

City-County Government and Promises of Economic Development: A Tale of Two Cities

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The prevailing opinion in Louisville is that its central city, like many American cities, is terminally ill. People have moved to the suburbs and retail stores have located into the malls. All this has left the city with fewer people and fewer shops. But is the city really worse off? A great many claims about Louisville's imminent death are made by politicians anxious about a shrinking electoral base, by businesses concerned about declining investments and by newspapers worried about lost circulation. "Fragmented" Louisville is invidiously compared to the consolidated urban county of Lexington-Fayette—especially on the population count. Since 1970 Louisville has lost 25 percent of its residents and today is down to 269,000 people. During the same period Lexington-Fayette registered a 108 percent gain and it holds 225,000 residents. Louisville's haunting fear is that Lexington Fayette will overtake it during the early part of the next century (Savitch and Vogel 1999, 4).

In the late 1990s, many political, business, and media elites in Louisville, Kentucky, feared that the combined population of Lexington and Fayette County would soon eclipse that of their own city, leaving Louisville the second-largest city in the

state and economically disadvantaged. These actors regarded city-county government as the primary instrument of this growth and promoted consolidation to enhance the viability of their own area (McDonough 2000; Savitch and Vogel 2004a, 2004b; "Vote 'yes' for a Greater Louisville" 2000). Several cities that had merged during the 1960s and 1970s became the centers of thriving metropolitan areas: Indianapolis rejuvenated its downtown, Jacksonville became a regional financial services center, and Nashville established itself as a health-care hub. Similar economic benefits were expected of the merger of Louisville and Jefferson County (McDonough and Poynter 2000, 1). After having been rejected by voters in 1982 and 1983, the measure was eventually approved by the electorate in November 2000.

This "tale of two cities" is a story of regional competition and the enduring appeal of promises of economic development. Long connected by geography, Lexington and Louisville now are linked in terms of their government structure. For advocates of city-county government across the country, the merger of Louisville and Jefferson County is a watershed event. It is the first consolidation of major governments in nearly 30 years and evidence that consolidations in large urban counties can be achieved. The media have

praised the success of Louisville's metro government in improving economic development in the area, and delegations from more than 40 communities have traveled to Louisville to learn about this new government (Gainesville.com 2003; Greenblatt 2002; Peirce 2004a, 2004b; Wartman 2005).

Despite the favorable reception toward the restructuring, however, questions remain about whether the new Louisville metro government will actually produce the benefits promised by its advocates. It is too soon to assess the effects of this transformation. Analyses of major reorganizations require a decade or more before and after the change to draw sound, empirically based conclusions. Regardless, there are important implications in the near term for the many other communities that are considering following Louisville's lead.

Promises of Economic Development: The New "It" Strategy

Achieving substantial changes in economic development is not the only motivation for consolidating governments. The accountability and responsiveness of public officials (Carr 2004) and the efficiency of a large, complex government (Brierly 2004) also are cited as reasons. Lowery (2000) has argued that economic and racial segregation is best fought through city-county governments or other large-scale jurisdictions. In other instances, city-county consolidation may be perceived as the best way to dislodge entrenched politicians or to break up political machines (Leland and Thurmaier 2000). Moreover, given that some grants and business opportunities are based on population, there may be real benefits simply to being a more populous jurisdiction (Carr 2004).

Capturing scale economies and eliminating redundant service bureaucracies were key selling points for merging city and county governments several decades ago (Marando 1974), but economic development has become the favored argument in contemporary efforts (Carr and Feiock 2002; Leland and Thurmaier 2005). Campaigns to create city-county gov-

ernment employ heretical strategies (Riker 1986) whereby proponents seek to link the effects of the proposed government to latent attitudes for change in the community (Feiock, Carr, and Johnson 2006). The prospect of improved economic development promoted by locals (often business elites) usually has wide appeal in the community and thus is a highly effective strategy for disrupting the base of support for the existing structure of independent city and county governments.

As with any substantial reorganization of local government power, proposals to consolidate city and county governments are often intensely contested and highly rancorous. Arguments are made regarding the likely outcomes of adopting the new government, maintaining the status quo, or pursuing more modest changes to the existing structure. Given that economic development is often touted as a basis for adopting city-county government, empirical analyses of the development records of communities that have consolidated may help inform the debate in the many communities in which city-county consolidation is currently on the agenda.

