A Meta-Analysis of Cost of Community Service Studies*

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Abstract

Cost of community service (COCS) studies, which compare the ratio of expenditures-to-revenues for different land uses, are increasingly popular and influential in debates about municipal land-use planning. In this paper, we conduct a quantitative meta-analysis of COCS studies that focus on three land-use categories: residential, commercial/industrial, and agricultural/open-space. The dataset consists of 125 studies that take place across the United States. Using data from the studies themselves and the U.S. Census, we estimate models to investigate underlying patterns regarding the effect of different methodological assumptions and the geographic and financial characteristics of communities. Many of the results have implications for the conduct and interpretation of COCS studies in particular and the fiscal impacts of land use in general.

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I. Introduction

Land use largely determines the revenues and expenditures of municipal governments. Different land uses—including residential, commercial, industrial, agricultural, and open space—generate different amounts of revenue because they are taxed at different rates and are responsible for different amounts of intergovernmental aid. They also demand different expenditures for municipal services ranging from public education, police protection, roads, and other forms of infrastructure. When land uses change, therefore, the balance of municipal revenues and expenditures changes as well. Recognizing these relationships, municipalities, planners and land-use advocates are becoming increasingly concerned with the long-term financial implications of land-use decisions.

Cost of Community Service (COCS) studies are a well-known methodology for estimating the fiscal impact of different land uses within a municipality. Local governments, land-use planners, and advocacy groups frequently use COCS studies to quantify the fiscal costs and benefits of existing land uses. The studies are also used, albeit with some controversy, as an indicator of how land-use change is likely to affect municipal budgets. The American Farmland Trust (AFT) first developed the COCS methodology in the mid-1980s, following two seminal publications, *The Fiscal Impact Handbook* (Burchell 1978) and *Cost of Sprawl* (Real Estate Research Corporation 1974), which demonstrate the importance of cost-effectiveness for land-use planning.

The basic methodology of COCS studies is to first partition land uses into three classes: residential, commercial/industrial, and agricultural/open-space. Expenditures and revenues from the municipal budget are then allocated to the three different land-use categories. While the specific methodology for fiscal allocations differs among COCS studies, the final result is always a ratio of expenditures over revenues for each of the three land uses. For example, a residential ratio of 1.2 means that for every $1.00 of revenue raised from residential land uses, $1.20 of expenditures is spent on residential land uses. Studies then report a separate ratio for residential, commercial/industrial, and agricultural/open-space land uses.

A general finding of COCS studies is that commercial/industrial and agricultural/open-space ratios are less than one while residential ratios are greater than one. This is often interpreted to mean that commercial/industrial and agricultural/open-space land uses "pay their own way" while residential land uses do not. AFT and other land conservation advocates use these ratios to argue against the common perception that further residential development will decrease the property tax burden for current residents. The results are also used to argue that open lands provide fiscal benefits and that current use valuation, rather than potential development value, is justified for tax purposes.

One reason for the popularity of COCS studies is the relative ease of conducting them and understanding the results, but their simplicity also exposes them to criticism and calls for caution with interpretion. The main concerns are the following: Partitioning land uses into only three classes obscures potentially important variation within a given class (Crompton 2002, Deller 2002). COCS studies measure demand for services rather than benefits, which often include public goods for the greater community, and land use decisions should account for public benefits (Kelsey 1996, Deller 1999). The use of ratios does not reflect the magnitudes of surplus or deficit for a given land use (Kelsey 1996, Deller 1999). The fact that COCS studies are based on *average* expenditures and revenues is problematic because understanding the impacts of land use change requires information about *marginal* costs and benefits (Deller 1999, Staley 1999, Crompton 2000).

Despite these concerns, COCS studies have become increasingly popular and influential in debates about municipal land-use decision-making. COCS studies are frequently cited in land-use planning documents, government reports, academic research, and advocacy materials. While in the past, land-use debates have focused on social, aesthetic, environmental, and legal concerns, COCS studied have promoted greater emphasis on economic considerations. The increased emphasis on economic arguments through COCS studies has been particularly apparent among supporters of open-space/farmland conservation and in efforts to limit urban sprawl.

Although COCS studies often frame municipal land-use debates, the results of these studies have not been rigorously evaluated to determine the factors that contribute to differing results. How important are different methodological assumptions? In what ways do the geographic and financial characteristics of a community affect COCS ratios? Are there general insights that can be learned from COCS studies about local public finance? In order to answer these questions, we conduct a meta-analysis of existing COCS studies. We structure the methodology according to standard protocol for conducting quantitative meta-analysis. According to Stanley (2001) the method involves five fundamental steps: (1) include all relevant studies, (2) choose a summary statistic and reduce the evidence to a common metric, (3) choose explanatory variables that are thought to be consequential, (4) conduct a meta-regression analysis, and (5) subject the meta-regression analysis to specification testing.

Our final dataset consists of 125 studies that took place in communities across the United States. Using the studies themselves, along with U.S. Census data, we create explanatory variables for different methodological assumptions, geographic characteristics of each study area, and financial details of the local community. One contribution of the paper, therefore, is simply the collection of COCS studies. We report citation information for all studies included in the analysis, and the simple descriptive statistics provide a general sense of patterns within the COCS literature. The meta-analysis is then based on a system of multivariate regression equations to examine how the different variables affect the expenditure-to-revenue ratios within each land-use class. The meta-analysis takes advantage of information among all studies to investigate underlying patterns regarding the effect of methodological assumptions, as well as the geographic and financial characteristics of communities.

The remainder of the paper is organized as follows. In the next section, we describe our data collection and preparation. Section III reports the details of the meta-regression analysis, namely our approach for estimating a system of seemingly unrelated regression equations. Section IV reports the results. Section V concludes with a discussion of the main results and their implications for the conduct of COCS studies in particular and the fiscal implications of land use in general.

II. Data Collection and Preparation

We attempted to compile all COCS studies that were conducted through 2007. We searched for studies using American Farmland Trust (AFT) references, citations in journal articles and COCS reports, references from COCS study authors, technical reports, and web searches. We identified COCS studies for 168 different locations. The report for 43 of these locations could not be obtained or did not include sufficient data. Hence the final dataset used in our analysis consists of 125 observations. The Appendix Table includes a list of all 125 COCS locations with a complete citation for each.

The studies show variation in location and results. Figure 1 shows the geographic distribution of studies across the United States. The vast majority of studies take place in the northeast and the mountain west, with fewer in the mid-west and mid-Atlantic regions. The figure also shows the corresponding level of governance for each study, which we discuss below. Figure 2 shows the frequency distributions of the COCS ratios for each of the three land-use categories. Consistent with expectation, we find that nearly all residential ratios exceed one, meaning that residential expenditures exceed revenues. One residential ratio, an outlier at 3.25 for Broadwater County in Montana, is not included in Figure 2 or any of the subsequent analysis. Also consistent with expectation is the finding that the vast majority of commercial/industrial and agricultural/open-space ratios are less than one, meaning that expenditures for these land uses are less than revenues. Within all three land-use categories, the ratios indicate substantial variation. In what follows, we aim to identify variables that explain the variation in results among studies.

