The Political Economy of School District Mergers

Nora Gordon and Brian Knight[*†]

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Abstract

The number of school districts in the United States has fallen from around 130,000 in 1930 to just under 15,000 at present. Despite the large observed decline, many districts resisted consolidation before ultimately merging and others never merged, choosing to remain at enrollment levels that nearly any education cost function would deem inefficiently small. Why do some districts voluntarily integrate while others remain small? In attempting to answer this question, we empirically examine the role of three theoretically-identified factors: 1) potential economies of scale, 2) the loss in autonomy associated with heterogeneity in preferences between merger partners, and 3) state-level financial incentives for mergers. In order to measure the role of these factors, we focus on the state of Iowa, which experienced a wave of voluntary mergers during the 1990s due in part to state financial incentives. We have obtained a pre-merger school district map, which identifies potential merger partners, as well as data on pre-merger district characteristics, such as population, demographics, and assessed property values, and calculated the financial incentives offered by the state to each potential merger pair. While standard econometric models fail to capture the interdependence in merger decisions and the legal requirement that any mergers be approved by voters in both districts, we have developed a model that captures these two key institutional features. Applying this methodology to the Iowa data, our preliminary results demonstrate the importance of economies of scale and the state financial incentives in explaining the observed patterns of mergers in Iowa. We find only a minor role for various heterogeneity measures, although these results can not necessarily be generalized to other states.

[*] Respectively, Department of Economics, University of California, San Diego, email: ngordon@ucsd.edu, and Department of Economics, Brown University, email: Brian_Knight@brown.edu.

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1 Introduction

Throughout the twentieth century, bureaucrats, professional educators, and elected officials in the United States encouraged school districts to consolidate. Proponents of consolidation argued that by consolidating, districts would gain from economies of scale: high schools could offer more subjects, elementary schools could separate classes by grade level, and the quality of education could generally be improved at lower costs in larger consolidated schools and districts than in smaller ones. But many school districts resisted: residents consistently voted in favor of retaining their small districts, revealing that they preferred local control over the types of schools their children attended, who their children's classmates would be, and the determination of local tax rates to their own estimation of the potential efficiency gains so touted by consolidation's proponents. Ultimately, many states enacted legislation mandating or providing strong financial incentives for districts to consolidate, prompting sharp drops in the number of school districts (see Hooker and Mueller (1970) for an overview of such legislation), and a vast number of these political battles were resolved in favor of consolidation. As Figure 1 shows, the number of school districts in the United States plummeted from around 130,000 in the early 1920s to just under 15,000 today.

What explains the pattern of consolidations over this period? Why do some districts voluntarily integrate while others choose to remain small? In attempting to answer this question, we first develop a simple theoretical model of local political economy in which voters have preferences over a publicly-provided good, such as education, as well as private consumption. Voters differ according to income and preferences and the level of the publicly-provided good chosen thus depends upon the preferences and income of the median voter. In this model, the median voter in a district compares her utility under separation to her utility under integration, in which case she may no longer be the median voter. In the context of this choice of separation versus integration, the model identifies three factors affecting the incentives for a district to merge. First, regarding the role of population, small districts may benefit from any economies of scale due to the spreading of fixed costs over more taxpayers. On the other hand, large districts may be discouraged from any diseconomies of scale associated with mergers. Second, if the potential merger partner has different preferences for publicly-provided goods, the median voter may fear the loss in autonomy associated with consolidation. Finally, the model highlights the importance of state financial incentives in encouraging merger decisions.

In order to measure the role of these factors in predicting school district consolidations, we focus on the state of Iowa, which offered significant financial incentives for mergers during the early 1990s. Due in part to these incentives, over 50 mergers involving over 100 districts occurred during this period, and, due to these mergers, the number of districts fell from 433 in 1989, the first year included in the analysis, to 373 in 2001, the final year in the analysis. In order to identify all *potential* mergers, which can occur only between adjacent districts, we have obtained a school district map from 1989, the first year of the sample period. In order to examine the above hypotheses identified by the theoretical model, we have also collected data on pre-merger district characteristics, such as population, demographics, and property values. Finally, we have calculated the state-level financial incentives specific to each potential merger. These incentives were offered for only a three-year period and were targeted at small districts, those most likely to benefit from any economies of scale. Eligibility for the incentives was based on whether enrollment in the initial district fell below a threshold of 600 students; this discontinuity allows us to identify the effect of the incentives distinctly from effects due to economies of scale.

Standard econometric models of discrete choice fail to account for two key features of the merger protocol in Iowa. First, mergers must be approved by voters in both districts, and only mergers supported by both districts are thus observed. Second, in addition to deciding *whether or not* to merge, districts have multiple borders and thus must decide *with whom* to merge, with only one merger permitted per district per year. While Poirier's bivariate Probit model addresses the first, it fails to account for the multiplicity of potential merger partners. We develop an econometric model that accounts for both of these two key features of the merger protocol and apply it to our data from the state of Iowa. Preliminary results demonstrate the importance of economies of scale as well as diseconomies of scale in explaining the patterns of mergers in Iowa during this time period. We also find an important role for the state financial incentives in encouraging these mergers. We find only a minor role for heterogeneity, although these results can not necessarily be generalized to other states.

2 Existing Literature

Several existing empirical studies shed light on the role of factors underlying political integration. Alesina, Baqir, and Hoxby (2004) examine the number of jurisdictions, including school districts, within U.S. counties over the period 1960-1990 and find evidence for a trade-off between economies of scale and heterogeneity in both race and income. That is, counties with high levels of heterogeneity in these dimensions tend to have more school districts, all else equal. On the other hand, they find little effect of heterogeneity in religion or ethnicity. Regarding the role of state governments, the authors find that the strength of annexation laws matter in determining the number of school districts within a state. In a study analyzing the role of state characteristics in determining the number of school districts within a state, Kenny and Schmidt (1994) find that the decline the number of school districts between 1950 and 1980 can be explained by the decline in farming and corresponding increase in population density, the increased importance of state aid, and the increased prominence of teacher unions.

The only studies of which we are aware that examine the decisions of individual school districts to consolidate are a series of papers by Brasington. Brasington (1999) identified 298 pairings of Ohio communities that either do or potentially could jointly provide education services through a single school district. He then estimates a bivariate Probit model developed by Poirier (1980); this model allows for both communities to have veto power over the merger decision and thus a merger is observed only if it is supported by both districts. Using this econometric methodology, he finds that small and large districts tend to jointly provide education services, while medium-sized communities do not enter such arrangements. Neither racial heterogeneity nor income levels explain these patterns. In two follow-up papers, Brasington uses the same dataset from Ohio but allows for the coefficients to vary between the larger and smaller merger partner (Brasington, 2003b), between the richer and poorer district (Brasington, 2003a), and between the more and less white district (Brasington, 2003a).

