and $\overline{n}_p$ is the number of children attending public school per household. Equation (4) assumes that the income of all households is taxed at the same rate s. In particular, the model abstracts from issues of tax evasion and illegal immigration. While it would be straightforward to modify the model to allow for tax evasion, the lack of reliable data on undocumented immigration and tax evasion make it difficult to incorporate this phenomenon into the empirical model.[9]

A household with children can also opt for private education. Thus, a household's consumption is equal to its after-tax income minus any spending on private education:

$$c = y(1 - s) - nzI\left(z\right),$$

where I am assuming that the household spends the same amount z in private education for all of its children.

[9]It is worthwhile to stress two points on illegal immigration. First, I suspect that the prediction of the model would not change significantly if illegal immigrants represented a constant fraction of the population over time. In this case, in fact, allowing for tax evasion would affect the equilibrium of the model mainly by changing the magnitude of the estimated parameters of Section 4. A potentially more important effect of tax evasion would occur if the latter phenomenon were to become increasingly important over time, thus leading to an equilibrium decline in education spending per student. Thus, from this perspective, the counterfactual results of Section 5 would represent a lower bound on the effect of immigration on education spending in California. Second, the view that illegal immigrants do not pay state and local taxes is not supported by the available evidence. For example, according to the U.S. General Accounting Office (1994), estimated that in 1992 illegal aliens contributed 1.1 billion dollars in state and local revenue in California. To place this figure in perspective, the same study by the GAO estimates that the cost of elementary and secondary education for illegal aliens in California in 1994 was about 1.6 billion dollars.

Given s, in case the household opts for private education, its indirect utility is defined as:

$$V\left(y\left(1-s\right),n,e,\lambda\right)\equiv\max_{z}\left\{u(y(1-s)-nz,e,z,n,\lambda)\right\}.$$

Conditional on opting for private education, the optimal amount of private education chosen by a household is given by:

$$z=\frac{(1-s)y}{n+(n/\lambda)^{\frac{1}{1-\alpha}}}. \tag{5}$$

Notice that the per-child optimal investment in private education is increasing in the household's after-tax income and decreasing in the number of children.

A household that chooses public over private education ($z=0$) receives utility:

$$U\left(y\left(1-s\right),n,e,\lambda\right)\equiv u(y(1-s),e,0,n,\lambda),$$

where the dependence of U on n is due to the fact that households with school-age children value public education differently from households without children.

Of course, a household will choose public over private school if and only if:

$$U\left(y\left(1-s\right),n,e,\lambda\right)\geq V\left(y\left(1-s\right),n,e,\lambda\right).$$

Let the household's indirect utility function be denoted by:

$$v\left(y\left(1-s\right),n,e,\lambda\right)=\max\left\{U\left(y\left(1-s\right),n,e,\lambda\right),V\left(y\left(1-s\right),n,e,\lambda\right)\right\}. \tag{6}$$

Denote by $\widehat{y}$ the level of income at which a household with n children is indifferent between private and public schools:

$$\widehat{y}\left(n,s,e,\lambda\right)=\frac{e}{1-s}\left[\frac{\lambda}{\left(\lambda^{\frac{1}{1-\alpha}}n^{-\frac{\alpha}{1-\alpha}}+1\right)^{1-\alpha}-1}\right]^{\frac{1}{\alpha}}. \tag{7}$$

Higher spending per student on public education would increase the income cut-off for attending private school. For given spending, a higher tax rate s has the same effect, by reducing the household's disposable income. A higher number of children in the household has the effect of increasing the

income cut-off for private school.

In addition to their income and number of children, households differ in three other dimensions. First, I distinguish between households headed by a citizen ($x = 1$) and households headed by a non-citizen ($x = 0$). Citizenship allows a household to vote for spending on public education, but does not affect directly any other element of its preferences or budget constraint. Second, in order to conduct counterfactual experiments, I distinguish between native and pre-1970 immigrant ($m = 1$) households on the one hand and new immigrant households on the other ($m = 0$). In Section 5 a household is considered "new immigrant" if its head immigrated to the U.S. after 1970. Last, households also differ in terms of the weight attached to education spending, λ.

Let $f(y, n, x, m, \lambda)$ denote the joint density of income, number of children, citizenship, and the parameter λ in the population of households. For given s and e, the per household measure of children attending public school is given by:

$$\overline{n}_p = \sum_{n,x,m} \int_0^{\infty} \int_0^{\widehat{y}(n,s,e,\lambda)} n \times f(y, n, x, m, \lambda) dy d\lambda. \tag{8}$$

Since $\widehat{y}$ is increasing in s, a higher tax rate increases public school attendance. This implies that spending per student might actually drop in response to an increase in the tax rate, as first pointed out by Epple and Romano (1996).

The tax rate s is assumed to be determined by majority voting by households headed by a U.S. citizen. In what follows I focus on a myopic majority-voting equilibrium in which, when voting, households take as given their own choice of school as well as the choice of all other households. Formally, a majority-voting equilibrium is comprised of a tax rate s^*, levels of public and private school spending per student, e^* and z^*, and a measure of students attending public school $\overline{n}_p^*$, such that:

- Private school spending per student, z^*, by a household characterized by (y, n, λ) is given by equation (5) if $y > \widehat{y}\,(n, s^*, e^*, \lambda)$ and zero else.
- The government's budget constraint, equation (4), is satisfied.
- Public school attendance $\overline{n}_p^*$ is given by equation (8).

- The equilibrium tax rate and level of spending (s^*, e^*) are preferred by at least 50 percent of the citizen-voters to any alternative (s, e) such that:

$$e \equiv \frac{s\overline{y}}{\overline{n}_p^*}. \tag{9}$$

It is straightforward to show that, at a majority-voting equilibrium, the preferred tax rate by a household takes the general form:

$$s\left(y, n, \lambda; s^*, e^*, \overline{n}_p^*\right) = \frac{1}{1 + \Psi\left(y, n, \lambda; s^*, e^*\right)\left(\overline{n}_p^* y/\overline{y}\right)^{\frac{\alpha}{1-\alpha}}} \tag{10}$$

where the term $\Psi\left(y, n, \lambda; s^*, e^*\right)$ takes the following values:

$$\Psi\left(y, n, \lambda; s^*, e^*\right) = \begin{cases} \left[(1+\gamma)\lambda\right]^{\frac{1}{\alpha-1}} & \text{if } n > 0 \text{ and } y \leq \widehat{y}\left(n, s^*, e^*, \lambda\right) \\ \left(1 + \lambda^{\frac{1}{1-\alpha}} n^{-\frac{\alpha}{1-\alpha}}\right)(\gamma\lambda)^{\frac{1}{\alpha-1}} & \text{if } n > 0 \text{ and } y > \widehat{y}\left(n, s^*, e^*, \lambda\right) \\ (\gamma\lambda)^{\frac{1}{\alpha-1}} & \text{if } n = 0 \end{cases}$$

Everything else equal, the preferred tax rate for households with children in private school is smaller than the preferred tax rate of households without children, which, in turn, is smaller than the preferred tax rate of households with children in public school. The term $\overline{n}_p^* y/\overline{y}$ in equation (10) is the tax price of spending per student for a household with income y. It represents the amount by which this household's taxes would have to increase for a unit increase in e. The effect of a change in the tax price on a household's preferred tax rate is governed by the sign of the parameter α. Specifically, in the borderline case in which $\alpha = 0$ (log preferences), the preferred tax is independent of the tax price, while if $\alpha < 0$, as will be assumed in the empirical section of the paper, a higher tax price increases the household's preferred tax rate.[10]

Since voting is assumed to be myopic, households preferences are single-peaked over tax rates. Thus, the majority-voting equilibrium tax rate s^* is the median tax rate when *citizen* households' preferred rates are sorted from lowest to highest. Let $Q\left(s; e, \overline{n}_p\right)$ denote the fraction of households

[10] The sign of the parameter α determines whether the substitution or income effect of higher income y prevails. Since education is a normal good, a household would like to purchase more of it as its income increases. However, its tax price also increases with y, generating a substitution effect in the opposite direction. The former effect prevails if the parameter α is negative.

with a citizen head whose most-preferred tax rate is smaller than s when spending in public education is e and the per-household number of students enrolled in public school is $\overline{n}_p$. Then, a median voter equilibrium is a quadruple $\left(s^*, e^*, z^*, \overline{n}_p^*\right)$ such that:

$$Q\left(s^*; e^*, \overline{n}_p^*\right) = \frac{1}{2}, \tag{11}$$

and equations (5), (8) and (9) hold.