We collected data from the COCS studies themselves and the U.S. Census to create variables is three broad categories: geographic, methodological, and financial. Table 1 lists and defines all variables. Among the geographic variables, we categorize studies based on the corresponding level of governance: city, county, and township level. Figure 1 shows the geographic distribution of studies that take place at each level of governance. We do not create variables for geographic location, such as census regions, because they are highly correlated with the variables on level of municipal governance. When creating the variable for county-level governance, we also distinguish between studies that exclude subset municipal finances (*Countyonly*) and studies that include them (*Countyall*). Other geographic variables include population, population growth, total land area, and population density.

The methodological variables include categories for different types of sponsoring organizations, including the American Farmland Trust (AFT), other nongovernmental organizations, government agencies, and academic institutions. We create dummy variables for several other methodological choices as well: whether the school budget is included in the analysis; whether the financial allocations come from only normal operating budgets; whether agricultural residences are included in the agricultural/open-space category rather than the residential category; whether researchers conduct interviews with government officials to help allocate budget items; and whether researchers use standard fallback percentages (based on proportional property tax revenues) to allocate expenditures not directly tied to a particular land use.

The financial variables include municipal expenditures, revenues, surplus, expenditures per capita, and median home value. These are all reported in year 2000 dollars. We also create a variable for school expenditures as a proportion of total expenditures, where the variable is coded as zero if the study did not take account of the school budget. The final three variables are property taxes for each of the three land use categories as a proportion of total property taxes.

Table 2 reports descriptive statistics for all variables. The majority of studies take place at the *City* level of governance (54%), followed by *Countyonly* (29%), *Township* (10%), and

Countyall (7%). The municipalities vary substantially with respect to population, land area, and population density. The average population growth rate is 16 percent. The most common sponsor of a study is an academic institution (38%), followed by AFT (25%), a governmental agency (19%), and other nongovernmental organizations (18%). Seventy percent of the studies account for school budgets in the analysis, 20 percent use financial allocations based on normal operating budgets, and 24 percent include agricultural residences in the calculation of *AgOs* rather than *Residential*. Seventy-seven percent of the studies report using interviews with government officials to help allocate budget items, and 70 percent report using standard fallback percentages. The municipalities are highly variable with respect to expenditures, revenues, expenditures per capita, and median home value. While the mean for *Scholbdg* reported in Table 2 includes all the zeros for studies that did not consider the school budget, the mean among those that did consider the school budget is 0.62, meaning that for these municipalities the school budget accounts for 62 percent of total expenditures. Finally, the average proportion of property tax attributable to each of the land use categories of residential, commercial/industrial, and agricultural/open-space is 69%, 20%, and 10%, respectively.

We can make predictions based on the existing literature about the effect of some variables on the results of COCS studies. A wide body of research finds that greater density of development is associated with lower costs of providing community services (Knaap 1992, Altshuler 1993, Ladd 1994, Duncan 1995, Pendall 1999, Edwards 2000, Carruthers 2003). In the context of COCS studies, researchers have compared residential results in two different communities and found that density has a negative impact on ratios (Edwards et al. 2000). Although population density is a coarse and sometimes difficult variable to interpret, it follows that in a meta-analysis one might expect *Density* to have a negative affect on *Residential* ratios and possibly *ComInd* ratios as well.

Two of the methodological variables generate priors about how they might be associated with COCS ratios. The first is *Scholuse*. While property taxes from all land uses typically contribute to the revenues used in school budgets, COCS studies that account for the school budget allocate school expenditures solely to the residential category. Moreover, because educational expenses are such a large portion of many budgets, residential ratios are primarily a reflection of the school budget when they are accounted for in COCS studies (Kelsey 1996, Crompton 2000, Edwards et al. 2000). Not surprisingly, therefore, researchers find that the inclusion of a school budget in the analysis tends to increase residential ratios (Kelsey 1996, Edwards et al. 2000). We expect a similar finding in our analysis here; that is, we expect *Scholuse* to have a positive affect on *Residential* ratios. At the same time, because only school revenues are counted against the other land uses, we expect *Scholuse* to have a negative affect, if any, on *ComInd* and *AgOs* ratios.

The second methodological variable thought to be important is *Agres*, which indicates that agricultural residences are included in the calculation of *AgOs* rather than *Residential* ratios. Two studies find that including farmhouses in the agricultural/open-space category increases *AgOs* ratios (American Farmland Trust 1993, Piedmont Environmental Council 1993). Two factors in combination help explain this result: residential ratios tend to be greater than one and agricultural residences are likely to comprise a large proportion of the agricultural/open-space category. For these reasons, we expect that *Agres* will have a positive affect on *AgOs* ratios in the meta-analysis. But because agricultural residences are likely to be a relatively small proportion of all residences, we expect that *Agres* will have no affect on *Residential* ratios.

Among the financial variables, median home value is expected to have a negative effect on residential ratios and possibly the others as well. While we have seen that residential land uses tend to not “pay their own way,” more detailed studies find that high-value homes are more likely to pay for the services they receive (Dorfman 2002, Englehart 1997). This suggests that with higher home values, revenues tend to increase faster than expenditures. Hence the prediction here is that *Homevalu* will have a negative effect on *Residential* ratios. Furthermore, to the extent that higher home values are positively correlated with other property values, and revenues increase faster than expenditures for other land uses as well, we expect *Homevalu* to have a negative effect on *ComInd* and *AgOs* ratios.

Many of the other variables are thought to be consequential, although prior expectations about the directional effects are less clear. Whether a study takes place at the city, county, or township level may matter because different levels of governance tend to provide different services, and there are no established trends about how this affects the balance of expenditures and revenues for different land uses (Snyder and Ferguson 1994, DeBoer and Zhou 1997). *Population* might capture (dis)economies of scale, and *Popchng* might capture the affect of recent land-use change primarily in the residential and commercial/industrial categories. We test explicitly for effects of the methodological variables *Intervu*, *Standfallbk*, and type of study sponsor (*AFT*, *Org*, *Gov*, *Academic*). The type of study sponsor is included to investigate potential bias beyond that attributable to the other methodological assumptions for which there are controls (Bunnell 1997, 1998, Deller 1999). Although we examine the effects on COCS ratios of the remaining explanatory variables, we have no clear prior expectations about the potential consequences.