Relative to the most closely related papers, those by Brasington, our paper provides several contributions to this literature. First, while all of Brasington's papers assume that merger decisions are independent across borders, we develop and estimate an econometric model that allow for districts to have multiple potential merger partners; we argue below that a failure to account for such interdependence in merger decisions leads to both specification errors as well as incorrect inference due to the statistical dependence of the observations. Second, while Brasington uses school district characteristics, such as enrollments, test scores, and property values, from the early 1990s to explain consolidation decisions in Ohio, many of which occurred during the 1930s and 1960s, we better model the timing of the merger decisions. The failure to account for these timing considerations could lead to problems in interpretation. For example, if mergers lead to a convergence of school district characteristics, then Brasington's analysis may incorrectly attribute the decision to merge to similarities in district characteristics. Our study, by contrast, measures school district characteristics during the year in which the merger decisions were made, allowing us to separately identify the causes of mergers from their subsequent effects. In separate work (Gordon and Knight, 2005), we are examining the effects of these mergers on subsequent school district outcomes, such as per-pupil spending, in order to determine whether or not economies of scale were realized in practice. While we have provided several methodological contributions to this literature, Brasington's specification is somewhat more general in other dimensions. In particular, it allows for a correlation between the unobserved preferences for consolidation between the two merger partners and, in the two follow-up papers, allows the coefficients to vary across the two potential merger partners. Thus, we view our approach as complimentary to this existing line of research.

3 Theoretical Framework

Consider two adjacent school districts, 1 and 2, that are contemplating a merger.[1] District 1 has N_1 residents, while district 2 has N_2 residents. In order to focus on the role of changes in borders, holding fixed the characteristics of students and taxpayers, we assume that residents are immobile. As a benchmark, consider the resource allocation problem facing the median voter in district 1 in the absence of a merger with district 2. This median voter has preferences over the per-capita consumption of a publicly-provided good (G_1/N_1), which is financed through an income tax (rate τ_1), and private consumption, which equals:

$$Y_{1m}(1-\tau_1) \tag{1}$$

where Y_{1m} represents the median voter's income, which is assumed to be exogenous. Taken together, the median voter chooses the tax rate (τ_1) and the provision of the publicly-provided good (G_1) in order to maximize the following Cobb-Douglass utility function:

$$\alpha_{1m}\ln[G_1/N_1] + (1-\alpha_{1m})\ln(Y_{1m}(1-\tau_1)) \tag{2}$$

where α_{1m} is the utility weight placed upon the publicly-provided good by the median voter. The public resource constraint is given as follows:

$$\tau_1 Y_1 = G_1 c(N_1) \tag{3}$$

where Y_1 is total community income and $c(N_1)$ is the unit cost of the publicly-provided goods, which, in order to capture potential economies of scale and diseconomies of scale, may

[1] For related theoretical models, see Alesina and Spolaore (1997, 2003), Bolton and Roland (1997), and Persson and Tabellini (2000).

depend upon population size. Substituting this public resource constraint into the objective function, the median voter chooses the publicly-provided good (G_1) in order to maximize the following:

$$\alpha_{1m} \ln[G_1/N] + (1-\alpha_{1m}) \ln\left[\frac{Y_{1m}(Y_1 - G_1 c(N_1))}{Y_1}\right] \tag{4}$$

Given the Cobb-Douglass specification, the median voter thus chooses to spend a fraction of the tax base on the publicly-provided good:

$$G_1^s = \alpha_{1m} Y_1 / c(N_1) \tag{5}$$

The provision of this good in district 2 can be expressed in a similar fashion [$G_2^s = \alpha_{2m} Y_2 / c(N_2)$].

Consider next the problem faced by the median voter of preference α_{um} in a new district formed by a merger between districts 1 and 2. Given our desire to focus empirically on the role of financial incentives for mergers, suppose that the state provides a merger incentive, or financial subsidy, given by s. In this case, the median voter chooses the publicly-provided good as follows:

$$G^u = \alpha_{um}(Y_1 + Y_2 + s)/c(N_1 + N_2) \tag{6}$$

Next, we consider whether the district 1 median voter supports or opposes a merger with district 2. In particular, the median voter receives the following indirect utility under separation:

$$\begin{aligned} V_{1m}^s =& \alpha_{1m} \ln[\frac{\alpha_{1m} Y_1}{N_1 c(N_1)}] + (1-\alpha_{1m}) \ln[Y_{1m}(1-\alpha_{1m})] \\ =& \alpha_{1m} \ln(\alpha_{1m}) + (1-\alpha_{1m}) \ln(1-\alpha_{1m}) - \alpha_{1m} \ln(c(N_1)) + \alpha_{1m} \ln(y_1) + (1-\alpha_{1m}) \ln(Y_{1m}) \end{aligned} \tag{7}$$

where y_1 is the average income across voters in district 1. Similarly, the median voter in district 1 receives the following indirect utility under a merger, or unification:

$$\begin{aligned} V_{1m}^u =& \alpha_{1m} \ln[\frac{\alpha_{um}(Y_1 + Y_2 + s)}{(N_1 + N_2) c(N_1 + N_2)}] + (1-\alpha_{1m}) \ln\left[\frac{Y_{1m}(Y_1 + Y_2 + s)(1-\alpha_{um})}{Y_1 + Y_2}\right] \\ =& \alpha_{1m} \ln(\alpha_{um}) + (1-\alpha_{1m}) \ln(1-\alpha_{um}) + \frac{s}{Y_1 + Y_2} + \alpha_{1m} \ln(y_u) \\ & - \alpha_{1m} \ln(c(N_1 + N_2)) + (1-\alpha_{1m}) \ln(Y_{1m}) \end{aligned} \tag{8}$$

where we have used the approximation

$$\ln\left[1+\frac{s}{Y_1+Y_2}\right]\approx\frac{s}{Y_1+Y_2}. \tag{9}$$

Thus, we can write the gain, which is potentially negative, to district 1 from a merger with district 2 as follows:

$$\begin{aligned} V_{21} =& V_{1m}^u - V_{1m}^s = \underbrace{\{\alpha_{1m}\ln[\alpha_{um}] + (1-\alpha_{1m})\ln[1-\alpha_{um}] - \alpha_{1m}\ln[\alpha_{1m}] - (1-\alpha_{1m})\ln[1-\alpha_{1m}]\}}_{preference\ heterogeneity} \\ &+ \underbrace{\frac{s}{Y_1+Y_2}}_{subsidy\ value} + \underbrace{\alpha_{1m}\ln\left[\frac{c(N_1)}{c(N_1+N_2)}\right]}_{economies\ of\ scale\ effect} + \underbrace{\alpha_{1m}\ln(y_u/y_1)}_{tax\ base\ effect} \end{aligned} \tag{10}$$

A similar expression can be written for the gains to district 2 from a merger with district 1 (V_{12}).

