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DO FEDERAL MATCHING FUNDS INHIBIT STATE GROWTH?

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Abstract

To obtain Federal Matching Funds (FMFs), state governments must increase their own expenditures. Most frequently, the additional expenditures are consumption expenditures, which have a well-documented negative effect on growth (Barro 1991.) To test the hypothesis that FMFs might be harmful to state economic growth, we propose two forecast models to estimate the effect of FMFs on the growth rate of the state's GDP per capita for the state of Texas. The first model looks at the immediate impact of increased FMF expenditures and the second looks at long-term effects. We also hypothesize that increases in FMFs have a negative effect on local tax revenues. To test this effect on the state's budget, we develop a third model that relates the Matching Funds' growth rate to the first difference of growth rates in real tax revenues. We used the results of the three different models to evaluate whether or not the state should try to maximize FMFs.

Employing data for the state of Texas from 1963 through 2006, we conclude that increases in FMFs lead to lower state economic growth. We also conclude that FMFs have both an immediate and a long-term impact, which suggests that a policy of maximizing FMFs is detrimental to longer-run growth. Finally, we find that increases in FMFs are associated with decreases in real local tax revenues.

1. Introduction

Barro (1991) finds that empirical models support the neoclassical economic growth theory's assertion that poor countries grow faster than richer countries, but only if the empirical tests account for human capital. Employing primary and secondary school enrollment rates as proxies for human capital, Barro shows that both the initial level of real GDP and the initial level of human capital are highly positively correlated with the subsequent growth in GDP. He also looks into the relationship between growth and government expenditures, but divides the total expenditures into government consumption and government investment and tests their effects separately. As predicted by theory, he finds that "Per capita growth and the ratio of private investment to GDP are negatively related to the ratio of government consumption expenditure to GDP" (p. 437). The ratio of government investment to GDP has no significant relationship with economic growth. This suggests that government activity introduces negative distorting effects into the economy, but if the spending is used for investment the growth stimuli offset the distortion effects.

Turnovksy (2004) uses numerical simulations of a non-scale, calibrated economy to show the effects of different types of government spending on economic growth. The main finding of the paper is that while different fiscal policies have the same effect on the long-term equilibrium growth rate, they have substantially different effects for a prolonged period of time in the interim. This results in different long-run equilibrium *levels* for the key economic variables. The differences suggested by this theoretical model are significant, as the author notes that "an increase in government investment from 0.04 to 0.08 of output raises the long-run level of output by 44.6 percent. Raising the tax on capital income from 0.28 to 0.4 reduces long-run output by 16 percent" (p. 906). Turnovsky asserts that a fixed fraction of output devoted to public investment leads to a better outcome in the long term than if it is spent on public consumption, but the benefits from the investment take a longer time to accrue. His analysis shows the public consumption has invariably positive, yet relatively small, effects on output while investment initially causes a slowdown and a subsequent increase in growth. It is important to note that these theoretical conclusions differ from Barro's empirical research. We believe the difference stems from the fact that while positive, government consumption effects are dominated by the public investment's effects Thus, government consumption has a relative negative effect on GDP growth, and that relative effect is what shows up in empirical tests.

Sala-i-Martin, Doppelhofer, and Miller (2004) use a Bayesian Averaging of Classical Estimates, constructing coefficients by averaging the estimates of ordinary least squares across models, to test for the significance of sixty-seven different variables linked with economic growth. Out of the sixty-seven initial covariates, the authors find eighteen that are significant and three that are marginally significant. Because this study supports the earlier work of Barro (1991) by reaching similar conclusions about school enrollment rates, level of starting GDP and the ratio of government consumption, those three variables, which achieve statistical significance in Sala-i-Martin et. al., are of particular interest. This study also determines that distortions in the relative price of capital have significant negative effects on the real GDP growth, as previously suggested by Barro. Therefore, the relevance of those four particular variables has both theoretical and empirical support, with two distinctively different empirical approaches reaching similar conclusions.

Strouse and Jones (1974) find that FMFs are not only positively correlated with state expenditures but their augmenting effect has become increasingly important over time. Using data for between 1940 and 1968, the authors show that FMSs have increased their share of state welfare, highway and, to some extent, educational expenditures. Their results show that while

FMFs explained only about one quarter of all educational expenditures in 1968, they explained more than half of the state expenditures on welfare programs. Such findings suggest that FMFs are going mainly to fuel growth in government consumption, which has been shown to have a negative effect on relative economic growth.[1] Moreover, the authors assert that while FMFs have increased their significance in determining overall state spending on education and infrastructure, the importance of FMFs for welfare programs has increased at a faster pace.

Kormendi (1983) and Kormendi and Meguire (1986 and 1990) provide an exhaustive analysis of the effects of government spending on the private sector behavior. They provide a new theoretical treatment for the relationship between private consumption and government spending, which is also reconcilable with the Ricardian Equivalence Theorem. They propose that public consumption spending would have a greater negative effect on growth than public investment spending to the extent to which public consumption goods are viewed as substitutes to privately provided products. The empirical tests confirm their theoretical conclusions, finding government expenditures to have an invariably negative effect on private consumption. It is interesting to note that their framework suggests a difference in the effects caused by public consumption and public investment.

