

Creating a Cost-of-Doing-Business Index

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ABSTRACT

In this paper we develop an index for comparing the cost of doing business across several metropolitan areas in the U.S. Such indices can be used to help firm identify the places into which they should consider relocation or expansion of operations. Alternatively, they can be used as leading indicators of metropolitan economic growth.

We find that the index's variance across metropolitan areas decreases as the time horizon across which it is measured increases. This is due in part to the declining influence of effective base-year tax rates. Although an index can be created using either industry-based or pooled techniques, statistical comparison of metropolitan areas only is facilitated through the pooled variant. Analysis of statistical significance reveals that higher values of the index do not necessarily denote concomitantly higher costs of doing business.

1. Introduction

Local economic development is probably the most extensively covered topic in the regional/urban economics literature. A large proportion of it concentrates on the effects of tax and public spending on business location. This research uses the framework provided by this body of literature to develop an index for comparing the costs of doing business across large metropolitan areas in the U.S. Such indices can be used as leading indicators of metropolitan economic growth or to help firms in their location and relocation decision making. The data used are contained in CUPR's State of the Nation Cities (SONC) database, which was created for use by the U.S. Department of Housing and Urban Development. Using these data, we create a single index comparing 74 metropolitan areas. To create the index, we first choose an appropriate measure of economic activity. We then identify factors that influence the change in this measure of economic activity at the local level (metropolitan areas) in the U.S. We then create an instrument that allows us to compare metropolitan areas on the basis of the climate that they provide for business development. We interpret the result as an index of the climate metropolitan areas provide for business development. The index accounts for the statistical significance of pair-wise differences

between industry-level metropolitan area instruments.

In the next section, we present a review of the literature relevant to this research. Following that, we present the model used to identify the factors that influence economic development. In the fourth section, we describe the procedure used to construct the cost-of-doing-business index.

2. Literature Review

Bartik (1991) provided an excellent survey of the literature on the influence of taxes on business activity through the 1990s. In that review, Bartik points out two areas of the literature where consensus has not yet been achieved: measuring business activity and the effects of taxation on that activity. Hence, we focus on these two gaps in the next two sections. The first section is a review of measures that researchers have used as proxies for business activity, typically the dependent variable in their econometric analyses. The second reviews tax variables that these same researchers have used. A general discussion of public spending and other control variables follows these two sections.

Measuring business activities

Over time, researchers have used many different measures of business activity. The measures can be grouped into several categories:

(1) New Establishments

There are several examples of this literature relying either on primary survey data or on data gleaned from Dun and Bradstreets' records. Coughlin, Terza, and Arromdee (1991), for example, used the number of manufacturing establishments added through foreign direct investment at the state level. Eberts (1991) used the number of new plant openings by metropolitan area and industry; McConnell and Schwab (1990) used the number of new automobile branch plants set up in each county. This type of measure is relatively easy to

calculate once that data are available, but it fails to take into account the size differences of the new openings. It also fails to account for any coincident establishment closings. Hence, it is a relatively crude measure of the business activity. In addition, the analysis is typically performed on a single type of industry and fails to account for any substitution or multiplier effects.

(2) Output Growth

Ideally, some equivalent of gross domestic product (GDP) should be used to estimate business activity, since it measures the change in net wealth. Hence, several studies have used such measures (gross state product and gross metropolitan product). For example, Mullen and Williams (1991) used the average growth rate of Gross State Product, and Crihfield (1990) used the percentage change in metropolitan output (as a proxy for metropolitan output, Crihfield uses value added). Unfortunately, such measures fail on two counts. First, the measurement of subnational levels of gross domestic product (and perhaps even national levels) is generally quite rough. Second, such measures tend only to grab the attention of economists, while more tractable measures like employment and income remain policy objectives. Hence, from the point of view of policy makers a cost-of-doing-business index should account for the changes in these politically charged variables.

(3) Employment Growth

Employment change mirrors well the political objective of most local governments. Hence, Munnell (1990) used state employment growth rates, Carroll and Wasylenko (1989) used percentage change in employment by industry, and Summers and Luce (1985) used metropolitan employment growth rate by manufacturing industry. In recent years, however, as more and more jobs have become part-time and the real average wage per worker has declined, many governments have learned that this measure fails to capture fully the true rate of change in area business activity.

(4) Other measures

Other measures of business activity change includes the change in per capita personal income (Duffy-Deno and Eberts, 1989), the probability of a manufacturing firm locating out of state (Nakosteen and Zimmer, 1987), and per capita investment in states as a share of U.S. total (Benson and Johnson, 1987). Like the more heavily used measures, however, each of these has their own merits and problems.

Tax environment

In the literature, three groups of tax measure have been proposed.

(1) Nominal Tax Rate

The most natural type to test is the nominal tax rate since this rate is published and readily available to firms. Gyourko (1984) and Doeringer, Terkla, and Topakian (1987), for example, used the nominal corporate income tax rate. This measure has at least three problems. First, it fails to account for differences across states in the definition of taxable corporate income. This causes inconsistency in measuring the tax burden. Second, corporate income tax only accounts for a small portion (about one tenth) of the state and local taxes paid by businesses. Other similar measures of nominal rates of selected taxes also fail to account for the full tax liabilities of businesses. The third problem is that, due to tax credits as well as specialized abatements and services, nominal tax rates applied to taxable corporate income rarely yield the total tax revenues received from businesses.

(2) Effective Tax Rate Proxies

The effective tax rate is the ratio of tax revenues to the tax base. There is a lot of controversy about the appropriate tax base, however. The most commonly used tax bases are personal income (e.g., Mehay and Solnick 1990; Mofidi and Stone, 1990; Canto and Webb, 1987) and population (Coughlin, Terza, and Arromdee 1991). While persuasive, both of

these measures are problematic. To understand why, we must first consider how taxes affect business location.

Economic principles generally assume that businesses locate in places where they can obtain their greatest profit. Hence, tax rates influence business location by affecting profits. Hence, the tax base should be directly related to business profit. Neither of the two previously mentioned tax bases—population and personal income—is closely related to profit. Let us illustrate. Recall that in recent years, when corporations boosted profits by cutting costs, including payrolls, business profits increased but personal income did not, at least not immediately.

(3) Effective Tax Rate

The third group of tax measure is the effective tax rates. Many different measures of the effective tax rates have been proposed, a typical one being the long run, after-tax rate of return (AFTAX), as used by Papke (1989,1991) and Tannenwald (1996). The “representative firm” approach¹ used to compute AFTAX has certain limitations, however. First, the dimension of the problem rises with the number of sites, and with the number of industries considered. Hence, it is difficult to apply this approach to national studies using relatively large samples. Also, the industry mix and the nontax factors affecting economic development are quite heterogeneous across metropolitan areas. Therefore, the assumption that sites differ only through tax climate is rather strong.

Public Spending

Public services affect businesses because they can increase the marginal product of other factors of production (i.e., they create some urbanization economies). Some studies

¹ This approach works in the following way: (1) hypothetical firms (identical in all respects, except the tax climate they face) in selected industries are assumed to be located at several sites; (2) each establishment’s local, state, and federal tax liabilities, and after tax cash flows are computed for a specified long-run period; (3) a new facility is also assumed to be built at each site; (4) AFTAX is calculated by comparing the net present value of each establishment’s cash flows with and without expansion.

have verified this positive relationship between the provision of public services and business activity [for example, see Aschauer (1989) although there is some dissension (e.g. Eberts, 1991; Munnell 1990)].

Even though there might be a positive and significant effect of public service provision on business activity, policy makers are typically interested in the direct effect of public spending on economic growth. The positive effects of public spending have been more clearly documented. For example, using state-level data Munnell (1990) found that spending on public service did contribute positively to state employment growth. In addition, Eberts and Stone (1988) estimated local labor demand and supply functions using the value of public infrastructure as an independent variable. They also found significant positive impacts of public infrastructure on the labor market.

Control Variables

Other variables, often included in studies of this nature, measure the magnitude of existing business activities. Instead of using the absolute magnitude of growth they are often standardized by using their growth ratio or their growth rate. As mentioned in the last section, regional effects should be included. This can be done by including regional binary variables for all but one region in the study. Other variables included by researchers are the real wage rate, the price of electric power, the rate of union membership, the price of office space, per capita income, population density, crime rates, and pollution levels.

Summary of Findings in the Literature

The results of past studies present a mixed picture. There are contradicting answers to the question of whether tax (business tax) effects are significant. For those where it is significant, the elasticity of tax on long-run business growth ranges from -0.12 in Glickman

and Woodward (1987) to -2.52 in Charney (1983). There is some argument that structural change intervenes in the tax effects. Since, tax effects have appeared increasingly insignificant in recent years (Carroll and Wasylenko, 1994).

3. The Model and the Data

In our study we used data on the 74 metropolitan areas contained in the State of the Nation Cities database². As our measure of economic activity, we used the percentage change in aggregate earnings for each of seven sectors—construction, finance, manufacturing, retail sales, services, transportation, and wholesale. As a measure of business activity, change in aggregate earnings is superior to the variables mentioned in the previous section. First, it measures the net change in business activity as opposed to the number of new openings of factory branches. The change in aggregate earnings accounts not only for number of new factory branches, but also for the size of the new openings, the expansions of the existing plants, the plant closings and downsizing. Second, it is a more accurate measure of business activity than employment growth. Even though employment growth measures the net change in business activity, it fails to distinguish between part-time and full time jobs. Third, it is less affected by measurement error than gross domestic product, while being a more important policy objective. Fourth, it is superior to income growth because it is measured by job location as opposed to the residence location of income, and it is also available by industry.