4 Empirical Implementation

The model is calibrated to the beginning of the post-education reform period in California, around 1980. To calibrate the economy I need to specify the values of the two preference parameters α, γ, that are common to all households in the population, and estimate the joint density $f(y, n, x, m, \lambda)$ for each Census year.

Consider first the parameter α. The value of α determines the tax price elasticity of the demand for education for the median voter through the following equation:

$$\text{median voter's tax price elasticity} = -\left(\frac{1-\alpha s^*}{1-\alpha}\right).$$

Lower values of α are associated with a more price-inelastic demand. This parameter could in principle be estimated by exploiting the observed variation in income and education spending per student across two Census years. Instead of following this approach, I proceed by adopting the value of α preferred by Fernandez and Rogerson (1999) in their study of education finance reform in California. Their preferred value, $\alpha = -0.25$, was such that their model generated the best fit for the observed distribution of spending per student across students in California before education finance reform. The implied tax price elasticity of education is about -0.81. This value is a bit higher in absolute value than the range $(-0.25, -0.5)$ reported by Bergstrom et al. (1982) in their survey of the literature. In Section 7, I re-estimate the model assuming that $\alpha = -1$, with an associated price elasticity of -0.52. It turns out that the benchmark version of the model accounts better for the evolution of education spending in California in 1990 and 2000 than the version with a more

price-inelastic demand.

To calibrate the density $f(y, n, x, m, \lambda)$, write the latter as:

$$f(y, n, x, m, \lambda) = f(y, \lambda | n, x, m) h(n, x, m), \tag{12}$$

where $h(n, x, m)$ is the joint density of (n, x, m). The joint density of (y, λ) conditional on (n, x, m) is assumed to take the following bivariate lognormal form:

$$f(y, \lambda | n, x, m) = \frac{1}{2\pi\sigma_y(n, x, m)\sigma_\lambda\sqrt{1-\rho^2}y\lambda} \times$$
$$\exp\left\{-\frac{1}{2(1-\rho^2)}\left[\left(\frac{\log y - \mu_y(n, x, m)}{\sigma_y(n, x, m)}\right)^2 - 2\rho\frac{\left(\log y - \mu_y(n, x, m)\right)(\log\lambda - \mu_\lambda)}{\sigma_y(n, x, m)\sigma_\lambda} + \left(\frac{\log\lambda - \mu_\lambda}{\sigma_\lambda}\right)^2\right]\right\}.$$

Notice that the parameters σ_y and μ_y are a function of n, x, and m, while the preference parameters $\sigma_\lambda, \mu_\lambda$, and ρ are not. The parameters σ_y and μ_y are estimated by matching the conditional mean and variance of the marginal density of household income, conditional on (n, x, m):

$$\mu_y(n, x, m) = \ln E[y|n, x, m] - \frac{1}{2}\ln\left[1 + \left(\frac{V[y|n, x, m]}{E[y|n, x, m]^2}\right)\right] \tag{13}$$

$$\sigma_y(n, x, m) = \left\{\ln\left[1 + \left(\frac{V[y|n, x, m]}{E[y|n, x, m]^2}\right)\right]\right\}^{\frac{1}{2}}, \tag{14}$$

where $E[y|n, x, m]$ denotes and $V[y|n, x, m]$ denote the conditional mean and variance of y. Citizenship (x) and immigration status (m) take two possible values each, while a household's number of children (n) is assumed to take four possible values: 0, 1, 2, and 3^+, where 3^+ equals the average number of children in households with at least 3 children.[11]

To calibrate the remaining three parameters $(\sigma_\lambda, \mu_\lambda, \rho)$ I use the following three moments. First, since for $\alpha < 0$ a lower average level of λ implies a higher number of children attending public school (see equation 7), it is natural to set the parameter μ_λ to match the per household number of children in public school in 1980. According to the Census this number was 0.4722 (see Table 1). The parameter ρ determines the degree to which preferences for education spending and income are correlated across households. For example, if $\rho < 0$, households with relatively low income tend to

[11] This figure was 3.43 in 1980 and 2000, and 3.40 in 1990.

have higher values of λ and are therefore more likely to have children attending private school than their income level alone would predict. In practice, I set ρ to match the ratio between the average incomes of households with children in public and private schools in 1980. This figure, computed from the Census data, is 0.8151. The parameter σ_λ determines the dispersion of λ in the population. Higher values of σ_λ are associated with more dispersion in household income within private or public schools. This parameter is set to match the coefficient of variation of income across households with children in public schools in 1980. This is equal to 0.6545, based on the 1980 Census data. Finally, the density $h(n, x, m)$ is estimated non-parametrically using the frequency count of each cell (n, x, m).

Notice that the parameters of the density $f(y, n, x, m, \lambda)$ can be estimated independently from the value of the parameter γ because the choice of school does not depend on γ. Higher values of γ are associated with higher preferred tax rates by all households. This, in turn, translates into majority-voting equilibria characterized by higher spending on public education. It is then possible to pin down the value of γ at which the society chooses to spend exactly 4.94 percent of its income in public education ($s^* = 0.0494$, Table 1).

Table 3 reports the calibrated values of the parameters.[12]

[Table 3 here]

Notice that the estimated value of ρ is negative. This is because the observed difference in income across public and private school households is smaller than what a version of the model with homogeneous λ would imply. Relatively poorer households that attend private school must do so because of an unobserved higher taste for education spending.[13] Also, notice that the estimated value of the parameter γ is smaller than one, which is consistent with the idea that, everything else equal, households without children care less about public education spending than households with children.

[12] The estimates of the densities are available from the author upon request.

[13] How should one interpret the negative estimate of the parameter ρ? This amounts to explain why there is more income mixing in public schools than what the model would predict if ρ had been zero. One explanation is that peer effects are an important determinant of educational outcomes in addition to spending. If peer effects are related to average income within a school and schools differ in this dimension, high income households should be expected to attend public schools more often than what predicted by this model. An alternative explanation is that households have preferences for religious education and the intensity of these preferences is stronger for lower income households.

The Census data on private school attendance by household income and immigration status of the household head provide useful information to evaluate the performance of the model. The calibrated model can also be used to predict the share of spending in education as a fraction of total income, enrollment in public schools, and other moments of interest for the Census years 1990 and 2000. In using the model to predict outcomes for 1990 and 2000, I use the same parameters $(\alpha, \gamma, \sigma_\lambda, \mu_\lambda, \rho)$ from Table 3. The conditional densities $f(y, \lambda|n, x, m)$ for 1990 and 2000 are re-estimated along the lines described above for 1980.

Table 4 summarizes the moments predicted by the model and presents them against the actual data for California.

[Table 4 here]

Notice that the model accounts reasonably well for the evolution of the triple $(e, s, \overline{n}_p)$ observed in California in 1990 and 2000. Specifically, the model correctly predicts the reduction in the share of income devoted to public education between 1980 and 1990 and the subsequent rise between 1990 and 2000. There are two main forces that drive the dynamics of s in the model. The first one is the variation over time in average income per public school student, $\overline{y}/\overline{n}_p$. Equation (10) and the assumption of $\alpha < 0$ imply that as average income per student in public school rises, voters prefer a smaller tax rate s but a higher level of spending per student. From Table 1, we know that the ratio $\overline{y}/\overline{n}_p$ went from \$97,308 in 1980 to \$132,365 in 1990 and subsequently fell to \$125,124 in 2000. This pattern is consistent with the qualitative variation in s generated by the model over this period. The second major force that determines the dynamics of s is private school attendance by citizen households. Higher private school attendance reduces the support for public education and tends to lower the equilibrium tax rate. In this respect, notice that the model incorrectly predicts a slight decline in private school attendance among native households between 1980 and 1990, while it gives rise to an increase in the 1990's, so that the predicted attendance rate is remarkably close to the data in the year 2000. The model-predicted pattern of private school attendance by native households tends to offset the dynamics implied by the ratio $\overline{y}/\overline{n}_p$ by increasing the equilibrium s in 1990 and decreasing it in 2000.

Table 4 contains additional information about the model-predicted ratio of average incomes of

public and private school households and their average number of children. Notice that, consistently with the data, public school households' income has on average declined in the 1980's and 1990's relative to its private school counterpart. Also, the model correctly predicts that public school households have, on average, more school-age children than private school ones.