III. Statistical Model

The meta-regression analysis aims to investigate the effects of different explanatory variables on COCS ratios for the three different land-use categories. We estimate a system of regression equations with the following general specification:

$$\begin{aligned} Residential_i &= f\left(Methodology_{iR}, Geographic_{iR}, Financial_{iR}, \beta_R\right) + \varepsilon_{iR} \\ ComInd_i &= f\left(Methodology_{iC}, Geographic_{iC}, Financial_{iC}, \beta_C\right) + \varepsilon_{iC} \\ AgOs_i &= f\left(Methodology_{iA}, Geographic_{iA}, Financial_{iA}, \beta_A\right) + \varepsilon_{iA}, \end{aligned}$$

where the subscript *i* denotes an observation, and subscripts *R*, *C*, and *A* correspond with the residential, commercial/industrial, and agricultural/open-space land uses, respectively. *Methodology*, *Geography*, and *Financial* denote vectors of the corresponding variables that may differ among equations. The betas are coefficients to be estimated, and the epsilons are error terms. Throughout the analysis, we consider both linear and log-linear functional form specifications.

We began with ordinary least squares (OLS) estimation of each equation separately with different sets of explanatory variables. The goal of this first step is to reduce the number of explanatory variables given the relatively small number of observations in the dataset. We estimate each equation with different combinations of the *Methodology*, *Geographic*, and *Financial* variables: each set separately, each combination of two sets, and all three sets. The only exceptions are the property tax variables of *Restax*, *ComIndtax*, and *AgOstax*, which were always included in the equations for the corresponding land-use equation. If a variable never came through as statistically significant at the 90-percent level in any of the runs, we conclude that it has no significant effect on the COCS ratios for that particular land-use category and thus drop it from further analysis. We do not report these results here, but they, along the complete data, are available upon request.

With the remaining set of explanatory variables for each equation, we estimate a system of seemingly unrelated regressions (SUR) (Zellner 1962). Compared to OLS estimation, the SUR estimator has the advantage of increased efficiency when the explanatory variables differ among the equations. The reason is that correlation across the errors in different equations provides a link that is exploited in estimation (see Wooldridge 2002), and given that the cross-equation ratios come from the same municipalities and studies, correlation may exist and be meaningful. Table 3 reports the SUR estimates for the linear and log-linear specifications for all three land use categories. We do not report OLS estimates of these same equations because they do not differ in any substantial way. We also estimate OLS models with standard errors (and therefore *t*-statistics) that are robust to cross-equation correlation, heteroskedasticity, and clustering to account for cases in which a COCS study reported more than one set of ratios (see the Appendix Table). We ran these models as a robustness check of the statistical inference, as the standard errors account for the fact that not all studies are published separately and therefore may not be entirely independent observations. But we do not report these results either, as accounting for this feature of the data has no qualitative effect.

All of the equations reported in Table 3 include 117 observations. Seven observations are dropped because of missing data for the property tax variables, which are important to the analysis. We also ran models without these variables and including the dropped observations, but the pattern of results was very similar. One remaining observation is dropped because its residential ratio is an outlier, as discussed previously. All of the equations fit reasonably well, with *R*-squared values ranging from 0.29 to 0.37. *AFT* is the omitted category for the sponsoring organization, meaning that the coefficients on the other categories are interpreted relative to the *AFT* baseline. *City* is the omitted category and therefore the baseline for interpreting coefficients on the level of governance variables. Overall, the qualitative results, in terms of statistical significance, are similar between the linear and log-linear specifications.

IV. Results

Let us first consider results for the geographic variables. We find that *Population* has a statistically significant effect on the *Residential* and *ComInd* ratios, but the two effects have opposite signs. An increase in population increases residential ratios but decreases commercial/industrial ratios. In discussing magnitudes, here and throughout, we focus on the log-linear specifications, which are intuitive because marginal effects are interpreted as percentage changes in the COCS ratios. We find that an increase of 10,000 people increases *Residential* by 1 percent and decreases *ComInd* by 2 percent. These results suggest that, with respect to the ratio of expenditures-to-revenues, population exhibits decreasing returns to scale for residential land uses, but increasing returns to scale for commercial/industrial land uses. A possible explanation for the latter result is that larger populations are associated with greater density of commercial districts, which may have smaller expenditure-to-revenue ratios.

Population density has a positive and statistically significant effect on both the *ComInd* and *AgOs* ratios. The magnitude of the effect in terms of a percentage change is similar between the two land-use categories: an increase of 100 people per square mile increases both ratios by 2 percent. We have no obvious explanation for the *ComInd* result, but the effect of *Density* on *AgOs* ratios may be due to the fact that open spaces in higher density areas tend to be smaller, more urban parks. While parks of this type do not generate revenue, they tend to require sizable expenses for routine upkeep, resulting in higher ratios. Somewhat surprisingly, we find no statistically significant effect of *Density* on the *Residential* ratios, although the coefficient is negative. Recall that the existing literature provides evidence that greater density tends to decrease the expenditure-to-revenue ratio of residential land use. One general concern, however, is that our measure of density is crude, despite its frequent use in research. Population divided by total land area is an estimate of aggregate population density, but it may not provide a good proxy for the actual density of development in different areas.

Among the categorical variables for different levels of governance, the most general result is that they seem to not matter very much. While different levels of governance manage different categories of expenditures and revenues, the breakdown in terms of ratios for different land uses is relatively constant and/or are estimated with little precision for *ComInd* and *AgOs*. We do, however, find some statistically significant differences in the *Residential* equation. Most notably, *Township* is associated with greater residential ratios than *City*, by a magnitude of nearly 12 percent. While it is difficult to provide a clear interpretation, one possible explanation is once again related to the density of development. To the extent that townships have less dense residential development, the result can be interpreted as consistent with the existing literature. A further observation about the level of governance variables is that the sign of all coefficients for the *Residential* and *ComInd* equations have the opposite sign. Although most of the estimates are not statistically distinguishable from zero, the pattern is interesting enough to point out.

The remaining geographic variables that are not statistically significant in any of our specifications are square miles of the municipality and population change. The later result is particularly interesting given that COCS studies are most frequently used to affect decision-making about growth management. It is surprising, therefore, that *Popchng* is not a significant determinant of COCS ratios, especially for residential land uses. The finding of no effect may lend support to critics of COCS studies who question whether the average ratios are useful for making inferences about marginal effects. While the residential ratios, which are based on an overall average, indicate the residential land uses do not "pay their own way," we find that marginal changes in population growth have no effect on the ratio of expenditures-to-revenues.

Let us now turn to the methodological variables. As expected, COCS studies that include the school budget in the analysis report higher residential ratios. The coefficients on *Scholuse* in the *Residential* models are positive and highly statistically significant. In terms of the magnitude, we find that inclusion of the school budget increases ratios by an average of more than 15 percent. As explained previously, this is due to the fact that school expenditures are allocated solely to residential land uses, while the revenues come from all land uses. The implication, regardless of whether one believes the budget should be included, is that including the school budget in a COCS analysis causes residential land uses to appear less likely to "pay their own way." We also find, as expected, that *Scholuse* has an insignificant effect on the other land-use categories.

