STUDENT EMIGRATION AND THE WILLINGNESS
TO PAY FOR PUBLIC SCHOOLS: A TEST
OF THE PUBLICNESS OF PUBLIC HIGH
SCHOOLS IN THE U.S.

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ABSTRACT

This paper presents a test of Weisbrod's hypothesis that a public-
goods aspect to education, coupled with anticipated emigration by
students, leads communities to underinvest in education. It
analyzes, in a simultaneous equations framework, the effects of
both immigration and emigration on high school finance decisions
in the United States. The analysis does not support the
hypothesis of a public investment motive in educational finance.
However, the revealed negative correlation between immigration and
educational expenditures suggests that communities may be free-
riding on human capital produced elsewhere by substituting
"imported" human capital for local production.

Human capital may or may not generate externalities. Many economists strongly disagree on the subject. There are several arguments, however, that support the notion that human capital (or more specifically, the average level of human capital in a jurisdiction) produces externality effects. For examples of these arguments, see Weisbrod (1964), Hirsch and Marcus (1969), Holtman (1971) or Lucas (1988).

If human capital produces externalities, then a community's expenditures on education should be correlated with its efficiency in producing externality benefits. In his 1964 research report <u>External Benefits of Public Education:</u> <u>An Economic Analysis</u>, Burton Weisbrod theorizes that migration patterns indicate the efficiency of educational expenditures in producing externality benefits because the majority of externality benefits accrue to the community only if the educated individuals do not move away. Empirical analyses of this hypothesis by Weisbrod (1964) and Charles Clotfelter (1976) support the hypothesis by finding a negative correlation between emigration and educational expenditures.

This paper extends the work of Weisbrod (1964) and Clotfelter (1976) by examining the relationship between migration and educational expenditure when both emigration and immigration are endogenous rather than exogenous. Unlike previous work, this analysis also incorporates an educational production function to reflect efficiency differences in producing human capital. Data for the analysis come from the longitudinal data set High School and Beyond and the 1980 census. The analysis is conducted across states at the individual school level.

I find that emigration and expenditures are positively correlated in states that finance schools with a foundation formula. Therefore, I cannot

support the hypothesis of a public investment motive in educational finance. However, I find a negative correlation between immigration and educational expenditures, suggesting that communities may be substituting "imported" human capital for local production.

The Relationship Between Migration and Education

Assume, for the moment, that human capital produces externalities, and let the average level of educational attainment within the community indicate the extent of those externalities. In this situation, the ability of communities to capture educational externalities becomes a function of their ability to increase the local average education level. Ceteris paribus, communities that anticipate high emigration of individuals educated locally should be less willing to pay for investments in education because the educational expenditures will not succeed in increasing the general education level. The negative effect on expenditures should be most pronounced when communities anticipate the migration of recent graduates, because then the present value of any lost benefits is at its largest. On the other hand, if educational expenditures attract new residents that are already highly educated, then, ceteris paribus, communities that experience high immigration of educated persons should be more willing to pay for schooling. Finally, if school expenditures are not an attraction for educated persons, then communities that anticipate high immigration of educated individuals should substitute this "imported" human capital for the locally produced variety and be less willing to pay for schooling, ceteris paribus.

These expected relationships between educational expenditures and migration under the assumption of human capital externalities suggest a test

of the hypothesis that education is an impure public investment good.[1] In simplest terms, one tests for the existence of a significant, negative correlation between the emigration of recent students (given the level of immigration by individuals with comparable human capital) and the willingness of communities to pay for their education (as revealed by the level of community spending on education), ceteris paribus. If such a correlation exists, then one can conclude that, from a community perspective, education expenditures are at least in part investments in future human capital externalities. After all, the private benefits from education are not lost when the graduate moves.

The direction of causation also seems clear in the case of migration by recent graduates. Families with school-age children may be attracted to communities that spend heavily on schools and repelled by communities that spend little on them, but the population of recent high school graduates is very unlikely to have such children. It is improbable that their migration is motivated by the lure of alternative public school systems. For this group, there is no purely private explanation for the rate of out migration by recent graduates to increase as expenditures on education decline, ceteris paribus. The migration literature holds that if anything, the better educated are more likely to move.[2] I can therefore interpret a negative correlation between educational expenditures and emigration of recent students as support for the hypothesis that public investment motives influence school finance. A positive correlation, on the other hand, neither confirms nor rejects the

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[1] Because there are substantial private benefits, education cannot be a pure public good.

[2] See, for example, Borsch-Supan (1990), Schultz (1982) or Myers (1972).

hypothesis.

While migration may affect educational expenditures, many community characteristics affect migration. Educational quantity (years of schooling) is significantly and positively correlated with the propensity to migrate. By extension, there should be a similar correlation for educational quality. To the extent that school quality is attributable to school expenditures, local expenditures on education will influence the future migration patterns of students. Further, a search for school quality probably leads parents to migrate in direct response to the level of school expenditures; parents are attracted to communities with high expenditures and repelled by communities with low expenditures. At the very least, characteristics of the local labor market that help to define the community's ability to pay for schools also define the likelihood of migration for reasons of employment.