5 Counterfactual Exercise

In this section I use the model developed so far to provide an answer to the following question: what level of public education spending per student would have occurred in California in 1980, 1990, and 2000 if U.S. immigration would have been capped at its level in 1970? The model can be used to compute counterfactual enrollment rates in private school and education spending relative to income. To perform such exercise one has to take a stand about the role of at least two other potential effects of immigration. First, we might need to evaluate the effect of restricted immigration on the income of native households residing in California. Not considering this general equilibrium effect might lead one to either under- or over- state the negative impact of immigrants on relative spending per student in California. The effect of immigration on the labor income of natives and previous cohorts of immigrants is the subject of some controversy in the literature (see e.g., Borjas, 2003 and Card, 2007). Recent research by Ottaviano and Peri (2008) points to a possible positive effect of immigrants on the average income of natives, but this finding has been challenged by Borjas, Hanson, and Grogger (2008). In light of the uncertainty about the effect of immigration on the income of natives, I take as a benchmark the case in which the income of natives and pre-1970 immigrants is unaffected by restrictions to immigration. Section 7 of the paper discusses the consequences of relaxing this assumption.

Second, given the tendency of immigrants to cluster in California, a smaller number of immigrants might produce a compensatory inflow of households from other parts of the U.S., as argued among others by Borjas, Freeman, and Katz (1997). The demographic characteristics of these households would have affected, both directly and through the voting process, the level of spending on public education. Again, the evidence on the extent to which immigration displaces internal migration by natives is mixed (see Card, 2001 and Borjas, 2006 for two opposing views on this point). Also,

in this case I start by considering the benchmark in which restricting immigration does not induce compensatory flows of households from other parts of the U.S. and discuss the role of this assumption in Section 7.

Given these assumptions, I use the model to compute the counterfactual level of spending per child and other indicators of interest in 1980, 1990, and 2000 excluding immigrant households whose head immigrated into the U.S. in or after 1970, according to the U.S. Census. Formally, the conditional density:

$$f(y, n, x, m, \lambda | m = 1) = \frac{f(y, n, x, 1, \lambda)}{\sum_{n,x} h(n, x, 1)} \tag{15}$$

has to be used in the counterfactual exercise, instead of the one in equation (12).

Table 5 contains the results of these exercises.

[Table 5 here]

Notice that immigration has a large negative effect on spending per student, especially in 1990 and 2000. For example, in the latter year, in the economy with immigration restrictions spending per student would have been $1,459 (or 24 percent) higher than in the benchmark economy. Most of these gains are due to the large drop in the number of public school students per household from about 0.52 in the benchmark economy (and in the data) to about 0.42 in the economy with restricted immigration. In the year 2000, the economy with restricted immigration is also characterized by an average income that is about $3,000 larger than in the data. Given that each additional dollar of average income entails an increase in spending per student of about 10 cents, the increase in the average level of income accounts for about 20 percent of the computed increase of $1,459 in spending per student in the counterfactual exercise.[14]

In order to place the magnitude of these results in perspective, the last two rows of Table 5 also show a back-of-the-envelope calculation of what spending per students would have been in California over time without its education finance reform. In performing this computation I assume that the income share of public education spending in California would have remained constant over time

[14] The actual sensitivity of spending per student to average income is $s^*/\overline{n}_p^*$. With a tax rate of about 5 percent and an average number of students per household of about 0.5, one obtains the figure of 10 cents on the dollar.

at 98 percent of its value in the rest of the U.S. This figure corresponds to the income share of education spending in California relative to the rest of the U.S. in 1970. As the numbers in the table suggest, in 1980 and 1990 without education finance reform California would have enjoyed a higher level of education spending corresponding to about $300 (1999 dollars) per student relative to the no immigration scenario. In 2000, however, the quantitative importance of education finance reform would have been dominated by the importance of immigration as a determinant of education spending per student. These computations, while raw, are consistent with the quantitative effects of education finance reform estimated by Fernandez and Rogerson (1999) and Hoxby (2001). They suggest that, especially in more recent times, immigration is likely to have played a more significant role than education finance reform in the relative decline of education spending per student in California.

6 Computing the Fiscal Impact of Immigrants

Most studies of the fiscal impact of new immigrants assume that governments respond to the flow of new immigrants by holding constant the level of services provided to current residents (e.g. National Research Council, 1997). This paper claims that, at least as far as public education spending in California is concerned, this has not been the case. It is interesting to evaluate the extent to which the assumption of a constant level of services leads to under or over estimate the fiscal impact of immigrants relative to the situation in which the level of services is endogenously determined.

According to the standard approach, the fiscal cost of immigration is represented by the additional taxes paid by households residing in California in the status-quo relative to an economy in which immigration had been restricted to 1970 levels, while keeping education spending per student at the same level in the two economies. In addition, in the standard approach public school attendance by native households is assumed not to adjust to the new tax rates and spending levels in the economy with restricted immigration. The fiscal cost of immigration computed in this way is equal to 0.2, 0.9, 1.4 percent of native households' income in the counterfactual economy in 1980, 1990, and 2000 respectively.

Alternatively, the cost of immigration can be computed by assuming that in the counterfactual economy the tax rate and spending per student are determined by majority voting, given the new

structure of the economy as summarized by the conditional density in equation (15). The equivalent variation $\tau(y, n, \lambda)$ for a household characterized by the triple (y, n, λ) is such that the following indifference condition holds:

$$u(y(1-s^*) + \tau(y, n, \lambda) - nz^*, e^*, z^*, n, \lambda) = v\left((1-s^c)\, y, n, e^c, \lambda\right), \tag{16}$$

where the super-script "c" denotes the majority-voting equilibrium in the counterfactual economy, and the super-script "*" represents the equilibrium in the status-quo. In words, the equivalent variation represents the increase in a household's consumption such that the household is indifferent between living in the status-quo economy and living in the counterfactual economy with restricted immigration.[15] The equivalent variation $\tau(y, n, \lambda)$ can be solved for analytically. For households with children in school, the equivalent variation will depend on whether the children are in public or private school in the status-quo and in the counterfactual economy. For simplicity, I only report the measures for households without children and with children who are always enrolled in public school in both scenarios. In these cases the equivalent variation takes the general form:

$$\tau(y, n, \lambda) = y\left\{\left[\left(\frac{1-s^c}{1-s^*}\right)^{\alpha} - \Phi\frac{(e^*)^{\alpha} - (e^c)^{\alpha}}{[y(1-s^*)]^{\alpha}}\right]^{\frac{1}{\alpha}} - 1\right\}, \tag{17}$$

where the parameter Φ is defined as follows:

$$\Phi \equiv \begin{cases} \lambda(1+\gamma) & \text{if children enrolled in public school in both scenarios,} \\ \gamma\lambda & \text{if household has no children,} \end{cases} \tag{18}$$

From Table 5 we know that the counterfactual economy has lower taxes and higher spending per student ($s^c < s^*$ and $e^c > e^*$) than the benchmark economy. The equivalent variation takes both of these advantages of the counterfactual economy into account. Thus, it is always the case that $\tau(y, n, \lambda) > 0$. Moreover, when $\alpha < 0$ the elasticity of the equivalent variation with respect to household income is larger than one if the household has no children or has children enrolled in public school in both scenarios. Under this condition, in fact, households with a higher income

[15] Notice that in defining the equivalent variation, I do not allow households in the benchmark economy to modify their choice of school in response to the transfer τ.

desire a higher level of spending in public education and taxes than households with lower incomes. The former kind is therefore relatively more hurt by the reduction in spending per student that is associated with immigration. In terms of ranking, it is straightforward to check that, everything else equal and independently of α, households without children have a smaller equivalent variation than households with children in public school, because the latter attach a higher weight to spending on public education than the former.

In what follows I integrate out the unobserved heterogeneity λ for each combination (y, n) by defining the average:

$$\overline{\tau}(y, n) = \int \tau(y, n, \lambda)\, l(\lambda | y, n, m = 1)\, d\lambda,$$

where $l(\lambda | y, n, m = 1)$ denotes the density of λ conditional on y, n, and the household being native $(m = 1)$. Figure 5 plots $\overline{\tau}$ as a function of household income in the year 2000 for different values of n and for y below \$300,000. For comparison, the figure also represents the cost of immigration as a function of natives' income computed using the standard approach described above. According to the latter the cost of immigration is a linearly increasing function of income. This is close to the equivalent variation of households without children. For the other households the relationship between $\overline{\tau}(y, n)$ and y depends on two opposing forces. First, for households choosing public schools or households without children, a higher y is associated with a higher willingness to pay for public education $(\alpha < 0)$. Second, a higher y leads some households to switch from public to private education. Since the equivalent variation for households with children in private school is lower than for observationally (in terms of y and n) identical households with children in public school, the average equivalent variation $\overline{\tau}(y, n)$ might eventually decrease in y, reflecting the increasing share of households choosing private school. The latter effect prevails for households with one child $(n = 1)$, while the former prevails for households with three of more children. For households with two children, instead, the two effects appear to balance out.