Linking City-County Government and Development Patterns

Merger proponents in Louisville and elsewhere contend that city-county governments are better able to facilitate economic development because the obstacles created by multiple and competing agencies are eliminated and the increase in population makes the community more likely to attract firms that smaller communities cannot. Those who advocated consolidation in Louisville believed the area was losing ground to Lexington and pointed to the city-county government in the rival community as a key factor in this divergence. Jefferson County consisted of a large number of municipal governments when Fayette County and Lexington merged their governments in 1972, and the number and population of these suburban governments increased throughout the next two decades. The growth of Louisville's suburbs was cited as an obstacle to the city's

efforts to pursue development opportunities and was considered to be a drag on the prospects of their entire county (see Table 1 for a comparison of community demographics).

This article contributes to the limited literature on city-county government and economic development by providing an assessment of the development records compiled in the Louisville-Jefferson and Lexington-Fayette communities over the past half-century. Economic development patterns in Lexington-Fayette are analyzed to determine whether they were altered by the consolidation of the governments in 1972. Comparing what was going on in each community in the same state over the same period is an important consideration, especially should the Lexington-Fayette show improvements in economic development in the postconsolidation period.¹ Discrepancies in the fortunes of the two communities in the period after Lexington and Fayette merged governments might be appear as gains in Lexington, losses in Louisville, or a combination of both. Even stability in the Lexington area relative to decline in Louisville may be seen as evidence of a benefit attributable to city-county government.

Analysis

Although economic development can be measured in a variety of ways (e.g., changes in wages, jobs, and office space leased), this analysis employs the fairly simple measures of growth in the numbers of establishments and payroll in the manufacturing, retail, and service

sectors in Fayette and Jefferson Counties to determine the effects of consolidation.² The assumption is that increased wages and/or greater numbers of businesses in the area are indicative of an enhanced economy and that the benefits of consolidating governments might not be equally distributed across establishments of differing scales.

This study follows Carr and Feiock (1999) by examining changes in the size of the county's manufacturing, retail, and service sectors following consolidation. However, whereas that study assessed how the entire sector changed, this analysis examines the effects of consolidation on changes in the growth of wages and in establishments of different sizes within these same sectors. Carr and Feiock's analysis found no evidence of a link between city-county consolidation and local economic development, but their study did not examine if wages in the community improved or whether establishments of varying scales were affected differently by the consolidation. As one proponent of merger in Louisville noted, the Carr and Feiock analysis ". . . treats the mom and pop boutique the same as a UPS hub" (David Kaplan, quoted in McDonough and Poynter 2000, 3). Given that proponents of city-county government often cite its benefits for attracting large employers, perhaps the development benefits of consolidating governments should not be expected to be equally distributed across establishments of differing scales. In particular, city-county government may offer an advantage in attracting large employers to the area.

Table 1. Community Demographics Compared

Community Demographics	1950		1972		1997	
	Fayette	Jefferson	Fayette	Jefferson	Fayette	Jefferson
County population (N)	100,746	484,615	174,323	695,055	260,512	693,604
City population (N)	55,534	369,129	108,137	361,472	260,512	256,231
Land area (square miles)	285	386	285	386	285	386
Municipalities (N)	1	34	1	65	1	94
Special districts (N)	2	10	4	51	1	29

Source: U.S. Census of Governments (Washington, DC: U.S. Bureau of the Census, 1957, 1972, 1997); *County and City Data Book* (Washington, DC: U.S. Bureau of the Census, 1950, 1970, 2000).