The Research Framework

A proper test of the relationship between migration and educational expenditures, therefore, requires a formulation that incorporates the endogeneity of migration. Consider a system of four simultaneous equations: one for expenditures, another two for migration (both in and out), and a fourth for educational quality. Specifically:

$$\text{EXPEND} = f(Y, S, T, \text{MOVEOUT}, \text{MOVEIN}, \epsilon_1) \tag{1}$$

$$\text{MOVEOUT} = g(L, F, C, \text{POSTTEST}, \epsilon_2) \tag{2}$$

$$\text{MOVEIN} = h(L, F^*, C, \text{POSTTEST}, \text{EXPEND}, \epsilon_3) \tag{3}$$

$$\text{POSTTEST} = i(F, \text{PRETEST}, \text{EXPEND}, \epsilon_4) \tag{4}$$

where EXPEND is the current school expenditure per pupil (locally);[3] MOVEIN

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[3]I assume that communities decide on the level of support for schools but are seldom involved in the professional decisions concerning the manner in which those funds are spent, and that therefore the distribution of funds need

is the immigration of individuals with a high school diploma (as a fraction of community population); MOVEOUT is the emigration rate among recent students; POSTTEST is a measure of post-secondary school human capital; Y is a vector of those factors that determine the community's income (such as personal incomes and unemployment rates or intergovernmental transfers); S is a vector of the explicit costs of education (such as teacher salaries); T is a vector of educational taste parameters (such as the general education level or average family size); L is a vector of local labor market characteristics (such as the manufacturing wage and unemployment rate); F is a vector of student and family characteristics; F* is a vector of immigrant characteristics; C is a vector of community characteristics; PRETEST is a measure of human capital prior to the relevant level of schooling; and the ϵ_is are error terms. The income and labor-force vectors (Y and L, respectively) have some members in common, while the local taste for education (T) includes some of the family and community parameters found in F and C, respectively. This formulation, unlike those used in previous analyses, allows migration rates to be influenced by expenditures via the effect of expenditures on educational quality and allows educational expenditures to be influenced by both immigration and emigration.

Each equation in this ideal system represents one of the four endogenous variables. The quality equation excludes immigrant characteristics (F*), community characteristics (Y, L and C), educational tastes (T), and local educations costs, such as starting teacher salaries or indicators of unionization included in vector S. The immigration equation excludes the pretest of human capital and local education costs, and the expenditures

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not be considered here. This is particularly likely when on considers only current expenditures.

equation excludes migrant characteristics and the pretest. The order

conditions for identifying each of these equations are thus satisfied.

Because expenditures are the focus of this approach, the technique is

sufficient for my purposes -- the estimation of the effect of emigration on

expenditures. A significantly negative effect indicates a public investment

goods aspect to education.

When using this model to test the impure public investment goods

hypothesis for secondary schools, particular care must be taken in the

specification of the emigration variable (MOVEOUT) to isolate recent public

school student migration from general migration. The migration pattern of

parents motivated by the search for quality schooling (and therefore leaving

communities with low quality/expenditures) mimics the negative correlation

between expenditures and emigration expected under the impure public

investment goods hypothesis. Thus, general data that include the migration of

parents with school-age children are biased in favor of the hypothesis and

should not be used to test it. Arbitrarily deleting parents from the data

set, however, would introduce self-selection bias. By limiting consideration

to data from recent graduates, parental migration motives are effectively

purged from the data without bias. When the respondents are too young to have

school-age children (and definitely too young to have high school age

children) there can be no question of self-selection.[4] This approach has the

added advantage of focusing attention on individuals in whom the present value

of any educational externality is maximized, highlighting the impact of their

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[4] It is conceivable that a recent graduate may have step-children of
school age or have a child born during the student's own high school years.
Such situations, however, are probably sufficiently rare that their effect on
the analysis is negligible.

potential emigration. Only public school student migration should be used because this is the group in which investment may have been made, and only their behavior is relevant.

Similar care should be taken when measuring immigration to consider only those immigrants already endowed with a level of human capital comparable to that of the (potentially) emigrating students. After all, only comparably educated immigrants are substitutes for the local students in the production of an increased local average education level.

Applying the Research Framework

This analysis of the impure public investment goods hypothesis relies heavily on data from the High School and Beyond (HSB) data set, which was gathered between 1980 and 1986 by the National Center for Educational Research at the instigation of the U.S. Department of Education. The data set follows the secondary education and post-secondary activities of up to thirty-six students in the sophomore class and a like number in the senior class from each of 1,015 high schools in the United States. The students were surveyed four times at two year intervals starting in their sophomore and senior years, respectively. The survey responses provide student-specific data on migration patterns, employment and general demographics. In addition, identical academic achievement tests were administered to the younger cohort at the time of the sophomore and senior surveys, while the elder cohort answered an identified subset of the test questions at the time of the senior survey. This paired data permits construction of a strong value-added test of school quality. Reports from the schools' administrations provide specific information about the high schools attended by these students.

The HSB data set permits analysis of student emigration and public

school expenditures at the local level. Senior migration patterns can be computed for each HSB school using survey data from just less than six years after the students' expected graduations. Among the school information are data on high school expenditures per pupil. Further, HSB provides census data on county per capita personal incomes, unemployment rates, and average hourly manufacturing wages.[5] The administration survey provides data on teacher salaries and student body composition by school.

A secondary advantage to HSB is that data on union representation of teachers are available from the same administration survey. These data permit testing for distinctions between union and nonunion school districts in educational production and finance.

In most parts of the country, the school district is the jurisdiction responsible for school expenditures decisions and the jurisdiction most comparable to the admittedly loose definition of community used above. To use HSB for this test, it is necessary to assume that the school district is a representative component of the county (or for those regions in which there are many school districts per county, that the county is representative of the whole district), and that the school chosen by the compilers of HSB is a representative high school in the district. Such assumptions are consistent with the described study design.

Data problems remain, however. One problem arises from privacy considerations that make merging HSB and census data difficult; a second problem arises within HSB itself.

HSB has not been designed with this test in mind, and consequently it

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[5]In some cases, Standard Metropolitan Statistical Area data on wages substitute for county data.

provides no information on local immigration. Migration data are available from the 1980 census, but the problem with collating the data is twofold. First, the census provides a breakdown of immigration by educational attainment only at the state level, forcing me to assume that county immigration is roughly proportional to total state immigration in percentage terms.[6] Second, HSB for reasons of student privacy does not identify the states in which its high schools are located (much less the counties).