The studies cited above functioned as a stepping stone in the development of the three forecast models which we use to test the two hypotheses underlying this paper. First, we theorize that FMFs are negatively associated with economic growth as they have the effect of increasing government consumption expenditures, as shown by Strouse and Jones. Such increases in government consumption have been found to affect economic growth negatively by both Barro and Sala-i-Martin et.al. Secondly, we theorize that FMFs are negatively associated with state tax

[1] See Barro (1991) and Sala-i-Martin et al .(2004)

revenues. The main reason for this is the crowding out of the private sector given augmented government spending.

2. Model

In order to estimate the impact of FMFs on Texas's economic growth, we build an empirical-growth model based on the literature discussed in the previous section. Our model departs from previous work in the area mostly in the definitions of the dependent variables. While most researchers in the past have focused their attention on explaining variations in the growth of per capita GDP of different countries over time, our goal was to explain variations in the growth of Texas per capita GDP relative to the U.S. average per capita GDP growth over time. In other words, our model answers the question why the growth in Texas income per capita differs from the national average. To this end, the dependent variable is the first difference of the ratio of Texas real GDP per capita divided by US real GDP per capita. We take the first difference of the variable to correct for non-stationarity.

The ratio of GDPs is the dependent variable for our first two models. The third model tests the effect of FMFs on tax revenues. In this model, the dependent variable is the first difference of the growth rates in real tax revenues for the State of Texas. Again, we choose the specific form of the variable in order to correct for non-stationarity.

The regressor of primary importance in all three models is the growth rate in the ratio of FMFs to the Gross State Product (GSP). It is present in all three models we build and our goal was to isolate the nature of its relationship with the dependent variables. We chose the ratio of FMFs to GSP rather than the gross amount of FMFs spent in any given year following the results of previous work on government expenditures by Barro (1991). Note that we use both FMFs and GSP in gross, not real, numbers. Both numbers refer to money spent in the local Texas economy, thus they should be deflated using the same price index. Using the same deflator index for both numbers would cancel in the ratio and yield the same result as taking the ratio of the gross numbers.

In assessing the effect of FMFs on economic growth, we built two models. One looks at the relationship between current FMFs expenditures and current relative GDP growth and the other includes indefinite lags of the FMFs variable, testing the hypothesis that those expenditures introduce lasting distortions in the state economy. In estimating their effect on tax revenues, we built a model that depicts the relationship between current federally funded expenditures and current real taxes. We also test the hypothesis that FMFs have a lasting effect on tax collection by considering another indefinitely lagged model. The lags are highly insignificant, however, which lead to the conclusiong that FMFs do not have lagged effects on tax revenues. Thus, we only consider the immediate effect model. Lastly, we transform the variable by taking the growth rate to correct for non-stationarity.

Following Sala-i-Martin et. al. (2004) and Barro (1991), we include measures of human capital and government spending in our model. However, these variables are not statistically significant and are not present in the final model. We believe the model fails to find these variables significant because of the special relationship between Texas and the United States as a whole as discussed below.

We use high school and college graduation rates as measures for human capital, which do not differ significantly between Texas and the nation as a whole. Moreover, as opposed to being an independent country, Texas is just one part of the United States and as such it is highly influenced not only by its own graduation rates, but also by the national averages because of the free movement of labor. This free movement of labor, and hence human capital, is not present on the international level, which would explain the difference in the empirical results. Additionally, we believe proxies for government expenditures are not significant because Federal Government expenditures not only affect the US economy in general, but also affect the Texas local economy. However, there exists no reliable and meaningful way in which we can compare the goals and results of Texas state government fiscal policy and Federal fiscal policy. Previous research was conducted with data obtained from sovereign countries, where fiscal policy and human capital are independent of each other across the sample. In this case, however, the two are interdependent due to the special nature of the relationship of Texas and the United States, as one part of a bigger whole. This difference in the entities for which the data was collected explains the divergence in the empirical results.

In the case of the other control variables, we correct for the interdependence of Texas and the national economy by using the differences in one of the major coincident indicators: industrial production. Using information from the Federal Reserve System, we have included comparative industrial production growth in our model as a control variable. The comparative industrial production variable is the difference of the growth rate of the Texas Industrial Production Index (Berger and Long 1989) and the growth rate of the US Industrial Production Index (Federal Reserve System Board of Governors.) This variable controls for the effect of Texas's industrial activity growing at a different pace than the national average. Macroeconomic theory predicts such deviations should help explain differences in the growth rates of GDP. While each of the indices taken separately is non-stationary, taking the difference in their growth rates takes advantage of their co-integrated relationship and removes the non-stationarity problems.

Lastly, the model estimating the impact on Texas's local tax revenues includes the first difference of the growth rate of Texas real GSP. The reasoning behind including this variable is that a bigger local economy would be able to support larger state government budget and taxes. First difference and growth rates were taken to correct for non-stationarity.