Table 6 reports the average (per household) fiscal cost of immigration computed under the standard method in which spending per student is kept constant in response to immigration and the equivalent variation measure described above.

[Table 6 here]

The utility-based cost computed according to the model is about 70 percent larger than the cost computed according to the standard approach. As Figure 5 suggests, this difference is related to the heterogeneity between households with and without children. From this figure it appears that there is not a large difference between the two measures of fiscal cost of immigration for households without children, but that for households with children the fiscal cost is clearly higher when measured by the equivalent variation. Consider first households without children. The latter account for about 70 percent of all households, so that the equilibrium level of spending mainly reflects their preferences for public education. It follows that their chosen bundle of consumption and education spending must dominate all other budget-feasible bundles, in particular the one characterized by the same level of education spending and higher consumption.[16] Therefore, a restriction on immigration that yields higher spending per student makes households without children better off, on average, than a restriction on immigration that simply yields lower taxes. This argument is even stronger for households with children. The latter prefer higher levels of spending in public education and taxes than households without children. Therefore, a restriction on immigration that yields higher spending per student makes households with children better off, on average, than a restriction on immigration that simply yields lower taxes.

7 Discussion and Extensions

In this section I discuss some of the assumptions of the basic model presented in Sections 3 and 4, and evaluate the impact of relaxing them on the main results.

7.1 Effect of Immigrants on Natives' Incomes

The analysis, thus far, has assumed that immigration has no effect on the income of native households.[17] While this is a useful benchmark to consider, it is worthwhile to try to evaluate the effects of this assumption on the results of the counterfactual experiment of Section 5.

[16] As Figure 4 shows, high income households without children appear to lose more from immigration when the standard approach to measuring its cost is used than with the equivalent variation measure. This is due to the estimated negative correlation between unobserved preferences for education (λ) and household income (y).

[17] Recall that "native households" also include households headed by a foreign-born individual who migrated into the U.S. before 1970.

The current literature is not unanimous on the effect of immigration on the wages of native workers. On the one hand, Borjas (2003) has argued that immigration significantly reduces the relative wages of native workers in skill groups where the supply of foreign labor tends to concentrate. Others, such as Card (2001, 2007), have played down the quantitative significance of such effects. Recently, Ottaviano and Peri (2008) and Peri (2007) have argued that immigration might even increase the average wages of native workers because the latter are complements rather than substitutes for foreign workers with the same observable skill mix. For our purposes, if immigrant workers had a negative (positive) effect on the relative and absolute wages of natives, the results from the counterfactual exercise of Section 5 would represent a lower (upper) bound for the effect of immigration on school spending. In order to evaluate the robustness of my results, I perform the counterfactual exercise allowing for a decline in native households' incomes following restrictions to immigration. To implement this effect in a tractable manner, I assume that the *counterfactual* joint distribution of natives' characteristics, instead of being given by equation (15), is instead given by

$$f_{\delta}(y,n,x,m,\lambda|m=1)=\frac{1}{\delta}f(\frac{y}{\delta},\lambda|n,x,1)\frac{h\left(n,x,1\right)}{\sum_{n,x}h\left(n,x,1\right)}, \tag{19}$$

where δ is a positive constant which is less than one if the inflow of immigrants contributes to increase the wages of natives. The conditional density $\delta^{-1}f(y/\delta,\lambda|n,x,1)$ in equation (19) corresponds to a conditional joint distribution of income and unobserved heterogeneity that is lognormal with parameters $\left(\log\delta+\mu_{y}\left(n,x,1\right),\sigma_{y}\left(n,x,1\right),\sigma_{\lambda},\mu_{\lambda},\rho\right)$. Thus, the mean of the distribution of income conditional on n and x, is increasing in δ.[18] Since preferences are homothetic, if all households' income is scaled down by the same factor δ, the majority-voting equilibrium will yield the same counterfactual tax rate s^{c} and spending per student would simply be equal to

$$e_{\delta}^{c}\equiv\frac{s^{c}\delta\overline{y}^{c}}{\overline{n}_{p}^{c}}=\delta e^{c},$$

where $\overline{y}^{c}$ and $\overline{n}_{p}^{c}$ are the counterfactual average level of income and public school attendance per

[18] Notice that δ affects both the mean and the variance of the marginal distribution of income, but not measures of inequality, such as the coefficient of variation. Thus, I am ignoring distributional effects of immigration (and associated effects on the voting equilibrium) and instead focus on the average effect of immigration on incomes.

household in the benchmark case of Section 5.[19] Thus, the equilibrium level of public education spending per student in the counterfactual economy in which the restriction on immigration reduces the incomes of natives by $1-\delta$ percent would be a fraction δ of the counterfactual level of spending reported in Table 5.

Instead of calibrating the parameter δ, I compute its value, denoted by $\widehat{\delta}$, that would set the spending level in the counterfactual economy equal to the actual level of spending predicted by the benchmark version of the economy. The latter is given by $\widehat{\delta} = e^*/e^c$. Based on the values of e^* and e^c in Tables 4 and 5 for the 2000 Census, $\widehat{\delta}$ is equal to about 0.81. In words, a ban on post-1970 immigration to the U.S. would have had to reduce California natives' incomes by 19 percent in the year 2000 to offset the negative impact of immigration of spending on public education.

To put this figure in perspective it is instructive to consider the estimates of the impact of immigrants on the average wages of natives that are found in the immigration literature. The magnitude of this estimate depends crucially on the size of the elasticity of substitution between natives and immigrants with the same education and experience in the production function. Traditionally, the literature (Borjas, 2003) has assumed an infinite elasticity of substitution, but Ottaviano and Peri (2008, Table 3) estimate a value of about 20. With this elasticity they find that the 1990-2006 immigration wave into the U.S. will contribute in the long-run to increase average wages for U.S. natives by 0.6 percent. This is a relatively small number compared by $1-\widehat{\delta}$. It might be argued correctly that since California disproportionately attracts immigrants, U.S. wide averages are not representative of what would have happened to average wages in California. Using the same theoretical and empirical approach developed in Ottaviano and Peri (2008), Peri (2007, Table 9) estimates that immigrant inflows into California in the period between 1990 and 2004 have increased average wages by 2.2 percent. Peri obtains this result assuming an elasticity of substitution between immigrants and natives of about 10, which is much smaller than the value estimated by Ottaviano and Peri (2008). Thus, the 2.2 percent figure is likely to be an upper bound for the effect of 1990-2004 immigration on average California wages. Thus, the available evidence does not suggest that the effect of immigration on native incomes, even if on average positive, is large enough to change significantly the magnitude of

[19] Notice that the income cut-off for attending private school goes down by a factor of δ. However, since all incomes go down by the same factor, the proportion of households with income below the cut-off remains the same.

the impact of immigration on public education spending per student reported in Section 5.[20]

7.2 Fertility of Comparable Native Groups

A second and related point has to do with whether a restriction on immigration would cause native workers from the rest of the U.S. to move to California. If this was the case, one would expect little impact of national immigration restrictions on California's local labor market, as argued by Borjas (2006). This effect would provide a rationale for keeping native household's incomes constant in the counterfactual exercise. However, a second key question for my purposes, would be whether the increased school enrollment that might have resulted from this internal migration would have caused spending per student in California to fall. In order to address this concern, I computed the average number of children per household by income group and Census year of post-1970 immigrant households residing in California, native households residing in California, and those not residing in California.[21] Within each income group and for each Census year, immigrant households have a significantly larger number of children than native households, especially in the lowest income groups. In turn, native households not residing in California have a number of children comparable to native households residing in California. Thus, even if a ban on immigration would have led to an inflow of native households into California, the latter would have been quite similar, as far as fertility is concerned, to California's native households belonging to the same income group.

7.3 Immigrants' Vote

To what extent is the drop in education spending per capita associated with immigration the result of the fact that non-citizen immigrants cannot vote for higher levels of spending in the model and possibly in reality as well? In principle the answer to this question is ambiguous. Immigrant households tend to have relatively low income and are more likely to have school-age children relative to natives. The former effect makes them want to spend less than otherwise identical native

[20] A caveat to these comparisons is represented by the fact that the Ottaviano-Peri results pertain only to wage income. Immigration should also have a positive effect on capital income by virtue of the complementarity between labor and capital in production (Borjas, 1999). While I am not aware of any empirical study of the effect of immigration on the profit income of corporations, a small literature has documented a positive effect of immigration on housing prices and rents (Saiz, 2003 and Ottaviano and Peri, 2007).