Fortunately, it is possible to infer state locations for HSB from the students' college attendance patterns and to use the inferred state identifications to graft state-level data onto HSB. The inference procedure (discussed in more detail in Hanushek and Taylor 1990) concludes that a HSB high school is located in a particular state if a large percentage of the post-secondary students from that high school received their post-secondary schooling in that state. This procedure identified 797 of the 869 public schools that at least partially completed the school administrator's questionnaire. Many of the unidentified high schools are undoubtedly located on the border between states, such as in Kansas City or Washington D.C., or in geographically small states.[7]

The other significant mismatch between the ideal model and HSB is the current brevity of the longitudinal data set. Between them, the younger and

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[6]Total state immigration is the sum of gross state immigration and intrastate migration. Intrastate migration is a measure of the percentage of state residents who report a county of residence in 1980 that is different from their county of residence in 1975 but that is in the same state. This combination represents a gross measure of movement into counties within the state.

[7]Some schools may have been lost because of unusually high migration for educational purposes which led a high percentage of the students to attend post-secondary schools in different states.

elder cohorts provide sufficient information to test the complete system of equations, but independently each cohort is missing one essential year of observations. The younger cohort has the advantage of the paired test data, but the most recent follow-up survey (1986) was administered less than four years after graduation (during the traditional college years). Any migration data that this cohort provides is probably tainted by students who have left home to attend college and are expected to return. On the other hand, the 1986 survey of the elder cohort provides migration data from just under six years after high school. These data, which were gathered after the traditional undergraduate years, are much less likely to lead to confusion between temporary migration for educational purposes (a potentially desirable event from the home community's perspective) and permanent migration that deprives the home community of any expected externalities. Unfortunately, the elder cohort lacks any pretest data, seriously flawing any estimation of educational quality (see Hanushek and Taylor 1990).

The following estimation procedure is employed to deal with this problem. First, the quality equation is estimated in reduced form using individual data from the surveys completed in their senior year by the younger cohort, the school's administration survey, and the 1980 census (either provided by HSB or merged directly at the state level). Seven school-level variables are constructed school averages using a pooled data set containing both elder and younger cohort observations.[8] Although drawn from the student

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[8]These pooled variables are HOMEOWN, the percentage of parents at the school who own their home; S-EDMALE and S-EDFEMALE, the average effective years of education for the male and female parent or guardian, respectively (if there is no such person in the household, then the education is not reported, and treated here as zero); S-WCMALE and S-WCFEMALE, the fraction of male and female parents or guardians who hold (or have most recently held) white collar jobs, respectively; S-NUMROOMS, the average number of rooms in

survey responses, these constructs are intended to measure community rather than student characteristics and represent a part of the community characteristic and taste vectors. The dependent variable (POSTTEST) is the total number of correct answers on the mathematics, reading, and vocabulary tests taken by the younger cohort during their senior year. It is used as a measure of post-secondary human capital. The measure of incoming human capital (denoted PRETEST) is the total number of correct answers on the common mathematics, reading, and vocabulary tests taken by the younger cohort during their sophomore year. All of the questions on the common tests were asked of both the elder and younger cohort during 1980 and represent a subset of the questions asked of the younger cohort during 1982 (their senior year). Incoming human capital also enters the estimation quadratically (variable PRESQUARE) to capture the nonlinearities in achievement growth found in previous studies of the education production function.

Formally, the reduced form POSTTEST equation estimates

$$POSTTEST = \alpha + \alpha_1 PRETEST_y + \alpha_2 PRESQUARE_y + \beta X + \mu,$$

where $X = (Y, S, T, L, F, F^*, C)$ is a vector of all the exogenous variables in the system of equations, except $PRETEST_y$ and $PRESQUARE_y$.

Because the missing migration variable is endogenous to the model, this reduced-form equation is exactly the one that two-stage least squares would have estimated had the younger cohort data been complete. I can therefore have considerable confidence in the estimated coefficients (the βs) and use them with the elder cohort data to derive a fitted value for the elder

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the student's places of residence; and S-NUMSIBS, the average number of student siblings.

cohort's post-secondary human capital, denoted POSTHAT.[9] $PRETEST_e$, the estimate of incoming human capital for the elder cohort, is missing and ignored in creating this instrumental variable. Specifically,

$$POSTHAT = \alpha + \beta X_e .$$

The fitted value POSTHAT is correlated with the variables in X (and thus with POSTTEST) but uncorrelated with the error terms. As such, it is a consistent estimator for the individual stock of human capital, albeit a decidedly imperfect one. SPOSTHAT, the school mean value of POSTHAT, is then used as an instrumental variable for POSTTEST in migration equations of the ideal system, and the system is reduced to three estimable equations.

$$EXPEND \quad - f(\ Y, \ S, \ T, \ MOVEOUT, \ MOVEIN, \ \Sigma_1) \tag{1}$$

$$MOVEOUT \ ' \quad - g(\ L, \ F, \ C, \ SPOSTHAT, \ \Sigma_2) \tag{2a}$$

$$MOVEIN \ ' \quad - h(\ L, \ F^*, \ C, \ SPOSTHAT, \ EXPEND, \ \Sigma_3) \tag{3a}$$

This simplified system of equations can now be estimated using instrumental variables. Data on school, community, immigration, and labor-market characteristics are unchanged from those used to fit POSTHAT. School-level measures of student and family characteristics (including emigration) are constructed exclusively from the elder cohort surveys.[10] Students who reported that their residence in February 1986 was more than fifty miles from the community in which they attended their senior year of high school (in 1980) are said to have moved significantly. The migration variable used in

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[9]Such a derivation is possible because the data from the younger HSB cohort can be paired with the data from the elder HSB cohort according to the high school attended by both cohorts. The two classes (sophomore and senior) can be thought of as two random draws from the same pool of public high school students at a given school.