Using this expression, we can focus on four incentives facing the median voter in district 1 when deciding whether to support or oppose a merger with district 2. First, the preference heterogeneity term is non-positive and reflects the loss in autonomy suffered by the median voter in district 1. This term is maximized (at zero) when the preferences of the median voter in district 1 are identical to the preferences of the median voter in the new unified district ($\alpha_{1m} = \alpha_{um}$). Movements in either direction away from this special case of homogenous preferences ($\alpha_{1m} < \alpha_{um}$ or $\alpha_{1m} > \alpha_{um}$) entails a loss in utility for the median voter in district 1. While we have focused on the case of preference heterogeneity theoretically, we will investigate the role of several alternative forms of heterogeneity, including demographic heterogeneity and spatial heterogeneity, in the empirical analysis to follow.

Second, the subsidy value term is positive and reflects the increased aid received by the new district from the state after a merger. Essentially, this term reflects an exogenous increase in resources available to the new district and is scaled by the tax base of the unified district ($Y_1 + Y_2$). Empirically, we will develop measures of the financial incentives provided for school district mergers; these incentives were available between 1991 and 1993 and were targeted at small districts, those most likely to benefit from economies of scale.

Third, the economies of scale effect is positive if the unit costs are lower under integration

$$c(N_1+N_2) < c(N_1) \tag{11}$$

and negative otherwise. With an eye towards the empirical analysis, we use the following specification for economies of scale:

$$c(N) = cN^{\beta+\gamma N} \tag{12}$$

Importantly, this specification allows for a U-shaped average cost curve, as suggested by the literature on education cost functions (see Andrews, Duncombe, and Yinger (2002) for a review of this literature). In particular, if $\beta < 0$ and $\gamma > 0$, then this cost curve is U-shaped, and economies of scale will dominate for mergers involving small districts, while diseconomies of scale will set in for mergers involving large districts. Under this specification, the economies of scale effect identified above can be re-written as follows:

$$\ln(c(N_1)) - \ln(c(N_1+N_2)) = \beta\left[\ln(N_1) - \ln(N_1+N_2)\right] + \gamma\left[N_1\ln(N_1) - (N_1+N_2)\ln(N_1+N_2)\right] \tag{13}$$

where β and γ are the parameters, which we refer to as economies of scale and diseconomies of scale, respectively, that will be estimated in the empirical analysis to follow.

Finally, the tax base effect is positive for the relatively poor district and negative for the relatively rich district. Unfortunately, the tax base effect cannot be empirically identified without additional functional form assumptions, and we thus abstract from the role of this fourth factor empirically. If, for example, the income in district 1 increases, holding constant the income of district 2, the gains to a merger for district 1 decrease but the gains to a merger for district 2 increase, and hence the overall effect on the probability of a merger is ambiguous. In order to identify this effect, we believe that district-specific voting data on the merger question would be needed in order to separately identify the loss to district 1 from the gains to district 2. As an alternative to measuring the tax base effect, we include measures of tax base heterogeneity in several of our empirical specifications.

4 Empirical specification

Consider first the simple two-district case described above; we will describe the case with multiple potential partners below. In particular, districts 1 and 2 are considering merging with each other or remaining alone. In this case, the districts will merge if and only if both median voters support the merger:

$$\begin{aligned} V_{21} + \varepsilon_{21} &> \varepsilon_{11} \\ V_{12} + \varepsilon_{12} &> \varepsilon_{22} \end{aligned} \tag{14}$$

where ε_{21} is the unobserved utility to district 1 of merging with district 2 and ε_{11} is the unobserved utility to district 1 of remaining alone. The observed gains incorporate the three factors identified in the above theoretical model, while the unobserved gains capture any factors not included in our data.

Additional assumptions over the distribution of unobserved preferences are required in order to generate a closed-form expression for the probability of a merger between these two districts. While we plan to investigate alternative formulations, we begin by assuming symmetry in unobserved match quality ($\varepsilon_{21} = \varepsilon_{12}$) and that the unobserved components ($\varepsilon_{12}, \varepsilon_{11}, \varepsilon_{22}$) are distributed independent logistic. Under these assumptions, we can write the probability of observing a merger between districts 1 and 2 as the following, which we refer to as the two-district logit:

$$\Pr(y_{12} = 1) = \frac{1}{1 + \exp[-V_{21}] + \exp[-V_{12}]} \tag{15}$$

where y_{12} is a dummy variable indicating a merger between districts 1 and 2. As expected, the probability that such a merger occurs is increasing in the gains to district 1 (V_{21}) and the gains to district 2 (V_{21}).

One drawback of this two-district logistic model, as well as the Poirier bivariate probit model used by Brasington, is the assumption that district merger decisions are independent. That is, the decision of districts 1 and 2 to merge is assumed to be independent of other potential merger partners. Of course, most jurisdictions have multiple borders and thus multiple potential merger partners; we address this issue next. In particular, suppose now that districts 1 and 2 can merge with other districts: district 1 can merge with districts 2 or 3, and district 2 can merge with districts 1 or 4.

Given the introduction of multiple potential partners, the process through which mergers occur is now more complex and requires additional assumptions. Clearly, districts 1 and 2 will only merge if they prefer merging to remaining alone. But what about the role of the new districts 3 and 4? While we plan to relax this assumption in future work, we feel that a natural starting place is to assume that districts 1 and 2 merge if and only if they are each other's most preferred option; that is, in order for a merger to occur between districts 1 and 2, district 1 must prefer merging with district 2 over both remaining alone and merging with district 3 and likewise for the preferences of district 2. Under this assumption, the conditions for a merger between districts 1 and 2 can be expressed as follows:

$$\begin{aligned} V_{21}+\varepsilon_{21} &> \varepsilon_{11} \\ V_{21}+\varepsilon_{21} &> V_{31}+\varepsilon_{31} \\ V_{12}+\varepsilon_{12} &> \varepsilon_{22} \\ V_{12}+\varepsilon_{12} &> V_{42}+\varepsilon_{42} \end{aligned} \quad (16)$$

Again, assuming symmetry in match quality ($\varepsilon_{21}=\varepsilon_{12}$) and that the unobserved factors are distributed independently and logistically, we can write the probability of districts 1 and 2 merging as the following, which we refer to as the two-district multinomial logit:

$$\Pr(y_{12}=1)=\frac{1}{1+\exp[-V_{21}]+\exp[V_{31}-V_{21}]+\exp[-V_{12}]+\exp[V_{42}-V_{12}]} \quad (17)$$

Thus, the probability of a merger between districts 1 and 2 is now modified to include two additional terms. In particular, the probability of a merger is decreasing in the attractiveness of district 3, relative to district 2, for district 1 ($\exp[V_{31}-V_{21}]$) and the attractiveness of district 4, relative to district 1, for district 2 ($\exp[V_{42}-V_{12}]$).