[21] These results are available from the author upon request.

households on public education due to the fact that, by assumption, $\alpha < 0$. The latter effect should make them want to spend more on public education than native households with the same income but without children. To compute the net effect, I recomputed the majority equilibrium for each year allowing all households to vote, independently of their citizenship status. The results are reported in Table 7.

[Table 7 here]

Allowing non-citizen immigrants to vote in the model leads to higher tax rates and levels of spending. By the year 2000, the model predicts that spending per student would have been about $269 higher if non-citizen immigrants were allowed to vote over education spending. This is about 18 percent of the drop in spending per student associated with immigration, according to the model (see Section 5). The main reason for this is that, even if all households were allowed to vote in the status-quo economy, the tax price of education faced by each household is larger in the status-quo than in the counterfactual economy.

7.4 Sensitivity Analysis on the Price Elasticity Parameter

In order to evaluate the sensitivity of the results to different values of the utility parameter α, I re-estimated the model assuming $\alpha = -1$. This corresponds to a more price inelastic demand than the benchmark. Table 8 reports the main predictions of the model in this case.

[Table 8 here]

Since restrictions to immigration effectively reduce the relative price of education spending, the model delivers smaller counterfactual education spending levels when $\alpha = -1$ than the benchmark economy. According to this version of the model, immigration reduced education spending per student by about $590 in 1990 and $950 in 2000, instead of $928 and $1,459 implied by the benchmark calibration. The average cost of immigration among households, as measured by the equivalent variation, is instead higher when demand for education is relatively more inelastic. Notice, however, that when $\alpha = -1$, the model does not perform as well as the benchmark in tracking the actual level of spending per student and the share of education spending in 1990 and 2000. Moreover, this version

of the model is less accurate in predicting private school attendance rates by native and pre-1970 immigrant households.

8 Conclusions

In this paper I quantify the impact of immigration on per student spending in public education in California in the period 1970-2000. According to my computations, immigration has played a major role in the decline in public education spending per student in California during the period in consideration, especially after 1990.

The focus of the paper is the experience of the state of California. The latter is the major immigrant receiving state in the U.S. and its education finance system is such that education spending is approximately equalized among public school students and independent of households' residential location. Are the predictions of the model developed in this paper consistent with the experience of other immigrant-receiving states, at least qualitatively? While it is outside the scope of this paper to perform a systematic analysis of other states, the available evidence is in accordance with the main results of this paper.

Consider, for example, the State of Florida. When U.S. states are ranked in terms of the change in the share of school-age children from immigrant-headed households between 1970 and 2000 Florida is fourth, while California is first.[22] In addition, Florida's education finance system shares some important features with California, with the state accounting for about two-thirds of the combined state and local funding sources (Wood et al., undated). According to Census and NCES data in the period 1970-2000 Florida has experienced a drop in education spending per student of about 4 percent relative to the rest of the U.S. Interestingly, this has occurred despite an increase in the number of households per student since 1970. Differently from California, the drop in education spending per student has been driven by a sharp decline in the share of education spending relative to income from 4.81 percent in 1970 to 4.10 percent in 2000. Florida's experience can be explained using the model developed in this paper. The key is the observation that the internal migration of retirees

[22] According to Census data, after California, Texas has experienced the second largest increase in the share of school-age children from immigrant-headed households, followed by Nevada, Florida, Rhode Island, and Arizona. The traditional immigrant-receiving states such as New York, New Jersey, Illinois come in 8th, 7th, and 9th in this ranking.

to Florida has acted to balance the inflow of immigrant households and led to an increase in the number of households per student. However, according to my model, households without school-age children display a smaller support for public education spending. In the language of the model, the inflow of retirees to Florida has shifted the identity of the median voter in the direction of smaller tax rates. This interpretation is consistent with the evidence (Poterba, 1997) that demographic differences among households are an important determinant of the share of spending devoted by a state to public education.

Beyond Florida's experience, the empirical results obtained by Poterba (1997) and Fernandez and Rogerson (2001) using state-level panel regressions show that higher school enrollment is associated with lower education spending per capita.[23] Thus, the paper's main results are likely to be general. One might wonder whether higher school enrollment due to immigration would have a different effect on education spending per student than higher school enrollment by natives, due, for example, to a baby-boom. Schrag (1998, page 9) hints at this point in relationship to California's experience with the provision of education and other public goods, by asking whether "...is the problem caused by some combination of hostility and indifference on the part of a body of voters that isn't sure it wants to carry this kind of load for *those kinds* of people?" To try to answer this question, I have augmented a Fernandez and Rogerson (2001) type of panel regression with a variable that denotes the share of children from immigrant households in total enrollment. The estimated coefficient is negative but small and not statistically different from zero. While this issue deserves further scrutiny, I do not find clear-cut evidence for the "Schrag hypothesis".[24]

What are the broader policy implications of this paper's findings? As far as immigration is concerned, the paper identifies a channel through which an inflow of immigrants is likely to have lowered the welfare of natives. Given the focus on a relatively narrow, although important, issue - public education spending - no conclusion can be drawn from this result about the overall welfare consequences of immigration. This point is reinforced by the observation that the nature of the analysis performed here is essentially static. As has been pointed out (National Research Council,

[23] Along these lines, I find that the correlation between the state-level change in the share of school-age children from immigrant-headed households and the change in a state's education spending per student relative to the U.S. average between 1970 and 2000 is equal to -0.70 and statistically significant.

[24] Alesina et al. (1999) instead find some evidence in favor of this view. They estimate a negative correlation between spending on education and other productive public goods and measures of ethnic fragmentation across U.S. cities and metropolitan areas.

1997) in order to evaluate the fiscal consequences of immigration one would need to compute the taxes paid and transfers received by immigrants over the course of their entire lifetime rather than at a point in time only. The latter point raises an interesting dimension to the immigration debate. Even if immigration was fiscally neutral for a country as a whole, its costs and benefits might not be evenly distributed from a *geographical* point of view if immigrants were concentrated in a few regions of that country. For example, while the state of California pays a large share of immigrants' education, the U.S. federal government collects federal taxes on the incomes of immigrants. The National Research Council (1997, Table 6.5) estimates that the net annual fiscal impact imposed by immigrant-headed households on native residents in California in 1994 is small and *positive* as far as Federal revenues and expenditures are concerned, and significantly negative at the state and local level. In other words, California's immigrants appear to make a small positive net contribution to the U.S. Federal government's budget but a negative one for local and state budgets. This tension between *federal* immigration policy and the regional fiscal impact of immigration has become manifest in 1994 when California and other states unsuccessfully filed a lawsuit against the U.S. federal government to recover the costs of public education for illegal immigrants. At other times this tension might instead be reflected in the attitudes of natives toward immigrants. It would be interesting to explicitly consider this issue and the welfare implications of alternative policy options such as, for example, transfers from the federal to state governments linked to immigration flows.

As far as the education literature is concerned, the results of the paper help to put in perspective the reform of the finance system that occurred in California in the 1970's by emphasizing the role of immigration in the relative decline of public education spending per student. It would be interesting to dig deeper into this comparison by explicitly considering the interactions between the nature of education finance and the consequences of demographic shifts like the one that occurred in California. More specifically, one could redo the exercise carried out in this paper considering a foundation system, as the one described in Fernandez and Rogerson (1999). This system would have obviously given rise to a certain amount of inequality in the distribution of education spending across school districts and the inflow of immigrants would have probably led to a significant increase in inequality over time. From this perspective, the education finance reform that occurred in California in the early 1970's had the unintentional effect of increasing the extent of redistribution from native to

immigrant households.

References

Alesina A., Baqir R., and Easterly W. (1999): "Public Goods and Ethnic Divisions," *Quarterly Journal of Economics*, 1243-1284.

Bergstrom T., Rubinfeld, D. and P. Shapiro (1982): "Micro-Based Estimates of Demand Functions for Local School Expenditures," *Econometrica* 50, 1183-1205.

Betts J. and R. Fairlie (2003): "Does Immigration Induce 'Native Flight' from Public Schools into Private Schools," *Journal of Public Economics*, 87, 987-1012.

Borjas G. (1999): "The Economic Analysis of Immigration," in *Handbook of Labor Economics*, Volume 3A, edited by O. Ashenfelter and D. Card, North-Holland, 1999, 1697-1760

Borjas G. (2003): "The Labor Demand Curve *Is* Downward Sloping: Reexamining the Impact of Immigration on the Labor Market," *Quarterly Journal of Economics*, 1335-1374.

