Federal Competition and Economic Growth

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Abstract

We examine how competition between governments affects economic growth. Using data on metropolitan statistical areas in the United States, and exploiting exogenous variation in the country's natural topography to instrument for the number of local governments, we find that the number of local governments significantly and positively affects the growth rate of income per employee over 1969-2006. In particular, doubling the number of county governments is associated with an 18% increase in the income growth rate, which implies an approximate \$3900 difference in 2006 income. Decomposing this effect, we find that 60% stems from inter-jurisdictional competition changing the composition of the workforce, while 40% comes from making existing workers more productive.

JEL Codes: H77, H11

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1 Introduction

Decentralization is a key component of institutional reform around the world. Dillinger (1994) reports that all but twelve of the world's seventy-five largest countries claim to be devolving political power to local government, motivated by the goals of economic growth and a higher standard of living. However, the economic effects of such devolution of power are still hotly debated.[1] The majority of prior work is composed of cross-country studies, and faces at least two methodological problems: first, consistently defining and measuring federalism, and, second, failing to address the endogeneity of institutional choice to economic outcomes like growth. As a result, previous work has not reached firm conclusions.[2]

We avoid these methodological difficulties by concentrating on a single country—the United States—and using an instrumental variables approach to ensure identification. We find that inter-jurisdictional competition is a powerful determinant of growth. Doubling inter-jurisdictional competition between county governments within a metropolitan area (e.g., by increasing the number of county governments from 1 to 2) leads to an approximate 0.15 percentage point increase in the average real annual growth rate of income per employee over 1969-2006.[3] As the mean of this variable is 0.85, the magnitude of the effect is relatively large and meaningful,

[1]Kim et al. (1995), Huther and Shah (1998), Akai and Sakata (2002), Stansel (2005) and Hammond and Tosun (2006) find a positive effect of decentralization on economic growth, while Davoodi and Zou (1998) and Zhang and Zou (1998) find a negative effect; see Boadway and Shah (2009) for a recent summary of the literature. Other empirical work regarding the effects of decentralization is similarly unsettled: see both Treisman (2000) and Fisman and Gatti (2002) on the question of decentralization and corruption. See also Barankay and Lockwood (2007) on decentralization and allocative efficiency.

[2]See the discussion of Oates (1993), Ebel and Yilmaz (2002), and Rodden (2004) below.

[3]Throughout, when we refer to income, we refer to income per employee in 2000 dollars. We use this focus since different regions of the U.S. witnessed very different demographic shifts in reproduction and female employment during 1969-2006. We did not want our results to be skewed by this local variation, and instead wanted to track changes in what working individuals produced. Nonetheless, our results are very similar when we instead consider growth in per capita personal income; doubling inter-jurisdictional competition within a metropolitan area in that case leads to an approximate 0.11 percentage point increase in the average annual growth rate of personal income per capita over 1969-2006. We discuss this further in section 2.

amounting to an 18% increase in the income growth rate.

There is a large theoretical literature on the effects of decentralization, much of which is related to economic growth. Early work by Hayek (1945) argues that decentralization will lead to more efficient provision of local public goods, as local officials have better information on the optimal level of such goods. Later scholars such as Brennan and Buchanan (1980) emphasized the ability of such competition between sub-national units to restrain the power of a monopoly local government over its citizens. However, Zodrow and Mieszkowski (1986) questioned these conclusions, pointing out that inter-jurisdictional competition may yield a "race to the bottom," whereby productivity-enhancing public goods are under-provided by sub-national governments in an effort to attract taxable but mobile factors of production.[4] Hatfield (2010), on the other hand, provides a model where competition for capital drives districts to provide productive public goods at levels which maximize economic growth. Similarly, Brueckner (2006) provides a model where federalism enhances incentives to invest in human capital, which in turn boosts economic growth.[5] The theoretical literature does not tell us which effects dominate, which motivates our empirical analysis of the net effect of decentralization on growth.

Existing empirical literature on decentralization and economic growth can be roughly divided into two categories. The first is cross-country regressions, where economic growth is regressed on a measure of decentralization such as local revenue share or local expenditure share. The results of this empirical exercise have been inconclusive, as Kim et al. (1995), Huther and Shah (1998), and Iimi (2005) find a positive effect of decentralization on growth, while Davoodi and Zou (1998) find a negative one, and Woller and Phillips (1998) do not find any significant relationship.

[4]Wilson (1984) and Wildasin (1987) provide similar insights. See Wilson (1999) for a summary of this literature.

[5]See also Weingast (1995) and Hatfield and Padró i Miquel (2011) which argue more generally that federalism can enhance incentives for long-term productive investments. See Montinola and Weingast (1995) for an application of these ideas to the recent economic growth in China.

However, a number of scholars have pointed out that these studies (and related works on other effects of decentralization) have substantial methodological problems. Rodden (2004) shows that a unidimensional measure of federalism cannot quantify how the relationship between local and national governments varies across countries.[6]

The second category of literature studies outcomes within one country, and considers growth as a function of the amount of inter-jurisdictional competition within a sub-national unit. By concentrating on one country, we can be confident that any measure of inter-jurisdictional competition measures the same thing across data points. A number of papers take this approach. Stansel (2005) and Akai and Sakata (2002) both find a positive effect of decentralization on growth. In a similar vein, Barankay and Lockwood (2007) show that greater decentralization within Swiss cantons is associated with better educational outcomes.

However, empirical work in this area faces a significant challenge to identification, described by Oates (1993): "Is decentralization a 'cause' or an 'effect' of economic development?"[7] Causality has not been well-established by the existing literature. Some papers, such as Panizza (1999), even estimate the effect of income (among other factors) on decentralization, rather than considering income to be determined by the level of decentralization.

To overcome these empirical difficulties, we concentrate on one nation—the United States—and consider how variation in the number of competing jurisdictions affects economic performance. To address threats to identification, we implement an in-

[6]Ebel and Yilmaz (2002) additionally point out that the International Monetary Fund's Government Finance Statistics (GFS) do a poor job measuring the degree of decentralization, although GFS is the typical measure used in this line of empirical work. For instance, these statistics do not differentiate between discretionary and nondiscretionary spending by local governments. Some countries, such as Denmark, have very high proportions of local spending while carefully regulating local public finance; many of the theoretical models considered above would not consider Denmark to be very decentralized, leading to a mismatch between the econometric specification and the theoretical implication. Similarly, there is great variance in the level of local borrowing authority enjoyed by sub-national units, as well as differing beliefs over whether these debts are, in the end, the responsibility of the national government. Nonetheless, neither of these factors is generally considered in econometric specifications of decentralization and growth.

[7]A similar point is made in Bardhan (2002).

strumental variables strategy. Specifically, we use the total miles of small streams in a metropolitan statistical area (MSA) as an instrument for the number of county governments. This identification strategy is inspired by the methodology of Hoxby (2000). We argue that, while small streams are unlikely to directly affect growth in the modern era, they may have increased the number of natural "break-points" between counties at the time of an MSA's founding, thus affecting the level of decentralization. Boundaries are likely to carry over to the modern era given the costs and complications of changing them. Thus, we expect more miles of small streams to lead to more county governments in an MSA, but we do not expect small streams to have an independent effect on growth. Our analysis circumvents criticisms related to measuring streams and using them as an IV (see, for example, Rothstein (2007)). Specifically, we use GIS data that ensures objective and consistently-applied definitions of streams, which increases the accuracy and precision of our measures.

We also investigate whether our finding that inter-jurisdictional competition enhances growth may be due to MSAs with many county governments having relatively low incomes before 1969; if this were true, then our results might be due to conditional convergence. To the contrary, however, we find that having more county governments appears to be associated with *higher* initial income, and that the effect of the number of county governments on the level of end of period income is even greater than its effect on the level of initial income. Specifically, doubling inter-jurisdictional competition is associated with a 1969 income per employee that is \$1000 higher, but with a 2006 income per employee that is \$3900 higher (both in constant 2000 dollars). Lower inter-jurisdictional competition was already associated with lower income at the beginning of the window over which we measure growth, and the disparity only grew over the intervening 37 years.

Finally, we investigate whether the difference in wage levels that we observe is due to differences in the characteristics of the workforce in those areas, or due to true differences in worker productivity. We find that approximately 60% of the increase in wage income is explained by differences in worker characteristics and quality. Inter-jurisdictional competition changes the composition of the workforce, attracting more productive types. The remaining 40% comes from inter-jurisdictional competition making existing workers more productive. Specifically, for a given worker, moving to an area with double the amount of inter-jurisdictional competition leads to a 4.2% increase in yearly wages (about $1500 for the average worker in our sample).

The paper is organized as follows. Section 2 describes the dataset and our empirical approach. Section 3 presents the main empirical results; Section 4 presents a variety of robustness checks. Finally, Section 5 concludes.