The methodological decision to include expenses and revenues associated with farmhouses in the *AgOs* category, rather than the *Residential* category, has a large effect on the *AgOs* ratios. In both models, the coefficient on *Agres* is positive and highly statically significant. In the log-liner model, the magnitude is substantial: the variable increases *AgOs* ratios by an average of 60 percent. As described above, this result is expected because residential ratios tend to be greater than agricultural/open-space ratios and farm houses are likely to comprise a large faction of *AgOs* land uses in terms of revenues and expenditures. In contrast, farm houses are less likely to comprise a large faction of overall residential land uses, which explains why we found no significant results of *Agres* on *Residential* ratios.

Among the categorical variables for the organization that sponsored each study, we find significant differences between *Gov* and *AFT* (the omitted category). Government sponsored studies have higher *Residential* ratios and lower *ComInd* ratios. It is, of course, difficult to determine whether these results reflect a bias in the COCS studies, omitted variables in the regression equation, or sample selection of the sponsoring organization. Nevertheless, the pattern is of interest. To the extent that local governments seek to promote development, perhaps with the idea of increasing the tax base, they appear to find more favorable results for commercial and industrial land uses. The more surprising result, however, is that *AFT* finds lower residential ratios than *Gov* and the other sponsoring organizations. If anything, one might expect that *AFT*, as a conservation organization, would find larger ratios for residential land uses in order to show that residential development does not "pay its own way," thereby providing an argument against further residential development. But this appears not to be the case. We also find that *AFT* does not significantly differ from *Gov* and *Academic* with respect to the *AgOs* ratios. *AFT* is, however, associated with higher ratios than *Org*, meaning that other nongovernmental organizations tend to produce more favorable agricultural and open-space results than *AFT*. The difference is close to 30 percent, which is substantial. Because the other nongovernmental organizations that tend to carryout COCS studies advocate open-space conservation, it is perhaps not surprising that they find more favorable *AgOs* results than other sponsoring organizations. But the fact that AFT is so different may lend support to the credibility of AFT studies.

Several of the other methodological variables did not produce statistically significant results in any of the specifications and, therefore, are not included in the models reported in Table 3. Specifically, we find conducting interviews with government officials to help allocate budget items (*Intervu*) has no effect; whether researchers use standard fallback percentages (based on proportional property tax revenues) to allocate expenditures not directly tied to a particular land use (*Standfallbk*); or whether the financial allocations come from only normal operating budgets (*Genfund*). Thus, these methodological differences appear to be unimportant in terms of reported ratios.

Turning now to the financial variables, we find that median home value does not have a statistically significant effect on *Residential* ratios. This result appears contrary to the expectation that higher home values would cause residential land uses to be more likely to “pay their own way” (e.g., Englehart 1997, Dorfman 2002), but it may point instead to the fact that an overall community median might be too broad to capture the effect. We do, however, find statistically significant results for *Homevalu* on the *ComInd* and *AgOs* ratios, although those for the former result are more robust. Even still, the magnitude is quite small: a $10,000 increase in median home value is associated with a .25 percent decrease in the commercial/industrial land-use ratios.

School expenditures as a proportion of total expenditures has a negative effect on ratios for all three land-use categories. The result for *Residential* is somewhat surprising. Our prior was that when the school budget comprises are larger fraction of the overall budget, it would push up *Residential* ratios because of larger expenditures begin allocated to that land use. But the result here suggests that as school budgets increase, proportionally more revenue is being allocated to the *Residential* sector, possibly through property taxes, state aid, or other funding sources ear-marked for education as a result of state equalization in many states. The results for *AgOs* and *ComInd* are more intuitive: as the school budget comprises a larger share of the overall budget, more revenue is likely to be reallocated from these land uses towards the residential category.

A consistent set of results is that when a particular land use generates a larger proportion of total property taxes, it is more likely to “pay its own way.” The results are particularly strong for the *Residential* and *ComInd* models. In terms of the magnitudes, a 10 percent increase in the proportion of total property tax that comes from residential land uses is associated with a 3-percent decrease in the *Residential* ratios. The result for commercial/industrial land uses is bigger: a 10-percent increase in the proportion of total property tax is associated with a 10 percent decrease in the *ComInd* ratios. Together these results suggest that as the property-tax burden increases for a particular land use, the land use appears to not receive a proportional increase in expenditures.

Finally, several of the financial variables were never statistically significant in any of the estimated equations. We had no prior expectations about *Expenditures*, *Revenue* and *Surplus*, and they appear to make little difference on reported ratios for each land-use category. The same holds for *Expercap*, but one might nevertheless expect this variable to play an important role. For instance, with greater expenditures per capita, it would be reasonable to expect that certain land uses would benefit more or less. While we find no evidence for this based on differences in ratios between studies, it may still be the case that it explains differences among the ratios for land uses within a municipality.

V. Conclusion

Quantitative meta-analysis is a statistical technique that is useful for summarizing and reviewing the results of existing research. In this paper, we conduct a meta-analysis of COCS studies. Using 125 studies, along with U.S. Census data, we create explanatory variables to investigate underlying patterns regarding the effect of methodological assumptions, as well as the geographic and financial characteristics of communities. The overall objective is to exploit variation across studies to explain differences in reported ratios of expenditures-to-revenues within the three land use categories of residential, commercial/industrial, and agricultural/open-space. Understanding what drives differences is important because COCS studies are increasingly popular and influential in debates about municipal land-use decision-making. In particular, arguments are made in favor of land uses associated with lower ratios, which are interpreted to mean that the land use is more likely to "pay its own way."

The main findings of our analysis are the following. We find clear support for the common perception that residential land uses tend to have ratios greater than one, while commercial/industrial and agricultural/open-space land uses tend to have ratios less than one. Recent population growth has little effect on COCS ratios for all land-use categories. The level of governance—city, county or township—is also of little consequence to COCS results. Among the methodological decisions that COCS researchers must make, two have particularly large effects. Including the school budget in a COCS study increases residential ratios by more than 15 percent, and including farm houses in the agricultural/open-space category, rather than the residential category, increases agricultural/open-space ratios as much as 60 percent. After controlling for different methodological assumptions, differences remain for the effect of the type of organization that sponsored the study. COCS studies carried out by local governments find less favorable residential ratios and more favorable commercial/industrial ratios than studies carried out by the AFT. Furthermore, when other nongovernmental organizations conduct a study they find more favorable agricultural/open-space ratios than the AFT. Median home values have no effect on the residential ratios, but they do tend to decrease the ratios for other land uses. Finally, when a particular land use accounts for a greater share of overall municipal property tax revenue, that land use has a lower expenditure-to-revenue ratio.