Borjas G. (2006): "Native Internal Migration and the Labor Market Impact of Immigration," *Journal of Human Resources*, 41, 221-258.

Borjas G. and L. Hilton (1996): "Immigration and the Welfare State: Immigrant Participation in Means-Tested Entitlements Programs," *Quarterly Journal of Economics*, 111, 575-604.

Borjas G., R. Freeman, and L. Katz (1997): "How Much do Immigration and Trade Affect Labor Market Outcomes?," *Brooking Papers on Economic Activity*, 1997, 1-90.

Borjas G., J. Grogger, and G. Hanson (2008): "Imperfect Substitution Between Immigrants and Natives: A Reappraisal," NBER Working Paper 13887.

Card D. (2001): "Immigrant Inflows, Native Outflows, and the Local Market Impact of Higher Immigration," *Journal of Labor Economics*, 19, 22-64.

Card D. (2007): "How Immigration Affects U.S. Cities," CReAM Discussion Paper Series No 11/07.

Clune M. (1998): "The Fiscal Impacts of Immigrants: A California Case Study," in *The Immigration Debate*, J. Smith and B. Edmonston eds., National Academy Press.

Downes T. (1992): "Evaluating the Impact of School Finance Reform on the Provision of Public Education: the California Case," *National Tax Journal*, 45, 405-419.

Downes T. and D. Schoeman (1998): "School Finance Reform and private School Enrollment: Evidence from California," *Journal of Urban Economics*, 43, 418-443.

Epple D. and T. Nechyba (2004): "Fiscal Decentralization," in V. Henderson and J.-F. Thisse eds, Handbook of Regional and Urban Economics, Vol. 4, 2423-2471, Elsevier.

Epple D. and R. Romano (1996): "Ends Against the Middle: Determining Public Service Provision When There are Private Alternatives," *Journal of Public Economics*, 62, 297-325.

Fernandez R. and R. Rogerson (1999): "Education Finance Reform and Investment in Human Capital: Lessons from California," *Journal of Public Economics*, 74, 327-350.

Fernandez R. and R. Rogerson (2001): "The Determinants of Public Education Expenditures: Longer-Run Evidence From the States, 1950-1990," *Journal of Education Finance*, 27, 567-583.

Fernandez R. and R. Rogerson (2003): "Equity and Resources: an Analysis of Education Finance Systems," *Journal of Political Economy*, 111, 858-897.

Garvey D. and T. Espanshade (1998): "Fiscal Impacts of Immigrants and Native Households: A New Jersey Case Study," in *The Immigration Debate*, J. Smith and B. Edmonston eds., National Academy Press.

Hoxby C. (2001): "All School Finance Equalizations Are Not Created Equal," *The Quarterly Journal of Economics*, 116, 1189-1231.

Murray, Evans, Schwab (1998): "Education-Finance Reform and the Distribution of Education Resources," *American Economic Review*, 88, 789-812.

National Research Council (1997): *The New Americans - Economic, Demographic, and Fiscal Effects of Immigration*, National Academy Press.

Ottaviano G., and G. Peri (2007): "The Effects of Immigration on U.S. Wages and Rents: A General Equilibrium Approach," Working Paper, U.C. Davis.

Ottaviano G., and G. Peri (2008): "Immigration and National Wages: Clarifying the Theory and the Empirics," Working Paper, U.C. Davis.

Peri G. (2007): "Immigrants' Complementarities and Native Wages: Evidence from California," Working Paper, U.C. Davis.

Poterba J. (1997): "Demographic Structure and the Political Economy of Public Education," *Journal of Policy Analysis and Management*, 16, 48-66.

Ruggles S., Sobek M., Alexander T., Fitch C., Goeken R., Hall P., King M., and C. Ronnander (2008): Integrated Public Use Microdata Series: Version 4.0 [Machine-readable database]. Minneapolis, MN: Minnesota Population Center.

Saiz A. (2003): "Room in the Kitchen for the Melting Pot: Immigration and Rental Prices," *Review of Economics and Statistics* 85, 502-521.

Schrag P. (1998): *Paradise Lost*, The New Press, New York.

Silva F. and J. Sonstelie (1995): "Did *Serrano* Cause a Decline in School Spending?" *National Tax Journal* 48, 199-215.

Sonstelie J., Brunner E., and K. Ardon (2000): *For Better or For Worse? Education Finance Reform in California*, Public Policy Institute of California.

U.S. General Accounting Office (1994): *Illegal Aliens - Assessing Estimates of Financial Burden on California*.

Wood C., Chambers M., Mendonca S., K. Birkett, undated: Florida, http://nces.ed.gov/edfin.

A Data Appendix

Yearly state-level data on current nominal expenditures and fall enrollment in public elementary and secondary education for the school years 1969-1970 to 2004-2005 is from the National Center for Education Statistics (http://nces.ed.gov).

Micro data at the yearly frequency for the period 1970 to 2005 comes from the Current Population Survey. I have dropped from these samples individuals living in group quarters and with missing household income information.

Micro data at the decennial frequency starting in 1970 are from the U.S. Census of the Population. The following samples were obtained from the Integrated Public Use Microdata Series (Ruggles et al., 2008): 1970 1% Form 2 State sample, 1980, 1990, and 2000 5% State samples. For all years I drop individuals who live in group quarters. A school-age individual is defined as an individual who was between 5 and 17 years of age at the time of the Census and was enrolled in school according to the Census' criteria. The Census also provides information on whether the individual is attending public or private school. In the model, the choice of public vs private school is the same for all children in the same household, while in practice this is not always the same (i.e. some households have some children in public and others in private school). For practical purposes I assume a household has all of its children in public school if at least half of its own school-age children in school are reported attending public school. In the model, a household's number of school-age children can take one of these values: 0, 1, 2, 3^+ where the latter represents the average number of school-age children in California in a given Census year among households with 3 or more school-age children. In a given Census year, I define a household to be "immigrant" if its head (according to the Census) satisfies the following restrictions: (i) born outside of the 50 states of the U.S. and the District of Columbia; (ii) not born abroad of American parents; (iii) immigrated to the U.S. after the year 1970. Notice that requirement (iii) is introduced in the quantitative part of the model in order to use the year 1970 as a benchmark. A household is considered "native" if its head is not an immigrant, according to the requirements (i)-(iii) above. A household is considered "not a citizen" if its head is not a citizen according to the U.S. Census. Household income is the IPUMS variable "total household income" after 1970. Since this variable is not available for 1970, I have computed household income as the sum of total personal income of all household members for that year.

Table 1

Public Education Spending and its Components: California vs the Rest of the U.S.

Total public education spending is from the National Center for Education Statistics and refers to the academic year ending in the year mentioned in the table (e.g. 1969-1970 for 1970). Enrollment in public schools, household income, and the number of households are all from the U.S. Census of Population. The Census figures exclude individuals living in group quarters. Household income refers to the year before the census year. In the table CA stands for California, while US^{-} refers to the rest of the U.S. excluding California. Public education spending and household income are converted into 1999 CPI-U-RS adjusted dollars.[25]

Year	1970		1980		1990		2000	
	CA	US^{-}	CA	US^{-}	CA	US^{-}	CA	US^{-}
Public education spending per student (1999$)	3,510	3,133	4,806	4,509	6,222	6,510	6,338	7,065
Income share of public education (%)	5.48	5.59	4.94	5.56	4.70	5.67	5.06	5.49
Public school students per 100 households	65.08	66.82	47.22	51.39	43.47	41.04	52.28	43.04
Average household income (1999$)	41,667	37,467	45,949	41,642	57,539	47,107	65,415	55,388

[25] The conversion factors are 3.918 for 1969, 2.139 for 1979, and 1.304 for 1989.

Table 2

Immigration and School Attendance in California

"Native" in this table and in the paper refers to households who are either U.S. natives or immigrated to the U.S. before 1970. "Immigrant" refers to non-native households. The data are from the U.S. Census of Population. The data refers to California only.

	Year			
	1970	1980	1990	2000
% "native" households without school-age children	65.57	71.51	75.58	73.59
% immigrant-headed households without school-age children	-	62.42	52.99	48.46
Average # of school-age children per "native" household with children	2.11	1.78	1.67	1.70
Average # of school-age children per immigrant household with children	-	2.06	1.96	1.93
Average # of school age children per "native" household	0.73	0.51	0.41	0.45
Average # of school age children per immigrant household	-	0.77	0.92	1.00
% immigrant-headed households	0	5.89	15.96	29.65
% school children from immigrant-headed households	0	8.25	26.51	39.72

Table 3

Estimated Parameter Values

The parameter α is set a-priori to -0.25, which corresponds to the preferred value used by Fernandez and Rogerson (1999). The remaining parameters have been estimated along the lines described in Section 4.