The models to be estimated are:

$$Y_t = \alpha + \beta_1 F_t + \beta_2 (P_T - P_{US}) + \rho u_{t-1} + u_t \quad (1)$$

$$Y_t = \alpha + \beta_1 (F_t + \lambda F_{t-1} + ... + \lambda^t F_1) + \beta_2 (P_T - P_{US})_t + \rho u_{t-1} + u_t \quad (2)$$

$$T_t = \alpha + \beta_1 F_t + \beta_2 G_t + \beta_3 (P_T - P_{US}) + \rho u_{t-1} + u_t \quad (3)$$

Data on all variables was collected from 1963 to 2006, except for the Industrial Production indices which are available only starting 1970.

Detailed description of the variables can be found in the table below.

Y_t	First difference in $\frac{GDP_T}{GDP_{US}}$, where GDP_T is the per capita real GDP of Texas in period *t* and GDP_{US} is the per capita real GDP of the US in period *t*
F_t	Growth rate of the ratio of Federal Matching Funds in Texas's budget and Texas Gross State Product from period *t-1* to *t*
P_T	Growth rate in Texas Industrial Production Index from period *t-1* to *t*
P_{US}	Growth rate in the National Industrial Production Index from period *t-1* to *t*
T_t	First difference in the growth rate of total real Texas state tax revenues from period *t-1* to *t*
G_t	First difference in the growth rate of Texas real GDP from period *t-1* to *t*

4. Results

The results of ordinary least-squares estimation of equation (1) using White's Heteroskedasticity Consistent Standard Errors appear below in table 1. The results of two stage least-squares estimation of equation (2) appear in table 2, and the ordinary least-squares estimation of equation (3) appear in table 3 below.

Table 1: Results of OLS estimation of Equation (1)

$Y_t = \alpha + \beta_1 F_t + \beta_2 (P_T - P_{US}) + \rho u_{t-1} + u_t$			
Coefficient	**Estimate**	**Standard Error**	**P-value**
α	0.009	0.0087	0.3060
β_1	-0.1700	0.0753	0.0309
β_2	0.3399	0.0862	0.0004
ρ	0.5385	0.1475	0.0009
Observations	36		
R- squared	0.5829	F-statistic	14.9091
Adjusted R-squared	0.5438	P-value (F-statistic)	0.0000
S.E. of Regression	0.0237	Durbin-Watson stat.	1.8057

Table 2: Results of TSLS estimation of Equation (2)

$Y_t = \alpha + \beta_1 (F_t + \lambda F_{t-1} + ... + \lambda^t F_1) + \beta_2 (P_T - P_{US})_t + \rho u_{t-1} + u_t$			
Coefficient	**Estimate**	**Standard Error**	**P-value**
α	0.0024	0.0065	0.7115
β_1	-0.1863	0.0599	0.0044
β_2	0.3520	0.0831	0.0002
λ	0.7048	0.2875	0.0210
ρ	0.3569	0.2430	0.1535
Observations	32		
R- squared	0.6558	F-statistic	12.8589
Adjusted R-squared	0.6048	P-value (F-statistic)	0.0000
S.E. of Regression	0.0227	Durbin-Watson stat.	1.9288

Table 3: Results of OLS estimation of Equation (3)

$T_t = \alpha + \beta_1 F_t + \beta_2 G_t + \beta_3 (P_T - P_{US}) + \rho u_{t-1} + u_t$			
Coefficient	**Estimate**	**Standard Error**	**P-value**
α	0.0051	0.0057	0.3818
β_1	-0.1522	0.0750	0.0511
β_2	1.1819	0.2061	0.0000
β_3	0.3989	0.1823	0.0364
ρ	-0.4781	0.1709	0.0088
Observations	36		
R-squared	0.6369	F-statistic	13.5960
Adjusted R-squared	0.5901	P-value (F-statistic)	0.0000
S.E. of regression	0.0452	Durbin-Watson stat.	2.0959

Notice that the estimates of the coefficients and standard errors of the same regressors in the different models are very close to one another. This shows stability in the overall choice of the theoretical framework on which the empirical models are based. Finally, notice that there is an autocorrelation of the first order correction in every equation. In Equation (1) and (3) those corrections are induced by formal empirical autocorrelation tests, while in Equation (2) the correction is included due the special theoretical nature of the indefinite lag model.

The estimate of β_1 in Equation (1) indicates that a 1 percent increase in the size of the FMFs relative to Texas's GSP is associated with a decline of 0.0017 in the rate of growth of Texas real GSP per capita with respect to the US real GDP per capita. Thus, every 1 percent increase in matching funds corresponds, on the average, to a 0.17 percent slower relative growth in Texas's per capita GSP. This negative relationship between FMFs and state living standards is predicted by theory and supports the earlier hypothesis. As found by Strouse and Jones (1974), federal grants in general are almost exclusively used to fuel government consumption spending which, as already shown, has a well-documented negative relationship with economic growth. In addition, the latest Texas State Budget supports these findings: Over 60 percent of FMFs are expended on public consumption.[2] Moreover, obtaining FMFs involves substantial lobbying efforts by state officials and continued attention and maintenance expenditures on federally funded projects. Such actions are likely to disrupt the normal operations of the state government and limit its ability to handle fiscal policy in the best interest of the state economy. Both of these concerns are borne out by the data, as the negative relationship between the FMFs and average state incomes in Texas is highly significant.