2 Data and Empirical Approach

Our primary units of observation are the nearly 300 Metropolitan Statistical Areas (MSAs) and Consolidated Metropolitan Statistical Areas (CMSAs) in the United States. As the Office of Management and Budget (OMB) describes, "The general concept of a Metropolitan Statistical Area . . . is that of an area containing a recognized population nucleus and adjacent communities that have a high degree of integration with that nucleus." MSAs are defined as areas with at least one urbanized area of at least 50,000 population. CMSAs are relatively larger than MSAs, but are conceptually similar entities as they are also defined by the degree of integration of populations. Rather than break CMSAs into constituent urban clusters (Primary Metropolitan Statistical Areas, or PMSAs), we consider MSAs and CMSAs (two mutually exclusive geographic concepts) to be our units of analysis. We are interested in examining areas with an inter-connectedness that makes competition between governments possible.[8] Hereafter, for simplicity, we refer to MSAs and CMSAs, collectively, as MSAs.

MSAs are made up of one or more counties. OMB defines which counties are

[8]For a more detailed presentation of definitions, see *Federal Register*, Vol. 65, No. 249, 27 December 2000, p. 82228-82238.

included in an MSA by an algorithm which takes into account area populations and commuter patterns. The set of counties included in an MSA is therefore subject to change due to changes in the algorithm, population, or commuter patterns.[9] As a result, MSAs are not stable geographic entities, and change over time. We chose to fix the set of counties in each MSA at the 1999 boundaries in order to ensure that we examine the same collection of counties when measuring growth over time. To estimate the effects of decentralization on economic growth, we then collected data on the number of local governments in 1962 in an MSA (geographically defined by its 1999 boundaries), and then examined the growth rate of income per employee over 1969-2006.

The choice of 1999 boundaries is rather arbitrary, and we show that our main results are robust to using earlier years.[10] In part, we use 1999 because some of our analysis involves 2000 Census data, which use 1999 MSA boundaries. Since the Census does not identify the county of residence, we would not be able to carry out any empirical analysis using 2000 Census data if we did not consider MSAs as they were defined in that Census.

In New England, MSAs contain only portions of counties, complicating our empirical analysis given that data on many of our covariates were not available at more disaggregated levels than the county level (such as the town or city level). We thus consider only MSAs that contained whole counties in 1999, and not MSAs containing portions of counties. Unfortunately, this forced us to exclude New England's MSAs from our analysis. Additionally, there are a few MSAs in which the boundaries of the counties within them changed over time. As this prevented us from collecting comparable county-level data over time, it also prevented the collection of compara-

[9]ibid.

[10]We test the robustness of our results to using the MSA boundaries of the 1970 Census. We find that the choice of boundary year does not seem to matter much; using the MSA boundaries in place at the start of the period over which we measure growth only makes the key effects of inter-jurisdictional competition marginally higher in both magnitude and statistical significance; see Section 4.

ble MSA-level data over time. As such, we have excluded the six MSAs for which county boundaries changed over the period for which we measure economic growth (1969-2006).[11] Note that we have not excluded MSAs that saw either an increase or a reduction in their number of counties. We have simply excluded MSAs that saw changes in the way county boundaries were actually drawn. In total, we were able to include 222 MSAs for which we have data on all of our covariates.

MSAs are thus segments of the relatively more urban portions of the U.S. that include surrounding areas linked to them by heavy commuting patterns. While similar in these regards, MSAs vary greatly in the amount of inter-governmental competition present. In particular, some MSAs are made up of a very small number of county governments or a single county government. Some contain many more city and township governments than others. This variation in inter-jurisdictional competition is important for several reasons. First, increasing the number of jurisdictions leads governments to compete for population and associated tax payments. With many jurisdictions, individuals can hold similar jobs that use similar skills even after relocating to another jurisdiction within the same MSA. For example, someone working in Washington, D.C. might choose to live in the neighboring counties of Maryland or Virginia, all of which are in the Washington, DC-MD-VA MSA. The more county governments there are in an MSA, the more options an individual in that MSA has regarding the jurisdiction under which they wish to live. As a result, there is greater competition between jurisdictions to attract talented, wealthy people to live within their boundaries. Second, as the number of county governments in an MSA increases, there is greater tax competition between jurisdictions. This competition may drive counties to choose better or worse economic policies in their quest to acquire and keep capital.[12] Finally, the efficacy of yardstick competition is likely to be increasing in

[11] The six MSAs excluded for reasons of changing county boundaries are: Denver-Boulder, CO CMSA; Greeley, CO MSA; Yuma, AZ MSA; Anchorage, AK MSA; Norfolk-Virginia Beach-Newport News, VA MSA; Lynchburg, VA MSA.

[12] See Hatfield (2010) for an argument for the former, and Zodrow and Mieszkowski (1986) for an

the number of county governments in an MSA, with citizens being able to compare neighboring jurisdictions with one another along a number of lines, and demand better policies from their own leaders based on what they see around them in geographically and demographically similar areas.[13]

The sub-national general-purpose governments in an MSA include county, municipal, and township governments. The precise definition of what qualifies as a municipal or a township government varies across states, so we focus our attention primarily on the relatively more uniformly-defined notion of a county government. Counties are the primary legal divisions of most states, and are thus an important component of sub-national governance. We focus specifically on the number of functional county governments in each MSA, which is slightly broader than the number of county governments as it also includes governments that have county-like control over a given land area: consolidated city-counties and independent cities.[14]

The Bureau of Economic Analysis (BEA) publicly provides annual county-level data on earnings by place of work per employee for 1969-2006. Earnings by place of work is defined by the BEA as "the sum of wage and salary disbursements (payrolls), supplements to wages and salaries, and proprietors' income." Dividing this by the total number of employed persons in an MSA gives an estimate of how much is produced by each person involved in production. We then used this to compute the average annual growth rate of income per employee in each MSA during this period. Table 1 presents summary statistics for this growth variable, earnings by place of

argument for the latter.

[13]See Besley and Case (1995) for an early model of yardstick competition.

[14]The term "functional" here refers to the fact that the local government behaves like a county government. This definition includes all county governments as well as the governments of independent cities and consolidated city-counties. Independent cities are cities that a state deems to be not located within the boundaries of any of the state's counties. Consolidated city-counties are jurisdictions for which the functions of the city and the county governments have been merged into a single jurisdiction. An example of the former is St. Louis, Missouri; an example of the latter is Honolulu, Hawaii. All of these governments behave like county governments in the sense that they are units of local government that are comparable to the county governments found in most states, and no other county government has jurisdiction over the area. We therefore count these as "functional county governments."

work in 1969 and in 2006, and all of the other variables we use in our analysis. The reason for focusing on this measure rather than a more traditional measure of income is that women entered the workforce in significant numbers and also began having fewer children during our sample period (1969-2006), and we did not want our results to be skewed by local variation in reproduction and workforce participation patterns. Furthermore, we did not wish to penalize areas such as Arizona and Florida which have seen a large influx of non-working individuals (i.e. retirees) during this period. Instead, we were interested in a measure of what the workforce in each MSA actually produced, and thus we opted for earnings by place of work per employee. We computed the average annual growth rate of real income per employee during 1969-2006. The mean of this variable is 0.85, which is far lower than the mean of a more traditional measure of growth: growth in personal income per capita (with a mean of 2.0). Throughout the paper, economic growth, or growth of income per employee, both refer to growth in "earnings by place of work" per employee, as defined by BEA.

Data on the number of functional county governments in each MSA by year was available from the 1962 Census of Governments. Because of their potential importance for an MSA's growth rate, we also collected data on whether an MSA borders the Atlantic Ocean/Gulf Coast, the Pacific Ocean, the Great Lakes, or any major river.[15] Access to these bodies of water may be associated with greater potential for commercial activities, and we therefore considered them to be important control variables in order to avoid omitted variable bias.[16] MSA access to these natural amenities is summarized in Table 1.

[15]Major rivers are defined by the Environmental Systems Research Institute's (ESRI) Data and Maps GIS software (2008) for the U.S.A., and come from file rivers.sdc. The data are based on four sources: ArcWorld 1:3M, the Rand McNally New International Atlas, the Times Atlas of the World, and the Digital Chart of the World. The data include 34 rivers from seven major river systems—the Mississippi (12950 miles), St. Lawrence (7152 miles), Colorado (2703 miles), Columbia (2343 miles), Rio Grande (2144 miles), Yukon (1866 miles), and Nelson Saskatchewan (569 miles)—plus 21 rivers that are not a part of a system. Thus, there are 55 total major rivers.

[16]We also included them since they are likely correlated with the number of miles of small streams, which is the excluded instrument in our IV strategy.

As discussed in the previous section, our paper faces a serious threat to identification. Specifically, the number of local governments is likely endogenous to economic growth. While theory suggests that more local governments will be associated with higher rates of growth, higher growth rates might in turn lead to swelling resources and populations, and thus more local governments. The best solution to this problem is a valid instrumental variable that allows us to infer the causal impact of total county governments in an MSA on its subsequent economic growth.