α	μ_λ	σ_λ	ρ	γ
-0.25	-1.8295	1.0027	-0.6891	0.1412

Table 4

Model's Predictions - California

The first five data moments in this table are constructed using the data described in the legend of Table 1. The last three moments were computed using data from the U.S. Census of Population. Public education spending has been converted into 1999 CPI-U-RS adjusted dollars.

Year	1980		1990		2000	
	Data	Model	Data	Model	Data	Model
Public education spending per student (1999$)	4,806	4,806	6,222	6,128	6,338	6,171
Income share of public education (%)	4.94	4.94	4.70	4.70	5.06	4.94
Public school students per 100 households	47.22	47.22	43.47	44.18	52.28	52.35
Ratio average public/ private school income (×100)	81.51	81.51	65.95	60.87	59.04	47.96
Coefficient of variation income public school (%)	65.45	65.45	81.43	81.65	99.85	97.09
Private school children per private school households	1.60	1.76	1.51	1.71	1.54	1.75
Public school children per public school households	1.82	1.92	1.76	1.82	1.81	1.87
% children from pre-1970 CA households in private school	9.84	10.13	10.21	9.15	11.23	11.55

Table 5

Counterfactual Experiments

Under the heading "No Immigration", I present the results from the counterfactual exercise of restricted immigration in the U.S. after 1970. The counterfactual exercise consists of using the model to predict the variables reported in the Table's rows by restricting attention to the conditional distribution of households who had immigrated to the U.S. before 1970 (see equation 15). Under the heading "No Reform" I present the amount of public spending per student in California under the assumption that the share of public education spending relative to income in California would have stayed constant over time relative to the rest of the U.S. at its pre-education finance reform 1970 value (i.e. 98 percent). Dollar figures are expressed in 1999 dollars using the CPI-U-RS deflator.

Year	1980	1990	2000
No Immigration			
Public education spending per student (1999$)	4,983	7,056	7,630
Income share of public education (%)	4.92	4.55	4.65
Public school students per 100 households	46.05	38.23	41.78
% children in private school	9.21	6.19	6.81
Average household income	46,601	59,227	68,484
No Reform of Education Finance System			
Public education spending per student (1999$)	5,303	7,359	6,732
Income share of public education (%)	5.45	5.56	5.38

Table 6

Alternative Measures of the Average (Per Household, Per Year) Fiscal Cost of Immigration

Entries in this table correspond to two different measures of the average (per household) fiscal cost of immigration. The first one is the extra taxes that, on average, a household has to pay in the status-quo relative to the economy without post-1970 immigration. The second measure is the equivalent variation when spending per student adjusts endogenously in response to restrictions to immigration. Figures are expressed in 1999 CPI-U-RS adjusted dollars.

	Year		
	1980	1990	2000
Extra Taxes - Constant Expenditures	112	505	896
Equivalent Variation - Endogenous Policy	189	862	1,513

Table 7

Model's Predictions with Immigrants' Vote - California

The table represents moments generated by two versions of the model. The first column ("I. Vote") of each year refers to the version of the model in which immigrants are allowed to vote, while the second column ("Bench.") reproduces the benchmark results of Table 4. Public education spending has been converted into 1999 CPI-U-RS adjusted dollars.

Year	1980		1990		2000	
	Model		Model		Model	
	I. Vote	Bench.	I. Vote	Bench.	I. Vote	Bench.
Public education spending per student (1999$)	4,868	4,806	6,310	6,128	6,440	6,171
Income share of public education (%)	5.02	4.94	4.88	4.70	5.21	4.94
Public school students per 100 households	47.40	47.22	44.48	44.18	52.89	52.35

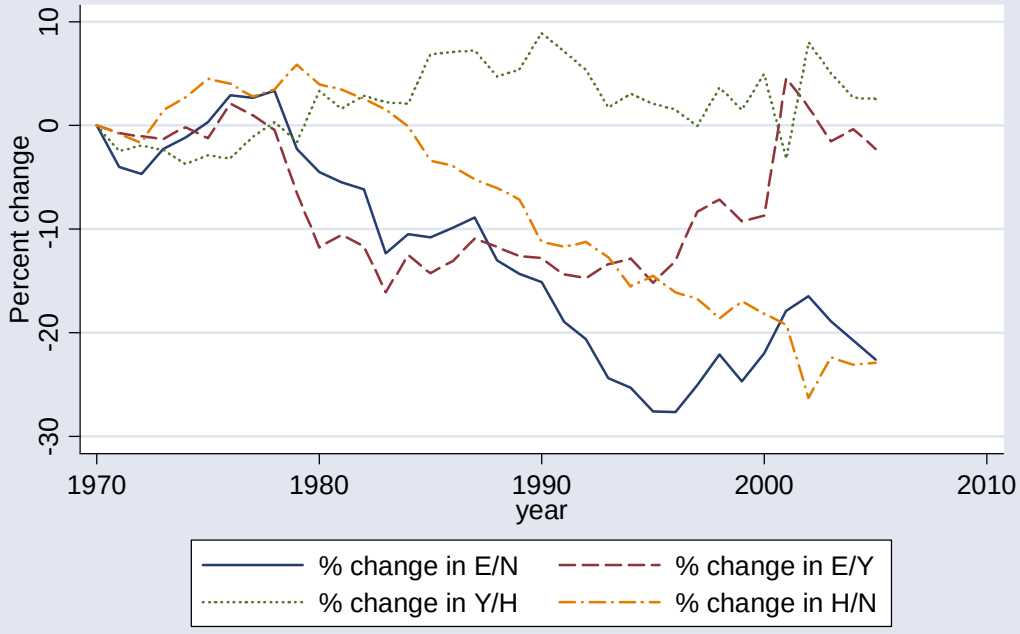
Table 8

Sensitivity Analysis with Respect to the Price Elasticity Parameter α

In this table I present the results for $\alpha = -1$. The calibration procedure is described in Section 4 and it is such that the model matches certain key moments in the year 1980. The estimates of the other parameters of the model are: $\mu_\lambda = -2.8180$, $\sigma_\lambda = 1.2739$, $\rho = -0.9865$, $\gamma = 0.1049$. For each year, the column "Act" presents the prediction of the model for the moments of interest (i.e., the equivalent results to those in Table 4). The column "Cou" instead presents the results of the counterfactual experiment of restricted immigration (i.e., the equivalent results to those in Table 5). Dollar figures are expressed in 1999 dollars using the CPI-U-RS deflator.

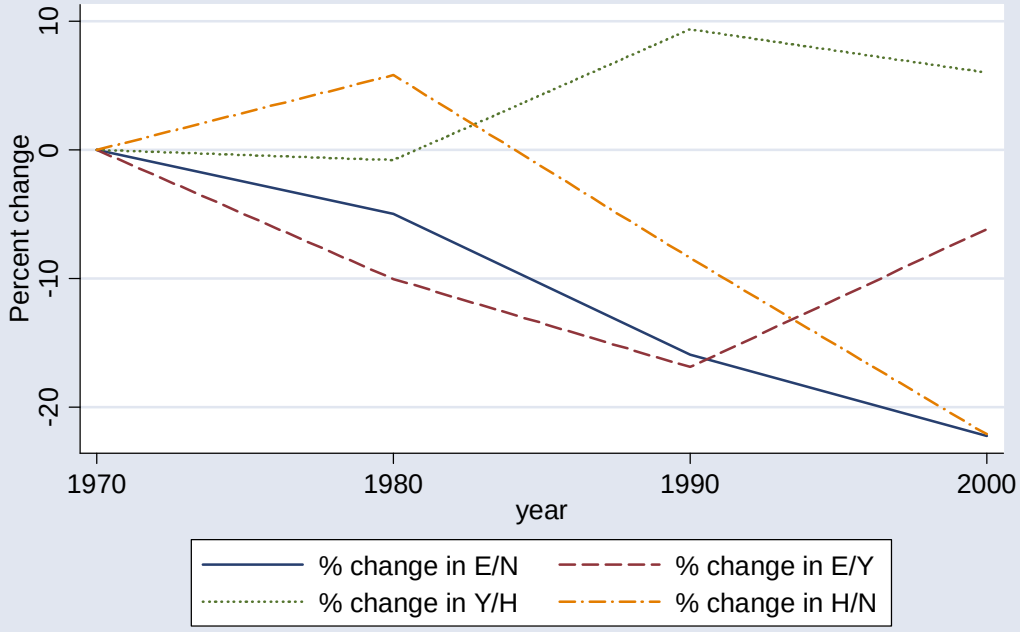
Year	1980		1990		2000	
	Act.	Cou.	Act.	Cou.	Act.	Cou.
Public education spending per student (1999$)	4,806	4,922	6,055	6,645	6,089	7,039
Income share of public education (%)	4.94	4.92	4.74	4.43	4.81	4.30
Public school students per 100 households	47.22	46.57	45.09	39.52	51.64	41.85
% children from pre-1970 CA households in private school	10.35	8.18	7.22	3.03	14.27	6.65
Average equivalent variation	-	198	-	916	-	1,620