[10]The emigration data are the only information used at this stage that were not collected for 1980 (the elder cohort's senior year). Data used earlier from the younger cohort's senior year were collected in 1982.

this system is the fraction of respondents from each school who have significantly moved.[11]

The expenditures variable is the local contribution to the high school's per pupil expenditure (LOCALEXP). This variable is constructed by weighing the high school per pupil expenditure (as reported on the school administrator's questionnaire) by the average local share in educational expenditure for the state in 1980 (National Center for Education Statistics 1983). Similarly, a measure of the level of state (STBASE) and federal (FEDBASE) support for schools is constructed by weighing the high school per pupil expenditure by the shares in average school expenditures of state and federal spending, respectively. The data are available for 380 schools.[12]

Local fiscal incentives vary with the state's school finance structure. The financing structures fall into two broad categories --foundation formulas and guarantee formulas. Under a foundation formula, the state sets a minimum

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[11]The 1986 survey was administered to less than half of the students in the elder cohort. Most of the students lost were deliberately deleted by HSB before the 1982 survey. From that point on, only a sample (intended to be proportionally representative on certain key dimensions of interest to HSB -- most noticeably, ethnicity) was surveyed. Although extensive efforts were made to locate all members of the representative sample, only 88 percent of the sample senior cohort responded to the 1986 survey. The school average migration rates are constructed from this group. It is likely that these averages underestimate the true migration rate because the students HSB could not locate are probable migrants.

[12] Three hundred fifty schools that provided all other necessary information did not respond to the question on the level of high school expenditures. To determine the bias, if any, introduced by nonresponse, I constructed an indicator variable for response and tested for the partial correlation between the indicator and school characteristics using ordinary least squares. Of the variables used elsewhere in this analysis, only MILETECH, the distance to a vocational or technical school, was significant at the 5-percent level. High schools that provided expenditures data were farther from vocational post-secondary institutions than high schools that did not provide data.

level of educational expenditure. Generally, local school expenditures supplement state and federal aid, but in some states (within a certain range of expenditures) state aid can diminish as local expenditures increase. Under a guarantee program, state aid increases as local expenditures increase, although not at the same rate.

Under a foundation system, the marginal cost to the community of an additional dollar in educational spending is essentially one dollar of additional taxation. However, under a guarantee system the marginal cost to the community of an additional dollar in educational spending is a function of the rate at which the state matches local revenues. Because I lack information on the appropriate matching rates to apply in states with guarantee financing systems, I restrict my attention to states with foundation systems as the primary feature of their school finance structure.[13]

Complete data are available for 153 schools in foundation states. To control for variations in the size of the student populations from which school-level variables are constructed, analyses at the school level are weighted by the number of students in the elder cohort.[14] Tables 1, 2, and 3 present details of the specification together with estimated coefficients and standard errors. Table 4 presents variable means and standard deviations. The appendix presents a complete description of the variables used in this analysis.

Empirically, the appropriateness of pooling union and nonunion school

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[13]The information on fiscal structure used here comes from Tron (1982).

[14]The elder cohort for each school has nominally thirty-six members, (except for schools with fewer than thirty-six seniors, in which case all seniors are sampled), but the distribution of missing responses to survey questions is not uniform and therefore the effective cohort size varies.

districts for this analysis remains questionable. Eberts and Stone (1987) find significant differences in educational production functions between union and nonunion elementary schools, and the potential influence of teacher's unions on education finance is obvious. A Chow test of the reduced-form educational production function (equation 4) does not reject pooling of data on union and nonunion schools at the 5-percent level, nor is pooling rejected for the educational finance equation (equation 1). The seeming contradiction of Eberts and Stone's research most likely reflects the emphasis in their work on teacher and principal characteristics that are not a part of this analysis. Because the primary interest of this paper is educational finance, union influence on the distribution of educational resources is not addressed. The indication of insignificant union influence on the size of the educational budget (per pupil) is somewhat unexpected, but it is not inconsistent with a theory of efficient labor contracts.

Testing the Impure Public Investment Goods Hypothesis

My interest in the effect of emigration on school expenditures leads me to highlight the effect of the migration variables on LOCALEXP. According to the impure public investment goods hypothesis, emigration by recent students should negatively affect the local willingness to pay for schools. In the framework discussed above, the variable MOVEOUT isolates the effect of emigration on expenditures, and from Table 2 it is clear that, contrary to the findings of Weisbrod (1964) and Clotfelter (1976), this effect is significantly positive in this estimation. I cannot accept the null hypothesis of a public investment motive in educational finance.

Those with strong priors in favor of the publicness of education may resist such a conclusion. There are interesting community characteristics,

such as the size of the local tax base, that are unavailable from HSB and therefore could not be used in this analysis. This introduces the possibility of omitted variables bias in at least the expenditures equation. Although obvious outliers, such as schools with annual per pupil expenditures of $6, have been removed from the working data set, measurement error is always a problem.[15] No empirical work is free from these criticisms. Nonetheless, no more accurate test of the hypothesis can be conducted at this time.

Accepting the verdict of the data, there are three possible interpretations. Either education is not an impure public investment good, or other objectives dominate community behavior, or education is a public investment good but the rate of return is such that the communities in the sample do not choose to consume it.