More generally, with more than two borders for each potential merger partner, we have the following probability of districts 1 and 2 merging:

$$\Pr(y_{12}=1)=\frac{1}{1+\exp[-V_{21}]+\sum_{k\in B_1}\exp[V_{k1}-V_{21}]+\exp[-V_{12}]+\sum_{k\in B_2}\exp[V_{k2}-V_{12}]} \quad (18)$$

where B_1 is the set of potential merger partners, not including district 2, for district 1 and likewise for B_2. It is instructive to consider several special cases. As district 2 becomes severely disinclined to merge, V_{12} grows towards negative infinity, and the probability of a merger converges towards zero and thus becomes independent of the preferences of district 1. On the other hand, as the gains to district 2 (V_{12}) grow large, towards positive infinity, the merger decision has been effectively delegated to district 1, and the probability converges to a standard multinomial logit:

$$\lim_{V_{12}\to+\infty}\Pr(y_{12}=1)=\frac{\exp(V_{21})}{1+\exp[V_{21}]+\sum_{k\in B_1}\exp(V_{k1})} \quad (19)$$

We estimate the parameters of equations 15 and 19, those expressing the probability of mergers, using non-linear least squares (NLLS).[2] In particular, allowing i to index borders and t to index time, the NLLS estimator solves the following problem:

[2] The obvious alternative would be to estimate the parameters using maximum likelihood. Unfortunately,

$$\min_{\beta} \sum_{t=1}^{T} \sum_{i=1}^{N_t} \{y_{it} - \Pr(y_{it} = 1; \beta)\}^2 \tag{20}$$

where T is the total number of time periods and N_t is the number of borders in year t. Thus, the NLLS estimator chooses the parameters in order to get the predicted merger decisions as close as possible to the observed merger decisions (y_{it}). In order to account for both heteroskedasticity and within-year correlations in merger decisions, we use robust standard errors that are clustered within a year. This clustering feature allows for arbitrary correlations between borders within a given year. In order to account for any correlations across years, we include a regressor that indicates whether or not a district has merged in the last five years; this regressor will be discussed more fully in the next section.

5 Consolidations in Iowa

We choose to look at the experience of Iowa in the 1990s for several reasons. First, while the state did provide financial incentives for consolidation, the decision to integrate ultimately rested with the school districts themselves. Earlier consolidation waves in other states, in contrast, were often preceded by state or county-level planning of which specific districts were to be targeted for consolidations. Second, concentrating on more recent consolidation activity gives us access to better data on school district finances and the demographics of students and voters. Third, by looking at a period of consolidation beginning just after the 1989 Census was administered, we have access to the initial school district boundaries as geo-coded in the Census TIGER files.

Financial incentives applied to school districts voting by November 30, 1990 to make their consolidations effective between July 1, 1991 and July 1, 1993. As Figure 2 shows, districts appear to have responded strongly to these time-specific incentives. Beginning in 1966, the start of our administrative data on consolidations, through 1990, there were zero to three consolidations per year (with 1966 the only year with more than two). In 1991, the first year for which districts received financial bonuses for consolidating, there were four consolidations. This rose to seven consolidations effective in 1992 and twenty in 1993. Interestingly, this was followed by three additional years of higher than average merger activity, even though districts whose consolidations first took effect in these years were not

maximum likelihood assumes independence of observations, which are borders in this case. This assumption is clearly violated in this application and we thus turn to a moment-based estimator, which can be modified to allow for arbitrary correlations between the observations.

eligible for the financial incentives. We discuss two possible explanations for these post-1993 mergers below.

The financial incentives had two key components, which are summarized in Table 1. The largest incentive for districts to consolidate between 1991 and 1993 was a five-year reduction in their foundation tax rate. This incentive effectively allowed school districts to retain, rather than pay to the state of Iowa through a redistributive formula, a larger fraction of property taxes collected in their district. During our sample period, the foundation tax rate in Iowa was \$5.40 per \$1000 of assessed valuation (5.40 mills). By consolidating, districts with enrollments of fewer than 600 students before consolidating could lower their foundation tax rate to 4.40 mills in the first year post-consolidation, increasing by 0.20 mills per year until reaching 5.40 again in the sixth year after consolidation, where it would remain. To be clear, the enrollment limit is defined separately for each of the two potential merger partners; all property in the post-merger, or unified, district will be eligible for the lower foundation rate if both partners had enrollment below 600 students. For mergers involving one district below 600 students and one district above 600 students, only the property in the district of the smaller partner is eligible for the lower foundation rate. Mergers involving two large districts, those with enrollments in excess of 600 students, were ineligible for these incentives.

The second major incentive is related to the practice of whole grade sharing (WGS). Under WGS, two distinct districts do not merge their finances and thus maintain independent tax bases; instead, two districts divide responsibility over providing education services for particular grades. A common version of WGS involves both districts maintaining their own elementary school, one district having a middle school serving students from both districts, and the other district having a high school serving students from both districts. Iowa had encouraged whole grade sharing by assigning an additional weight to students in whole grade sharing arrangements when making foundation payments to districts. Specifically, students in WGS arrangements counted as 1.1 "regular" students. The Iowa state legislature changed the school finance law to eliminate additional weights for students in WGS arrangements, but allowed school districts consolidating effective 1991-1993 to continue to weight their enrollments according to the proportion of students previously in WGS for five years after merging. For districts consolidating, this would yield a gain of about \$200 per pupil per year over a five-year period, and most districts consolidating in Iowa in the 1990s had been engaged in WGS arrangements prior to merging.[3] Both the foundation tax rate reduction and continued use of supplemental WGS weights gave districts an incentive to consolidate

[3] Add cite from Guy Ghan.

effective 1991-1993. If we view the decision to consolidate as a choice between WGS and consolidation, districts may have chosen not to consolidate in earlier years in order to retain their supplemental weights. This reason not to consolidate is not valid for mergers effective after 1993 (although they would still receive greater benefits from merging between 1991 and 1993), so may explain why more districts than average consolidated even after the greatest financial incentives were no longer applicable. Another possibility is that the school board had referred the merger to voters by November 30, 1990 but that voters initially turned down the merger before approving it, albeit without the financial incentives, in subsequent years.