We consider the percentage change in earnings over three different time periods: 1992 - 1993, 1992 - 1994, and 1992 - 1995. This is done to determine the viability of the

² State of the Nation Cities database was created by CUPR for use by the U.S. Department of Housing and Urban Development. The database is available at <http://policy.rutgers.edu/cupr/sonc.htm/policy>. Table A.1. in Appendix A presents the names of the 74 metropolitan areas.

resulting index as a leading economic indicator, as well as to verify the time-horizon findings of Carroll and Wasylenko (1994).

Table 1. Descriptive statistics for percentage change in earnings

Sector	1992 - 1993		1992 - 1994		1992 - 1995	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Construction	0.073	0.078	0.203	0.137	0.263	0.174
Finance	0.091	0.046	0.14	0.082	0.199	0.105
Manufacturing	0.031	0.046	0.09	0.089	0.153	0.127
Retail sales	0.043	0.027	0.11	0.051	0.182	0.073
Services	0.053	0.019	0.119	0.038	0.221	0.061
Transportation	0.058	0.038	0.121	0.067	0.181	0.101
Wholesale	0.019	0.034	0.083	0.059	0.177	0.086

To describe the tax environment we use the effective rates of four categories of taxes: corporate tax, property tax, income tax, and general sales tax. The effective tax rates are calculated using the formula:

$$\text{tax rate} = \text{tax revenue} / \text{tax base}$$

For the tax revenue, we use the sum of state and local tax revenues in the region from the 1992 Census of Government Finances. With this approach it is also not necessary to count for the tax deductibles, tax credits, subsidies and privately negotiated tax terms: all of these have already been accounted for in the total tax revenue. For the tax base, we use the gross metropolitan product³ (GMP). GMP is a good measure of business activities because it is closely related to the profit.

Spending by state and local governments (henceforth, simply referred to as “local government”) can influence economic development in many ways. First, spending on public services (e.g., transportation, health, safety, and education) can make the area more attractive to many businesses. Second, high levels of other public expenses (e.g., welfare, unnecessary administration, interest on general debt, environmental services) can repulse

³ The gross metropolitan product was calculated using data on gross state product and 2-digit SIC earnings. For each industry, we let the metropolitan area’s share of industry gross state product be the area’s share of state earnings.

firms. Third, a large local government can imply an attractive market for business service, retail trade, and financial firms. As a consequence we had no expectation on the sign of the relationship between the expenditures on administration (directly correlated with the size of the local government) and changes in industry aggregate earnings. To account for local government spending we used two variables: (1) the per capita expenditures on administration and (2) the per capita expenditure on all other public services. We also included a variable that measured the per capita interest paid on general debt by the local government. A larger amount paid on interest is expected to reduce the funds available to the local government for expenditure on the other more productive items previously mentioned.

As mentioned earlier, we were also interested in measuring the effects of factor prices on the economic development. It is difficult, however, to precisely measure the prices of all inputs. And in our case it would have severely reduced the number of degrees of freedom in the regression equation (we had only 74 observations to begin with). Hence, we used a set of proxies. For example, as a proxy for the price of fuels, we used the prevailing commercial price of electricity. To measure labor costs, we used a metropolitan earnings index, which controls for area industry mix to some extent. We also included the class A central-city rental rate of office space in the specification. Because a highly unionized local labor market may increase the risk of a strike and may signal to firms that the area's wages are relatively higher, we used the percentage of workers in the state who are union members, as well as a binary variable that indicates whether the state has right-to-work laws. When a metropolitan area crossed state boundaries, it was assumed only to be in the state, which contained the bulk of the area's employment. We also explored whether a relatively better educated (more productive) work force had a positive influence on development, by using the percentage of population with a college degree.

Another set of factors that is likely to have an important effect on economic development is that pertaining to attributes of the local market. Among the factors in this category, the size of the market matters the most in business location decisions. We used the dependency ratio as a proxy for market size. The dependency ratio represents the proportion of population younger than 18 or older than 65 in the total population. We interpreted a high dependency ratio to mean a smaller potential market because a smaller part of the population was likely to be active in the workforce. We expected places that have a relatively high dependency ratio to have lower growth rates.

4. Estimation Technique and Results

We estimated the model in two ways. First, we considered each of the seven sectors of economic activity separately. For each sector we ran an OLS regression. Because of potential heteroscedasticity problem in the model we ran a Breusch-Pagan test, with and without Koenkar's correction. For the sectors that displayed some heteroscedasticity, we reran the regressions, this time using the White correction for heteroscedasticity. The reason for choosing this general way to deal with the problem, instead of parametrizing the variance-covariance matrix, is because there are many possible sources of heteroscedasticity (e.g., differences across states, or among metropolitan areas in the frost- and sunbelts).

In addition to the set of industry-specific models, we pooled the observations across sectors and estimated the model with the entire sample simultaneously. In this second approach, binary variables for each sector were included. This approach increased the degrees of freedom. It also simplified construction of the index because factor coefficients were the same across sectors. Meanwhile, different constants (given by the sector dummies)

allowed for different rates of growth across sectors. Here, we also ran the Breusch-Pagan test, which again indicated the presence of heteroscedasticity. We subsequently made the requisite White correction for the variance-covariance matrix.

In the following sections, we analyze the results of the OLS regressions for each of the seven sectors. In the cases in which the tests indicated the presence of heteroscedasticity, we compute the variance covariance matrix using White correction. Throughout, the dependent variable is the percentage change in earnings between 1992-1993 in the respective sector. Hence, the regression equation is

$$\begin{aligned} \frac{Earn93 - Earn92}{Earn92} = & \beta_0 + \beta_1 * Erndx92 + \beta_2 * Unionpct + \beta_3 * R_to_work + \beta_4 * Elprice + \\ & + \beta_5 * Rentcom + \beta_6 * Igdp_p + \beta_7 * Adm_p + \beta_8 * Te_ad_p \\ & + \beta_9 * College + \beta_{10} * Depend + \beta_{11} * Lnctax + \beta_{12} * Lnitax \\ & + \beta_{13} * Lnptax + \beta_{14} * Lngstax + \varepsilon \end{aligned}$$

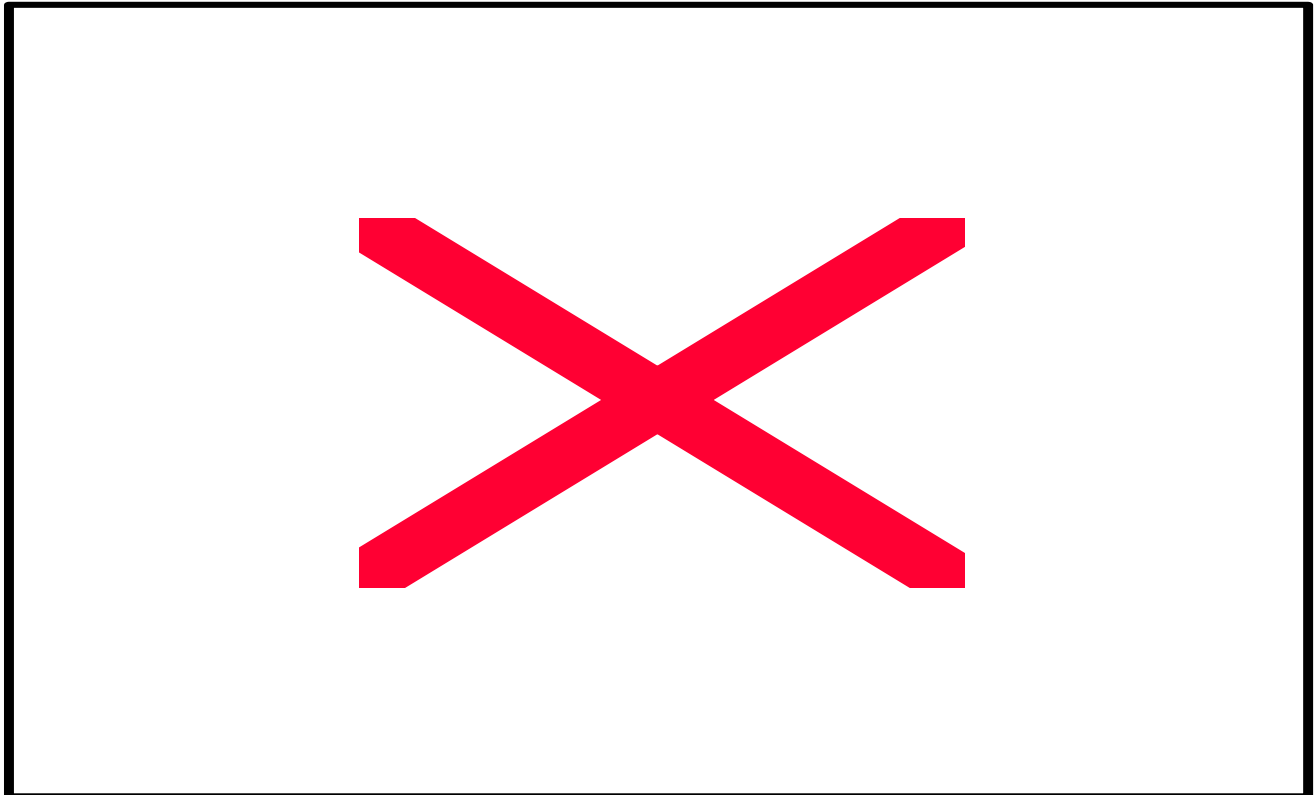
where $Lnctax = Ln(1 + ctax)$, $Lnitax = Ln(1 + itax)$, $Lnptax = Ln(1 + ptax)$, $Lngstax = Ln(1 + gstax)$. and $ctax, itax, ptax, gstax$ are the effective rates for the four categories of taxes used: corporate, individual income, property, and general sales.