To instrument for the total number of county governments in each MSA, we used GIS data to compute the number of miles of small streams in an MSA. To focus on *small* streams in particular, we relied on the Environmental Systems Research Institute's (ESRI) Data and Maps software (2008) for the U.S.A., file name hydroln.sdc (a vector digital dataset). These data are based on the United States National Atlas, published by the United States Geological Survey (USGS). This dataset omits major rivers, and includes only streams, intermittent streams,[17] canals, intermittent canals, dams, aqueducts, falls, and intracoastal waterways,[18] as defined by the USGS in the National Atlas of the United States.[19] To compute what we refer to as total miles of small streams—and use as our primary instrument—we excluded canals, intermittent canals, dams, and aqueducts, as these are generally manmade, and may

[17]According to the USGS, an intermittent stream is a stream that "contains water for only part of the year, but more than just after rainstorms and snow melt."

[18]An intracoastal waterway is one of the series of natural inlets, saltwater rivers, bays, and sounds along the U.S. coastline that are so designated by the U.S. Army Corps of Engineers. We only consider those portions of intracoastal waterways contained within MSA boundaries, which is a fraction of total U.S. intracoastal waterways.

[19]The following steps were performed by ESRI: "This file was originally digitized by the National Mapping Division based on the sectional maps contained in 'The National Atlas of the United States of America' published by the USGS in 1970. The 1:2,000,000-scale Digital Line Graph data were merged into a single national hydrography coverage. Where necessary to effect the merge, alignment changes were made. The names were taken from the USGS Topographic 1:100,000-scale maps... The following steps were performed by ESRI: Downloaded the compressed file from the National Atlas of the United States and extracted it. Removed unneeded attributes. Removed all records except those with feature attribute types of 'Aqueduct', 'Braided Stream', 'Canal', 'Canal Intermittent', 'Dam', 'Falls', 'Intracoastal Waterway', 'Stream', and 'Stream Intermittent'. Reduced the attribute widths of FEATURE and NAME. Added attribute MILES and calculated its values."

be preferentially built in areas of high growth, thus endogenizing our instrument.[20]

The history of county formation in the U.S. motivates our IV strategy and sheds light on why some MSAs have more counties than others with similar land areas and populations. The median county founding year is 1848, and maps of counties changed relatively little in the 20th century. When the majority of county governments were formed, geographic obstacles like streams were relevant and focal "break-points" between populations which had real implications for the number of governments. Land surveying historian Farris Cadle (1991) underscores the importance of natural boundaries like streams in making county limits clear and easy to convey to important parties:

"Georgia's twelve parishes, which existed before the Revolution, were arrayed in a single upright tier stretching from the St. Mary's River on the south to the Broad River on the north. The Atlantic Ocean and the Savannah River formed the eastern limits, while their northern and southern boundaries were delineated by creeks flowing into these bodies of water...Following the Revolution, extensive migration into the hinterland made it necessary to define with precision the buttings and boundings of the growing proliferation of counties...The acts providing for the creation of these new counties relied heavily on well-known roads and natural features such as rivers, streams, and ridges to demarcate boundaries... The acts generally described the artificial lines as running from one landmark to another. Bearings or distances were specified only in extremely rare cases"(p. 145).

Cadle describes many costly disputes over land boundaries, suggesting that more counties might be formed in areas that lent themselves to easier demarcation of boundaries—such as areas with abundant streams. Thus, the very fact that the majority of county boundaries in the U.S. were drawn out before telephones, automobiles, or GPS existed—combined with the benefits of those boundaries being clear and visible ones—means that geography had an impact on the founding of U.S. counties.

Small, nature-made streams are unlikely to affect an area's potential for commerce and economic growth. However, more streams are likely to be associated with

[20]A detailed explanation and a list of commands used to generate our streams variables from the original GIS shapefiles are available upon request.

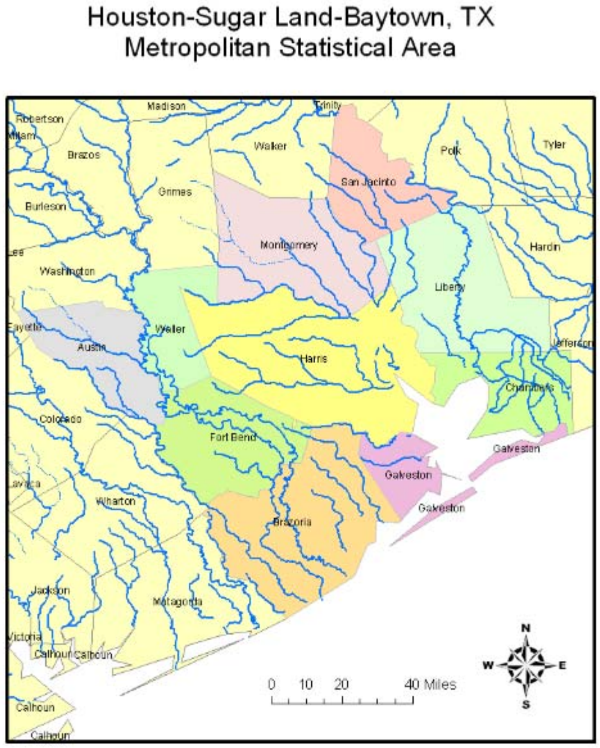

Figure 1: The pastel-colored counties comprise the Houston-Sugar Land-Baytown MSA, as defined in 2009. Blue lines denote streams in the ESRI dataset. Note how streams create the boundaries between counties such as Galveston and Harris, Waller and Austin, or Montgomery and San Jacinto.

more county governments, particularly given that county boundaries were formed when transportation options and technology were far less advanced than they are currently. This made streams and rivers particularly focal and sensible lines that would demarcate county boundaries. An example is given in Figure 1, which shows how streams have contributed to the demarcation of county boundaries in the greater Houston area in 2009. An example of the opposite effect is the Phoenix, AZ MSA, where few streams—and only two county governments, as of 2009—can be found. In the modern era, the number of streams is unlikely to have a direct effect on the efficiency of government, but their legacy has been left in the amount of decentralization of local governing powers. We therefore argue that the number of streams in an MSA should only affect the average annual growth rate during 1969-2006 through its effect on the number of county governments in an MSA. That is, the number of streams should be uncorrelated with the error term in our growth regressions.

Hoxby (2000) introduced a similar methodology, using a count of small streams in a metropolitan area as an instrument for the degree of Tiebout choice over schools. She argues that a larger number of streams implies a larger number of *natural* school district boundaries, particularly since these boundaries were chosen long ago, when streams increased travel time to school. However—similar to our argument—she maintains that streams are exogenous to modern-day school productivity.[21] There has been some controversy regarding exactly how streams are measured and used as an IV (see, for example, Rothstein (2007)), but our use of GIS data to measure miles of streams directly addresses these criticisms. Also, despite the controversy, small streams have been widely recognized as forming legitimate "natural boundaries"that introduce exogenous variation in the number of jurisdictions in an area.[22]

The next section includes our empirical results and their interpretation. We begin with Ordinary Least Squares (OLS) results. Noting the likely endogeneity of our measure of inter-jurisdictional competition, we then instrument for the number of governments with total miles of small streams, as calculated from the GIS data.

[21]Surprisingly, few papers since Hoxby (2000) have conducted empirical analyses leveraging off of the natural boundaries formed by rivers and streams, and none have used it to investigate changes in economic outcomes (outside of education) due to enhanced inter-jurisdictional competition. Baqir (2001) uses steams as an instrumental variable for the number of electoral districts within U.S. counties. Cutler and Glaeser (1997) use streams as an instrumental variable for the level of segregation in major metropolitan areas.

[22]Our complete dataset, as well as the code for running all of our regressions, are available on upon request.

3 Results

Our OLS results suggest that more county governments are indeed associated with higher economic growth rates. Using our IV approach, the coefficient on the number of governments is even larger. We take this as evidence of a robust, causal effect of increased inter-jurisdictional competition on economic growth, which may be underestimated when failing to account for the endogeneity of the number of governments.

3.1 OLS Results

We began by estimating several versions of the following fixed effects model:

$$g_i = \beta_0 + \beta_N \log(N_i) + \gamma \mathbf{X}_i + \alpha_j + \varepsilon_i$$

Each observation, i, is an MSA. g_i is the average annual growth rate of income per employee over 1969-2006. N_i is the number of functional county governments in MSA i. α_j are state group fixed effects.[23] $\mathbf{X}_i$ is a vector of control variables for MSA i. These include: an indicator for having one or more counties classified as coastal by the National Oceanic and Atmospheric Administration (NOAA); indicators for bordering the Pacific Ocean, the Atlantic Ocean, and one of the Great Lakes; an indicator for having access to a major river (as defined by ESRI); and the land area of the MSA in thousands of square miles, based on its 1999 boundaries.

Our OLS results are reported in Table 2. An OLS regression of average annual economic growth over the period 1969-2006 on the log of the number of functional county governments suggests a robust correlation between these variables. The coefficient on the logged number of county governments is 0.12, and it is statistically significant at the 1% level. Doubling inter-jurisdictional competition results in a 0.08

[23] Many MSAs cross state boundaries, and so we create a separate "state group" fixed affect for each combination of states that an MSA falls into. The Minnesota-Wisconsin state group, for instance, has three MSAs.

percentage point increase in the average annual growth rate of income per employee, which amounts to an approximate 9% increase in the growth rate over the period.