6 Data Sources and Variable Definitions

We draw on a number of data sources to compile our district-year level data on Iowa school districts from 1989 to 2001. Our analysis requires data on the timing and composition of school district consolidations, a listing of potential merger partners, and pre-merger characteristics, including demographics, property values, revenues and expenditures. Demographic data on school districts come from the Census of Population and Housing for 1990 and 2000, and the Common Core of Data. The Census data from 1989 are tabulated at the school district level in the School District Data Book (SDDB), and we use the "Top 100" dataset from the SDDB. For 1999 data, we use the School District Tabulation (STP2) Data, downloaded from the NCES School District Demographic System. These Census data include richer demographic variables than found in the Common Core, including the distribution of adult educational attainment, age, race and ethnicity, and self-reported home values. Because the Census data are available only decennially, we use the Common Core of Data for less refined demographic variables on an annual basis. For the purposes of our analysis, these variables include the number of total students enrolled in public school, enrollment by grade, and enrollment by race and ethnicity. Data on school district revenues and expenditures are from the School District Finance Data (F33) file, available annually in our time period from the fall of 1989 to the fall of 2001. In particular, we use measures of current instructional spending, and spending measures are converted into per-pupil measures using the corresponding enrollment variable. Finally, we have obtained administrative data from Iowa on property value assessments by year and school district.

6.1 Merger Decisions

In order to identify mergers, we have obtained administrative data on school district consolidations from the Iowa Department of Education dating to 1965. These data list the date on which each consolidation goes into effect, the names and Iowa state identification numbers of the districts merging, and the name and Iowa state identification number of the new district formed. In all cases except one, consolidations involved only two districts. One case did involve three districts; given the econometric complications involved with allowing for three-way mergers, we ignore the role of this single three-way merger in the empirical analysis to follow.[4]

In order to identify potential merger partners, we have obtained a map of school districts from 1989 as geo-coded in the Census TIGER files. According to this map, there were 431 districts and 1,211 borders in 1989. Thus, districts had roughly 5 potential merger partners on average. Given the date of the map, our sample is defined over the period 1989 through 2001, the last year for which we have complete data.

For tractability reasons, our theoretical and econometric framework is purely static in nature. That is, we do not allow districts to consider how a merger today might alter the pool of potential merger partners in the future. Given our use of panel data, however, we must incorporate such changes in potential merger partners in the construction of our dataset. In particular, if two districts A and B merge in year t to form a new district AB, this new district AB now shares borders with all of A's original borders and B's original borders, and we allow for such subsequent mergers between AB and any of these potential merger partners. Empirically, subsequent mergers were rare; there were only two cases in which a school district, as it existed in 1989, went through two consolidations between 1989 and 2001. Given that recently-merged districts may have less desire to merge again, we include in the econometric analysis a dummy variable for whether or not a district has merged in the previous five years.[5]

6.2 Heterogeneity Measures

As a baseline measure of preference heterogeneity, we use the absolute difference in per-pupil spending on education, adjusted for district tax bases, between the two districts. To mo-

[4] As a robustness check, we should also try a specification in which we treat this one three-way merger as three two-way mergers.

[5] We have also estimated specifications, which yield similar results, with an indicator for any mergers in the past 10 years.

tivate this measure, note that according to equation 5, per-pupil district spending under separation is given by $c(N_1)G_1^s/N_1 = \alpha_{1m}y_1$, and we can solve for preferences for education, the publicly-provided good in this case, as $\alpha_{1m} = [c(N_1)G_1^s/N_1]/y_1$. Thus, we estimate these preferences for education by dividing per-pupil expenditures, using instructional spending and enrollments in the Census data, by housing values in the district, as self-reported by residents in Census data. Finally, heterogeneity in preferences is defined as the absolute difference between these measures for the two potential merger partners ($|\alpha_{1m} - \alpha_{2m}|$). As alternative measures of heterogeneity, we examine both demographic heterogeneity and spatial heterogeneity, as emphasized in the work by Alesina and Spolaore (1997 and 2003). Regarding demographic heterogeneity, we examine the absolute difference in percent white among students in the two districts and the absolute difference in percent of adults who have completed high school in the two districts. Regarding spatial heterogeneity, we control for the size of the district, as measured in square miles, as well as the interaction between the size of the two districts. If transportation costs are convex in distance, two geographically large districts may have a disincentive to merge.

6.3 State Subsidy Measures

As described above, the state of Iowa offered two incentives for district mergers: a reduction in the foundation tax rate for districts with enrollments below 600 and an extension of whole-grade sharing incentives. To compute the reduction in the foundation tax rate, we use enrollment figures in order to determine whether the district was above or below 600 students as well as administrative data on assessed values. We then compute the present discounted value of the five-year stream of payments using an assumed discount rate of 3 percent, which is roughly the inflation rate during 1991, and, given the stagnant population in the Iowa, an assumed nominal growth rate in housing values of zero. As shown in Figure 3, mergers only occurred during this subsidy period 1991-1993 along borders in which at least one district had enrollments below 600 students, and the vast majority occurred along borders in which both districts had enrollments below 600 students. Taken together with the spike in mergers during this incentive period, as demonstrated in Figure 2, this evidence suggests that districts strongly responded to the financial incentives in place during this period.

In order to calculate the whole grade sharing incentives, we first estimate the number of students involved in whole-grade sharing by school district. To generate this estimate, we make the simplifying assumption that a district's enrollment, as reported in the district-level files, is equally distributed across all thirteen (including kindergarten) grades. We then multiply this estimated grade-level enrollment by the number of grades in which there is no reported enrollment across all school-level files for the district. This whole-grade sharing enrollment estimate is thus an estimate of the district's gross exported students. We then multiply the number of students involved in whole-grade sharing by $247, which is 10 percent of the foundation payment in 1991, the first year in which the incentives were in place. Finally, we take the present discounted value of the 5-year stream of payments assuming a discount rate of 3 percent and a nominal growth rate in the foundation payment of 4.5 percent, which is roughly the growth rate realized during this period.

6.4 Economies of Scale Measures

As motivated by equation 13, our basic measure of economies of scale is given by $[\ln(N_1) - \ln(N_1 + N_2)]$, where N is the district enrollment count in Census data, while our measure of diseconomies of scale is given by $[N_1 \ln(N_1) - (N_1 + N_2)\ln(N_1 + N_2)]$. We hypothesize that the coefficient on the first measure will be negative, while the coefficient measure on the second will be positive. Note that the economies of scale measures are identified separately from the merger subsidies measures because of two features of the subsidies. First, the subsidies were only in place for a three-year period. Second, the foundation rate incentives, the larger of the two merger incentives, had an important discontinuity in that it applied only to districts with fewer than 600 students.