Clearly, one possible conclusion is that communities do not perceive a public investment goods aspect to education. The data state quite firmly that these expenditures decisions are not negatively influenced by the subsequent migration of students. This correlation may be due to the absence of significant external benefits or a failure to perceive benefits that exist because of imperfect information problems.

It may also be that community educational decisions are not welfare, profit, or population maximizing. There are other political objectives for the school board, such as re-election, that may have higher priority. The time horizons of board members may be too short for an investment model. Under majority rule, the median voter holds sway, and it may be that the distribution of education within the community (or within the voters in the

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[15]Any school reporting per pupil high school expenditures of less than $500 or teachers' salaries of less than $2500 was removed from the data set. Several other schools were not included because of missing expenditures data.

community) is such that the median voter has an above-average education. Such a voter may find that the scarcity rents from his education outweigh any externality from an increased average level of education. If this is the case, we would not expect to observe any correlation between migration and the community's willingness to pay.

A third possible explanation is that education is an impure public investment good, but communities are unwilling to pay for any public aspects to it because there are cheaper substitutes. The development of "homegrown" human capital is only one technique for increasing the local general education level. Another technique is to import human capital by luring to the community individuals already endowed with education above the local norm. It may be that fishing for human capital is more cost efficient than producing it. In this situation, we would not expect to find public goods concerns motivating investment in education.

If communities are free riding on the externalities of human capital produced elsewhere (or paying for it with goods and services designed to lure the educated), then one would expect immigration to significantly influence local school expenditures, and vice versa. If there is free riding, or if the most cost effective lures for the educated are not educational expenditures, then one would expect to find a negative correlation between expenditures and immigration, ceteris paribus. A negative correlation is, after all, the expected substitution response. If there is a great deal of human capital moving into the area, there is no need to pay to produce it locally. This analysis indicates that educated immigration has a negative effect on high school expenditures that is significant at the 5-percent level. This supports the premise that education is not observed to be an impure public investment

good because a better substitute for locally produced human capital—namely,
imported human capital—is available. As the quantity of immigration
increases, the expenditures on a substitute source of human capital
externalities fall.

Finally, it should be noted that failure to accept the impure public
investment goods hypothesis is not a rejection of a public good aspect to
education. Rather, this test suggests that a community's interest in
education (from a public goods perspective) is not the children but their
parents. The willingness of nonfamily members to pay for schools that has
been found in previous work may most accurately be attributed to externalities
expected from the parents rather than to externalities expected from the
students. As the population ages and more individuals delay childbearing,
have fewer children, and remain childless, we should expect a shift away from
educational expenditures designed to attract the parents of school-age
children and a shift toward alternative taxation/expenditures schemes that
attract those without children.

Other Implications of the Analysis

There is a great deal of interest uncovered in this analysis beyond the
relationships between migration patterns and educational expenditures. In
terms of expenditures, it is very interesting that there is no evidence for a
systematic effect of teacher unionization or salaries on high school
expenditures. It is also interesting that the size of the student body (S-
MEMBERS) has only an insignificant effect on expenditures. This contradicts
the common notion that the educational production function demonstrates
economies of scale. One explanation for this result may be that larger
schools offer more expensive services or laboratory classes that are beyond

the means of schools without a 'critical mass' of students.

Taste parameters, with the exception of the distance measures (MILEJUCO and MILE4YRU), are generally insignificant in explaining educational expenditure.[16]   Although I expected that large distances to post-secondary institutions would indicate a distaste for education, the data indicate that secondary-school expenditures increase as distances to post-secondary schools increase. The insignificant effect of home-ownership rates found here suggests that the disadvantage of high property taxes may be counterbalanced by the potential capitalization of school quality into property values. The fraction of households in which English is not the dominant language has a positive explanatory power. This is consistent with the stereotypically greater interest of non-native parents in their children's education. As expected, transfer payments from the state (STBASE) negatively (if insignificantly) affect local spending. There is no significant distinction between the expenditures of urban and rural communities, although suburban communities may spend less than urban communities (the variable SUBURBAN is significant at the 10-percent level).

In terms of the migration equations, school quality (POSTTEST) is insignificant in explaining either immigration or emigration. Sex and race also have no overall effect on emigration. As is often the case, the pattern of migration is away from rural areas and toward urban ones. Unemployment

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[16]Taste parameters are represented by measures of average occupation and education for males and females in the community (S-WCMALE, S-WCFEMALE, S-EDMALE and S-EDFEMALE, respectively), the proportion of households that are non-English speaking at home (S-NONENGL), the proportion of white households (S-WHITE), and the distances to post-secondary schools (MILE4YRU, MILETECH and MILEJUCO). These last three indicate a revealed preference for post-secondary educational institutions, which may be expected to indicate a taste for education in general.

rates have the expected effects on emigration but no effect on immigration. Manufacturing wages have no significant explanatory power in either case. Perhaps most significant from the perspective of finance policy, immigrants with at least four years of high school are attracted by educational expenditures.[17]

A Brief Digression on the Educational Production Function

The educational production function also reveals some very interesting relationships. As is frequently the case, females and minority students demonstrate smaller achievement gains than do white males. Students who report a handicap also have smaller gains. The amount of time per week spent on a job has a significant, negative effect on white student achievement gains but no effect on minority students. Minority students may be less likely to substitute work hours for study time either because of greater discipline or because of a lower propensity to study.

Student senior-year performance (POSTTEST), as expected, is highly correlated with sophomore year performance (PRETEST). Because the senior test has more questions than the sophomore test, however, the reader should not conclude that students improved by 8.9 percent.[18] Senior performance is also significantly and positively correlated with the quadratic value of the sophomore test score (PRESQUARE). Students who are already above average gain even more than students who are below average. There is no evidence for

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[17]The F-statistic for the joint hypothesis that total educational expenditure—local expenditures (LOCALEXP) plus state expenditures (STBASE) plus federal expenditures (FEDBASE)—is significant at 14.57.