Lastly, the estimate of β_2 shows that, on average, every 1 percent faster industrial production growth in Texas relative to the national average corresponds to a 0.34 percent increase in the relative growth rate of the state's per capita real GSP. This result is also intuitive, since faster growing industrial production corresponds to economic booms. It is logical that at times of higher relative economic activity the per capita average of Texas grows faster than the national average.

The estimates of Equation (2) tell a similar story. All coefficients have a comparable degree of significance and, most importantly, direction. While the actual numbers differ slightly, it is the case that faster industrial production and slower growth in the FMFs correspond to a faster relative growth in Texas per capita GSP. Since the nature of those results has already been discussed above, we focus our attention on what makes Equation (2) different from Equation (1).

Equation (2) tests the hypothesis that past values of the relative size of FMFs affect the relative growth of average state income in the current period. The hypothesis is largely based on the theory that FMFs fuel distorting governmental expenditures that place a burden on the state of Texas for numerous years to come. This hypothesis is tested by indefinitely lagging the variable representing the relative size of the FMFs. The coefficient of geometric decline of the

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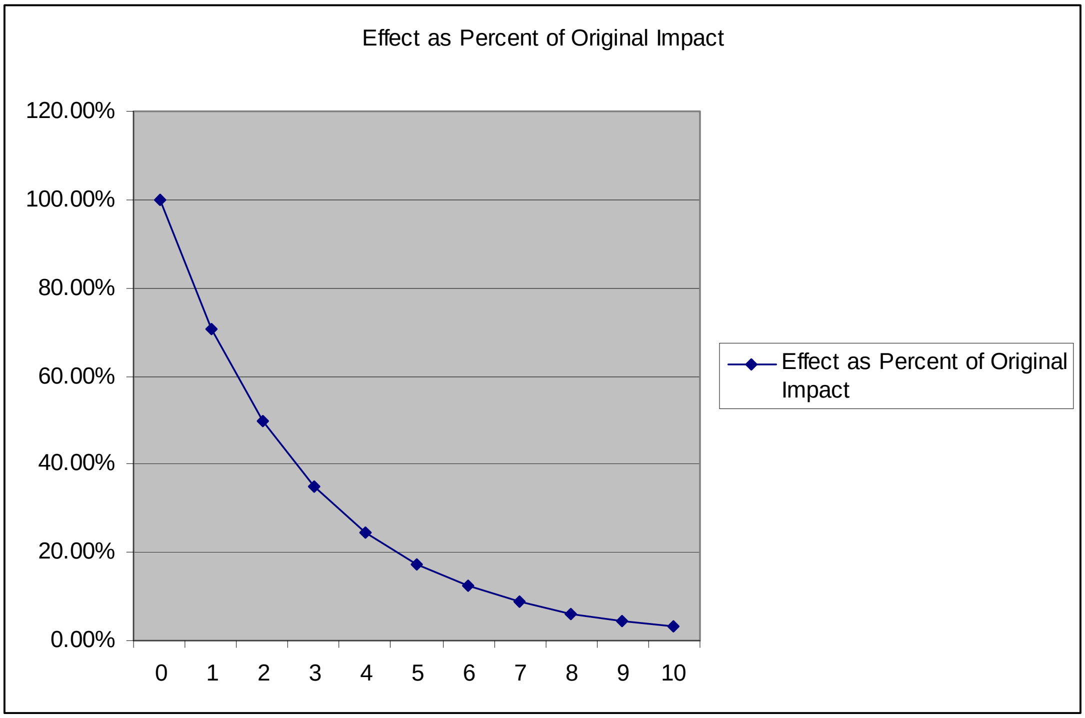
[2] Texas. Legislative Budget Board. Fiscal Size Up 2008-2009. Mar. 2008. 7 Apr. 2008 <http://www.lbb.state.tx.us/Fiscal_Size-up/Fiscal%20Size-up%202008-09.pdf>.

importance of past Federal money is represented by λ. The estimate suggests that the association of the growth of the relative size of FMFs in the previous year with the relative GSP growth this year is 70.48 percent of the current year association. Since a 1 percent increase in the growth rate of the relative size of the FMFs today is associated with a 0.1863 percent decline in the relative per capita GSP growth, one can see that a 1 percent growth in FMFs last year is then associated with a 0.1313 percent decline in the relative GSP growth rate today and so on. See table 5 for a detailed list of the relationship between past FMFs growth and current period relative per capita GSP growth.

Table 5: Decline of the Impact of past FMFs (in percent of current period impact)

Year	Percent of Original Impact
t +1	70.47%
t +2	49.66%
t +3	35.00%
t +4	24.66%
t +5	17.38%
t +6	12.25%
t +7	8.63%
t +8	6.08%
t +9	4.29%
t +10	3.02%

Graph 1: Diminishing Negative Effect Over Time



Lastly, Equation (3) tests the hypothesis that the relative size of FMFs is negatively associated with local tax revenues. It estimates the effect of the growth in FMFs in the current period on the real tax revenues of the state government in the same period, under the theory that the state government may preoccupy itself with collecting federal money and neglect local revenue streams. Moreover, FMFs augment the state's spending, which expands the size of the public sector of the economy at the expense of the private sector.[3] By crowding out private enterprise, the state of Texas would undermine its main revenue source—the sales tax. Through increased attention to federal lobbying efforts and a more sluggish and less private economy the local tax revenues stream should get weaker. Equation (3) is an empirical test for this hypothesis.