A prime concern is that there is a great deal of cross-state variation in laws, regulations, etc., and this variation is undoubtedly important for an MSA's growth potential and trajectory. As such, we control for state fixed effects. Because some MSAs cross state lines, we created state dummies not only for the 50 states, but also for each of the state combinations created by multi-state MSAs. There are 37 states or state groupings which contain more than one MSA, and it is variation among the MSAs within each of these that we exploit to estimate the growth implications of a change in the number of county governments. Our previous results are robust to the inclusion of state group fixed effects; the coefficient on the logged number of governments grows in both magnitude and statistical significance when they are included. The coefficient on inter-jurisdictional competition is now 0.15, indicating that doubling the amount of inter-jurisdictional competition in an MSA is associated with a 0.10 percentage point increase in the average annual growth rate of income per employee, which amounts to an approximate 12% increase in the growth rate.

We also considered the possibility that an MSA's proximity to major bodies of water could directly affect growth. The potential to expand business might be enhanced by the ability to construct and expand ports, and we thus found several controls to be relevant: a dummy for being on the Atlantic ocean or the Gulf coast, a dummy for being on the Pacific ocean, a dummy for being on the Great Lakes, and a dummy for being on a major national river. Our results are robust to the inclusion of all of these variables. A dummy for having at least one coastal county as classified by NOAA enters with a positive and statistically significant coefficient. However, when we add separate dummies that vary by which coast an MSA borders, we find that most of the positive effect of coastal access seems to come from being on the Pacific coast, as the Atlantic and Great Lakes dummies are insignificant. The coefficient on the major river dummy is negative and significant. It may be the case that any growth benefits of being on a major river had been internalized by MSAs before the start of the period over which we measure growth.[24] Even after adding these coastal and major river controls, the coefficient on logged county governments remains unchanged at 0.15, and it continues to be significant at the 1% level.

Finally, we include a control variable for the total land area of an MSA. More land could arguably lead to greater growth potential, and could also be a determinant of the number of county governments if more expansive land areas require more governments merely due to the costs of governing over relatively large areas. However, land area is insignificant in the regression, and its inclusion does not appreciably change the coefficient on the logged number of governments variable (now 0.14), or its significance. We use this final specification as our baseline.

A few notes about the selected functional form are warranted. We ran several Box-Cox regressions on our OLS model. In our baseline OLS model, we reject the null hypothesis that a reciprocal transformation of total county governments would maximize the likelihood of observing the data we did, and we reject that no transformation maximizes the likelihood. We cannot reject that a log transformation is the appropriate one. This bolsters our confidence that we have selected the appropriate functional form in logging total country governments.[25]

3.2 IV Results

Using the number of miles of small streams as an instrument for the logged number of county governments yields a strong first stage, reported in Table 3. Miles of small streams are highly positively correlated with logged county governments. The first stage regression t-statistic on the total miles of small streams is 9.84 (the F-Statistic

[24] The results also hold when we instead use miles of major rivers in an MSA rather than a dummy for having access to a major river. Indeed, the coefficient on inter-jurisdictional competition rises very slightly in both statistical significance and magnitude, to 0.16.

[25] The results of our Box-Cox regressions are available upon request.

is 96.8), suggesting that this instrument is quite strong.

Our IV results are reported in Table 4. As in our OLS results, the coefficient on the logged number of county governments is positive and statistically significant at the 1% level. However, the coefficient is even larger in magnitude when we use IV; it is now 0.22, suggesting that doubling the amount of inter-jurisdictional competition within a metropolitan area leads to an approximate 0.15 percentage point increase in the average annual growth rate over 1969-2006. As the mean real annual growth rate of income per employee during this period is 0.85, the magnitude of this effect is relatively large and meaningful, amounting to an average annual growth rate over 1969-2006 that is about 18% higher than in the case of half of the amount of inter-jurisdictional competition between county governments. A more modest 50% increase in inter-jurisdictional competition—such as would result in going from 2 to 3 county governments—leads to an approximate 0.09 percentage point increase in average annual growth over the same period, or a nearly 11% increase in the average annual growth rate over 1969-2006.

Several other factors seem to have some impact on growth. In particular, being on the Pacific Ocean is associated with between 0.22 and 0.24 additional annual percentage points of growth over 1969-2006, and being on a major river is associated with lower growth of between 0.13 and 0.14 annual percentage points.[26] Once again, being on the Atlantic Ocean or on the Great Lakes does not have a significant impact.

3.3 Income Levels

A natural question is whether our findings surrounding the effects of inter-jurisdictional competition on economic growth reflect convergance to a mean income level. In fact, we find that the reverse is true. Running regressions of the levels of 1969 earnings by

[26]Once again, results hold when we instead use miles of major rivers in an MSA rather than a dummy for having access to a major river. The coefficient on inter-jurisdictional competition rises in both statistical significance and magnitude, to 0.26.

place of work per employee and 2006 earnings by place of work per employee (each in constant 2000 dollars) on the number of counties reveals two things, which can be seen in Table 5. First, increasing the number of county governments appears to be associated with having a *higher* 1969 income. Specifically, doubling inter-jurisdictional competition is associated with a $1000 increase in 1969 income per employee (in constant 2000 dollars). Second, the effect of the number of county governments on the level of 2006 income, a $3900 increase, is clearly greater than is its effect on 1969 income. This supports the idea that lower inter-jurisdictional competition was already associated with lower income at the beginning of the window over which we measure growth, and the disparity only grew over the intervening 37 years. Intuitively, the mobility of people and capital is likely to be appreciably higher in 2006 than in 1969, due to improvements in communications and transportation technologies. This might make the effect of inter-jurisdictional competition even greater in the present than in the 1960s. In our levels regressions, being on a major river is insignificant in explaining income. However, having access to the Great Lakes and to the Atlantic Ocean are actually associated with higher income in 1969 (significant at the 5% level and the 10% level, respectively), although both have insignificant effects in 2006. On the other hand, there is a large, positive effect of being on the Pacific Ocean in 2006 that is insignificant in 1969.

3.4 Decomposing Growth Effects

There are two primary channels through which inter-jurisdictional competition might drive economic growth. First, competition between governments could simply make a given set of workers and firms more productive. Second, this competition may attract more productive workers and firms to the MSA, leading to a change in the composition and demographic characteristics of the work force. Decomposing the economic growth-enhancing effects of inter-jurisdictional competition allows us to compare the relative importance of each of these channels.

To empirically separate these effects, we use worker-level data from the 5% sample of the 2000 U.S. Census. These data allow us to compute a wage differential for each MSA, which is essentially the effect of living in that MSA on wages, after controlling for numerous observable characteristics of the working population. Specifically, to compute this differential, we regress logged hourly wage data on a set of MSA dummies and a vector of variables capturing the demographic, occupational, and industry characteristics of the worker.[27] We interpret the resulting MSA dummy coefficients as the causal effect of the MSA's characteristics on a worker's wages. We essentially net out the person-level factors that drive wages. To determine the effect of inter-jurisdictional competition on income after accounting for workforce composition, we run an MSA-level regression of the log of each MSA's wage differential on the logged number of county governments. This gives the effect of inter-jurisdictional competition on workers' imputed wages, which tells us how much income growth comes from the channel of government competition making workers and firms more productive. The amount by which income growth exceeds imputed income growth then tells us how much income growth comes from the channel of inter-jurisdictional competition attracting more productive workers and firms to the MSA.

We had hoped to compute the growth in imputed wages between the 1970 and the 2000 Censuses. However, the 1970 and the 2000 Census microdata are geographically incompatible in the sense that they cannot be used in combination to identify the same metropolitan areas. Each uses a different set of MSA boundaries, and over two-thirds of MSAs changed boundaries between the two censuses. Additionally, data on an individual's county of residence, or some smaller geographic unit that

[27] In this vector, we include age, age squared, a male dummy, a veteran dummy, a dummy for immigrating to the U.S. during the last 5 years, a set of race dummies, a dummy for being married, a set of education level dummies, 5 occupation dummies, 14 industry dummies, and the interactions of all of these variables with gender. Our methodology follows that of Albouy (2008) and Notowidigdo (2010).

could be mapped into the same metropolitan areas for both census years, are not available. As such, our analysis of imputed wages is confined to examining the effects of competition between governments on the year 2000 imputed wage. We nonetheless find this analysis informative as an indicator of how much more an individual with a given set of demographic characteristics and skills might earn by moving to an MSA with relatively more inter-jurisdictional competition.

Table 6 presents our imputed wage regressions. When we regress imputed wages on the logged number of county governments using our baseline set of control variables, we find that doubling inter-jurisdictional competition is associated with a 4.2% increase in the hourly wage. As the average hourly wage in the 2000 Census is \$18.44 per hour, this amounts to a wage increase of \$0.78 per hour for the average worker, or about an additional \$1500/year (in constant 2000 dollars). This indicates the increase in income that results from inter-jurisdictional competition making a given set of workers and firms more productive. We found in the previous section that the overall effect of doubling inter-jurisdictional competition on wages was about \$3900/year (also in constant 2000 dollars). This suggests that roughly 60% of the income-enhancing effect of inter-jurisdictional competition comes through attracting more productive firms and workers to the MSA, while the remaining 40% comes from making existing firms and workers more productive.[28]

[28] Note that this is a rough approximation. While earnings are measured in 2000 dollars throughout, \$3900 is the amount by which doubling inter-jurisdictional competition increases 2006 income per employee, while \$1500 is the amount by which doubling inter-jurisdictional competition increases imputed 2000 wages of employees. It is of course possible that the years 2000 and 2006 are not comparable for reasons other than inflation.