The other variables in the equation are:

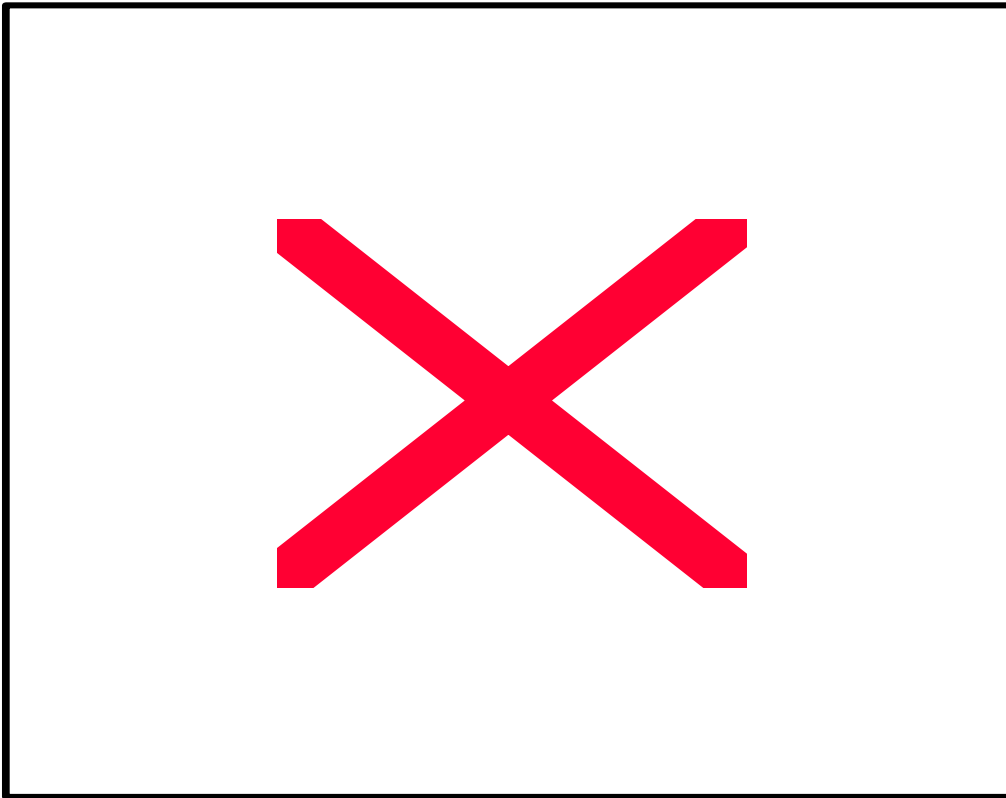
<i>Earn93, Earn92</i>	aggregate earnings in 1993 and 1992 respectively
<i>Erndx92</i>	earnings index
<i>Unionpct</i>	percentage of workers statewide who are union members
<i>R_to_work</i>	1 if the state has a right-to-work law, 0 otherwise.
<i>Elprice</i>	the commercial price per kilowatt hour of electrical power
<i>Rentcom</i>	class A rental rate of office space in the central city
<i>Igdp_p</i>	per-capita spending on general debt
<i>Adm_p</i>	per-capita administrative spending
<i>Te_ad_p</i>	per-capita spending on other (residual)
<i>College</i>	percentage of active population with a college degree

Depend dependency ratio

As shown in Tables 2.a and 2.b, the significance of the results varies considerably from sector to sector. The finance sector had the greatest number of significant variables. As expected, the coefficients of the cost of production factors are negative and significant for finance. In addition, right-to-work laws had a negative effect, mostly due to its endogeneity.⁴



⁴ The coefficient for right-to-work laws was negative and significant only for two sectors—finance and services. Since unionization does not play an important role in these sectors (and, therefore, a causal relationship is not likely), unaccounted for heterogeneity is likely responsible for the negative effect (for example, most financial centers are located in states that do not have right-to-work laws).



Interestingly, of the local government expenditures, only spending on administration was significant and positive. We regard this as a confirmation of the hypothesis that a large government (as reflected by large administrative spending) represents an attractive market for firms operating in financial sector. Also as expected, the coefficient on the dependency ratio was negative, meaning that a large market is an important factor in business development.

The coefficients for three of the four tax variables also were negative, but only those for corporate tax and property tax were significant. The coefficient for the general sales tax was positive but not significant.

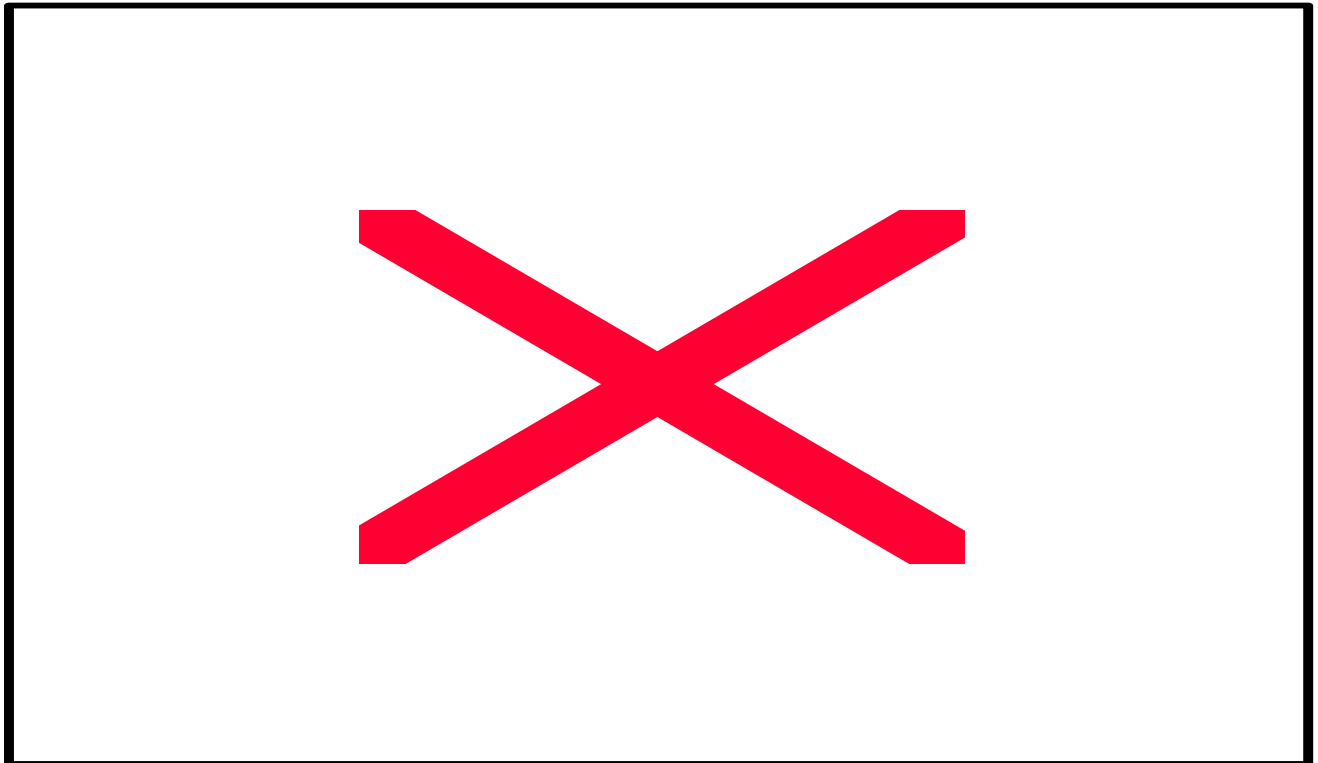
The coefficients for the factor prices were generally negative in all the regressions, and they usually bear most of the explanatory power. The coefficient on the dependency