7 Results

Table 2 provides summary statistics at the level of a school district border for our key variables in the econometric analysis. As shown mergers were more likely to occur along borders that were eligible for the merger incentives. Given the complexity of interpreting the economies of scale measures, we defer their discussion until the econometric analysis. Regarding heterogeneity measures, mergers were more likely to occur along borders with less heterogeneity in housing values and in smaller districts, as measured by square miles and the interaction between the square miles in the two districts. We next turn to a more formal econometric test of our hypotheses.

Table 3 provides the results from our econometric estimation of equation 15, in which we ignore the possibility of multiple potential merger partners. The four columns provide results incorporating several different measures of heterogeneity. Column 1 includes no heterogeneity measures and thus focuses solely on the role of economies of scale, diseconomies of scale, and financial incentives offered by the state of Iowa. As shown, all three of these measures have the expected coefficients. Borders with larger financial incentives were much more likely to merge, providing evidence that is consistent with the suggestive evidence in figures 2 and 3. As expected, the economies of scale coefficient is negative while the diseconomies of scale estimate is positive. In order to aid in the interpretation of these results, Figure 4 plots the log cost curve implied by these coefficients against district enrollments. Recall that our assumed cost curve is given by $c(N) = cN^{\beta+\gamma N}$, and thus we can write the log cost curve as follows:

$$\ln c(N) = \ln(c) + (\beta + \gamma N)\ln(N) \tag{21}$$

As shown in Figure 4, which normalizes c to one, these coefficients imply that average costs are minimized at enrollments of about 600 students. Thus, among equally sized districts, the most efficient mergers involve those with enrollments of 300 each, and mergers involving larger districts would entail diseconomies of scale. It is important to note that these estimates of economies of scale and diseconomies of scale should be interpreted as those perceived by the voters when deciding whether or not to integrate. These revealed preference estimates may differ substantially from the economies of scale actually realized by districts through consolidation. Indeed, estimates of education cost functions, as summarized by Andrews, Duncombe, and Yinger (2002), imply that diseconomies of scale may not set in until enrollments reach 6,000 students, although, as the authors point out, this optimal size may be significantly lower in sparsely populated states, such as Iowa, due to transportation costs.

Columns 2-4 provides results controlling for alternative measures of heterogeneity. As shown, we find little evidence that heterogeneity factors played a key role in shaping the patterns of consolidations in Iowa during this period. The only measures that appears to be significant are the spatial heterogeneity measures. While the estimates suggest that larger districts prefer to merge, the interaction coefficient is negative, suggesting that two large districts have a disincentive to merge, presumably due to the significant increases in transportation times associated with such mergers. While we find only a minor role for heterogeneity measures, those of spacial heterogeneity, the other key coefficients in the analysis, those on economies of scale, diseconomies of scale, and state financial incentives, tend to be statistically significant after controlling for these heterogeneity measures.

Table 4 provides analogous estimates of the parameters of equation 19. In addition to the decision over whether or not to merge, districts now choose with whom to merge among their set of potential partners. As shown, the results are similar to those in Table 3. In particular, state financial incentives, economies of scale, and diseconomies of scale, play an important role in predicting mergers in Iowa during this era. Heterogeneity measures again play only a minor role; spatial heterogeneity, measured as the interaction between the size of the two districts, is negatively related to the propensity of districts to merge. The robust story across Tables 3 and 4 is that state merger incentives as well as efficiency considerations play a key role in merger decisions in Iowa over this period.

8 Conclusion

This paper examines the determinants of school district consolidations during the early 1990s in Iowa. We begin with a theoretical analysis, which predicts that mergers are more likely to occur under state financial incentives, between districts with similar preferences for education, and when districts can realize economies of scale. We then develop an econometric model that accounts for two key features of the merger protocol: mergers must be approved by voters in both districts, and districts have multiple potential merger partners. Applying this model to our data from Iowa, preliminary results demonstrate the importance of economies of scale as well as diseconomies of scale in explaining the patterns of mergers in Iowa during this time period, while heterogeneity appears to play less of a role. We also find an important role for the state financial incentives in encouraging these mergers. One caveat is that these results, such as our finding that racial heterogeneity played only a minor role, may not generalize to other states and time periods. Iowa has very little racial heterogeneity, and, as noted above, other studies, such as Alesina, Baqir, and Hoxby (2004), have found a strong role for such heterogeneity in terms of predicting the number of districts within U.S. counties.

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Figure 1: School districts in the US over time