[18]PRETEST incorporates eighteen questions on mathematics, eight on vocabulary and eight on reading comprehension. The POSTTEST incorporates thirty-eight questions on mathematics, twenty-one on vocabulary and nineteen on reading comprehension.

systematic catching up in these skills (mathematics, vocabulary, and reading) during high school.

Family characteristics are significant factors in student achievement gains as well. Parental education and occupation have the expected effects, but the effect of family income is insignificantly negative. However, the size of the family home (NUMROOMS)—a frequent proxy for socioeconomic status—has a significant, positive impact.

State and federal expenditures have no significant effect on achievement gains; STBASE and FEDBASE are jointly as well as individually insignificant at the 5-percent level. This does not require that total expenditures be insignificant, however. It is likely, given the number of variables in the reduced form that are significant and that are not part of the original specification, that local expenditure is quite significant.

Students at schools in which the teachers are unionized show smaller gains (significant at the 10-percent level) than students at schools in which the teachers are not organized. While the size of the senior class (S-MEMBERS) has no explanatory power here, this should not be interpreted as an indicator that class size, in terms of pupils per classroom or instructor, is insignificant. Last, there is no distinction here among urban, suburban, and rural schools.

Conclusions

The initial conclusion of this analysis is the absence of support for the impure public investment goods hypothesis. Contrary to the work of Burton Weisbrod and others, this analysis finds that the migration of individuals educated locally does not lead to reductions in the local willingness to pay for schools. The data give no reason to believe that emigration

considerations lead to under-investment in education.

While emigration does not depress the willingness to pay for schools, immigration by individuals already endowed with the relevant education does negatively influence expenditures. This negative correlation suggests that the public investment goods aspects of education are not observed because of an alternative technology for generating educational externalities—the importing of human capital. If this substitution is occuring then there may be under-investment in education as communities free-ride on the externalities of human capital produced elsewhere. While the analysis supports the idea that high educational expenditures attract educated individuals, it may be useful to investigate other components to the community expenditures mix that could increase the local education level more efficiently than money spent on the schools.

Table 1: Fitting SPOSTHAT

POSTTEST=

	Intercept	1.413	(7.749)	
*	EDFEMALE	0.108	(0.038)	Effective Yrs. Schl Female H.H.
	EDMALE	0.076	(0.061)	Effective Yrs. Schl Male H.H.
	F-DAD	0.217	(0.635)	FEMALE X MALEHOME
	F-WORK	-0.010	(0.026)	FEMALE X HRSWORK
*	F-$$$$	0.040	(0.020)	FEMALE X FINCOME
	FEDBASE	-0.003	(0.003)	Federal Amt. of Schl Expend.
*	FEMALE	-2.394	(0.903)	Student is Female
#	FINCOME	-0.030	(0.018)	Family Income
*	HANDICAP	-1.055	(0.490)	Student Has Handicap
*	HRSWORK	-0.057	(0.021)	Hours Worked by Student
#	M-DAD	1.246	(0.641)	MINORITY X MALEHOME
	M-WORK	0.035	(0.027)	MINORITY X HRSWORK
	M-$$$$	-0.014	(0.022)	MINORITY X FINCOME
	MALEHOME	-0.518	(0.934)	Male Parent or Guardian in Home
*	MINORITY	-3.541	(0.973)	Student is Non-White
	NOUNION	-0.407	(0.403)	No Union Represents Teachers
*	NUMROOMS	0.254	(0.093)	Number of Rooms in Home
#	NUMSIBS	-0.165	(0.089)	Number of Siblings
*	PRESQUARE	0.017	(0.003)	PRETEST Squared
*	PRETEST	1.089	(0.104)	Number right Math+Vocab+Reading
	RURAL	0.454	(0.552)	High School is Rurally Located
	S-MEMBERS	0.0004	(0.001)	12th-Grade Membership
	STBASE	9.6E-5	(0.001)	State Amt. of Schl Expenditure
#	SUBURBAN	0.792	(0.453)	High School is Suburban
*	WCMALE	1.106	(0.310)	Male H.H. White Collar Job
*	WCFEMALE	1.125	(0.297)	Female H.H. White Collar Job
*	AGE-IN-F	-1.139	(0.564)	Avg. Age of Female Immigrant
*	CPCPI80	0.0003	(0.0001)	Cnty. Per Cap. Pers. Income 1980
*	PERCENTW	6.229	(2.961)	Percent of Immigr. White
*	S-EDMALE	0.482	(0.214)	Avg. Ed.--Male Parent / Guardian
*	S-WHITE	-0.021	(0.010)	% Student Body that is White
*	TAXDIST	0.890	(0.312)	Schl has Separate Tax District

R-square = .7440   Adj. R-Square = .7398   Number of Observations = 3268

* Significantly different from zero at the 5-percent level.
# Significantly different from zero at the 10-percent level.

For reasons of space, only those variables from the reduced-form equation that either are included in the original specification of the quality equation or are significant at the 5-percent level have been presented here. Standard errors are in parentheses.