4 Robustness

4.1 Other Forms of Inter-Jurisdictional Competition

In this section we show that our results are robust to considering other forms of inter-jurisdictional competition. County governments are not the only form of sub-national government in the U.S.. Municipal and township governments are also likely to define the degree of inter-jurisdictional competition in an MSA. The definitions of each of these latter types of governments vary by state, and their responsibilities are generally outlined by the state legislature. The Census Bureau defines township and municipal governments almost analogously, and the rules governing which is which vary a lot by state. As a result, we consider the number of township plus municipal governments, combined, as an alternate measure of the degree of inter-jurisdictional competition.[29]

We use two approaches to explore the effects of this alternate measure of inter-jurisdictional competition. First, we ran two sets of OLS regressions: growth on logged municipal plus township governments (one regressors measuring inter-jurisdictional competition), and growth on both logged county governments and logged municipal plus township governments (two competition regressors). These results appear in Table 7. These OLS results suggest that while both logged county governments and logged municipal plus township governments are correlated with economic growth, the correlation is stronger in the case of logged county governments. In the regressions

[29]Township governments are defined by the Census Bureau as "Organized local governments authorized in state constitutions and statutes and established to provide general government for areas defined without regard to population concentration," while municipal governments are defined as "Organized local governments authorized in state constitutions and statutes and established to provide government for a specific concentration of population in a defined area." The Census Bureau elaborates, in the documentation for their 2002 survey of governments, that: "These two types of governments are distinguished primarily by the historical circumstances surrounding their incorporation. In many states, most notably in the Northeast, municipal and township governments have similar powers and perform similar functions. The scope of governmental services provided by these two types of governments varies widely from one state to another, and even within the same state."

that control for both types of competition, the coefficient on logged municipal plus township governments is slightly smaller than that on logged county governments, although both are statistically significant. However, these results are only suggestive of the true relative contributions of county versus municipal plus township governments.

If the number of governments is endogenous in these growth regressions, then we cannot interpret the estimates as causal effects. Once again, a valid instrument would allow us to do so. However, one problematic factor is that we did not have two strong, excluded instruments to run an IV model in which we instrumented for both the logged number of county governments and the logged number of municipal plus township governments.[30] As a result, our second approach was to run our baseline IV specification where we used municipal plus township governments—instead of country governments—to measure inter-jurisdictional competition. These results appear in Table 8. We generate findings that are remarkably similar to our baseline IV results. The number of county governments and the number of municipal plus township governments seem to be capturing essentially the same phenomenon, and our results do not seem to be driven by our assumptions about how inter-jurisdictional competition is defined.

4.2 Results Using 1970 Metro Area Definitions

We have defined the entity over which we compute the 1969-2006 growth rate to be the Metropolitan Statistical Area (MSA), using the 1999 definition of the geographic boundaries. One concern with using these entities is that we are misrepresenting the amount of competition to which a metropolitan area was truly subject during

[30] While we experimented with employing the stream IVs in Hoxby (2000) and Rothstein (2007) in order to get identification, their combination with our IV resulted in a problem of severely weak instruments. As a second possible excluded instrument, we experimented with using the median year of county founding within an MSA, noting that there may have been more governments of all types in relatively older MSAs due to less sophisticated methods of travel and communication (e.g., automobiles, telephones, and faxes were invented after some county governments were founded, and before others were founded). Unfortunately, this instrument also proved too weak.

the nearly four decades over which we measure growth. If some counties were not included in an MSA at the beginning of the period over which we measure growth, then it may be the case that these areas (and their associated local governments) were not truly "competitors" of the MSAs at the beginning of the period. Thus, we might be overstating the amount of intergovernmental competition precisely in those cross-sectional units that experienced the most growth over 1969-2006.

To address this concern, we looked at the geographic boundaries delineating metropolitan areas at the beginning of the period over which we measure growth: Standard Metropolitan Statistical Areas (SMSAs). Specifically, we look at the metropolitan area boundaries used in the 1970 Census. SMSAs are conceptually similar to our 1999-defined MSAs, although there are generally fewer counties in each SMSA, owing to the lower U.S. population in 1970. Since 1970, many metropolitan areas have expanded to absorb more counties, and over two-thirds of metropolitan areas contained a different set of counties in 1970 than they later would in 1999. Encouragingly, we find that our results are fundamentally unchanged. In fact, the magnitude and statistical significance of the coefficient on logged country governments are both larger when we instead use pre-period metropolitan area boundaries.[31] This suggests that our results are not driven by any exaggeration of competition in metropolitan areas that gained county governments during 1969-2006.

4.3 Alternate Mechanisms

We control for MSA access to major rivers and bodies of water to increase our confidence that the results are not simply driven by a correlation between small streams and growth-enhancing features like seaports. However, it may be the case that having many small streams increases the costs of people spreading out and using greater swaths of land, or that they are simply an attractive feature in their own right.

[31] These regression results are available upon request.

This would mean that small streams lead to relatively higher population densities, to higher populations, to areas that are relatively richer *ex ante*, or to all of the above. If this is the case, we would expect controlling for an MSA's 1960 population, for its 1960 population density, and for its 1969 income to significantly mute our growth results. We did not include these controls in our baseline specification because of our concern that they may be endogenous to growth outcomes. However, adding them to our main specification is instructive. By doing so, we avoid attributing their effects to having more county governments.

Regressions with these additional controls appear in Table 9, columns 1-4. Controlling for population density does not appreciably change our results on the effect of inter-jurisdictional competition on economic growth—either in magnitude or in significance—and population density is itself insignificant in column 1. When we additionally control for 1969 income per employee, we find a stronger positive—and now significant—effect of population density, and a negative and significant effect of initial income, on economic growth. It is not surprising that having a more concentrated population leads to higher growth, or that it is harder to grow relative to other areas when you are already relatively wealthy. What is most interesting is the finding that the effect of inter-jurisdictional competition on economic growth *increases* in both magnitude and statistical significance when we control for population density and economic growth. This suggests that it is actually in relatively lower initial population density, and/or in higher initial income MSAs that there was more inter-jurisdictional competition in the 1960s. Our results on the effects of inter-jurisdictional competition on economic growth may have been biased downwards by failing to control for these factors.

When we also control for the log of the 1960 population, we find that it is not statistically significant. Much as in the case of adding controls for population density and initial income, our results on the effect of inter-jurisdictional competition only grow in magnitude once we introduce a control for log population. While the statistical significance of inter-jurisdictional competition drops from 1% to 5% once we control for population, we find it comforting that it does not drop in economic significance (magnitude), and that log population is itself insignificant.

Another concern is that areas with many small streams may simply have better weather patterns or favorable terrain that tend to either attract productive people or make them more productive. To ensure that any such correlations are not driving our results, we introduced controls for average monthly rainfall (inches), average hours of sunshine in January (100s), average degree of extreme high temperatures (cooling degree days, 100s) and extremes low temperatures (heating degree days, 100s), and the standard deviation of elevation.[32] The inclusion of these additional control variables did not dramatically change the results, and actually increased both the magnitude and statistical significance of the coefficient on inter-jurisdictional competition, as shown in column 5 of Table 9. To the extent that streams are correlated with particular patterns of weather or variance in elevation, this does not seem to be driving our results.[33]

It is comforting that the inclusion of these variables has little effect on our key results. Importantly, we find no evidence that the measured benefits of inter-jurisdictional competition stem from MSAs with many county governments being better equipped for growth at the outset, for reasons unrelated to inter-jurisdictional competition.

[32]Data on hours of sunshine come from the GIS data available in the 2002 Climate Atlas of the U.S., and reflect a 1941-1970 average. All other weather data are from the National Climatic Data Center (NCDC), and reflect a 1970-2000 average. Heating and cooling degree days are used to estimate amounts of energy required to to maintain a comfortable indoor temperature level. Daily heating degree days are equal to $\max\{0, 65-\text{mean temperature}\}$, daily cooling degree days equal $\max\{0, \text{mean temperature}-65\}$, and we take the average of monthly averages during the 30-year period. We computed the standard deviation of elevation using the Environmental Systems Research Institute's (ESRI) Data and Maps software (2008), 30-meter resolution, GTOP030 data series, for the U.S.A., and divided the resulting standard deviation by 100.

[33]As an additional control variable, we had hoped to include measures of soil quality, to account for the agricultural potential of an MSA. Unfortunately, after consulting the the National Soils Database Manager at the U.S. Department of Agriculture, Paul Finnell, we found that existing data do not yet cover highly-urbanized areas, including many of the counties in MSAs. These data are currently being collected, and will be available at an unknown future date.