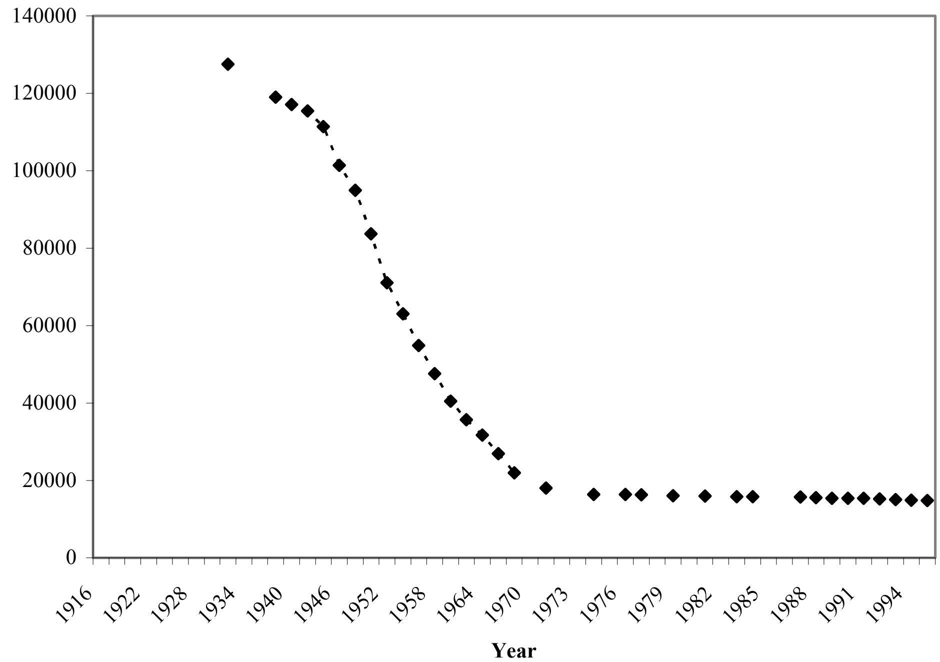
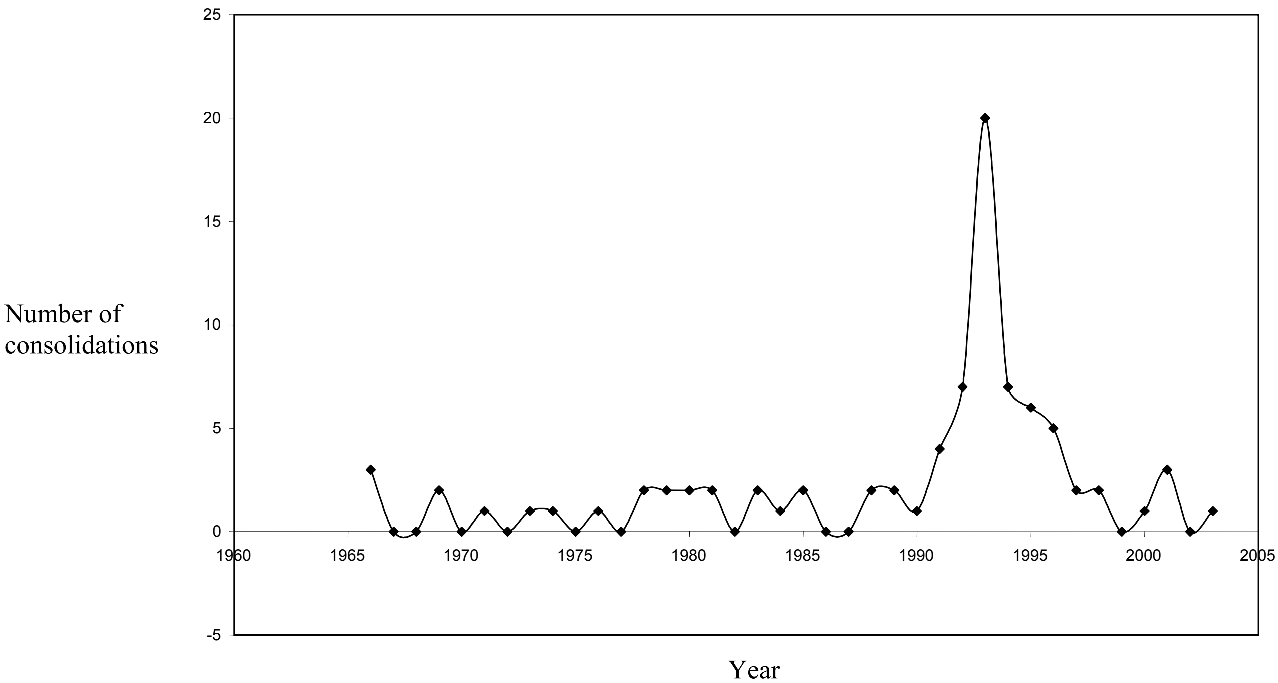


Figure 2: School district consolidations in Iowa, 1966-2003



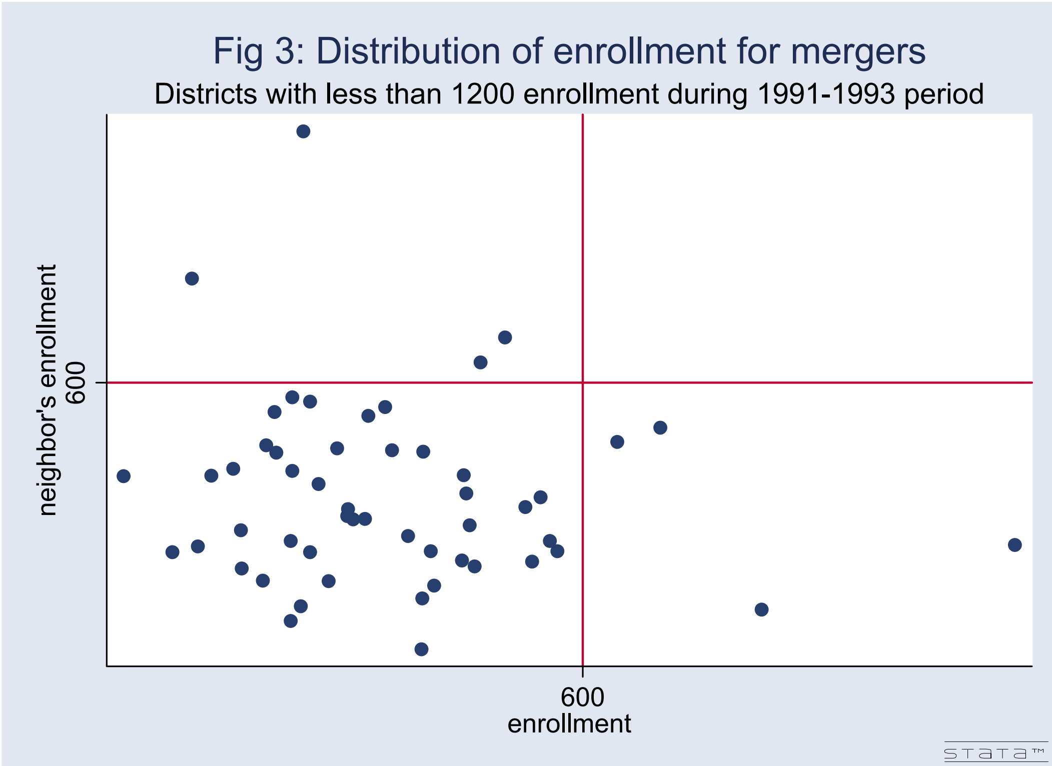


Fig 3: Distribution of enrollment for mergers
Districts with less than 1200 enrollment during 1991-1993 period
neighbor's enrollment
600
600
enrollment
stata™