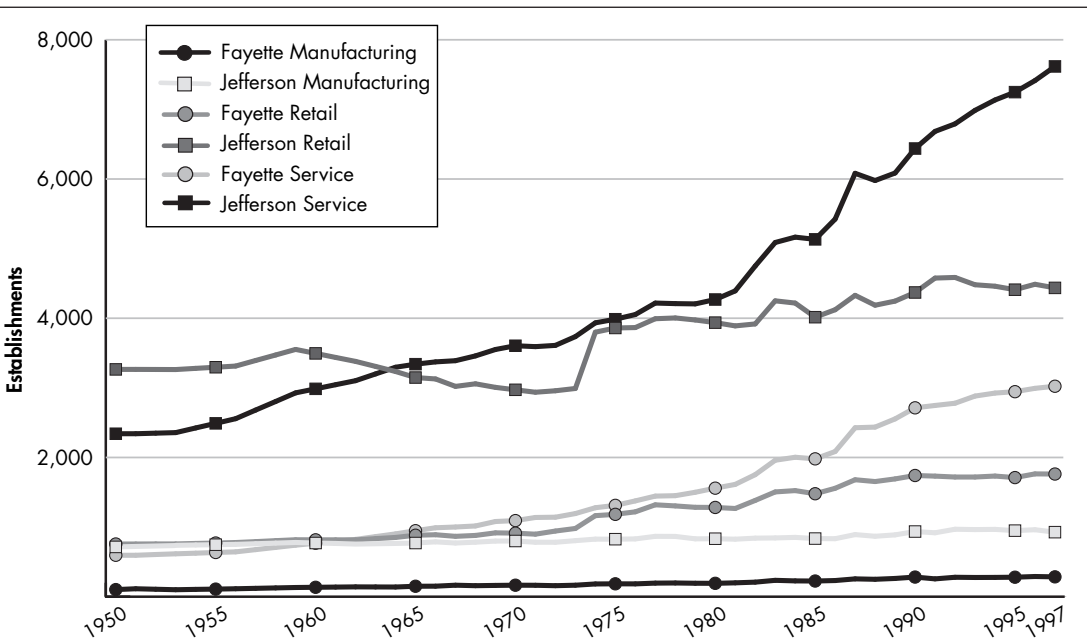
The stability of county boundaries over time makes these jurisdictions ideal units of analysis for this study. The two counties include all the relevant communities (i.e., the major cities and their suburbs) over the entire period, enabling pre- and postconsolidation comparisons to be made. Although trends in the regional economy are best revealed through analyses of multicounty regions or metropolitan areas (Savitch and Vogel 1999), county-level analyses are well suited for determining the more narrow development effects of mergers of county governments with their largest cities.

Figures 1 and 2 display the long-term trend in numbers of establishments and total payroll in the two counties for the three sectors from 1950 to 1997. These figures reveal that both communities experienced growth in establishments and payroll in all three sectors over the period. From these data, it is difficult to make the case that development patterns in Fayette County changed substantially after 1972 or that Jefferson County was falling be-

hind its neighbor. Indeed, the growth in the three Jefferson County series seems to have accelerated in the postconsolidation period, suggesting that it was instead Fayette County that was falling further behind its neighbor in the years following 1972.

To discern smaller, but still meaningful, changes in establishments and payroll growth following the adoption of the city-county government in Fayette County, it is necessary to determine whether the patterns are statistically different across the two time periods. A major event such as the creation of a city-county government is expected to interrupt existing development patterns in the county. Intervention analysis provides a method for assessing the impact of a discrete policy intervention, such as the creation of a city-county government, on the behavioral processes from which the values of a series are generated over time (Box and Jenkins 1970; Box and Tiao 1965).³ In the analyses, the consolidation intervention term is coded as a step function, with a value of 0 for the preconsolidation period

Figure 1. Manufacturing, Retail, and Service Establishments in Fayette and Jefferson Counties, Kentucky, 1950–97