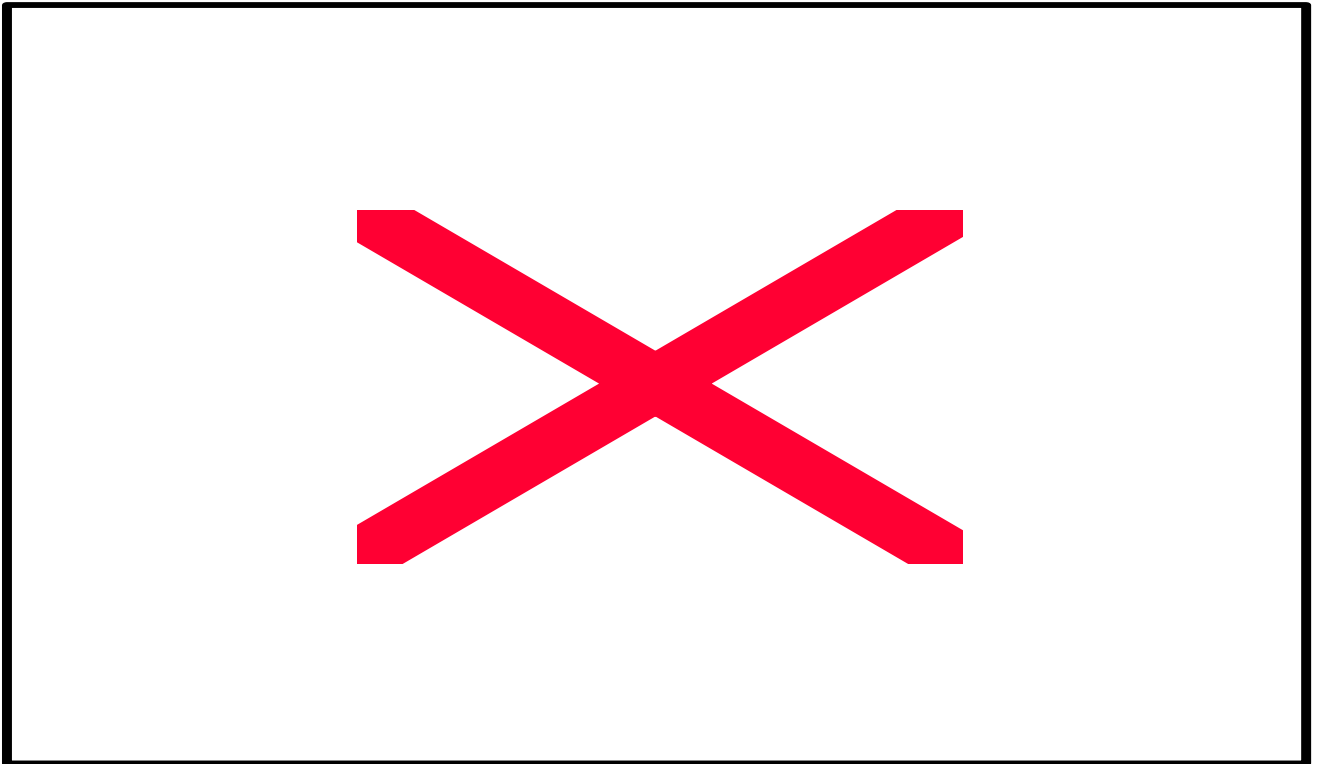
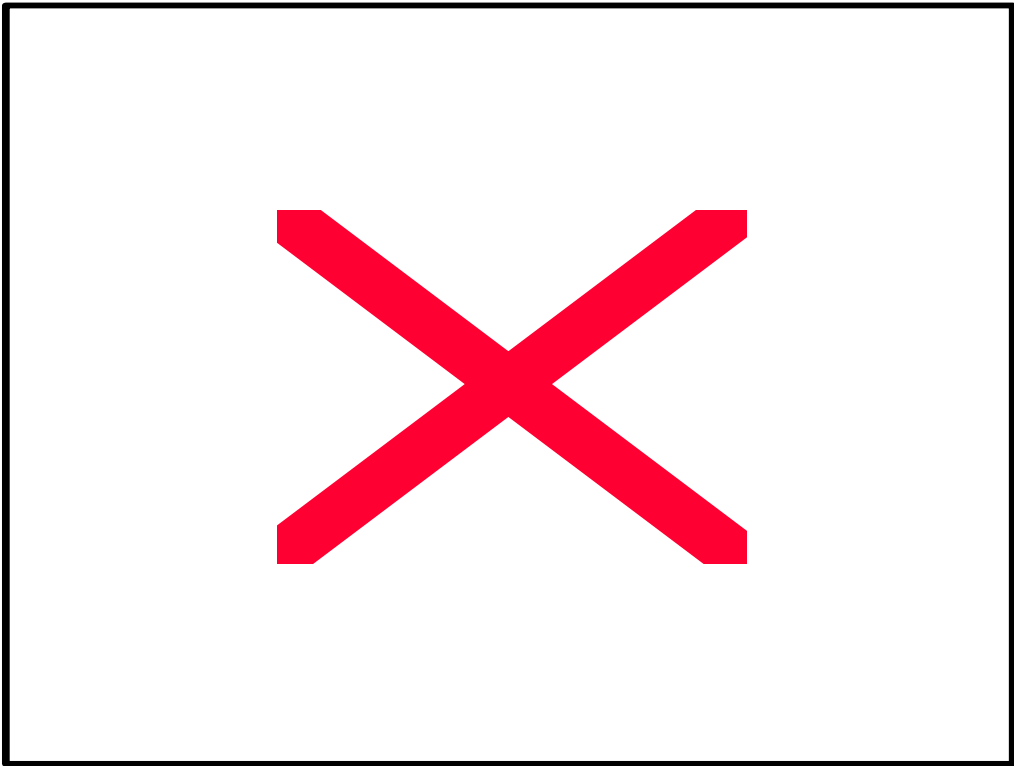
ratio, also behaved consistently (negative and significant) across the sectors. This does not come as a surprise, nor does the fact that the coefficient was less significant in the sectors for which the local market yields a small share of the revenues, like manufacturing. Administrative spending did not perform well in sectors outside finance. Indeed, manufacturing was the only other sector for which the coefficient was significant.

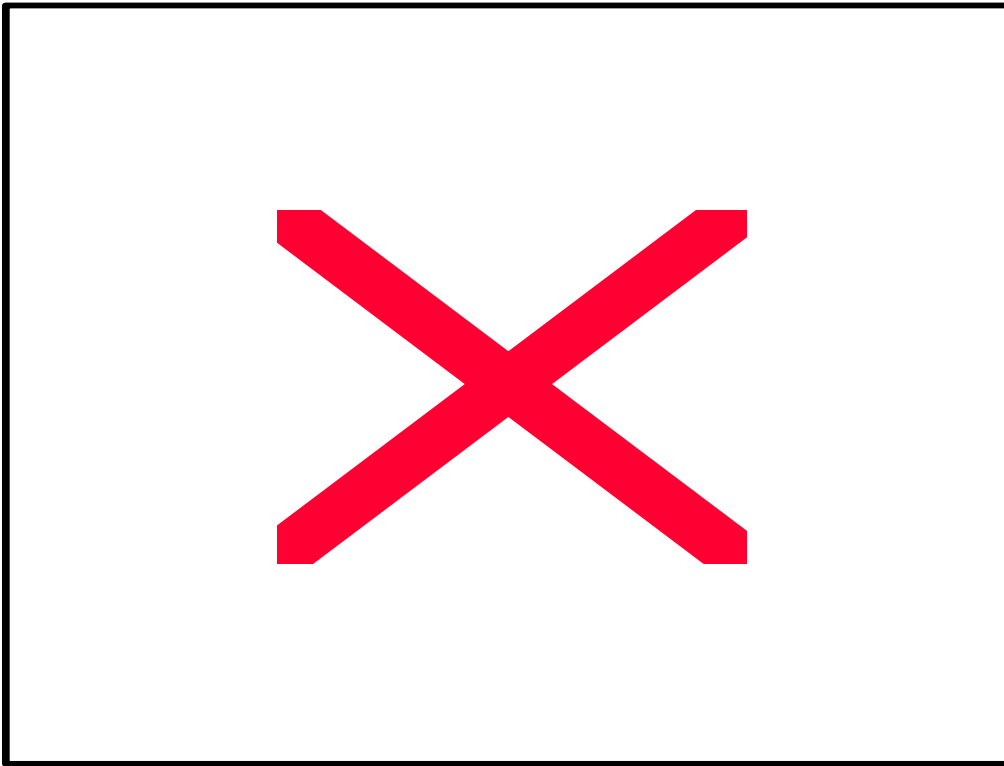
The coefficients on tax variables displayed the most volatility across sectors. In most cases they were not significant. The only variable that behaved consistently over sectors was the general sales tax, which was positive and significant in most of the cases. This was a bit puzzling, since we expected a negative effect for all taxes on economic development. There are three ways in which this kind of behavior could be explained. First, it may be that revenues from general sales taxes were used by local governments to promote economic development. If the effect of spending was large enough to offset the negative effect of the tax, a positive sales-tax coefficient would result. A second explanation, which is probably more likely, is the endogeneity of the effective sales tax rate. That is, large changes in earnings mean high sales-tax revenues. Third, it may be that reliance on corporate income and property taxes for revenues are related to factors not otherwise accounted for, such as age of metropolitan area, climate, and quality of life. Since sales tax is generally a state tax, they are not likely to play an important role in business location decisions (as opposed to, for example, property tax, which is typically a sub-state tax). Consequently, state governments may choose to raise or lower their sales tax rate based on their projected economic performance.

Tables 3.a, 3.b, and 4.a, and 4.b show the results for the regressions where the dependent variables are percentage change in earnings between 1992-1994 and 1992-1995, respectively. As expected, the coefficients become less significant over longer periods of evaluation. One possible explanation for this phenomenon may be that unaccounted changes

in the independent variables influenced business development (e.g., local tax reform). Since values for independent variables for 1992 are used throughout, any change in them that altered earnings, may have rendered the coefficients insignificant. Another explanation is that 1992 marked the end of a recession. Hence, expanding businesses were particularly sensitive to factor costs in that year. As the economy recovered, factors that maintained small shares in firms' costs tended to become less relevant in business location decisions. The second explanation is probably better, given that important changes in the determinants over the relatively short time period are unlikely.







Apart from the reduction in significance over time, it is worth noting the regression results for finance for 1992-1994. The tax variables are all negative, and three out of four are statistically significant. This result is consistent with expectations. Given the potential upward bias due to endogeneity (at least in the case of general sales tax), it may be that the negative effect is even stronger than the one described by the coefficients.

Having completed the analysis using a separate regression for each sector, we next estimated a model that used the entire sample. As mentioned in the opening of this section, using the whole sample increased the efficiency of estimation and enabled results that could be readily converted into an index. The cost of the convenience was that the factor coefficients were restricted to be equal across sectors. We did allow for different intercepts by including in the specification a set of dummies for sectors. We first ran a simple OLS regression for each of the three time intervals. Next, because the presence of

heteroscedasticity was even more likely when we pooled the whole sample, we ran the two tests for heteroscedasticity. Both Breusch-Pagan test and Breusch-Pagan test with Koenkar correction strongly indicated the presence of heteroscedasticity in the model.