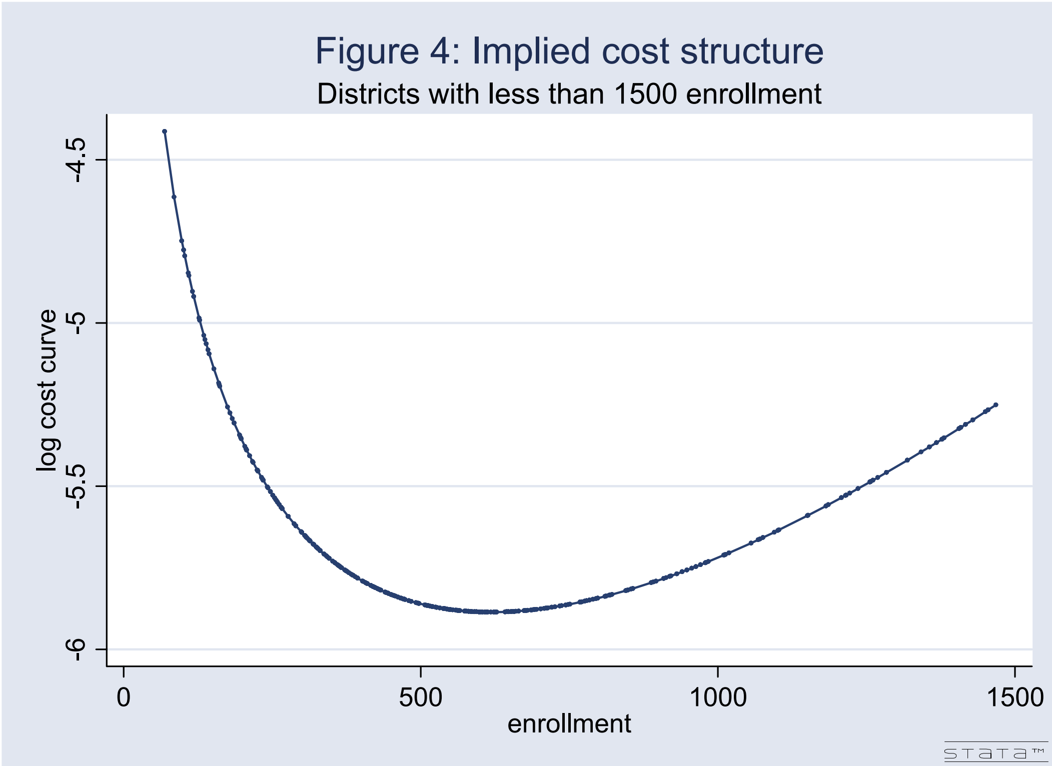


Figure 4: Implied cost structure
Districts with less than 1500 enrollment
log cost curve
-4.5
-5
-5.5
-6
0
500
1000
1500
enrollment
stata™

Table 1: Summary Statistics for Key Variables

Observation = school district / year

mean (standard deviation)

	merger n=108	no merger n=4,474
enrollment	452	1288
	(311)	(2499)
instructional spending	0.1542	0.1437
(scaled by tax base)	(0.0569)	(0.0660)
mean house value	36.1158	42.8166
(thousands)	(9.5053)	(15.0906)
percent students white	0.9858	0.9798
	0.0183	(0.0293)
area (square miles)	97.8460	127.72
	(41.0455)	(66.6031)
merger last 5 years	0.0093	0.0450
	(0.0962)	(0.2073)

Table 2: Summary Statistics for Key Variables

Observation = border / year

mean (standard deviation)

	merger n=51	no merger n=11,620
merger incentive (mills, pdv)	2.3222 (2.3783)	0.4114 (1.0055)
economies of scale ln(n1)-ln(n1+n2)	-0.7892 (0.4833)	-0.8468 (0.6307)
diseconomies of scale n1*ln(n1)-(n1+n2)*ln(n1+n2)	-3195.82 (2067.28)	-12243.46 (29077.94)
spending heterogeneity	0.0400 (0.0473)	0.0469 (0.0520)
house price heterogeneity	6.8451 (5.2644)	10.8776 (9.3013)
racial heterogeneity	0.0193 (0.0194)	0.0232 (0.0334)
heterogeneity in percent college graduates	0.0433 (0.0341)	0.0454 (0.0350)
square miles	96.6290 38.8276	133.6089 (68.1594)
square miles * neighbor square miles	8694.33 (3470.56)	18587.67 (14904.79)
merger in last 5 years	0.0098 (0.0990)	0.0357 (0.1856)

Table 3: Determinants of School District Consolidations
Outside option is to remain alone only

	column 1	column 2	column 3	column 4
merger incentive	0.4261**	0.4060**	0.4475**	0.4322**
	(0.0663)	(0.1188)	(0.0705)	(0.1573)
economies of scale	-1.0581**	-1.0022	-0.7531**	-1.0031*
ln(n1)-ln(n1+n2)	(0.2334)	(0.7857)	(0.1481)	(0.5811)
diseconomies of scale	0.0002**	0.0003**	0.0002**	0.0001*
n1*ln(n1)-(n1+n2)*ln(n1+n2)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
spending heterogeneity		-1.7409		
		(8.0341)		
house price heterogeneity		0.0056		
		(0.0201)		
racial heterogeneity			6.1710	
			(8.8731)	
heterogeneity in percent			2.3327	
college graduates			(13.8705)	
square miles				0.0265
				(0.0127)
square miles *				-0.0002*
neighbor square miles				(0.0001)
merger in last 5 years	0.2117	0.1435	0.8941	-0.7688
	(0.9440)	(1.3004)	(2.5768)	(1.0134)
constant	-4.5734**	-4.4006**	-4.6920**	-5.7305**
	(0.2391)	(0.3396)	(0.4794)	(1.0889)
Observations	11665	11515	11515	11515

Standard errors below coefficients
* significant at 10%; ** significant at 5%

Table 4: Determinants of School District Consolidations
Outside option is includes other potential merger partners

	column 1	column 2	column 3	column 4
merger incentive	0.4819**	0.4528*	0.5265**	0.5457
	(0.1858)	(0.2481)	(0.2569)	(0.4395)
economies of scale	-1.0876**	-1.0510	-1.1428**	-1.1170
ln(n1)-ln(n1+n2)	(0.3800)	(0.9609)	(0.5134)	(0.7367)
diseconomies of scale	0.0002**	0.0003*	0.0002**	0.0001**
n1*ln(n1)-(n1+n2)*ln(n1+n2)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
spending heterogeneity		-2.7783		
		(7.3430)		
house price heterogeneity		0.0017		
		(0.0186)		
racial heterogeneity			5.6624	
			(10.1915)	
heterogeneity in percent			2.1182	
college graduates			(14.1138)	
square miles				0.0352**
				(0.0144)
square miles *				-0.0002*
neighbor square miles				(0.0001)
merger in last 5 years	-0.1024	-0.1834	-0.0747	-1.3848*
	(0.9639)	(1.2358)	(1.5328)	(0.7803)
constant	-4.5088**	-4.2141**	-4.9690**	-6.4163**
	(0.3365)	(0.4006)	(0.4482)	(2.6353)
Observations	11665	11515	11515	11515

Standard errors below coefficients
* significant at 10%; ** significant at 5%