Figure 1 - Spending per Student and its Components



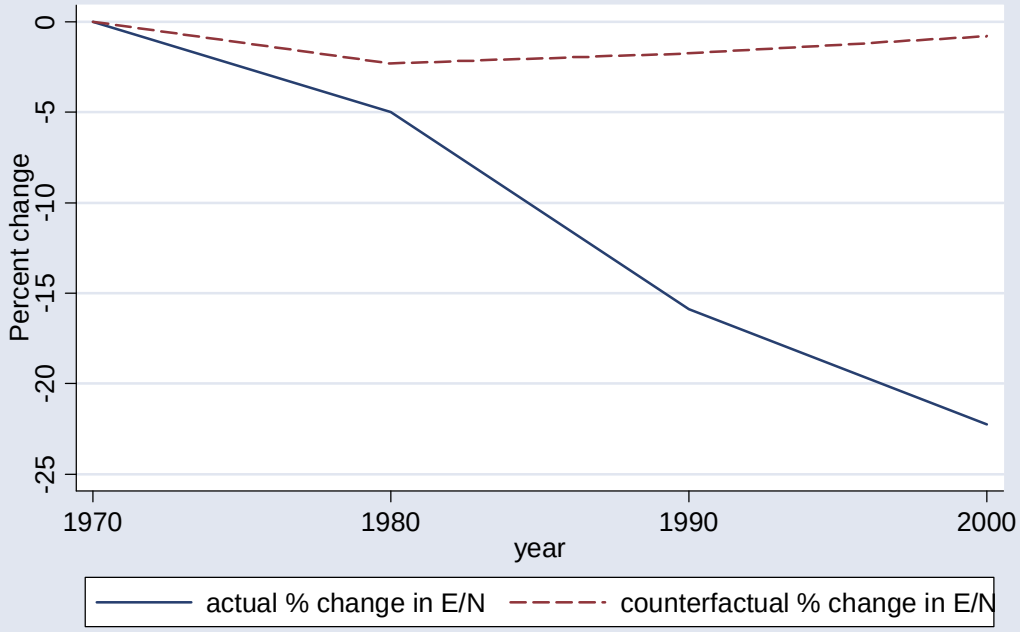
Data from National Center for Education Statistics and March CPS

Figure 2 - Spending per Student and its Components



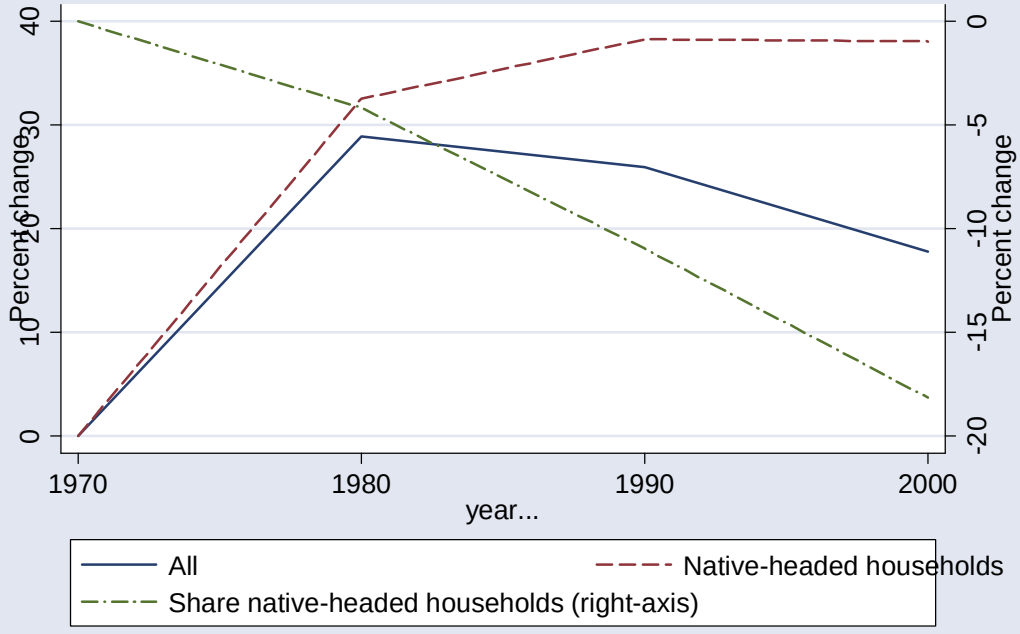
Data from National Center for Education Statistics and U.S. Census

Figure 3 - Spending per Student Using Native's H/N



Data from National Center for Education Statistics and U.S. Census

Figure 4 - Private School Enrollment Rates



Data from National Center for Education Statistics and U.S. Census

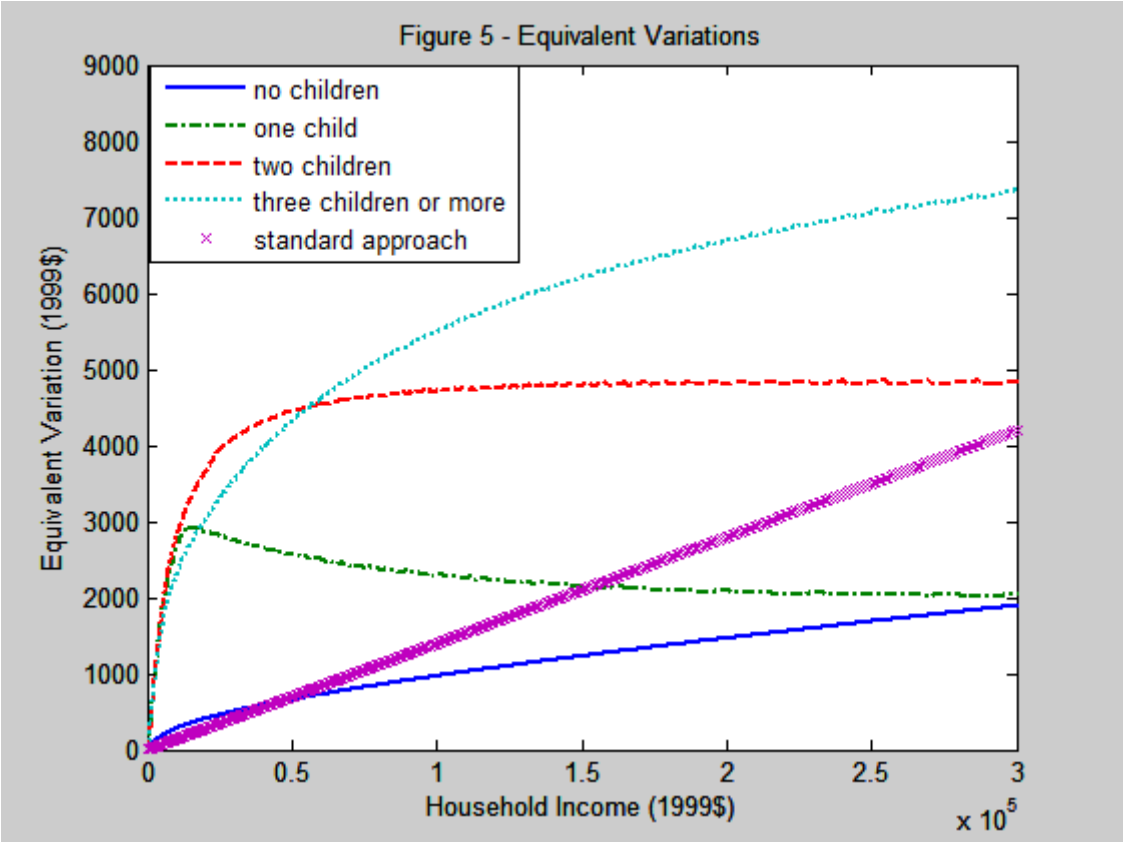


Figure 5 - Equivalent Variations
no children
one child
two children
three children or more
standard approach
Equivalent Variation (1999$)
Household Income (1999$)
x 10^5
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
0
0.5
1
1.5
2
2.5
3