In terms of guidance for the conduct and interpretation of COCS studies, we find that several methodological assumptions make little difference. In particular, researchers may want to simply take the least costly approach when deciding whether to conduct interviews, use standard fallback percentages, or use only the general fund. The important methodological decisions are whether to include the school budget and whether to include farm houses in the agricultural/open-space land-use category. COCS researchers should make these assumptions transparent and perhaps provide sensitivity analysis. Those transferring the results of COCS studies from one municipality to another should also be aware of the substantial effect that these methodological decisions have on the results. Users of COCS studies should also be aware of potential bias, although we find somewhat surprising results in this regard.

A more general implication follows from our findings that density and median home value have no effect on residential ratios. While many planning decisions about residential development tend to focus on density and factors that affect home values, the results here suggest that these planning dimensions may have relatively little affect on the balance of expenditures and revenues for different land-use categories. Future research should further investigate the effect of density with more refined measures of the actual density of development. The fact that population change had no effect on residential ratios is also an important result that some may point to as undermining the value of COCS studies for predicting the financial impacts of future land-use change. The result suggests that using averages from existing patterns of land use may be of questionable value for making predictions about future, marginal changes. Finally, the meta-analysis conducted in this paper focuses on explaining differences in COCS ratios within each of the three land-use categories between municipalities, but future research should also focus on explaining differences in the ratios between land-use categories. This would be useful because municipalities themselves are not only interested in the financial balance within each land-use category, they must also consider the overall budget balance among all types of land use.

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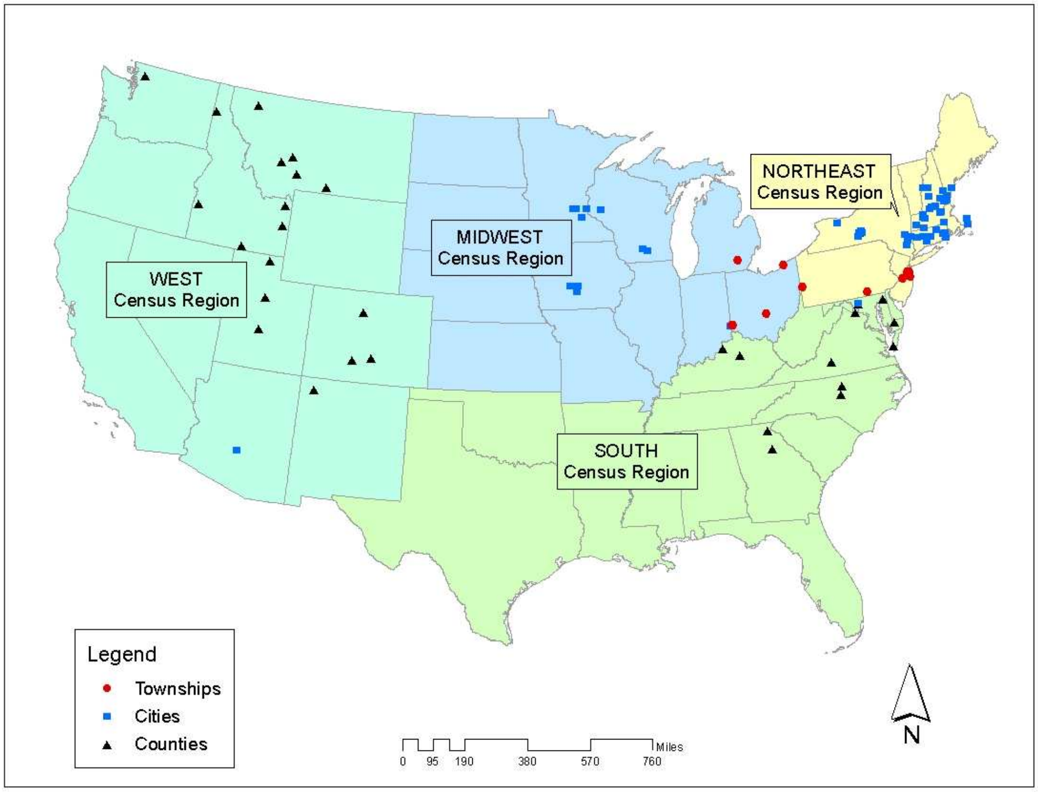

Figure 1: Geographic distribution of cost of community service studies and corresponding level of governance