Table 2: Testing the Impure Public Investment Goods Hypothesis

LOCALEXP=

	Intercept	167.347	(817.499)	
	CPCPI80	0.021	(0.022)	Cnty. Per Capita Personal Income
*	CUNEMR80	-4.748	(1.207)	Cnty. Unemployment Rate 1980
*	FEDBASE	1.320	(0.651)	Federal Amt. of Schl Expenditure
	HOMEOWN	-346.161	(306.945)	Share of Community Homeowners
*	MILE4YRU	2.972	(1.317)	Miles from University / College
	MILEJUCO	-0.365	(0.779)	Miles from a Junior College
	MILETECH	0.311	(1.004)	Miles from a Vo-Tech College
	NOUNION	-81.898	(82.245)	No Union Represents Teachers
	RURAL	-138.833	(106.678)	High School is Rurally Located
	S-EDFEMALE	31.341	(69.739)	Avg. Ed. -Female Parent/Guardian
	S-EDMALE	35.269	(36.539)	Avg. Ed. -Male Parent/Guardian
	S-MEMBERS	-0.007	(0.207)	12th-Grade Membership
*	S-NONENGL	4.566	(1.690)	% Non-English Speaking at Home
	S-WCFEMALE	142.490	(399.857)	% Area Females White Collar Jobs
	S-WCMALE	-451.443	(372.755)	% Area Males White Collar Jobs
	S-WHITE	1.558	(1.564)	% Student Body that is White
	SALARY01	0.012	(0.036)	Starting Salary BA Teacher
	STBASE	-0.014	(0.122)	State Amt. of Schl Expenditure
#	SUBURBAN	-134.205	(81.148)	High School is Located in Suburb
	TAXDIST	61.294	(54.690)	Separate Schl Taxation District
*	MOVEOUT	964.736	(428.434)	% Emigration by Students
*	MOVEIN	-5342.25	(2169.814)	% Educated Immigration

R-square = .3837   Number of Observations = 153

* Significantly different from zero at the 5-percent level.
# Significantly different from zero at the 10-percent level.
Standard errors in parentheses.

Table 3:   The Migration Equations

	MOVEIN=		MOVEOUT=	
Intercept	0.343 *	(0.089)	-0.725 #	(0.409)
AGE-IN-F	0.006	(0.006)	.	.
AGE-IN-M	0.006	(0.006)	.	.
CPCPI80	6.8E-7	(1.3E-6)	.	.
CUNEMR80	-0.0001	(0.0001)	0.001 *	(0.0005)
FEMALE	.	.	-0.288	(0.278)
F-DAD	.	.	0.294	(0.286)
F-4YRU	.	.	-0.009	(0.006)
F-JUCO	.	.	-0.002	(0.003)
F-TECH	.	.	0.012 *	(0.006)
FEDBASE	-0.0002 *	(4.8E-5)	.	.
FINCOME	.	.	-0.005	(0.004)
HANDICAP	.	.	0.253 #	(0.142)
HRSWORK	.	.	0.005	(0.004)
LOCALEXP	4.9E-5 *	(1.5E-5)	.	.
M-DAD	.	.	-0.100	(0.320)
M-4YRU	.	.	-0.004	(0.003)
M-JUCO	.	.	-0.004	(0.002)
M-TECH	.	.	0.001	(0.003)
MALEHOME	.	.	-0.284	(0.248)
MILE4YRU	0.0001	(0.0001)	0.006 #	(0.003)
MILEJUCO	7.8E-5 #	(4.7E-5)	0.002	(0.001)
MILETECH	0.0001	(0.0001)	-0.006 *	(0.003)
MINORITY	.	.	0.114	(0.237)
MWAGE	1.1E-6	(1.7E-5)	4.2E-5	(1.0E-4)
PERCENTF	-1.147 *	(0.238)	.	.
PERCENTW	-0.210 *	(0.038)	.	.
SPOSTHAT	0.004	(0.003)	0.003	(0.017)
RURAL	.	.	0.101 *	(0.042)
S-EDFEMALE	-0.002	(0.004)	0.031	(0.033)
S-EDMALE	-0.002	(0.002)	0.013	(0.020)
S-WCFEMALE	-0.025	(0.027)	-0.077	(0.203)
S-WCMALE	0.025	(0.022)	0.113	(0.178)
S-NUMROOMS	.	.	0.058 *	(0.025)
S-NUMSIBS	.	.	0.007	(0.026)
STBASE	1.7E-5 *	(6.9E-6)	.	.
SUBURBAN	.	.	0.049	(0.034)
R-square:	.5935		.4923	

* Significantly different from zero at the 5-percent level.
\# Significantly different from zero at the 10-percent level.

Standard errors are in parentheses. A dot indicates variables that are not included in the specification of this equation. There are 153 observations.

Table 4:   Population Means and (Standard Deviations)

AGE-IN-F	39.72	(16.77)
AGE-IN-M	38.80	(16.34)
CPCPI80	8870.92	(11575.27)
CUNEMR80	71.37	(188.48)
FEMALE	0.52	(0.64)
F-DAD	0.42	(0.60)
F-4YRU	13.96	(104.56)
F-JUCO	11.71	(106.33)
F-TECH	13.31	(118.12)
FEDBASE	174.74	(388.75)
FINCOME	20.66	(28.89)
HANDICAP	0.20	(0.52)
HOMEOWN	0.70	(0.64)
HRSWORK	19.73	(16.10)
LOCALEXP	586.63	(1790.31)
M-DAD	0.18	(0.93)
M-4YRU	6.46	(67.99)
M-JUCO	4.08	(46.39)
M-TECH	6.14	(79.65)
MALEHOME	0.80	(0.61)
MILE4YRU	26.62	(186.29)
MILEJUCO	23.51	(237.99)
MILETECH	25.40	(219.47)
MINORITY	0.26	(1.46)
MOVEIN	0.12	(0.14)
MOVEOUT	0.28	(0.97)
MWAGE	769.53	(811.69)
NOUNION	0.18	(2.11)
PERCENTF	0.48	(0.08)
PERCENTW	0.87	(0.41)
RURAL	0.36	(2.63)
SPOSTHAT	18.66	(9.17)
S-EDFEMALE	12.25	(4.29)
S-EDMALE	11.45	(7.68)
S-MEMBERS	353.64	(1038.98)
S-NONENGL	13.49	(128.46)
S-WCFEMALE	0.44	(0.73)
S-WCMALE	0.34	(0.84)
S-NUMROOMS	6.52	(4.20)
S-NUMSIBS	2.78	(3.13)
S-WHITE	66.68	(172.27)
SALARY01	10578.06	(5190.09)
STBASE	852.14	(2156.56)
SUBURBAN	0.43	(2.72)
TAXDIST	0.53	(2.75)
TOTALEXP	1613.51	(3236.24)

Number of Observations   153

Appendix

Defining the Variables

Endogenous Variables

LOCALEXP: High School principal's report of per pupil expenditures at his high school weighted by the average proportion of educational revenues raised locally for that state.