On the contrary, controlling for some additional factors, such as population density, initial income, population, weather, and elevation, reveals a potentially larger impact of inter-jurisdictional competition on economic growth.

4.4 Sample Truncation Robustness Tests

We also explored the possibility that our results are driven by a few outlier metropolitan areas that experienced abnormally high growth for reasons unrelated to having a high level of inter-jurisdictional competition. As a metropolitan area might experience a good growth draw merely by chance, we wanted to ensure that our results are robust to removing particularly high or low growth areas that could be capable of driving the results. It is encouraging that, when we remove from the sample the highest and lowest 5% of observations on 1969-2006 growth, our results are exceptionally similar. The coefficient on the logged number of county governments in our baseline IV specification drops from 0.22 to 0.18.

We also checked to see if our results are robust to dropping the few metropolitan areas that span multiple states, and which one might suspect to have unique growth opportunities unrelated to inter-jurisdictional competition, or to have a particularly strong form of inter-jurisdictional competition that is driving all of our results. Once again, we are encouraged to find that the coefficient on logged county governments is identical, at 0.22. Thus, our results do not appear to be driven by those MSAs with particularly high or low growth outcomes, or by MSAs facing special competition due to spanning multiple states.[34]

4.5 Alternate Measures of Streams

Several existing studies have used streams in U.S. counties as instrumental variables, probably the most prominent among them being Hoxby (2000) and Rothstein (2007).

[34]These auxiliary regressions are available upon request.

Fortunately, these studies provide alternate measures of stream activity in each of the counties of our MSAs, allowing us to check the robustness of our results.[35] We find that our results are substantially unchanged when we use different measures of stream activity, increasing our confidence that they are not sensitive to some particular feature of our computational method.

Hoxby (2000) collects two measures of streams and rivers: First, a measure of larger streams, computed by hand-counting lines of water with a width of 40 or more feet on the USGS's 1/24,000 quadrangle maps, and second, a measure of smaller streams, computed by calculating total streams from the USGS's Geographic Names Information System (GNIS), and subtracting off the hand count of larger streams. She points out that it is important to divide streams into those that are more (large streams and rivers) and less (small streams) suitable for commercial navigation. Thus, unlike our measure, hers is one of numbers of streams rather than miles of streams. For small streams, she associates streams with the MSA in which they have their primary location, as defined by the USGS. This differs from our method, which involves clipping streams at MSA boundaries and counting up all miles of streams (or parts of streams) that are housed within the boundaries of an MSA. Nonetheless, our results are substantially unchanged when we instead use Hoxby's small streams measure as our IV. These results appear in Table 10. As before, this IV is positively correlated with the number of county governments in an MSA, and we have a very strong first stage. When we run the same IV regression described earlier, the first stage t-statistic on the number of small streams is 7.88 (the First Stage F-Statistic is 62.2), suggesting no problems of weak instruments.

The coefficient on the logged number of county governments is 0.23, and it is positive and statistically significant at the 1% level. This is slightly larger in magnitude than our previous IV result, and indicates that doubling the amount of inter-

[35]Both of these authors use the 1990 boundaries of MSAs. As a result, in our robustness checks that use their IVs, we use the 1990 boundaries to compute all of our other regressors.

jurisdictional competition within a metropolitan area leads to an approximate 0.16 percentage point increase in the average annual growth rate over 1969-2006. This suggests that the average annual growth rate of income per employee over 1969-2006 would be more than 19% higher if inter-jurisdictional competition were doubled.

Rothstein (2007) levels several harsh criticisms at the measures of stream activity in Hoxby (2000). He disapproves of any personal discretion she used in counting larger streams and judging the adequacy of their width, and also considers it inappropriate to count streams as being in an MSA based on whether their USGS-assigned "primary location" is in the MSA, as some streams may flow through an MSA but do not have their "primary location" in one. Because he is not satisfied with how Hoxby counted larger streams, he is also unsatisfied with her count of smaller streams, which was derived by subtracting the hand-counted number of large streams from the GNIS-provided number of total streams. His solution is a measure of total streams in an MSA that counts a stream as long as any part of it flows through an MSA. These data come from the USGS's GNIS data.

It is worth pointing out that our measure of streams appears to address many of the criticisms associated with these existing measures of streams. Indeed, we need not grapple with how the USGS defines the "primary locations" of streams, or which criteria should be met for a stream to be included in our count (must the mouth be in the MSA? the endpoint? the "primary location"?). That being said, we find that our results, in addition to being robust to using Hoxby's small streams IV, are also similar when we use Rothstein's total streams IV. These results also appear in Table 10. This IV is positively correlated with the number of county governments in an MSA, and we have an exceptionally strong first stage (the First Stage F statistic is 98.95), suggesting no problems of weak instruments.

As in the result set using our own IV, the coefficient on the logged number of county governments is positive and statistically significant at the 1% level, although it is slightly smaller, at 0.20. This suggests that doubling the amount of inter-jurisdictional competition within an MSA leads to an approximate 0.14 percentage point increase in the average annual growth rate over 1969-2006. This now suggests that the average annual growth rate of income per employee over 1969-2006 would be just over 16% higher were inter-jurisdictional competition doubled.

4.6 Gross Municipal Product

As we have described above, there are several important reasons to use growth in earnings per employee as our primary dependent variable. However, it is important to explore the implications of this choice of outcome variable. One particular concern is that rather than increasing productivity, inter-jurisdictional competition changes the equilibrium returns to capital and labor. In particular, models such as those of Zodrow and Mieszkowski (1986) suggest that an increase in inter-jurisdictional competition will lead to lower wages and higher returns to capital. To explore this possibility, we consider as an outcome variable gross municipal product (GMP) per employee over time.

The BEA collects data on GMP, but the data correspond with the current year definition of MSA boundaries, which we know to be changing over time. As such, we cannot use these GMP data to compute a growth rate of GMP. It is, however, possible to examine the implications of inter-jurisdictional competition for the level of GMP in a single year. These results can be compared with our results on the effects of inter-jurisdictional competition for the level of 2006 earnings per employee. We simply must ensure that we are comparing the same geographic entities, which we can do as long as we choose a year of GMP data for which 1999 MSA boundaries were used to define MSAs. The earliest such year available on BEA's website is 2001. We can compute GMP per employee, as BEA also has data on employees per MSA in each year.

When we regress 2001 GMP per employee on logged county governments, our results are substantially similar to the levels results in which we used earnings per employee as the outcome variable. Table 11 presents these results. The coefficient on logged county governments in our baseline regression, column 5, is almost identical to and statistically indistinguishable from the same coefficient in the 2006 income per employee regression. Doubling inter-jurisdictional competition is associated with an additional $3900 in GMP per employee in 2001. Examining the results in columns 1 through 4, we see an even larger coefficient on logged county governments. In these columns, doubling inter-jurisdictional competition appears to be associated with between $5100 and $6100 of additional GMP per employee. This suggests that inter-jurisdictional competition has at least as great of an effect on GMP per employee as it does on income per employee, and perhaps even a greater effect. Hence, our results imply that inter-jurisdictional competition not only increases the productivity of a region, but also that these productivity gains are largely captured by employees.

5 Conclusion

We use an instrumental variables strategy to examine the causal impact of the number of county governments on metropolitan statistical area (MSA) growth. Doing so, we find that doubling inter-jurisdictional competition within an MSA (e.g., by increasing the number of county governments from 1 to 2) leads to an approximate 0.15 percentage point increase in the average annual growth rate of earnings per employee over 1969-2006. This effect is is relatively large and meaningful, amounting to an average annual growth rate over 1969-2006 that is more than 18% higher. We take this as evidence that decentralization has a robust impact on an area's growth potential.

These results are robust to alternate measures of our excluded instrumental variable, which measures stream activity. We also find a robust impact of inter-jurisdictional competition on growth when we instead measure inter-jurisdictional competition as the total municipal and township governments in an MSA.

We also investigate whether our findings are due to MSAs with many county governments having relatively low incomes before 1969; if this were true, then our results might be due to conditional convergence. To the contrary, however, we find that doubling inter-jurisdictional competition is associated with a 1969 income per employee that is $1000 higher, but with a 2006 income per employee that is $3900 higher (both in constant 2000 dollars). Lower inter-jurisdictional competition was already associated with lower income at the beginning of the window over which we measure growth, and the disparity only grew over the intervening 37 years.

Investigating further, we find that this differences in workforce composition do explain a significant portion of the difference in wages. However, even when we control for workforce composition, we find that wages are approximately 4.2% higher for a given worker when we double the number of counties in a given MSA.

Our empirical findings are not without caveats, and more work needs to be done to understand the implications of the results presented here. As we mentioned, we expect that both county governments as well as municipal and township governments affect growth and are endogenous variables in our growth regressions. However, lacking sufficient excluded instruments to identify a model that includes both of these regressors, our IV results may suffer from omitted variable bias (from leaving municipal and township governments out of our baseline IV specifications), and our OLS results that capture both measures of inter-jurisdictional competition may be biased and inconsistent due to the endogeneity of these variables. We have also not identified the mechanisms by which inter-jurisdictional competition leads to higher economic growth, and this is a ripe area for future research.