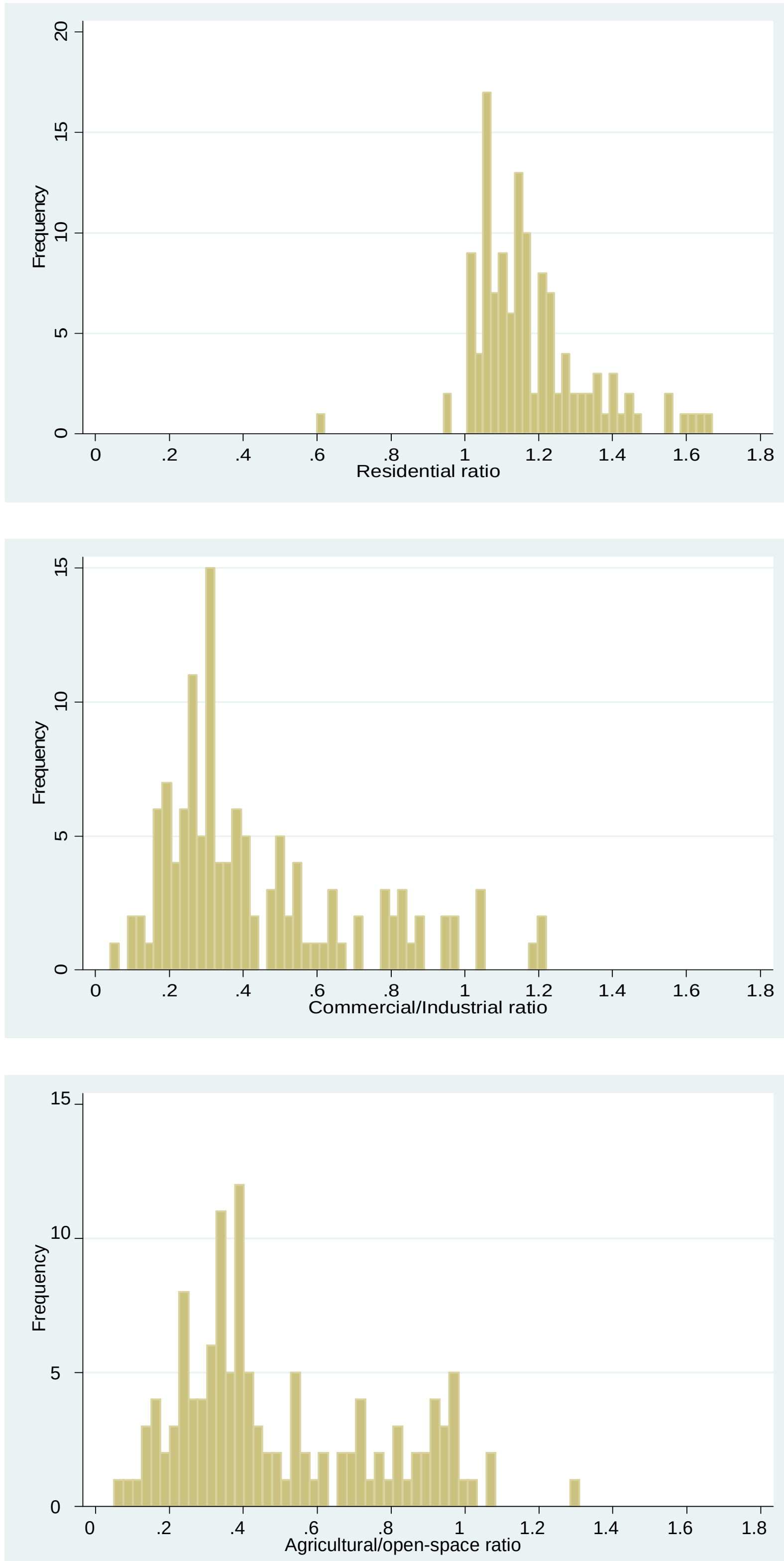

Figure 2: Frequency distributions of cost of community service study ratios for residential, commercial/industrial, and agricultural/open-space land uses

Table 1: List of variables and definitions

Variable	Definition
Ratios	
Residental	Ratio of expenditures over revenues for residential land uses
ComInd	Ratio of expenditures over revenues for commercial/industrial land uses
AgOs	Ratio of expenditures over revenues for agricultural/open spacve land uses
Geographic	
City	Dummy for budget at the city, town, or village level
Countyonly	Dummy for budget at the county level, excluding subset municipalities
Countyall	Dummy for budget at the county level, including subset municipalities
Township	Dummy for budget at the township level, excluding subset municipalities
Population	Total population for year study conducted (10,000s)
Sqmiles	Land area (square miles)
Density	People per square mile (100s people)
Popchng	Proportionate population change from 5 years prior to study year to 2 years after
Methodological	
AFT	Dummy for study sponsored by AFT
Org	Dummy for study sponsored by some other nongovernmental organization
Gov	Dummy for study sponsored by a government agency
Academic	Dummy for study sponsored by an academic institutions
Scholuse	Dummy for school budget used in the study
Genfund	Dummy for budget allocations from general fund only, i.e., normal operating finances
Agres	Dummy for agricultural residences included in *AgOS* rather than *Residental* ratios
Intervu	Dummy for interviews with government officials used to help allocate budget items
Standfallbk	Dummy for using standard fallback percentages to allocate expenditures
Financial	
Expenditures	Total expenditures in year of study (100,000s in year $2000s)
Revenue	Total revenues in year of study (100,000s in year $2000s)
Surplus	Total revenues minus total expenditures (*Revenue* – *Expenditures*)
Expercap	Total expenditures per capita (1,000s in year $2000s)
Homevalu	Median home value (100,000s in year $2000s)
Scholbdg	School expenditures as a proportion of total expenditures (= 0 if *Scholuse* = 0)
Restax	Residential property tax as a proportion of total property tax
ComIndtax	Commercial/industrial property tax as a proportion of total property tax
AgOstax	Agricultural/open-space property tax as a proportion of total property tax

Notes: All variables are derived from COCS studies themselves, except for *Population*, *Sqmiles*, *Density*, *Popchng*, and *Homevalu*, which are taken directly or derived from the U.S. Census. *Homevalu* is taken from the 1990 census for studies done before 2000 or the 2000 census for studies done after 2000. Other census variables are from projections for the specific years corresponding to the COCS study.

Table 2: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Ratios				
Residental	1.18	0.16	0.60	1.67
ComInd	0.44	0.27	0.04	1.22
AgOs	0.50	0.28	0.05	1.31
Geographic				
City	0.54	0.50	0	1
Countyonly	0.29	0.45	0	1
Countyall	0.07	0.26	0	1
Township	0.10	0.30	0	1
Population	4.26	13.21	0.02	139.29
Sqmiles	537.09	1,028.22	0.40	5,514.00
Density	3.75	6.05	0.02	28.00
Popchng	0.16	0.19	-0.13	1.63
Methodological				
AFT	0.25	0.43	0	1
Org	0.18	0.39	0	1
Gov	0.19	0.40	0	1
Academic	0.38	0.49	0	1
Scholuse	0.70	0.46	0	1
Genfund	0.20	0.40	0	1
Agres	0.24	0.43	0	1
Intervu	0.77	0.42	0	1
Standfallbk	0.70	0.46	0	1
Financial				
Expenditures	512.05	1,650.06	0.27	17,576.46
Revenue	516.51	1,682.10	0.48	17,937.58
Surplus	4.46	42.99	-115.48	361.12
Expercap	1.44	0.76	0.11	3.63
Homevalu	1.30	0.65	0.48	4.02
Scholbdg	0.43	0.32	0.00	0.94
Restax	0.69	0.18	0.00	0.99
ComIndtax	0.20	0.14	0.00	0.68
AgOstax	0.10	0.13	0.00	0.76

Notes: All variables have 125 observations, with a few exceptions. One outlier observation is dropped for *Residential*, and data is available for only 118 observations for *Restax*, *ComIndtax*, and *AgOstax*.

Table 3: Seemingly unrelated regression results for all three land-use categories