The estimate of β_1 supports the above-mentioned theory and suggests a negative relationship between the growth in the relative size of FMFs and the state's tax revenue growth.

[3] Refer to Kormendi and Meguire (1986 and 1990) findings on the effect of increased government spending

More specifically, it indicates that a 1 percent faster growth rate of the relative size of FMFs is associated with a 0.15 percent decline in the rate of change of the growth of the state's tax revenues. Thus, growth of the size of FMFs corresponds to a decline in the growth of the state's tax revenues. It is important to note that this model suggests an immediate effect of current FMFs on current tax revenue. Note that the sign of the coefficient was predicted by the theory.

The estimate of β_2 suggests that a 1 percent increase in the rate of change in the growth rate of the real GDP of Texas corresponds, on average, to a 1.18 percent increase in the rate of change of the growth in tax revenues. This is intuitive, since we would expect that a stronger local economy would increase tax revenues. Increases would come from larger sales taxes that would follow the increase in business activity and also larger property taxes, as asset prices tend to inflate during economic upturns.

Third, we find that a 1 percent increase in the difference of the growth rates of the industrial production in Texas relative to the overall industrial production of the United States is associated with a 0.40 percent increase in the rate of change in the growth of real tax revenues for Texas. This is also intuitive, as increased business and industrial activity would translate into higher tax revenues.

Following the estimation of the models, it is necessary to account properly for the direction of causation between the variable of interest, FMFs, and Texas per capita GDP and tax revenues. As shown by Barro (1991) and Sala-i-Martin et al. (2004), the relative size of government consumption expenditures has significant negative impacts on future economic growth. The underlying theory is that the government creates distortions in the economy by taking money away from its citizens and spending it in ways that fail to optimize economic growth. Public investment is typically aimed at fixing certain market failures, which would be beneficial to growth, something not true of government consumption expenditures, which are investments in intangible social welfare, such as equity, and whose benefits are not quantifiable nor empirically testable. Whether or not it brings high intangible benefits, however, the fact is that such government actions make its subjects poorer in real money terms. As previous research suggests, it is the case that FMFs are associated with sharp increases in state government consumption expenditures. This is especially true in the case of Texas, where the bulk of the FMFs go toward welfare programs. For example, more than 60 percent of total FMFs were allocated to government consumption in the latest Texas state budget. Thus, general economic theory suggests that increasing the relative size of FMFs would decelerate the economic growth of the state economy relative to the national economy due to the aforementioned distorting effects of increased government consumption.

One can further analyze the effects of increased FMFs expenditures by examining the specific government expenditures they support. According to state budget reports, the great majority of FMFs go towards the so-called Article IV programs: spending on welfare. At the individual level, increasing welfare expenditures has the effect of softening the blow of being laid off, but on the macroeconomic level it increases the size and average length of unemployment. It acts as unemployment insurance and decreases the costs individuals bear while unemployed. Economic theory postulates this is a negative influence on aggregate economic growth. The lower the cost of unemployment, the smaller the effort people put towards finding a new job, leading to the average unemployed person staying unemployed longer. Consequently, this decrease in labor availability has a negative effect on the state economy. Furthermore, increasing welfare expenditures as part of a long run government policy would lower the desire to find work not only in the current period but also in the periods to follow. It would introduce a structural change to the regional economy by fundamentally altering the incentives faced by the unemployed. The fact that increasing FMFs expenditures have been the rule for the last three decades would explain the high significance of lagged effects in Equation (2).

It is important to remember that both models estimate the impact of the FMFs on GSP but also control for the relative expansion of the industrial production. This suggests that FMFs expenditures have a significant negative impact on the service sector, which is hardly surprising. As was already discussed, the majority of FMFs go towards Article IV programs, entitled "Health and Human Services" and naturally focus on providing public services. Economic theory predicts that such provisions of public services might have a negative effect on the private service sector via crowding out. Governments are not concerned with profit maximization or low-cost production and command the power to greatly subsidize the production of goods and services. While it is generally inefficient to utilize public production of goods and services, they frequently end up priced lower than average market prices due to both the financial power of government and its productive inefficiency. Thus, if the state government does not exercise utmost care in choosing how and where to spend under Article IV, it could end up substituting Federally subsidized, inefficient, government-provided services in place of efficient, private service-sector-provided services. This theory is borne out by the data, as our results show a negative relationship between FMFs expenditures and relative GSP growth after controlling for the differences in industrial production. This suggests a crowding out effect on the private services sector.