Table 5 presents the regression result. Again, the variance-covariance matrix was computed using White correction. In the models of the three time periods the variables describing factor prices had negative signs. The estimates for the earning index, electricity price, and at least one of the variables accounting for labor organization were significant across all three time periods. The coefficient on the dependency ratio (DEPEND) also was negative and significant. The coefficient on administrative spending was positive and significant in all three regressions, while government spending on other public services had no apparent influence on the percentage change in earnings. Again, only the effective general sales tax was significant, and its sign was positive.

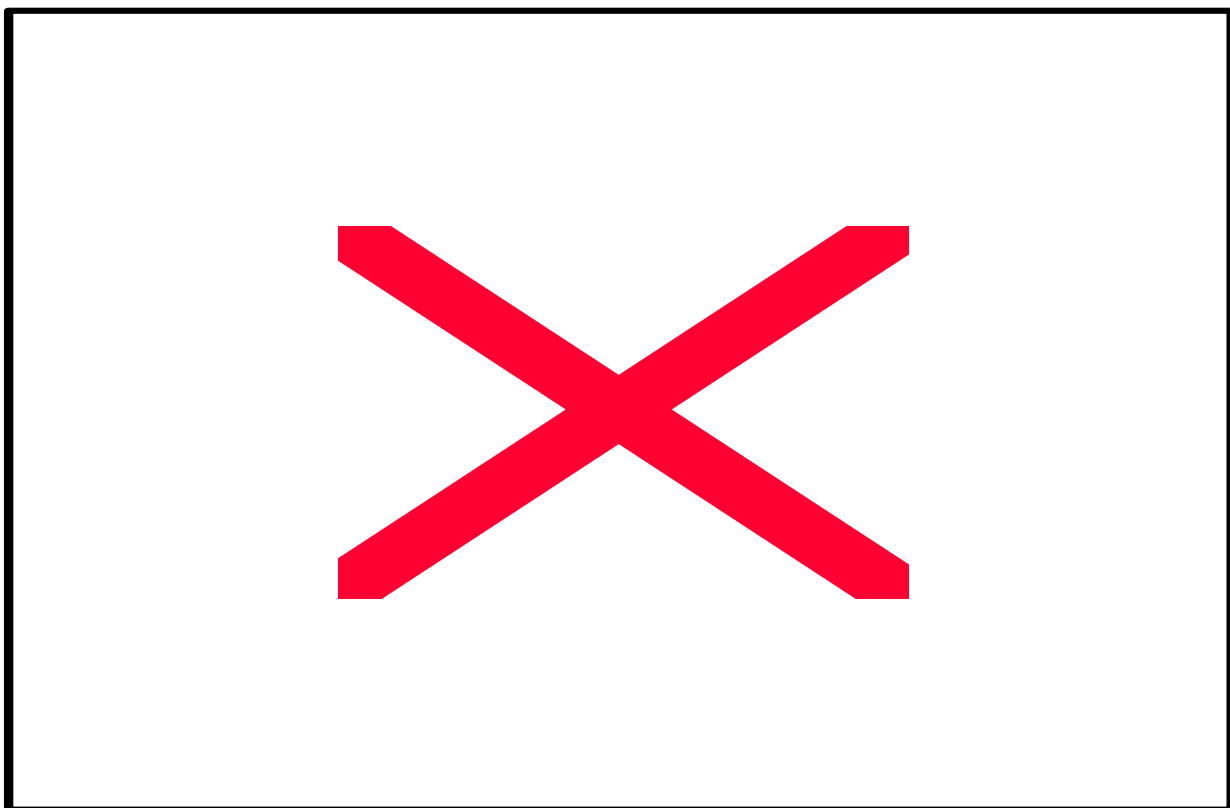
Table 5. Estimation results using the pooled data set

Dependent Variable	Percentage Change in Earnings		
	1992-1993	1992-1994	1992-1995
Independent variables			
const	0.268 ** (0.068)	0.559 ** (0.124)	0.833 ** (0.179)
erndx92	-0.068 ** (0.028)	-0.143 ** (0.052)	-0.117 * (0.073)
unionpct	-0.001 (0.0006)	-0.002 * (0.001)	-0.0038 ** (0.0017)
r_to_wk	-0.012 * (0.007)	-0.019 (0.014)	-0.015 (0.018)
elprice	-0.002 ** (0.0009)	-0.005 ** (0.001)	-0.007 ** (0.001)
rentcom	-8.75E-05 (0.0006)	7.14E-05 (87.7E-05)	-0.0003 (0.0011)
igdp_p	6.40E-06 (1.65E-05)	-8.68E-06 (2.85E-05)	-1.56E-05 (3.75E-05)
adm_p	4.64E-05 ** (1.48E-05)	8.59E-05 ** (2.82E-05)	8.75E-05 ** (4.53E-05)
te_ad_p	3.34E-06 (2.99E-06)	5.35E-06 (5.6E-06)	1.29E-06 (7.59E-05)
college	-0.0015 (0.0010)	-0.002 (0.0018)	-0.003 (0.002)
depend	-0.004 ** (0.001)	-0.007 ** (0.002)	-0.012 ** (0.003)
lnctax	-0.796 (1.155)	-0.273 (1.918)	-0.042 (2.50)
lnitax	0.095 (0.208)	0.245 (0.344)	0.708 (0.453)
lnptax	0.073 (0.223)	0.113 (0.435)	0.542 (0.556)
lngstax	0.552 ** (0.249)	0.953 ** (0.492)	1.668 ** (0.646)
constr	0.053 ** (0.009)	0.12 ** (0.015)	0.086 ** (0.020)
finance	0.072 ** (0.005)	0.057 ** (0.010)	0.022 (0.014)
mfg	0.012 ** (0.006)	0.007 (0.011)	-0.023 (0.016)
retail	0.023 ** (0.004)	0.026 ** (0.007)	0.004 (0.011)
service	0.033 ** (0.004)	0.036 ** (0.007)	0.044 ** (0.011)
tcp	0.038 ** (0.006)	0.037 ** (0.010)	0.003 (0.014)

*Note: ** significant at 95 percent level
* significant at 90 percent level
standard errors are in paranthesis*

5. The Index

The main purpose of the research was to construct an index that allows a comparison of the relative costs of doing business across metropolitan areas. We constructed two versions of the index. First, based upon industry-level data, we construct a set of indices for each of the following sectors: construction, finance, manufacturing, retail, and services. This approach benefits from the less restrictive estimation of the coefficients, and allows a comparison of metropolitan areas based on the costs facing a firm operating in any given sector. Second, we used the results of the pooled model, which imposes stronger restrictions on the coefficient estimates, to construct an overall measure of the cost of doing business for metropolitan areas. In both cases we implemented the assumption that the cost of doing business is equal to the loss in earnings accounted for by the variables describing the area's business environment.



To calculate the industry specific indices, we use the same procedure. Table 6 presents the values of the cost-of-doing-business index for the 74 metropolitan areas in the

data set, calculated using the pooled-data approach. We computed three indices, corresponding to the three time horizons: 1992-1993,1992-1994,1992-1995. In the appendix we present a set of indices based on industry specific data.

The two versions of the index are remarkably consistent both in terms of ranking and magnitude of index values. For a given time horizon there is little difference in ranking or magnitude across indices. As expected, metropolitan areas in the Northeast and California appear to have relatively high costs of doing business. Metropolitan areas with low costs of doing business fall in two categories: a) those benefiting from the businesses exodus from California⁵ and b) Sunbelt metropolitan areas.

Since it is a function of random variables, the index also is a random variable. Hence, any comparisons of the index across metropolitan areas ought to account for the variance of the estimates. Although indices are often constructed from regression coefficients, generally there is little concern about the statistical significance of any comparisons of index values developed this way. Discussions of significance tend to be employed when assessing the effect of certain independent variables on the value of the index but we were unable to uncover any studies that provided much information on statistical comparisons of index values.

⁵ We ran the regression adding a binary variable that denoted these metropolitan areas. While the new variable entered positively and significant, the results for the other variables were robust.