	Residential		Commercial/ Industrial		Agricultural/ Open space	
	Linear	Log-linear	Linear	Log-linear	Linear	Log-linear
Geographic						
Population	0.012***	0.010***	-0.011**	-0.020*	0.005	0.006
	(3.93)	(3.77)	(2.14)	(1.72)	(0.82)	(0.48)
Density	-0.003	-0.003	0.008**	0.020**	0.010***	0.020**
	(1.46)	(1.32)	(2.07)	(2.32)	(2.48)	(2.27)
Countyonly	-0.019	-0.009	0.064	0.169	0.012	0.074
	(0.46)	(0.25)	(0.94)	(1.07)	(0.17)	(0.48)
Countyall	-0.109*	-0.081	0.089	0.192	-0.102	-0.144
	(1.67)	(1.48)	(0.82)	(0.76)	(0.90)	(0.57)
Township	0.129***	0.117***	-0.089	-0.239	-0.057	-0.179
	(2.74)	(2.96)	(1.16)	(1.35)	(0.67)	(0.96)
City	--	--	--	--	--	--
Methodology						
Scholuse	0.187***	0.153***	0.104	0.339	0.082	0.381
	(2.66)	(2.59)	(0.91)	(1.29)	(0.65)	(1.36)
Agres	--	--	--	--	0.267***	0.600***
					(4.34)	(4.47)
Gov	0.090**	0.090***	-0.126*	-0.323**	-0.048	-0.192
	(2.24)	(2.67)	(1.91)	(2.11)	(0.67)	(1.21)
Academic	0.023	0.034	0.063	0.113	0.010	-0.130
	(0.66)	(1.16)	(1.12)	(0.87)	(0.16)	(0.90)
Org	0.053	0.055	-0.030	-0.025	-0.122	-0.359**
	(1.26)	(1.56)	(0.44)	(0.16)	(1.47)	(1.98)
AFT	--	--	--	--	--	--
Financial						
Homevalu	0.025	0.022	-0.130***	-0.252***	-0.091*	-0.156
	(0.95)	(1.01)	(3.06)	(2.57)	(1.88)	(1.47)
Scholbdg	-0.204**	-0.161*	-0.372**	-0.966***	-0.211	-0.785*
	(1.98)	(1.85)	(2.22)	(2.49)	(1.14)	(1.92)
Restax	-0.384***	-0.302***	--	--	--	--
	(4.88)	(4.53)				
ComIndtax	--	--	-0.469***	-1.056***	--	--
			(2.82)	(2.74)		
AgOstax	--	--	--	--	-0.181	-0.299
					(0.95)	(0.72)
Constant	1.309***	0.233***	0.789***	-0.293	0.601***	-0.611***
	(17.18)	(3.62)	(9.42)	(1.51)	(6.30)	(2.91)
R-squared	0.32	0.33	0.37	0.34	0.31	0.29
Observations	117	117	117	117	117	117

Notes: *t*-statistics are given in parentheses. One, two, and three asterisk(s) indicate(s) statistical significance at the 90-, 95- and 99-percent levels, respectively.

Appendix Table: List of cost of community service studies and locations for all observations included in the meta-analysis

Report citation	Study location
American Farmland Trust (1986). The Cost of Community Services in Hebron, Connecticut. Washington, D.C.	Hebron, CT Madison Township, OH Madison Village, OH
American Farmland Trust (1992). Does Farmland Protection Pay? The Cost of Community Services in Three Massachusetts Towns. Northampton, MA.	Agawan, MA Deerfield, MA Gill, MA
American Farmland Trust (1994). Farmland and the Tax Bill: The Cost of Community Services in Three Minnesota Cities. Washington, D.C.	Farmington, MN Independence, MN Lake Elmo, MN
American Farmland Trust (1997). The Cost of Community Services in Frederick County, Maryland. Washington, D.C.	Burkettsville, MD Frederick City, MD Frederick County, MD Walkersville, MD
American Farmland Trust (1998). The Cost of Community Services in Monmouth County, New Jersey. Washington, D.C.	Freehold Township, NJ Holmdel Township, NJ Middletown Township, NJ Upper Freehold Township, NJ Wall Township, NJ
American Farmland Trust (1999). Cost of Community Services Study: Northampton County, Virginia. Washington, D.C.	Northampton County, VA
American Farmland Trust (1999). Cost of Community Services Study: Skagit County, Washington. Washington, D.C.	Skagit County, WA
American Farmland Trust (1999). The Cost of Community Services in Lexington-Fayette County Kentucky. Washington, D.C.	Lexington-Fayette County, KY
American Farmland Trust (2002). Finding the Balance: Ranching and Rapid Growth in Bandera County, Texas: A Cost of Community Services Study. Washington, D.C.	Bandera County, TX
American Farmland Trust (2002). Kent County, Maryland. Cost of Community Services Study. Washington, D.C.	Kent County, MD
American Farmland Trust (2002). Wimico County, Maryland. Cost of Community Services Study. Washington, D.C.	Wimico County, MD
American Farmland Trust (2003). The Cost of Community Services, Oldham County, Kentucky. Washington, D.C.	Oldham County, KY
American Farmland Trust (2004). A Report on the Cost of Community Services in San Juan County, Washington. Washington, D.C., w/ Friends of the San Juans.	San Juan County, WA
American Farmland Trust (2005). The Cost of Community Services. Bedford County, Virginia. Washington, D.C.	Bedford County, VA
American Farmland Trust (2007). The Cost of Community Services. Okanogan County, Washington. Washington, D.C.	Okanogan County ,WA
American Farmland Trust Cost of Community Services Study: The Value of Farmland and Open Space in Bexar County, Texas. Washington, D.C.	Bexar County, TX

Annett, S., R. Cooksey, et al. (1993). Cost of Community Services, Fiscal Impact Analysis, City of Dover. Durham, NH, Department of Resource and Economic Development, University of New Hampshire.	Dover, NH
Auger, P. A. (1996). Does Open Space Pay? Durham, NH, University of New Hampshire, Cooperative Extension.	Deerfield, NH Freemont, NH Stratham, NH
Bonner, M. and F. Gray (2005). Cost of Community Services Study. Town of Rochester, New York.	Rochester, NY*
Bowden, M. A. (2000). The Cost of Community Services in Hays County, TX. Community and Regional Planning Program, University of Texas at Austin.	Hays County, TX
Brentwood Open Space Task Force (2002). Does Open Space Pay in Brentwood. Part 1: Housing and Taxes.	Brentwood, NH
Bucknall, C. The Real Cost of Development. Poughkeepsie, NY, Scenic Hudson, Inc.	Amenia, NY Fishkill, NY Red Hook, NY
Cecil County Office of Economic Development (1994). Fiscal Impact of Residential, Commercial/Industrial, and Agricultural Land Uses in Cecil County, Maryland. North East, MD.	Cecil County, MD
Citizens for a Better Flathead (1999). The Fiscal Impact of Different Land Uses on County Government and School Districts in Flathead County, Montana for the Fiscal year 1997. Kalispell, MT.	Flathead County, MT
Commonwealth Research Group (1995). Cost of Community Services in Southern New England. Southern New England Forest Consortium, Inc. Chepachet, RI.	Becket, MA Durham, CT Farmington, CT Franklin, MA Hopkinton, RI Leverett, MA Litchfield, CT Pomfret, CT West Greenwich, RI Westford, MA
Cornell Cooperative Extension of Dutchess County and American Farmland Trust (1989). Cost of Community Services Study: Towns of Beekman and Northeast, Dutchess County, New York. Millbrook, NY.	Beekman, NY North East, NY
Costa, F. J. and G. Gordon-Sommers (1999). Cost of Community Services for 1998 for Auburn Township, Geauga County, Ohio, Center for Public Administration and Public Policy, Kent State University.	Auburn Township, OH
Crane, L. P., M. M. Manion, et al. (1996). A Cost of Community Services Study of Scio Township. School of Natural Resources and the Environment. Ann Arbor, MI, University of Michigan.	Scio Township, MI
Dirt, Inc. (2002). A Revenue/Cost Analysis of Community Service Provision in Grand County, Colorado.	Grand County,CO
Dirt, Inc. (2002). A Revenue/Cost Analysis of Community Service Provision in Saguache County, Colorado.	Saguache County, CO
Dirt, Inc. (2002). A Revenue/Cost Analysis of Community Service Provision in San Juan County, New Mexico.	San Juan County, NM
Edwards, M., D. Jackson-Smith, et al. (1999). The Cost of Community Services for Three Dane County Towns: Dunn, Perry, and Westport, Wisconsin Land Use Program, University of Wisconsin-Madison.	Dunn, WI** Perry, WI** Westport, WI**