Additionally, FMFs might tie the hands of the local legislature. FMFs contracts are accompanied by binding clauses requiring state governments to spend a fixed amount of their local revenues on the funded projects for operation and maintenance expenditures. Thus, more

FMFs in the budget translate into tying up more of the discretionary tax revenues of the state with specific long-term projects. For example, more than 85 percent of the total local tax revenues in 2008/2009 were dedicated funds (both federally and otherwise restricted funds) and thus not available for discretionary policies. This decreases the autonomy of the state government, as it finds itself with a reduced amount of discretionary tax revenues. This might limit the Texas state government's ability to carry out discretionary fiscal policy to the benefit of the state economy, as it would not have full freedom of action to optimize its expenditures given the state of the economy. Thus, theory also suggests that increasing the relative size of FMFs in the state budget could cause slower economic growth through poor fiscal policy execution.

It is important to also consider the other side of the story: the possibility that the state of the regional economy drives the relative size of FMFs. This is the case where the causation behind the observed negative relationship goes from GSP growth to FMFs growth. It is plausible that this negative relationship is due to increased federal assistance during economic downturns as a way of automatic stabilization of the regional business cycle. This scenario is highly unlikely, however, as securing new FMFs contracts is a long ordeal for every state government. Even if the Texas economy is in a slight recession in a given year, by the time they receive new federal money, the economy would already be on the rise due to the natural developments of the business cycle. The timing difficulties make it is extremely unlikely that the government tries to engage in such a stabilization policy.

Equation (2) shows that past increases in the relative size of FMFs are negatively correlated with future economic growth. Increases as far back as ten years are shown to be negatively associated with GSP growth. This lasting effect lends more support to the theory postulating that FMFs cause government actions to distort the local economy. Only such structural distortions could still be felt ten years later, as stabilizing fiscal policy tends to have strictly short-term effects. Moreover, running a Granger Causality test shows that growth in FMFs causes the decline in relative GSP growth. We believe this exhaustive analysis of the theory postulates that the causation goes from FMFs growth to relative GSP growth decline.

Lastly, it is important to consider the direction of causation for Equation (3) as well. The Texas government has two different general sources of revenue and the revenue streams coming out of each source are proportional to the efforts and attention paid to each. This would suggest that increases in the size of FMFs (through increased lobbying efforts) would inevitably cause a decline in the collection of local tax revenues, just as the data shows. Moreover, the actual spending of FMFs has been shown to decrease the private service sector (Equations (1) and (2) suggest a negative crowding out effect on the private service sector), leading to negative effects for the economy. The decline in the private sector damages local government tax revenues by providing a smaller base for the sales tax, the most important independent source of tax revenue in Texas. Thus, the crowding out effect of increasing FMFs expenditures deteriorates the tax base and has a negative effect on the growth of taxes. Therefore, theory suggests that both the attempts to secure more FMFs and the actual spending of FMFs would have negative effects on tax collections. As demonstrated above, these theoretical predictions are supported by the data.

On the other hand, one could argue that rather than tax revenues being driven by FMFs, tax revenues drive the FMFs disbursements. Legislatures might try to supplement weak income in certain years with increased amounts of FMFs. This argument does not stand close scrutiny, however, because of the long period of time required to close a new deal with the federal government. It can take several years to secure a FMFs contract and it takes even more time for the money to actually be appropriated and spent. Current governments also have little effect on current tax revenues as those tax revenues are function of past stewardship. Thus, while any legislature would indeed wish to supplement weak years with FMFs, it would not be able to do so because of the time frame of closing such contracts. Lastly, a formal Granger Causality test also suggests that FMFs do cause the movement in the growth in taxes (significant at 0.07 level.) Therefore, the causation direction is very unlikely to be from tax revenue to FMSs.

The theoretical verdict in this case is again that the relative size of FMFs drives state tax revenue rather than the other way around. Now that we have established a rigorous theoretical basis for the direction of causation, it is time to look at the actual forecasts of the different impacts. We have used the coefficient estimates and their standard errors to calculate 90 percent and 95 percent confidence bands for the estimated impact of the main variable, the growth of the relative size of the FMFs.

Table 6: Summary of Estimate Results

	Mean Estimate	Lower 90%	Upper 90%	Lower 95%	Upper 95%
Equation (1)	-0.17002	-0.297308	-0.042736	-0.323066	-0.0171285
Equation (2)	-0.18632	-0.287714	-0.08492	-0.308233	-0.0645211
Equation (3)	-0.15219	-0.278962	-0.025414	-0.304616	9.04E-05
Lambda [Eq.(2)]	0.704782	0.218932	1.190632	0.1206125	1.2883766

This summary of the results suggests that the effect of 1 percent increase in the relative growth in FMFs can cause as much as a 0.297 percent decline in the relative growth rate in average income for Texas. Moreover, the negative effect of increasing the FMFs might continue to echo through the economy indefinitely. The upper 95 percent confidence estimate for λ suggests that the true coefficient could be 1, which implies there is no decrease in the negative effect of FMFs over time. If that is the case, instead of diminishing, the negative effect of this year's increase in FMFs expenditures will be the same for this year and for one hundred years from now. This is a sobering possibility, because it suggests that the negative effects of the FMFs are not only lasting, but could cause close to irreparable structural damage to the local economy. The negative effect of increasing the growth rate of the relative size of FMFs can cause as much as a 0.279 percent decline in the growth rate of tax revenues. A decline in the growth rate would affect not only current tax revenues, but also future tax revenues by decreasing the tax base which they can draw upon.