Table 6. The cost of doing business index, pooled-industry approach

Area Name	1992-1993	Rank	1992-1994	Rank	1992-1995	Rank
New York, NY (PMSA)	1.157	1	1.148	1	1.133	1
Philadelphia, PA-NJ (PMSA)	1.082	2	1.080	3	1.087	2
Newark, NJ (PMSA)	1.075	3	1.085	2	1.082	3
Fresno, CA (MSA)	1.036	10	1.037	11	1.081	4
Detroit, MI (PMSA)	1.074	4	1.065	5	1.069	5
Hartford, CT (NECMA)	1.071	5	1.070	4	1.057	6
Buffalo-Niagara Falls, NY (MSA)	1.020	17	1.027	14	1.057	7
Chicago, IL (PMSA)	1.061	6	1.060	6	1.057	8
Oakland, CA (PMSA)	1.031	13	1.052	7	1.057	9
Boston-Worceste, MA-NH (NECMA)	1.042	9	1.043	10	1.051	10
Cleveland-Lorain-Elyria, OH (PMSA)	1.029	14	1.031	12	1.044	11
San Francisco, CA (PMSA)	1.050	8	1.051	8	1.042	12
Pittsburgh, PA (MSA)	1.008	21	1.017	17	1.042	13
Toledo, OH (MSA)	1.012	19	1.015	18	1.031	14
San Jose, CA (PMSA)	1.056	7	1.051	9	1.029	15
Portland-Vancouver, OR-WA (PMSA)	1.000	24	1.004	22	1.025	16
Sacramento, CA (PMSA)	1.035	12	1.018	16	1.025	17
Salt Lake City-Ogden, UT (MSA)	1.020	16	1.006	21	1.024	18
Santa Ana CA	1.035	11	1.028	13	1.023	19
Cincinnati, OH-KY-IN (PMSA)	0.997	26	0.997	24	1.019	20
Manchester New Hampshire	1.005	22	1.009	19	1.010	21
Tampa-St. Petersburg-Clearwater, FL (MSA)	0.998	25	0.995	25	1.008	22
Wilmington-Newark, DE-MD (PMSA)	1.013	18	1.004	23	1.007	23
Wichita, KS (MSA)	1.023	15	1.007	20	1.006	24
Providence-Warwick-Pawtucket, RI (NECMA)	0.981	30	0.990	28	1.003	25
Baltimore, MD (PMSA)	0.990	27	0.993	27	0.998	26
Los Angeles-Long Beach, CA (PMSA)	1.002	23	0.995	26	0.996	27
San Diego, CA (MSA)	0.982	29	0.975	31	0.988	28
Milwaukee-Waukesha, WI (PMSA)	0.975	31	0.974	32	0.985	29
Indianapolis, IN (MSA)	0.985	28	0.974	33	0.982	30
Honolulu, HI (MSA)	0.966	37	0.977	30	0.980	31
Birmingham, AL (MSA)	0.973	33	0.972	35	0.974	32
Houston, TX (PMSA)	1.010	20	1.022	15	0.974	33
Anchorage, AK (MSA) 13/	0.877	68	0.893	66	0.972	34
Kansas City, MO-KS (MSA)	0.954	41	0.953	41	0.966	35
Tucson, AZ (MSA)	0.973	34	0.968	36	0.964	36
Portland, ME (NECMA)	0.955	39	0.955	39	0.963	37
Minneapolis-St. Paul, MN-WI (MSA)	0.945	45	0.951	42	0.963	38
Memphis, TN-AR-MS (MSA)	0.956	38	0.959	37	0.961	39
Phoenix-Mesa, AZ (MSA)	0.975	32	0.972	34	0.961	40
Charleston, WV (MSA)	0.939	48	0.942	46	0.952	41
Jackson, MS (MSA)	0.973	35	0.954	40	0.951	42
St. Louis, MO-IL (MSA)	0.951	42	0.958	38	0.950	43
Washington, DC-MD-VA-WV (PMSA)	0.939	49	0.941	47	0.949	44
El Paso, TX (MSA)	0.933	54	0.935	52	0.949	45
San Antonio, TX (MSA)	0.938	50	0.945	43	0.946	46
Des Moines, IA (MSA)	0.954	40	0.944	44	0.946	47
Columbus, OH (MSA)	0.943	46	0.939	50	0.945	48
Omaha, NE-IA (MSA)	0.942	47	0.932	54	0.942	49

Table 6. The cost of doing business index, pooled-industry approach (continued)

Area Name	1992-1993	Rank	1992-1994	Rank	1992-1995	Rank
New Orleans, LA (MSA)	0.936	51	0.941	49	0.941	50
Dallas, TX (PMSA)	0.968	36	0.979	29	0.941	51
Miami, FL (PMSA)	0.949	43	0.943	45	0.936	52
Burlington, VT (NECMA)	0.933	52	0.934	53	0.933	53
Billings, MT (MSA)	0.878	67	0.871	70	0.932	54
Little Rock-North Little Rock, AR (MSA)	0.949	44	0.941	48	0.931	55
Jacksonville, FL (MSA)	0.907	58	0.926	55	0.928	56
Fort Worth-Arlington, TX (PMSA)	0.933	53	0.938	51	0.922	57
Tulsa, OK (MSA)	0.902	61	0.909	59	0.919	58
Seattle-Bellevue-Everett, WA (PMSA)	0.891	64	0.915	57	0.919	59
Nashville, TN (MSA)	0.913	57	0.916	56	0.915	60
Sioux Falls, SD (MSA)	0.906	59	0.901	60	0.912	61
Oklahoma City, OK (MSA)	0.898	62	0.895	65	0.911	62
Albuquerque, NM (MSA)	0.887	65	0.889	67	0.904	63
Louisville, KY-IN (MSA)	0.895	63	0.900	61	0.903	64
Denver, CO (PMSA)	0.873	70	0.895	64	0.902	65
Las Vegas, NV-AZ (MSA)	0.869	71	0.888	68	0.900	66
Atlanta, GA (MSA)	0.915	55	0.913	58	0.897	67
Cheyenne, WY (MSA)	0.829	73	0.834	73	0.889	68
Virginia Beach-Newport News, VA-NC (MSA)	0.905	60	0.895	63	0.884	69
Charlotte-Gastonia-Rock Hill, NC-SC (MSA)	0.914	56	0.898	62	0.878	70
Austin-San Marcos, TX (MSA)	0.875	69	0.883	69	0.877	71
Columbia, SC (MSA)	0.881	66	0.866	71	0.862	72
Fargo-Moorhead, ND-MN (MSA)	0.846	72	0.836	72	0.850	73
Boise City, ID (MSA)	0.785	74	0.771	74	0.811	74

It was clear to us, nonetheless, that inferences on differences in index should be based on test statistics of the underlying random variables rather than on simple differences in index's values. This whole issue arose because, in creating the index, we collapsed a multidimensional measure into a mono-dimensional one.

To illustrate our point, consider the following example. Suppose that the index is of the form $I = X * \hat{\beta}$, where the $\hat{\beta}$ coefficients were obtained from the regression of Y on a k-dimensional X. In doing so, we project points from a k+1-dimensional manifold on the Y axis. The coefficient estimates, $\hat{\beta}$, are the slopes of X relative to Y. To further simplify the model, suppose that observation A differs from observation B only with respect to independent variable X_j , with A having the larger value. Also suppose that $\hat{\beta}_j$ is relatively large but not statistically different from zero. Hence, although A's index value is larger than

that of B's, the resulting index values for A and B are not statistically different from each other. The problem becomes more complicated when we allow the two observations to vary along more than one dimension, and even more so when more observations are added.

Space considerations prevent us from presenting the complete results of the statistical analysis. Nevertheless, a few general considerations deserve attention. The test statistics run for the pair-wise comparisons of the metropolitan areas reveal that two primary desirable properties of the mono-dimensional index are lost. That is, not only are different cardinal values of the index not significantly different from one another, but the more general transitivity of their ordinal relationships need not hold. To illustrate the second point, using the pooled-industry results, we constructed t-tests for pair-wise comparison of the costs for three selected metropolitan areas: Philadelphia, Manchester, and Tampa-St.Petersburg-Clearwater.

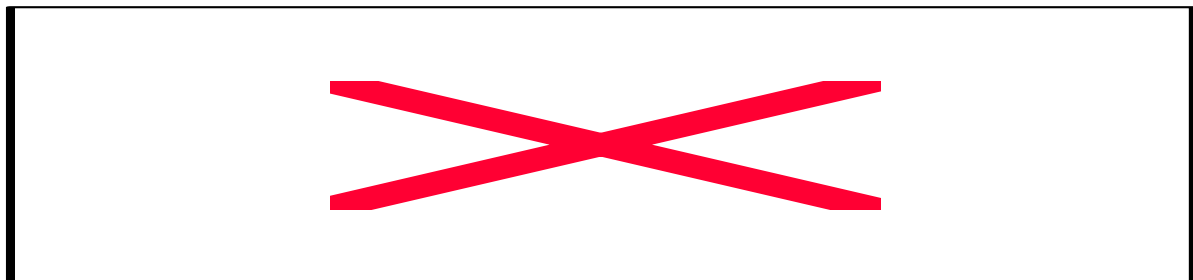
The value of the t - test is given by $t_{ij} = \frac{C_i - C_j}{\sqrt{V_{ij}}}$, where

C_i, C_j are the estimated costs of doing business for areas i, j

V_{ij} is the variance of $C_i - C_j$,

$$V_{ij} = V_i + V_j - 2\text{cov}(C_i, C_j).$$

V_i, V_j are calculated using the variance - covariance matrix of the regression estimates, and deltha method for the logarithmic function.



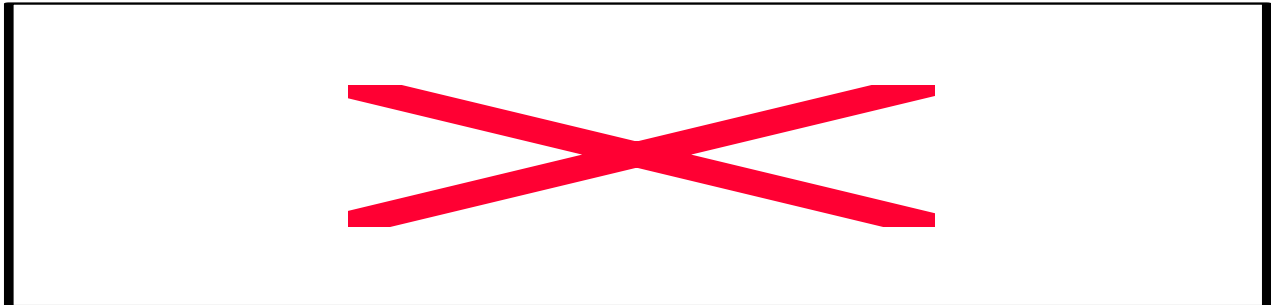
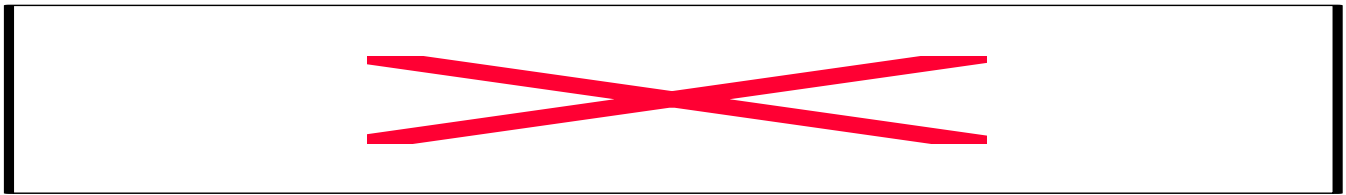
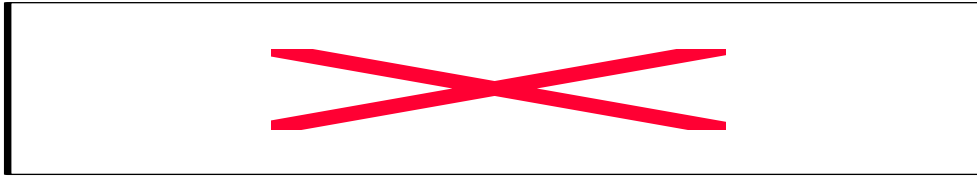