Fallon, Ed, Office of Iowa State Representative. (1998). The Cost of Community Services in Three Central Iowa Cities.	Altoona, IA Indianola, IA Waukee, IA
Haggerty, M. (1997). Fiscal Impacts of Alternative Development Patterns: Broadwater and Gallatin Counties. Bozeman, MT, Local Government Center, Montana State University.	Broadwater County, MT Gallatin County, MT
Haggerty, M. (2000). The Cost of Community Services in Custer County, Colorado. Sonoran Institute, Bozeman, MT.	Custer County, CO
Hartmans, M. and N. Meyer (1997). Financing Services for Residential, Commercial and Agricultural Parcels: The Cases of Canyon and Cassia Counties. Moscow, ID, Department of Agricultural Economics and Rural Sociology, College of Agriculture, University of Idaho.	Canyon County, ID* Cassia County, ID*
Innovative Natural Resource Solutions LLC (undated) Cost of Community Services Study. Town of Mont Vernon, New Hampshire.	Mont Vernon, NH
Innovative Natural Resource Solutions LLC (2005). Cost of Community Services Study. Town of Milton, New Hampshire.	Milton, NH
Innovative natural Resource Solutions LLC (2005). Cost of Community Services Study. Town of Jaffrey, New Hampshire.	Jaffrey, NH
Johnson, R. J. (1997). The Cost of Community Services in Portsmouth, Rhode Island. Narragansett, RI, The Aquidneck Island Partnership, Coastal Resources Center, University of Rhode Island.	Portsmouth, RI
Leighton, M. and N. Meyer (1999). Financing Services for Residential, Commercial and Agricultural Parcels: The Cases of Kootenia and Booneville Counties. Moscow, ID, Department of Agricultural Economics and Rural Sociology, College of Agriculture, University of Idaho.	Bonneville County, ID* Kootenia County, ID*
Littleton Planning Board (2002). Littleton Master Plan. Fiscal Impacts.	Littleton, MA
MacFadden, S. (1997). Cost of Community Services Study: Town of Peterborough, New Hampshire, Antioch New England, Peterborough Conservation Commission, SPACE:	Peterborough, NH
Murphy, B. (2001). Cost of Community Services in Jefferson County, Montana. Boulder, MT, Jefferson County Planning Board.	Jefferson County, MT
Neibling, C. R. (1997). Town of Exeter, New Hampshire: Cost of Community Services Study. Concord, NH, Innovative Resource Solutions, Submitted to Exeter Conservation Commission: 17.	Exeter, NH
Nellis, L. (1998). Cost of Community Services Study. Freemont County, Idaho, Freemont County Planning and Zoning Commission. Freemont County Planning and Zoning Commission.	Freemont County, ID
Nelson, N. and J. H. Dorfman (2000). Cost of Community Services for Habersham and Oconee Counties, Georgia. Athens, GA., Center for Agribusiness and Economic Development. The University of Georgia.	Habersham County, GA Oconee County, GA
Pickard, C. (2000). 1998 Cost of Community Services Study: Town of Lyme, New Hampshire, The Lyme Hill and Valley Association	Lyme, NH
Piedmont Environmental Council (1993). Financial Analysis of the 1991 Loudoun County Budget. Charlottesville, Virginia.	Loudoun County, VA*
Prindle, A. M. (2002). Fairfield County Development Strategy and Land Use Plan, Fiscal Impacts Chapter. Fairfield, OH.	Hocking Township, OH Liberty Township, OH
Prinzing, K. (1999). The Cost of Providing Community Services: Carbon County, Montana. Red Lodge, MT, Carbon County Commissioners.	Carbon County, MT

Renkow, M. (1998). The Cost of Community Services in Chatham County: A Report to the Chatham County Planning Department. Raleigh, NC, Department of Agricultural and Resource Economics, North Carolina State University.	Chatham County, NC
Renkow, M. (2006). The Cost of Community Services in Orange County. Raleigh, NC, Department of Agricultural and Resource Economics, North Carolina State University.	Orange County, NC
San Martin, I. (1998). Town of Gilbert: The Cost of Community Services. Tempe, AZ, Herberger Center for Design Excellence, College of Architecture and Environmental Design, Arizona State University.	Gilbert, AZ
Smith, L. J. and P. Henderson (2001). Cost of Community Services Study for Truro, Massachusetts: A Report on the Fiscal Implications of Different Land Uses, Association for the Preservation of Cape Cod.	Truro, MA
Smith, L. J. and P. Henderson. (2001). Cost of Community Services Study for Brewster Massachusetts: A Report on the Fiscal Implications of Different Land Uses. Association for the Preservation of Cape Cod.	Brewster, MA
Snyder, D. L. and G. Ferguson (1994). Cost of Community Services Study: Cache, Sevier and Utah Counties. Logan, UT, Economics Department, Utah State University.	Cache County, UT* Sevier County, UT* Utah County, UT*
South Central Assembly for Effective Governance (2002). Cost of Community Services: Hopewell Township, York County Pennsylvania.	Hopewell Township, PA
South Central Assembly for Effective Governance (2002). Cost of Community Services: Shrewsbury Township, York County Pennsylvania.	Shrewsbury Township, PA
Sutton Cost of Community Services Study Ad Hoc Committee (1998). Town of Sutton, New Hampshire: Cost of Community Services Study.	Sutton, NH
Taylor, D. T. (2000). 1997 Cost of Community Services Study: Groton, New Hampshire. Concord, NH, New Hampshire Wildlife Federation.	Groton, NH
Tompkins County Agriculture & Farmland Protection Board (1996). Study of Tompkins County Agriculture, Phase I Tompkins County Agriculture & Farmland Protection Plan.	Caroline, NY Danby , NY Dryden, NY Enfield, NY Groton, NY Ithaca, NY Lansing, NY Newfield, NY Tompkins County, NY Ulysses, NY
Wintersteen, J. (1996). Economics of Land Conservation, Scarbourough, Maine.	Scarborough, ME

Notes: Study locations with one or two asterisk(s) report two or three sets of ratios, respectively. All other study locations report one set of ratios.