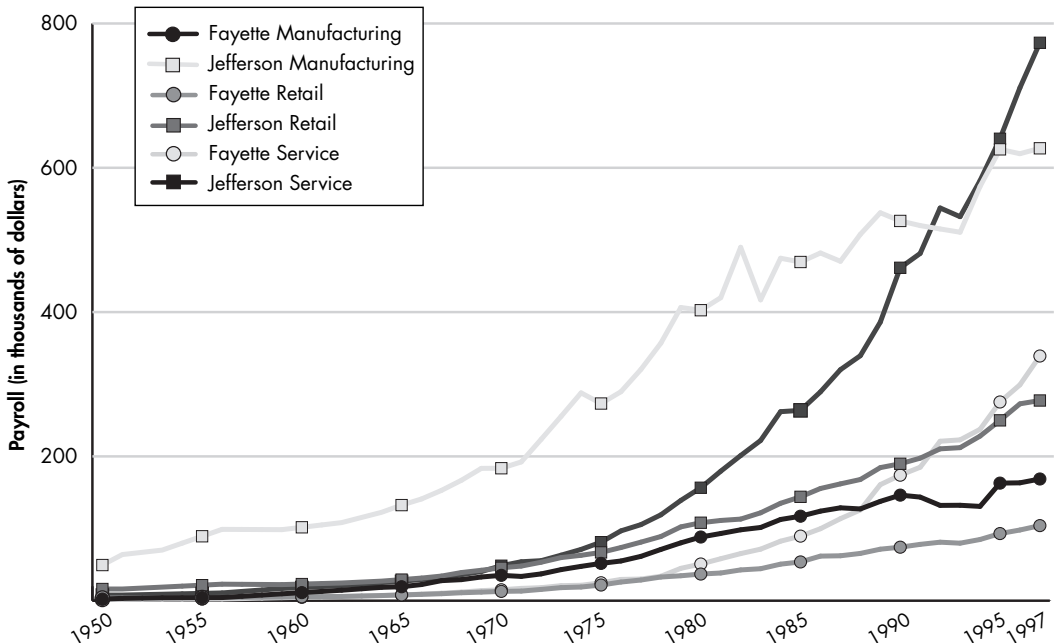
(1950–72) and 1 for the postconsolidation period (1973–97). This simple coding models the impact of the city-county government immediately after the merger and continuing throughout the period. The basic intervention model is as follows:

$$D(d)Y_t = a_0 + b_0I_t + AR(p) + MA(q) + \varepsilon_t,$$

where Y_t is a stationary time series, a_0 is the constant, I_t is the intervention term with the coefficient b_0 , and ε_t denotes random error. Observations within a time series are statistically dependent, and three terms in the intervention model describe how observations in one period are related to those in previous periods. $AR(p)$ indicates the number of autoregressive structures; $MA(q)$, the number of moving average structures; and $D(d)$, the number of times Y_t must be differenced for the series to be stationary. For each series, the statistical processes underlying the series are modeled using the ARIMA (auto-regression integrated moving average) identification and estimation procedures described in Enders (1995).⁴

The intervention model is a parsimonious representation of the factors affecting economic development in a community. The model is constructed to examine nonrandom changes in the levels of establishments and payrolls in the community arising from three different sources. First, the ARIMA terms capture nonrandom changes in the series related to dependency among the observations from autoregressive and moving average processes and from changes in the trend due to a nonstationary series.⁵ Second, the intervention term captures nonrandom changes in the series stemming from the introduction of the city-county government. A statistically significant coefficient for the intervention term is evidence that the average annual growth in the series changed from the pre- to postconsolidation period. If the establishment or payroll series is transformed, any changes are interpreted as the log or square root of the change over the two periods. Third, the constant term captures nonrandom changes stemming from all the other factors affecting development patterns in the community over time.⁶

Figure 2. Manufacturing, Retail, and Service Payrolls in Fayette and Jefferson Counties, Kentucky, 1950–97



Findings

Tables 2–4 report the findings of the 42 intervention models grouped by sector and in the case of Tables 3 and 4, by the number of employees. The 21 models estimated for Lexington-Fayette reveal very modest support for the claim that the adoption of the city-county government fundamentally altered the development patterns that were in place before consolidation occurred. The coefficient for the intervention term is statistically significant in only 5 of 21 models and none of the payroll models. Of the 5 models showing postconsolidation improvements in Lexington-Fayette, 2 are matched by similar improvements in the unconsolidated jurisdictions in Jefferson County. Thus, of the 21 economic development models estimated for the Lexington-Fayette community, only 3 models showed postconsolidation improvements that were not matched by similar findings in the comparison community, Jefferson County.

The strongest evidence for postconsolidation improvements in Lexington-Fayette is seen in retail establishments with fewer than 100 employees. Although a positive outcome for proponents of city-county governments, this result does not reflect the kind of extensive gains promised in their arguments for consolidation. Lexington-Fayette made progress in all three categories of small to medium-sized retail firms (see Table 3). Again,

this finding is qualified by the fact that both Fayette and Jefferson counties improved in the postconsolidation period in the case of retail establishments with 50 to 99 employees, suggesting that broader (at least regional) factors were responsible for this outcome. Still, the analyses do show that following the creation of the city-county government, Lexington-Fayette’s performance in a segment of the retail sector did improve in ways in which the nonconsolidated jurisdictions in Jefferson County did not.