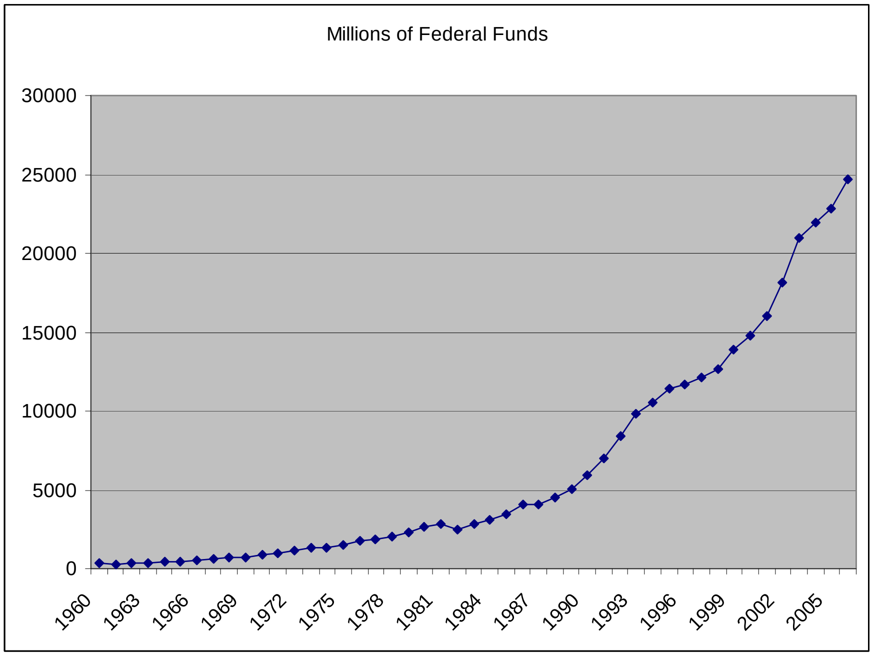
5. Conclusion

The purpose of this analysis was to empirically estimate the size and nature of the theoretically suggested negative impact of FMFs on the state of Texas's economic growth and tax revenues. The data strongly supports both of these theories and this has numerous implications for public policy at the state level in Texas.

Both theory and data conclude that FMFs have a significant negative impact on the relative growth rate of Texas's per capita GSP. While most state legislators in the United States seem to regard FMFs as free money for their state budgets, this analysis shows that this is certainly not the case. By introducing lasting structural distortions in the local economy, increased FMFs actually decreas economic growth. The optimal fiscal policy for the Texas government would then be to abandon most efforts to receive FMFs and focus instead on state issues.

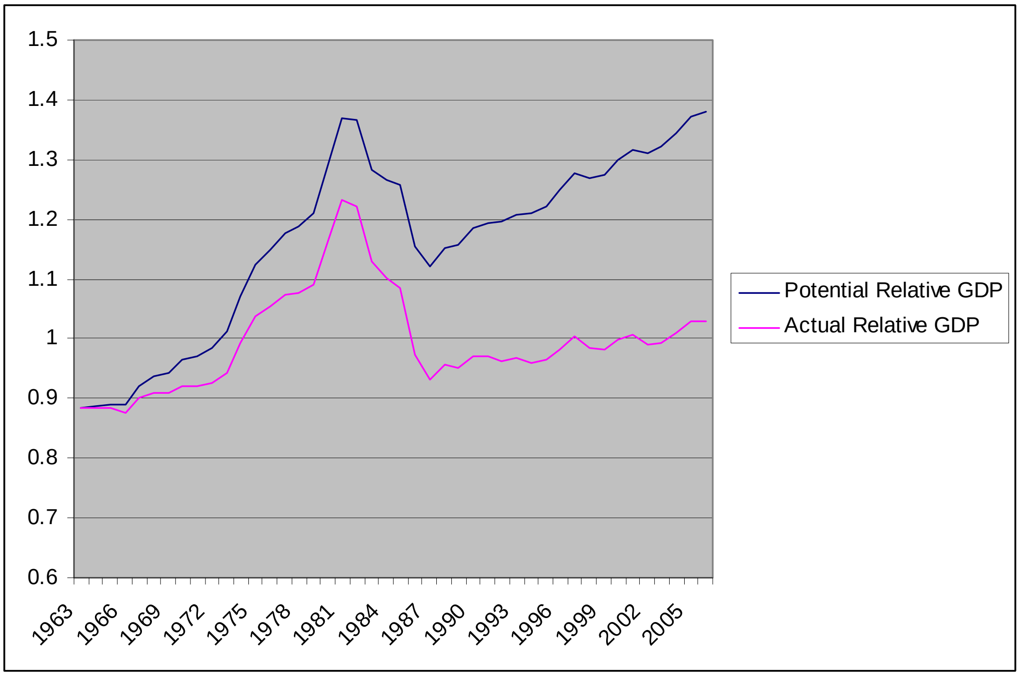
Moreover, from Equation (2) we find that increases in the relative size of FMFs has prolonged negative effects on economic growth, rather than only immediate ones. In fact, it is the case that the full impact of an increase in FMFs today may not be felt for as long as twenty or more years (and much long in the worst-case scenario.) This finding has a very interesting implication for the state legislature of Texas, as it seems that any given government would never be held responsible for the full extent of its actions. Politicians in office today would act so as to maximize their and their voters' welfare in the short-run, as they would certainly not plan to hold office for as long as twenty years. Thus, even if the current legislature is fully aware of the negative effects of appropriating FMFs, they will act so as to get more than the optimal amount of FMFs during their stay in office because part of the negative effects would be transferred to future legislatures. This implies the existence of an externality problem because the decision makers do not bear the full cost of their actions. It seems to be the case that current politicians maximize FMFs to carry out certain parts of their political agenda, as they bear only the partial cost of their policy decision. The incentives for this behavior stem from the fact that the political benefits from publicly signing large a new FMFs contract are immediate, while the costs are distributed over time and largely hidden in slower growth. Therefore, any politician signing a new deal gets all the benefits but bears only part of the cost. This state of affairs suggests that at any given point, politicians would want to appropriate more than the optimal amount of FMFs. This peculiar feature of FMFs might explain their starkly upward trend through time. In fact, despite their strikingly negative effect on economic growth and prosperity, the relative size of the FMFs has grown exponentially through the last forty years in Texas, as could be seen from graph 2.