Table 7 presents the index values and the results of the t-tests which compare the cost of doing business for the three selected metropolitan areas. Even though the cost value for Philadelphia is significantly higher than that for Manchester, and Manchester has a higher index value than Tampa-St. Petersburg-Clearwater, cost value for Philadelphia is not significantly different from that of Tampa-St. Petersburg-Clearwater.

Violations of transitivity, like the one described in the previous example pose a serious problem in drawing inference based on the values of the cost of living index. To overcome this problem we calculate a measure based on the index values which enables us to compare the cost of doing business of two metropolitan areas using the index. The measure is given by the minimum distance between two index values for which the corresponding values of the cost of doing business are significantly different from each other, at a given level of significance. To construct the measure we proceed in the following way. First, for each metropolitan area, we calculated the distances in index value to all the other metropolitan areas, and the respective t-tests for the comparison of the cost values. Second, for each area, we chose the minimum distance for which all the t-tests corresponding to larger distances in index were significant. Table 8 presents the summary

statistics for the minimum distance. Finally, we choose the sample maximum as our measure.



Using the results in table 8 we can infer that, for any two given metropolitan area, their respective values of the cost of doing business are significantly different (at 90% level of confidence) if the difference between their respective index values is larger than 0.1032.

6. Conclusions

In this paper, we analyze the effects of four groups of factors (factor prices, market characteristics, tax environment, and government spending) on economic development. Our results are generally consistent with economic theory and the results of previous studies. The spending on public services by the state and local governments appear to have little effect on economic development. A large government, however, may represent an attractive market for certain sectors. Our tax results show the greatest variability across types of tax, economic sectors, and time horizons. For most of the cases the effect is not significant. But in the case of the finance industry, we obtained negative and significant results for all four taxes.

We then used the model results to construct an index across metropolitan areas for the cost of doing business. Although we derived index values for each of 74 metropolitan areas, further inspection of pair-wise differences revealed that both cardinal and ordinal inferences from the index would be wrong-headed. This is because pair-wise comparisons of even significantly different index values were found not to have properties of transitivity. To overcome this problem we provided a measure which allows pairwise comparison of the cost of doing business, based on the index values. Hence, although such indices may be useful, direct comparison across several metropolitan areas may be inappropriate unless accompanied by detailed pair-wise statistical validation.

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Appendix A

Table A.1 The names of the metropolitan areas

No.	Area Name
1	Birmingham, AL (MSA)
2	Anchorage, AK (MSA) 13/
3	Phoenix-Mesa, AZ (MSA)
4	Tucson, AZ (MSA)
5	Little Rock-North Little Rock, AR (MSA)
6	Fresno, CA (MSA)
7	Los Angeles-Long Beach, CA (PMSA)
8	Oakland, CA (PMSA)
9	Sacramento, CA (PMSA)
10	San Diego, CA (MSA)
11	San Francisco, CA (PMSA)
12	San Jose, CA (PMSA)
13	Santa Ana CA
14	Denver, CO (PMSA)
15	Hartford, CT (NECMA)
16	Wilmington-Newark, DE-MD (PMSA)
17	Washington, DC-MD-VA-WV (PMSA)
18	Jacksonville, FL (MSA)
19	Miami, FL (PMSA)
20	Tampa-St. Petersburg-Clearwater, FL (MSA)
21	Atlanta, GA (MSA)
22	Honolulu, HI (MSA)
23	Boise City, ID (MSA)
24	Chicago, IL (PMSA)
25	Indianapolis, IN (MSA)
26	Des Moines, IA (MSA)
27	Wichita, KS (MSA)
28	Louisville, KY-IN (MSA)
29	New Orleans, LA (MSA)
30	Portland, ME (NECMA)
31	Baltimore, MD (PMSA)
32	Boston-Worcester-Lawrence-Lowell-Brocktn, MA-NH (NECMA)
33	Detroit, MI (PMSA)
34	Minneapolis-St. Paul, MN-WI (MSA)
35	Jackson, MS (MSA)
36	Kansas City, MO-KS (MSA)
37	St. Louis, MO-IL (MSA)
38	Billings, MT (MSA)
39	Omaha, NE-IA (MSA)
40	Las Vegas, NV-AZ (MSA)
41	Manchester New Hampshire
42	Newark, NJ (PMSA)
43	Albuquerque, NM (MSA)
44	Buffalo-Niagara Falls, NY (MSA)
45	New York, NY (PMSA)
46	Charlotte-Gastonia-Rock Hill, NC-SC (MSA)
47	Fargo-Moorhead, ND-MN (MSA)

Table A.1 The names of the metropolitan areas

No.	Area Name
48	Cincinnati, OH-KY-IN (PMSA)
49	Cleveland-Lorain-Elyria, OH (PMSA)
50	Columbus, OH (MSA)
51	Toledo, OH (MSA)
52	Oklahoma City, OK (MSA)
53	Tulsa, OK (MSA)
54	Portland-Vancouver, OR-WA (PMSA)
55	Philadelphia, PA-NJ (PMSA)
56	Pittsburgh, PA (MSA)
57	Providence-Warwick-Pawtucket, RI (NECMA)
58	Columbia, SC (MSA)
59	Sioux Falls, SD (MSA)
60	Memphis, TN-AR-MS (MSA)
61	Nashville, TN (MSA)
62	Austin-San Marcos, TX (MSA)
63	Dallas, TX (PMSA)
64	El Paso, TX (MSA)
65	Fort Worth-Arlington, TX (PMSA)
66	Houston, TX (PMSA)
67	San Antonio, TX (MSA)
68	Salt Lake City-Ogden, UT (MSA)
69	Burlington, VT (NECMA)
70	Virginia Beach-Newport News, VA-NC (MSA)
71	Seattle-Bellevue-Everett, WA (PMSA)
72	Charleston, WV (MSA)
73	Milwaukee-Waukesha, WI (PMSA)
74	Cheyenne, WY (MSA)