The findings reported in Table 3 do not suggest similar improvements in the other two sectors. Only one of the other six models estimated for Lexington-Fayette showed postconsolidation improvements in establishments, and this improvement was also seen in the comparison group. Lexington-Fayette’s record with small manufacturing establishments (i.e., one to nine employees) was statistically better after 1972, but so too was the record of the nonconsolidated jurisdictions in Jefferson County. Further, the magnitude of the coefficients for the intervention terms in the two models reveals that the improvements in these small manufacturers in Louisville-Jefferson in the postconsolidation period was double that seen in Lexington-Fayette.

Turning to the larger establishments examined in Table 4, the findings provide even less support for the arguments that city-county government improved economic development

Table 2. Comparing Postconsolidation Growth Patterns in Total Payroll

Parameter	Manufacturing		Retail		Service	
	Fayette	Jefferson	Fayette	Jefferson	Fayette	Jefferson
Constant	6.46 (3.58)**	10.30 (2.54)*	.06 (2.07)*	.05 (3.91)**	.11 (8.68)**	.10 (9.43)**
Post-Consolidation Growth	2.28 (.94)	3.29 (.60)	.02 (.76)	.02 (1.13)	.01 (.35)	.01 (.42)
Transformation Model (<i>p</i> , <i>d</i> , <i>q</i>)	Square Root (0, 1, 0)	Square Root (0, 1, 0)	Logarithmic (1, 1, 1)	Logarithmic (1, 1, 1)	Logarithmic (0, 1, 1)	Logarithmic (0, 1, 1)
<i>N</i>	47	47	47	45	47	46

p* < .05; *p* < .01.

Note: Values reported for constant and consolidation intervention terms are regression coefficients; *t* values are in parentheses. For each model, the values of the augmented Dickey-Fuller (ADF) test statistic, the Schwartz Bayesian criterion (SBC), and the Ljung-Box *q*-statistic are available from the authors.

Table 3. Comparing Postconsolidation Growth Patterns in Small to Medium-Sized Firms

Model/Parameter	Manufacturing		Retail		Service	
	Fayette	Jefferson	Fayette	Jefferson	Fayette	Jefferson
1-19 Employees						
Constant	1.33 (4.11)***	-.22 (-.15)	.03 (.52)	-.23 (-.90)	.03 (4.91)***	.02 (3.96)***
Postconsolidation growth	2.68 (5.56)***	5.92 (2.97)***	.32 (3.52)***	.56 (1.63)	.01 (1.07)	.01 (1.30)
Transformation	None	None	Square Root	Square Root	Logarithmic	Logarithmic
Model (p, d, q)	(1, 1, 1)	(1, 1, 1)	(0, 1, 2)	(0, 1, 2)	(0, 1, 2)	(0, 1, 2)
N	46	46	47	46	47	46
20-49 Employees						
Constant	.62 (.79)	1.33 (.81)	1.14 (.55)	4.50 (.71)	.07 (3.58)***	.05 (3.03)***
Postconsolidation growth	-.12 (-.11)	-.53 (-.24)	5.93 (2.11)**	9.38 (1.11)	-.02 (-.76)	-.02 (-.91)
Transformation	None	None	None	None	Logarithmic	Logarithmic
Model (p, d, q)	(0, 1, 0)	(0, 1, 0)	(0, 1, 0)	(0, 1, 0)	(0, 1, 0)	(0, 1, 2)
N	47	47	47	46	47	46
50-99 Employees						
Constant	.01 (.36)	.02 (1.17)	-.84 (-4.53)***	1.79 (1.78)*	1.04 (1.15)	3.00 (1.94)*
Postconsolidation growth	-.00 (-.03)	-.02 (-1.06)	3.61 (5.19)***	3.59 (2.51)**	1.27 (1.04)	3.36 (1.62)
Transformation	Logarithmic	Logarithmic	None	None	None	None
Model (p, d, q)	(0, 1, 0)	(0, 1, 0)	(2, 1, 3)	(2, 1, 3)	(1, 1, 0)	(1, 1, 0)
N	47	47	45	44	46	45

*p < .10; **p < .05; ***p < .01.