Perhaps the greatest caveat to the results presented here is that we have implicitly held the form of decentralization fixed, and only varied the degree of inter-jurisdictional competition. As a result, our findings are limited to federal systems similar to those of the United States. However, a key question of this literature is what *forms* of inter-jurisdictional competition lead to better outcomes, and it is only by understanding the answer to this question that economists can help to guide the decentralization reforms taking place. Nonetheless, this methodology may be helpful in answering this question, as our analysis could be easily replicated in other federal systems, such as that of Switzerland or Argentina. This would help us to determine what forms of inter-jurisdictional competition appear to enhance growth the most.

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Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
Average annual growth, 1969-2006	0.85	0.37	-0.01	1.99
Earnings by place of work, 1969 (2000$)	25.74	3.48	18.39	37.05
Earnings by place of work, 2006 (2000$)	35.24	5.14	25.31	60.31
Functional county governments	2.48	2.42	1	20
Log functional county governments	0.62	0.70	0	3.00
Municipal and town governments	37.75	55.92	1	406
Log municipal and town governments	2.86	1.29	0	6.01
Dummy - Pacific	0.04	0.20	0	1
Dummy - Atlantic	0.12	0.32	0	1
Dummy - Great Lakes	0.07	0.25	0	1
Dummy - Major River	0.24	0.43	0	1
Land area	2.30	2.88	0.39	33.96
Population density, 1960	1.49	1.30	0.08	8.24
Log population, 1960	12.09	1.02	9.44	15.86
100s of miles of streams (ESRI GIS Data)	2.94	2.69	0	16.62
Hoxby (2000) number of small streams	85.42	91.64	0	690
Rothstein (2007) total streams	151.48	163.01	0	912
Cooling degree days, 1970-2000 (100s)	1.16	0.80	0.09	3.25
Heating degree days, 1970-2000 (100s)	3.73	1.95	0.25	8.20
Hours sunshine in January, 1941-1970 (100s)	1.52	0.39	0.51	2.60
Average monthly rainfall, 1970-2000 (inches)	3.31	1.19	0.85	5.61
Standard deviation of elevation ($\div$ 100)	1.09	1.74	0.01	11.56
N		222		

Table 2: OLS Results, Showing the Effects of Logged County Governments on Income Growth

Average annual growth, 1969-2006					
	(1)	(2)	(3)	(4)	(5)
Log functional county governments	0.12	0.15	0.15	0.15	0.14
	(3.63)**	(4.91)**	(5.09)**	(4.98)**	(4.24)**
Dummy - Coastal (NOAA)			0.08		
			(1.67)+		
Dummy - Pacific				0.23	0.23
				(2.07)*	(1.88)+
Dummy - Atlantic				-0.07	-0.07
				(0.82)	(0.83)
Dummy - Great Lakes				0.01	0.01
				(0.21)	(0.20)
Dummy - Major River				-0.13	-0.13
				(2.73)**	(2.70)**
Land Area					0.003
					(0.29)
Constant	0.77	0.91	0.90	0.95	0.95
	(23.87)**	(7.88)**	(7.71)**	(8.49)**	(8.47)**
State Fixed Effects?	No	Yes	Yes	Yes	Yes
Observations	222	222	222	222	222
R-squared	0.06	0.53	0.54	0.56	0.56

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. Dummy - Coastal (NOAA) is a dummy variable for a MSA having one or more counties classified as coastal by NOAA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river (ESRI 2008). Land area is in 1000s of square miles.
Sources: BEA (1969-2006), Census of Governments (1962), ESRI (2008), and NOAA (2008).

Table 3: IV First Stage Results, Showing the Effect of the Number of Small Streams on the Logged Number of Country Governments

Log functional county governments	(1)	(2)	(3)	(4)	(5)
100s of miles of streams	0.15	0.22	0.22	0.22	0.21
	(8.11)**	(14.17)**	(14.66)**	(14.34)**	(9.84)**
Dummy - Coastal (NOAA)			-0.11		
			(1.35)		
Dummy - Pacific				-0.00	-0.03
				(0.01)	(0.14)
Dummy - Atlantic				-0.01	-0.01
				(0.05)	(0.04)
Dummy - Great Lakes				-0.01	-0.01
				(0.07)	(0.06)
Dummy - Major River				0.05	0.04
				(0.61)	(0.48)
Land Area					0.01
					(0.52)
Constant	0.18	-0.06	-0.05	-0.07	-0.07
	(3.63)**	(0.58)	(0.53)	(0.71)	(0.63)
State Fixed Effects?	No	Yes	Yes	Yes	Yes
Observations	222	222	222	222	222
R-squared	0.33	0.65	0.66	0.65	0.66

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. Dummy - Coastal (NOAA) is a dummy variable for the MSA having one or more counties classified as coastal by NOAA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles.
Sources: BEA (1969-2006), Census of Governments (1962), ESRI (2008), and NOAA (2008).

Table 4: IV Results, Showing the Effects of Logged County Governments on Income Growth

Average annual growth, 1969-2006					
	(1)	(2)	(3)	(4)	(5)
Log functional county governments	0.23	0.19	0.19	0.19	0.22
	(4.02)**	(5.44)**	(5.52)**	(5.26)**	(4.77)**
Dummy - Coastal (NOAA)			0.08		
			(1.85)+		
Dummy - Pacific				0.22	0.24
				(2.15)*	(2.34)*
Dummy - Atlantic				-0.08	-0.08
				(0.98)	(0.97)
Dummy - Great Lakes				0.0009	-0.0002
				(0.02)	(0.00)
Dummy - Major River				-0.14	-0.13
				(3.14)**	(2.89)**
Land Area					-0.01
					(1.56)
State Fixed Effects?	No	Yes	Yes	Yes	Yes
Observations	222	222	222	222	222
First Stage F Statistic	65.70	200.78	214.99	205.74	96.81

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. The instrumental variable is hundreds of miles of streams, intermittent streams, falls, and intracoastal waterways in the MSA. Dummy - Coastal (NOAA) is a dummy variable for the MSA having one or more counties classified as coastal by NOAA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles.
Sources: BEA (1969-2006), Census of Governments (1962), ESRI (2008), and NOAA (2008).

Table 5: IV Results, Showing the Effects of Logged County Governments on Earnings Per Employee in 1969 vs. in 2006

Income per employee (thous of 2000 $)

IV: 100s of miles of streams

	1969 Income		2006 Income	
	(1)	(2)	(3)	(4)
Log functional county governments	1.95	1.51	5.69	5.58
	(7.88)**	(4.76)**	(7.94)**	(6.36)**
Dummy - Pacific		1.01		5.46
		(1.38)		(2.99)**
Dummy - Atlantic		1.12		0.65
		(1.79)+		(0.56)
Dummy - Great Lakes		1.02		0.95
		(2.23)*		(1.12)
Dummy - Major River		0.57		-1.01
		(1.44)		(1.41)
Land Area		0.08		-0.05
		(1.64)		(0.46)
Constant	22.70	22.56	31.40	31.74
	(33.23)**	(33.97)**	(24.13)**	(24.62)**
State Fixed Effects?	Yes	Yes	Yes	Yes
Observations	222	222	222	222
First Stage F Statistic	200.78	96.81	200.78	96.81

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. All regressions also include state fixed effects. The instrumental variable is hundreds of miles of streams, intermittent streams, falls, and intracoastal waterways in the MSA. Dummy - Coastal (NOAA) is a dummy variable for a MSA having one or more counties classified as coastal by NOAA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles.
Sources: BEA (1969-2006), Census of Governments (1962), ESRI (2008), and NOAA (2008).

Table 6: IV Results, Showing the Effects of Logged County Governments on Imputed Wages in 2000

Log of Imputed Wage, 2000	(1)	(2)	(3)	(4)	(5)
Log functional county governments	0.07	0.06	0.06	0.06	0.06
	(7.17)**	(8.92)**	(8.74)**	(8.71)**	(7.22)**
Dummy - Coastal (NOAA)			0.02		
			(2.03)*		
Dummy - Pacific				0.05	0.05
				(3.69)**	(3.93)**
Dummy - Atlantic				0.005	0.005
				(0.38)	(0.38)
Dummy - Great Lakes				0.01	0.01
				(0.56)	(0.55)
Dummy - Major River				-0.02	-0.02
				(2.40)*	(2.28)*
Land Area					-0.0006
					(0.54)
Constant	No	Yes	Yes	Yes	Yes
Observations	195	195	195	195	195
First Stage F Statistic	60.15	190.35	206.67	199.50	96.12

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. The instrumental variable is hundreds of miles of streams, intermittent streams, falls, and intracoastal waterways in the MSA. Dummy - Coastal (NOAA) is a dummy variable for the MSA having one or more counties classified as coastal by NOAA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles.
Sources: BEA (1969-2006), Census of Governments (1962), ESRI (2008), and NOAA (2008).