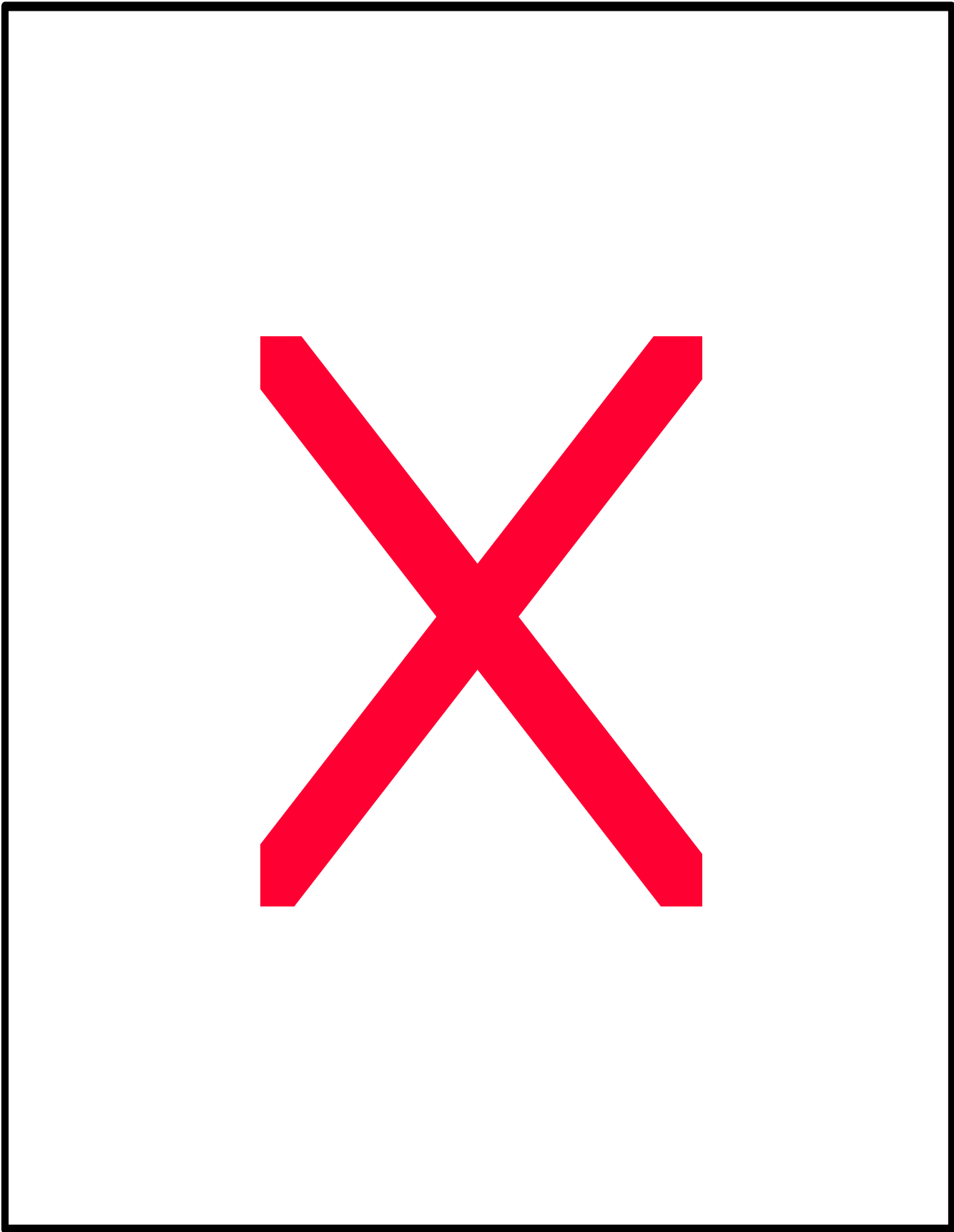
APPENDIX A

Table A.2 Data Sources

SPEDU92	Central County Government Finances, Expenditures on Education, 1991-92	current \$1,000	USBOC (1996b).
SPTRN92	Central County Government Finances, Expenditures on Transportation, 1991-92	current \$1,000	USBOC (1996b).
SPSFY92	Central County Government Finances, Expenditures on Public Safety, 1991-92	current \$1,000	USBOC (1996b).
SPHLT92	Central County Government Finances, Expenditures on Health Svces., 1991-92	current \$1,000	USBOC (1996b).
SPENH92	Central County Government Finances, Expenditures on Env. & Housing, 1991-92	current \$1,000	USBOC (1996b).
SPWEL92	Central County Government Finances, Expenditures on Public Welfare, 1991-92	current \$1,000	USBOC (1996b).
SPUTL92	Central County Government Finances, Expenditures on Utilities, 1991-92	current \$1,000	USBOC (1996b).
SPWST92	Central County Government Finances, Expenditures on Utilities, 1991-92	current \$1,000	USBOC (1996b).
GFC92IGD	Central County Government Finances, Expenditure on Interest on General Debt, 1991	current \$1,000	USBOC (1996b).
SPADM92	Central County Government Finances, Expenditures on Govt. Admin., 1991-1992	current \$1,000	USBOC (1996b).
ERNDX90	Metropolitan Earnings Index, 1990		BEA (1995) calc. by CUPR.
ERNDX93	Metropolitan Earnings Index, 1993		BEA (1995) calc. by CUPR.
GMP91	Gross metro product, 1991	1987 \$1,000	BEA (1995); calc. by CUPR.
GMP92	Gross metro product, 1992	1987 \$1,000	BEA (1995); calc. by CUPR.
LLF90	Metropolitan Labor Force, 1990	Persons	USDOL (1995).
LLF93	Metropolitan Labor Force, 1993	Persons	USDOL (1995).
LLF94	Metropolitan Labor Force, 1994	Persons	USDOL (1995).
LUR904	Metropolitan Unemployment, 1990-94	pct.	USDOL (1995).
LUR94	Metropolitan Unemployment, 1994	pct.	USDOL (1995).
REAPI90	Aggregate Personal Income, 1990	current \$1,000	BEA (1995).
REAPI91	Aggregate Personal Income, 1991	current \$1,000	BEA (1995).
REAPI92	Aggregate Personal Income, 1992	current \$1,000	BEA (1995).
REAPI93	Aggregate Personal Income, 1993	current \$1,000	BEA (1995).
REEARN90	Total Earnings, 1990	current \$1,000	BEA (1995).
REEARN91	Total Earnings, 1991	current \$1,000	BEA (1995).
REEARN92	Total Earnings, 1992	current \$1,000	BEA (1995).
REEARN93	Total Earnings, 1993	current \$1,000	BEA (1995).
REMP90	Total metropolitan employment, 1990	No. jobs	BEA (1995).
REMP91	Total metropolitan employment, 1991	No. jobs	BEA (1995).
REMP92	Total metropolitan employment, 1992	No. jobs	BEA (1995).
REMP93	Total metropolitan employment, 1993	No. Jobs	BEA (1995).
RPOP90	Total metropolitan population, 1990	1,000 persons	BEA (1995).
RPOP91	Total metropolitan population, 1991	1,000 persons	BEA (1995).

Table A.2 Data Sources

RPOP92	Total metropolitan population, 1992	1,000 persons	BEA (1995).
RPOP93	Total metropolitan population, 1993	1,000 persons	BEA (1995).
Unionpct	Percent of workers union members, 1994		Almanac of the 50 states 1
R_to_wk	Right to work state		Almanac of the 50 states 1
CM9LAND	Land area, metro, 1990	square miles	USBOC (1994).
CM9RENT	Median contract rent, metro, 1990	current dollars	USBOC (1991).
CM9DEPR	Dependency ratio, metro, 1990	pct. (persons)	USBOC (1991)
CM9HSCH	Percent high school graduates, metro, 1990	Pct. (persons 18+)	USBOC (1991)
CM9COLL	Percent college graduates, metro, 1990	Pct. (persons 18+)	USBOC (1991)
Elprice	Electricity price, 1993	cents	EIA Electric sales and rev
CO93	Carbon monoxide air concentration, 1993	parts per million	EPA (1994).
CONGESTI	Roadway congestion index, 1991	index	Schrank et al. (1994).
Crime	Violent crime rate, 1993	off./100,000 pop.	FBI (1993).
Deaths	Deaths, total number of deaths, metro, 1990	number of deaths	NCHS (1990).
GFC92CTX	Central County Government Finances, Revenues from Corporate taxes, 1991-92	current \$1,000	USBOC (1996b).
GFC92ITX	Central County Government Finances, Revenues from Income taxes, 1991-92	current \$1,000	USBOC (1996b).
GFC92PTX	Central County Government Finances, Revenues from Property taxes, 1991-92	current \$1,000	USBOC (1996b).
GFC92GSTX	Central County Government Finances, Revenues from General Sales taxes, 1991-92	current \$1,000	USBOC (1996b).
adm/p_cs	per-capita spendings on govt. administration = spadm92/population		
te-ad/pcs	per-capita non-administrative spendings =(total spendings - spadm92)/population		
ctx/i_cs	effective corporate tax rate = gfc92ctx/total income		
itax/i_cs	effective income tax rate = gfc92itx/total income		
ptx/i_cs	effective property tax rate = gfc92ptx/total income		
gstx/i_cs	effective general sales tax rate = gfc92gst/total income		
igd/p_cs	per-capita expenditure on interest on general debt = gfc92igd/population		



Appendix B. The cost of doing business index, industry specific approach (continued)

Area Name	Pooled ind.		Constructions		Finance		Manufact.	
	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Omaha, NE-IA (MSA)	0.942	49	0.701	61	0.998	33	0.931	49
New Orleans, LA (MSA)	0.941	50	0.720	58	0.982	46	0.897	59
Dallas, TX (PMSA)	0.941	51	0.859	38	1.014	25	1.001	28
Miami, FL (PMSA)	0.936	52	0.727	56	0.979	49	0.909	57
Burlington, VT (NECMA)	0.933	53	0.831	42	0.995	35	0.960	40
Billings, MT (MSA)	0.932	54	0.783	47	0.970	52	0.797	71
Little Rock-North Little Rock, AR (MSA)	0.931	55	0.727	57	0.991	37	0.934	48
Jacksonville, FL (MSA)	0.928	56	0.672	66	0.952	59	0.950	43
Fort Worth-Arlington, TX (PMSA)	0.922	57	0.764	52	0.981	47	0.971	35
Tulsa, OK (MSA)	0.919	58	0.821	44	0.945	61	0.948	46
Seattle-Bellevue-Everett, WA (PMSA)	0.919	59	0.971	27	0.985	43	0.844	69
Nashville, TN (MSA)	0.915	60	0.778	50	0.944	62	0.895	61
Sioux Falls, SD (MSA)	0.912	61	0.624	72	1.002	31	0.895	62
Oklahoma City, OK (MSA)	0.911	62	0.826	43	0.928	66	0.927	51
Albuquerque, NM (MSA)	0.904	63	0.734	54	0.967	53	0.873	66
Louisville, KY-IN (MSA)	0.903	64	0.813	46	0.927	67	0.870	67
Denver, CO (PMSA)	0.902	65	0.767	51	0.958	55	0.916	55
Las Vegas, NV-AZ (MSA)	0.900	66	0.901	34	0.862	74	0.753	73
Atlanta, GA (MSA)	0.897	67	0.710	60	0.942	63	0.896	60
Cheyenne, WY (MSA)	0.889	68	0.631	70	0.909	70	0.844	68
Virginia Beach-Newport News, VA-NC (MSA)	0.884	69	0.732	55	0.915	68	0.927	50
Charlotte-Gastonia-Rock Hill, NC-SC (MSA)	0.878	70	0.676	64	0.911	69	0.894	63
Austin-San Marcos, TX (MSA)	0.877	71	0.624	71	0.963	54	0.927	52
Columbia, SC (MSA)	0.862	72	0.675	65	0.907	72	0.949	45
Fargo-Moorhead, ND-MN (MSA)	0.850	73	0.576	74	0.935	64	0.829	70
Boise City, ID (MSA)	0.811	74	0.593	73	0.901	73	0.476	74