Note: Values reported for constant and consolidation intervention terms are regression coefficients; t-values are in parentheses. For each model, the values of the augmented Dickey-Fuller (ADF) test statistic, the Schwartz Bayesian criterion (SBC), and the Ljung-Box q-statistic are available from the authors.

in Lexington-Fayette. In only a single case, service establishments with 100 to 249 employees, did the community's record with larger establishments improve after consolidation. None of the other eight models examining the record for medium-sized to large employers revealed a substantial change in the growth patterns of these establishments following consolidation. Thus, instead of substantially improving total payrolls or attracting greater numbers of large employers, these findings show that the development benefits that can be attributed to the city-county government in Lexington-Fayette are limited to retail establishments with fewer than 50 employees and service establishments with 100 to 249 employees.

Again, the development record of the Lexington-Fayette government is only part of the story. What happened in Louisville-Jefferson over the same period is also of interest. Beginning with the question of whether Louisville experienced absolute decline in economic development, the tables show that in one of the 21 models, the intervention term is statistically significant and negative, indicating that Louisville-Jefferson was less successful in attracting manufacturing establishments with 500 or more employees than it was prior to 1972. The manufacturing sector is highly visible in and important to the local economy, and large firms are aggressively sought for their relatively high-wage jobs.

Table 4. Comparing Postconsolidation Growth Patterns in Medium-Sized to Large Firms

Model/Parameter	Manufacturing		Retail		Service	
	Fayette	Jefferson	Fayette	Jefferson	Fayette	Jefferson
100–249 Employees						
Constant	.04 (2.78)***	-.01 (-2.66)**	.03 (.91)	.04 (2.15)**	.07 (6.14)***	.17 (2.91)***
Postconsolidation growth	-.03 (-1.51)	.02 (3.90)***	-.01 (-.25)	-.00 (-.12)	.05 (3.02)***	.09 (1.19)
Transformation	Logarithmic	Logarithmic	Logarithmic	Logarithmic	Square Root	Square Root
Model (p, d, q)	(1, 1, 2)	(1, 1, 2)	(0, 1, 3)	(0, 1, 3)	(0, 1, 2)	(0, 1, 2)
N	46	46	47	46	47	46
250–499 Employees						
Constant	.24 (.51)	-2.00 (-1.25)	.13 (.99)	.00 (.00)	.02 (.17)	.06 (8.99)***
Postconsolidation growth	-.24 (-.37)	1.58 (.74)	-.06 (-.40)	.08 (.61)	.08 (.67)	.07 (2.45)**
Transformation	None	None	Square Root	Square Root	Square Root	Square Root
Model (p, d, q)	(0, 1, 0)	(0, 1, 0)	(2, 1, 3)	(0, 1, 0)	(1, 1, 1)	(1, 1, 1)
N	47	47	45	46	46	45
500+ Employees						
Constant	.21 (1.06)	.70 (11.91)***	.04 (1.51)	.03 (.42)	.08 (1.94)*	.09 (1.96)*
Postconsolidation growth	-.15 (-.57)	-1.48 (-11.30)***	.00 (.10)	-.04 (-.43)	-.01 (-.09)	-.03 (-.52)
Transformation	None	None	Square Root	Square Root	Square Root	Square Root
Model (p, d, q)	(0, 1, 1)	(0, 1, 1)	(3, 1, 3)	(1, 1, 0)	(0, 1, 0)	(0, 1, 0)
N	47	47	44	44	47	46

*p < .10; **p < .05; ***p < .01.

Note: Values reported for constant and consolidation intervention terms are regression coefficients; t-values are in parentheses. For each model, the values of the augmented Dickey-Fuller (ADF) test statistic, the Schwartz Bayesian criterion (SBC), and the Ljung-Box q-statistic are available from the authors.

Community leaders likely perceived consolidation as a means by which to attract manufacturing-sector jobs and redress a stagnant economy. There is no evidence, however, that city-county government is a solution to the problem of revitalization. The analysis shows that city-county government did not improve the performance of large manufacturers in Lexington-Fayette.

The models provide other evidence, albeit weak, for the proposition of relative decline in Louisville-Jefferson. Three models out of 21 indicate that development patterns in Lexington-Fayette statistically improved after 1972. Lexington-Fayette’s record in attracting retailers with 49 employees or less and service

establishments with 100 to 249 employees improved following consolidation, yet in both cases, Louisville-Jefferson’s performance was unchanged over the same period. Interestingly, the findings provide roughly the same support for the proposition that Louisville-Jefferson’s pre-1972 edge over Lexington-Fayette increased in the post-consolidation period, despite the presumed benefits of city-county government to the community. In Louisville-Jefferson after 1972, small (1 to 19 employees) and medium-sized (100 to 249 employees) manufacturers and large (250 to 499 employees) service establishments increased. However, the findings indicate no improvement in these groups in Lexington-Fayette.