Table 7: OLS Results, Showing the Effects of Logged Municipal and Township Governments on Income Growth

Average annual growth, 1969-2006	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log municipal + town governments	0.11	0.11	0.11	0.11	0.07	0.07	0.07	0.07
	(5.05)**	(5.12)**	(5.04)**	(4.07)**	(2.04)*	(1.98)*	(1.93)+	(1.90)+
Log functional county governments					0.07	0.08	0.08	0.08
					(1.59)	(1.70)+	(1.77)+	(1.82)+
Dummy - Coastal (NOAA)		0.07				0.08		
		(1.49)				(1.59)		
Dummy - Pacific			0.19	0.19			0.20	0.21
			(1.72)+	(1.63)			(1.84)+	(1.85)+
Dummy - Atlantic			-0.07	-0.07			-0.07	-0.07
			(0.75)	(0.75)			(0.81)	(0.80)
Dummy - Great Lakes			0.02	0.02			0.01	0.01
			(0.29)	(0.29)			(0.17)	(0.18)
Dummy - Major River			-0.13	-0.13			-0.13	-0.13
			(2.74)**	(2.73)**			(2.83)**	(2.72)**
Land Area				0.0008				-0.003
				(0.08)				(0.34)
State Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	222	222	222	222	222	222	222	222
R-squared	0.54	0.54	0.56	0.56	0.55	0.55	0.57	0.57

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<0.5; + indicates p<.10. The same sample of observations is used in all regressions. All regressions also include state fixed effects. Dummy - Coastal (NOAA) is a dummy variable for a MSA having one or more counties classified as being coastal by the National Oceanic and Atmospheric Administration. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles.
Sources: BEA (1969-2006), Census of Governments (1962), ESRI (2008), and NOAA (2008).

Table 8: IV Results, Showing the Effects of Logged Municipal and Township Governments on Income Growth

Average annual growth, 1969-2006	(1)	(2)	(3)	(4)	(5)
Log municipal + town governments	0.22	0.16	0.15	0.16	0.21
	(3.01)**	(5.44)**	(5.51)**	(5.39)**	(4.96)**
Dummy - Coastal (NOAA)			0.07		
			(1.57)		
Dummy - Pacific				0.15	0.19
				(1.52)	(1.98)*
Dummy - Atlantic				-0.07	-0.07
				(0.89)	(0.85)
Dummy - Great Lakes				0.002	0.0004
				(0.05)	(0.01)
Dummy - Major River				-0.14	-0.13
				(3.20)**	(2.75)**
Land Area					-0.02
					(2.86)**
State Fixed Effects?	No	Yes	Yes	Yes	Yes
Observations	222	222	222	222	222
First Stage F Statistic	30.26	162.97	166.40	168.04	58.65

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. The instrumental variable is hundreds of miles of streams, intermittent streams, falls, and intracoastal waterways in the MSA. Dummy - Coastal (NOAA) is a dummy variable for the MSA having one or more counties classified as coastal by NOAA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles.
Sources: BEA (1969-2006), Census of Governments (1962), ESRI (2008), and NOAA (2008).

Table 9: IV Regressions, Showing Robustness of Results to Inclusion of Controls for Population Density, Initial Income, Population, Weather, and Elevation

Average annual growth, 1969-2006	(1)	(2)	(3)	(4)	(5)
Log functional county governments	0.22	0.21	0.27	0.29	0.27
	(4.69)**	(4.14)**	(4.98)**	(2.11)*	(5.73)**
Dummy - Pacific	0.24	0.23	0.26	0.26	0.18
	(2.32)*	(2.24)*	(2.64)**	(2.53)*	(1.58)
Dummy - Atlantic	-0.08	-0.08	-0.02	-0.02	-0.16
	(0.93)	(0.98)	(0.32)	(0.30)	(1.71)+
Dummy - Great Lakes	0.00	-0.04	-0.05	-0.05	-0.00
	(0.00)	(0.77)	(0.92)	(0.96)	(0.07)
Dummy - Major River	-0.13	-0.14	-0.12	-0.12	-0.13
	(2.90)**	(3.04)**	(2.70)**	(2.69)**	(2.64)**
Land Area	-0.01	-0.01	-0.004	-0.002	-0.02
	(1.40)	(1.48)	(0.64)	(0.33)	(2.75)**
Population density		0.02	0.06	0.06	
		(1.30)	(3.14)**	(1.81)+	
Earnings by place of work, 1969			-0.05	-0.05	
			(5.97)**	(5.97)**	
Log population, 1960				-0.02	
				(0.18)	
Cooling degree days, 1970-2000					0.02
					(0.15)
Heating degree days, 1970-2000					-0.14
					(1.65)+
Hours sunshine, 1941-1970					0.08
					(0.65)
Average monthly rainfall, 1970-2000					-0.02
					(0.40)
Standard deviation of elevation					-0.001
					(0.11)
State Fixed Effects?	Yes	Yes	Yes	Yes	Yes
Observations	222	222	222	222	222
First Stage F Statistic	88.34	88.91	76.02	19.97	74.96

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. The instrumental variable is hundreds of miles of streams, intermittent streams, falls, and intracoastal waterways in the MSA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles. Population density is 100s of people per square mile in 1960. Earnings by place of work per employee in 1969 (1000s of constant 2000 dollars) is "the sum of wage and salary disbursements (payrolls), supplements to wages and salaries, and proprietors' income" per employee (BEA). Log population is the log of the 1960 population. Hours sunshine is the average hours of sunshine in January, during 1941-1970 (in 100s). Each day, heating degree days equal max{(0, 65−mean temperature}, cooling degree days equal max{0, mean temperature−65}, and the variables above are the 1970-2000 average, over 100. Standard deviation of elevation is at the MSA level, and has been divided by 100.
Sources: BEA (1969-2006), Census of Governments (1962), Climate Atlas of the U.S. (2002), ESRI (2008), NCDC (2008), and NOAA (2008).

Table 10: IV Results, Showing the Effects of Logged County Governments on Income Growth When Using Hoxby's (2000) and Rothstein's (2007) Excluded Instruments

Average annual growth, 1969-2006				
	Hoxby small streams IV		Rothstein rivers IV	
	(1)	(2)	(3)	(4)
Log functional county governments	0.22	0.23	0.20	0.20
	(4.82)**	(4.83)**	(5.14)**	(4.43)**
Dummy - Pacific		0.34		0.33
		(3.05)**		(2.92)**
Dummy - Atlantic		-0.02		-0.02
		(0.26)		(0.21)
Dummy - Great Lakes		-0.02		-0.01
		(0.33)		(0.22)
Dummy - Major River		-0.11		-0.11
		(2.26)*		(2.30)*
Land Area		-0.01		-0.01
		(2.03)*		(1.06)
State Fixed Effects?	Yes	Yes	Yes	Yes
Observations	215	215	215	215
First Stage F Statistic	103.31	62.15	144.33	98.95

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. All regressions also include state fixed effects. Dummy - Coastal (NOAA) is a dummy variable for a MSA having one or more counties classified as coastal by NOAA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles. The instrumental variable is either the measure of small streams used in Hoxby (2000) or the measure of total streams used in Rothstein (2007), as indicated. Hoxby's small streams IV was computed as the total streams that have their primary location in an MSA from the USGS's Geographic Names Information System, minus her hand count of larger streams in the MSA (40'+ width on the USGS's 1/24,000 quadrangle maps). Rothstein's total streams IV comes from the USGS's GNIS data; he counts the number of streams which pass through an MSA (whether or not their primary location is in the MSA).
Sources: BEA (1969-2006), Census of Governments (1962), Hoxby (2000), ESRI (2008), NOAA (2008), and Rothstein (2007).

Table 11: IV Results, Showing the Effects of Logged County Governments on Gross Municipal Product per Employee in 2001

GMP per employee, 2001					
	(1)	(2)	(3)	(4)	(5)
Log functional county governments	8.73	7.42	7.55	7.38	5.61
	(4.88)**	(7.49)**	(7.51)**	(7.47)**	(2.50)*
Dummy - Coastal (NOAA)			2.39		
			(2.55)*		
Dummy - Pacific				7.85	7.49
				(2.61)**	(2.46)*
Dummy - Atlantic				0.52	0.64
				(0.42)	(0.51)
Dummy - Great Lakes				0.67	0.50
				(0.39)	(0.29)
Dummy - Major River				-0.48	-0.62
				(0.48)	(0.63)
Land Area					0.75
					(1.04)
State fixed effects?	No	Yes	Yes	Yes	Yes
Observations	210	210	210	210	210

Notes: Each observation is an MSA. Robust t statistics appear in parentheses below the coefficient. ** indicates p<.01; * indicates p<.05; + indicates p<.10. The same sample of observations is used in all regressions. The instrumental variable is hundreds of miles of streams, intermittent streams, falls, and intracoastal waterways in the MSA. Dummy - Coastal (NOAA) is a dummy variable for the MSA having one or more counties classified as coastal by NOAA. Dummy - Pacific, Dummy - Atlantic, and Dummy - Great Lakes are indicators that equals 1 if the MSA borders the Pacific Ocean, Atlantic Ocean, and Great Lakes, respectively. Dummy - Major River is an indicator that equals 1 if the MSA has access to a major river. Land area is in 1000s of square miles.
Sources: BEA (1969-2006), Census of Governments (1962), ESRI (2008), and NOAA (2008).