MOVEOUT: Percent of seniors at the high school who report that their residence in 1986 (six years after their senior year) is more than 50 miles from the community in which they went to high school. S.

MOVEIN: Immigrants with at least four years of high school as a percentage of total state population. This variable is constructed by determining the level of total immigration within a state (as represented by the number of new residents plus the number of residents reporting a different county of residence in 1980); dividing by the total state population; and weighing the result by the fraction of state immigrants who have at least four years of high school. C.

POSTTEST: The sum of the number of correct answers on the mathematics, vocabulary and reading tests administered during the students' senior years. HSB.

Exogenous Variables

AGE-IN-MALE: Average age of (at least high school educated) male immigrant. C.

AGE-IN-FEMALE: Average age of (at least high school education) female immigrant. C.

CPCPI80: County per capita personal income in 1980. HSB.

CUNEMR80: County unemployment rate for 1980. HSB.

EDFEMALE: Effective years of schooling by female head of household. Equals zero when there is no such person living with the student. S.

EDMALE: Effective years of schooling by male head of household. Equals zero when there is no such person living with the student. S.

F-DAD: FEMALE x MALEHOME.

F-4YRU: FEMALE x MILE4YRU.

F-JUCO: FEMALE x MILEJUCO.

F-TECH: FEMALE x MILETECH.

F-WORK: FEMALE x HRSWORK.

F-$$$$: FEMALE x FINCOME.

FEDBASE: The estimated federal share of education spending. This variable was constructed by multiplying the average federal share in school expenditures for each state (1980) by the principal's report of per pupil high school expenditure.

FEMALE[#]: The student is female. HSB

FINCOME: Family income. S.

HANDICAP[#]: Student does not report the absence of any handicap. S.

HOMEOWN: Fraction of parents at this school own their homes. SC.

HRSWORK: Number of hours student spent working, first week February his senior year. S.
M-DAD: MINORITY x MALEHOME.
M-4YRU: MINORITY x MILE4YRU.
M-JUCO: MINORITY x MILEJUCO.
M-TECH: MINORITY x MILETECH.
M-WORK: MINORITY x HRSWORK.
M-$$$$: MINORITY x FINCOME.
MALEHOME#: Male parent or guardian in household. S.
MILE4YRU: Number of miles to nearest four year college or university. A.
MILEJUCO: Number of miles to nearest junior college. A.
MILETECH: Number of miles to nearest vocational/technical school. A.
MINORITY#: Student is non-white. HSB.
MWAGE80: County average manufacturing wage, 1980. Occasionally, the average manufacturing wage for the statistical metropolitan area is substituted. HSB.
NOUNION: Dummy for teacher representation by unions. 1=no union represents teachers. A.
NUMROOMS: Number of rooms in student's place of residence. S.
NUMSIBS: Number of student's siblings. S.
PERCENTW: Percent of (at least high school educated) immigrant population that is white. C.
PERCENTF: Percent of (at least high school educated) immigrant population that is female C.
PRETEST: Sum of the number of correct answers on the mathematics, vocabulary, and reading HSB tests administered to the younger cohort in 1980 (the sophomore year). HSB.
RURAL: High school is rurally located. HSB.
S-EDFEMALE: Average education (in years) of female parents or guardians for this school. SC.
S-EDMALE: Average education (in years) of male parents or guardians for this school. SC.
S-MEMBERS: 12th grade student membership. A.
S-NONENGL: Fraction of student body for whom English is not the first language spoken in the home. A.
S-NUMROOMS: Average number of rooms in the students' homes for this school. SC.
S-NUMSIBS: Average number of siblings for students at this school. SC.
S-WCMALE: Fraction of male parents or guardian for this school in white collar occupations. SC.
S-WCFEMALE: Fraction of female parents or guardian for this school in white collar occupations. SC.
S-WHITE: Fraction of student body that is white. A.
SALARY01: Salary for first teacher's salary step - BA degree. A.
STBASE: The estimated state share of education spending. This variable was constructed by multiplying the average state share in school expenditures for each state (1980) by the principal's report of per pupil high school expenditure.The average level of state educational funding by state.
SUBURBAN: High school is located in a suburb. HSB.
TAXDIST: Dummy for whether or not the high school is in a separate school taxation district. This variable takes on the value of one when

the school has a separate taxation district and zero otherwise. A.

WCMALE[#]: Male head of household has white collar occupation. S.

WCFEMALE[#]: Female head of household has white collar occupation. S.

KEY:

A: Data for this variable come from the school administrator's survey.

C: Data for this variable come from the US Census Bureau.

S: Data for this variable come from the student surveys administered during the students' senior years.

SC: Data for this variable, intended to represent a community characteristic, come from the combined elder and younger student surveys.

HSB: Data for this variable was provided by the compilers of High School and Beyond.

[#]: At the individual level (used when fitting SPOSTHAT) this is a dummy variable; at the school level this is the percentage of the school sample with this trait.

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