Conclusion

In Louisville and other communities around the country, economic development is offered as a rationale for consolidating city and county governments. Arguments for a unified city-county structure are consistent with political, business, and media elites' vision for how a region prospers in a highly competitive national and global economy (see Leland and Thurmaier 2005; Feiock, Carr, and Johnson 2006). Whether major substantial reorganizations of local governments actually improve the development prospects of communities is less clear, however.

The findings of this study provide little support for the contention that the adoption of city-county government substantially altered the development patterns in Lexington-Fayette that existed prior to the merger of its city and county governments. Indeed, they confirm earlier analyses showing no systematic development improvements from city-county government (Carr and Feiock 1999; Feiock and Carr 1997). For the most part, trends in both communities varied little during the period examined. Economic development in the more populous Jefferson County has traditionally outpaced the smaller, lesser-known Fayette County, and this basic dynamic was not changed by governmental consolidation. In the years after the merger, Lexington-Fayette did attract and retain small retailers, but there is no evidence to suggest that Lexington-Fayette's development record with large firms improved following the adoption of city-county government. Moreover, there was lack of evidence that development patterns in Louisville-Jefferson—whether measured in absolute terms or relative to Lexington-Fayette—declined during this period.

Although academics have devoted considerable attention to analyzing the factors explaining why local electorates adopt or reject city-county government, there is little empirical evidence of the long-term development impacts of this form of government. Given the importance of economic develop-

ment as a rationale for creating city-county governments and the potentially serious and far-reaching consequences of major reorganizations of local government (Feiock 2004), more rigorous study should be made of arguments regarding city-county government—especially when improved economic development or reduced public expenditures are touted as reasons for consolidation. Empirical studies that focus on different sets of communities and employ different research approaches are needed to better understand the implications of substantial reorganizations of local governments.

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Notes

1. Use of a comparison group is a common technique for accounting for threats to internal validity from local history in quasi-experimental designs.
2. First-quarter wages are used to minimize variation due to seasonal effects. Measuring wages at the same point each year minimizes problems from variations in wages within the year due to physical factors such as changes in weather or from institutional

factors such as social customs. This additional step is taken, even though seasonal effects are typically adequately captured in ARIMA models (Pankratz 1983). Because the intervention model examines variations in annual changes across two time periods, the choice of the measurement point is not as important as maintaining the same measurement point over time.

3. An important assumption of the intervention analysis is that the model adequately represents the deterministic portion of the series. The final step in the ARIMA estimation process involves performing diagnostic tests on the model residuals to ensure that they are randomly distributed. Tables 2–4 report Q-tests at lags 10 and 20. Large Q-statistics (significantly different from 0) suggest that the random shocks are likely correlated and the model should be respecified.
4. Enders (1995), Pankratz (1983), and Vandaele (1983) discuss the steps involved in building univariate intervention models. In the ARIMA model, a series is plotted to assess whether its mean and variance remain constant over time. Once the series is stationary, often after it has been differenced or transformed in some other way, the autocorrelation (ACF) and partial autocorrelation (PACF) functions are plotted to identify the AR and MA processes in the series. Models employing different combinations of AR (p) and MA (q) terms are estimated, assessed, and often reestimated until the researcher is confident that the residuals are random and normally distributed (i.e., contain only “white noise”) and that the model is a good fit for the data.
5. Economic measures often exhibit upward trends over time, but the Box-Jenkins estimation methods require a stationary series. Pankratz (1983) suggests using plots of the ACF to assess whether the stationarity requirement is met (i.e., autocorrelations move rapidly toward zero). The Augmented Dickey-Fuller (ADF) test, another common method to assess stationarity, tests the null hypothesis that the series follows a unit-root process (Enders 1995; Pankratz 1983). A statistically significant ADF statistic indicates that the series is stationary and ready to be modeled. Tables 2–4 provide ADF statistics for each series.
6. Other variables that may have contributed to changes in these measures over time are not unbundled to examine their independent effects. Rather, these factors are captured in the constant and are not part of the error term.

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