Graph 2: Annual Appropriations of Federal Funds

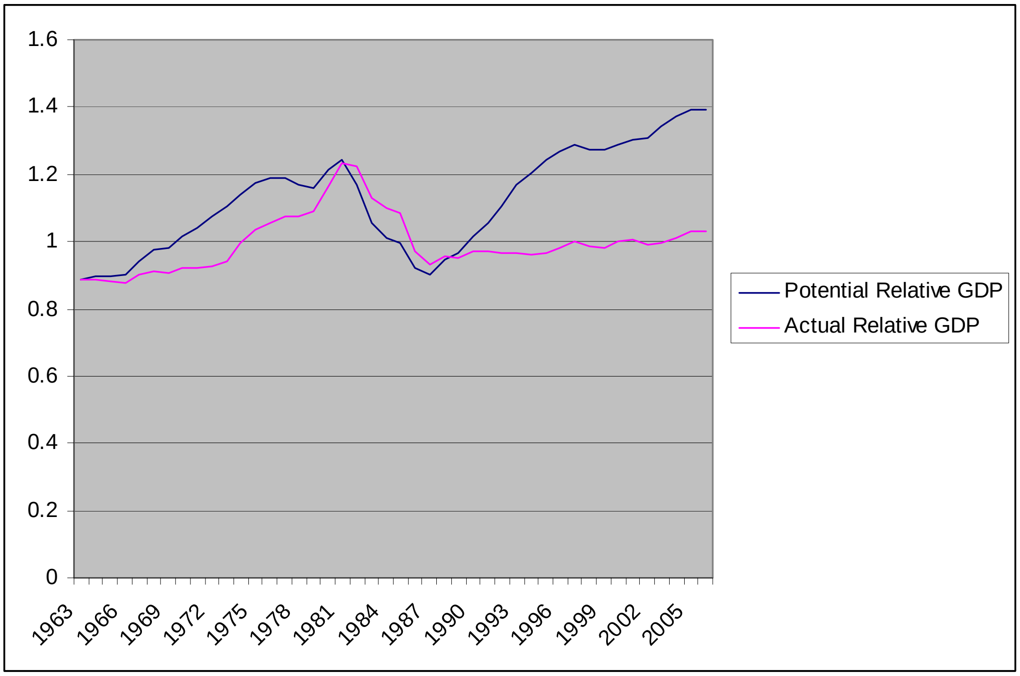


In fact, the average rate of increase in the relative size of FMFs from 1963 to 2006 has been 1.4 percent per year. Using the mean estimates from Equation (2), one can construct a rough estimate of the impact of each year of 1.4 percent increases in FMFs on the Texas economy. If we simply sum up the lifelong negative effects of each annual increase, we determine that each 1.4 percent annual increase reduced relative GSP growth by 0.63 percent. If this estimate is used, it is easily seen that if the FMFs had not grown over the last forty-four years, the average real per capita GSP in Texas could have now been 26.28 percent higher relative to the national average. In other words, it could have been as much as $9,900 higher (based on 2006 U.S.'s real GDP per capita of $37,832.) The attentive quantitative mind would notice, however, that this estimate is severely biased downwards because we have the applied algebraic sum of effects, while the growth rates have exponentially growing effects. A more rigorous analysis can be constructed by both accounting for the geometric growth and by using the actual growth rates of FMFs and GSP for those years. Approaching the problem in this way would also yield the most accurate forecast of the actual damaged caused by the past actions of Texas legislatures. Using the actual growth rates, it turns out that the growth in FMFs has decreased Texas real GSP per capita by about 35 percent, or $13,600. The graphs below summarize the results.

<u>Graph 3: Potential GDP given federal funds grew at 1.4 percent annually</u>



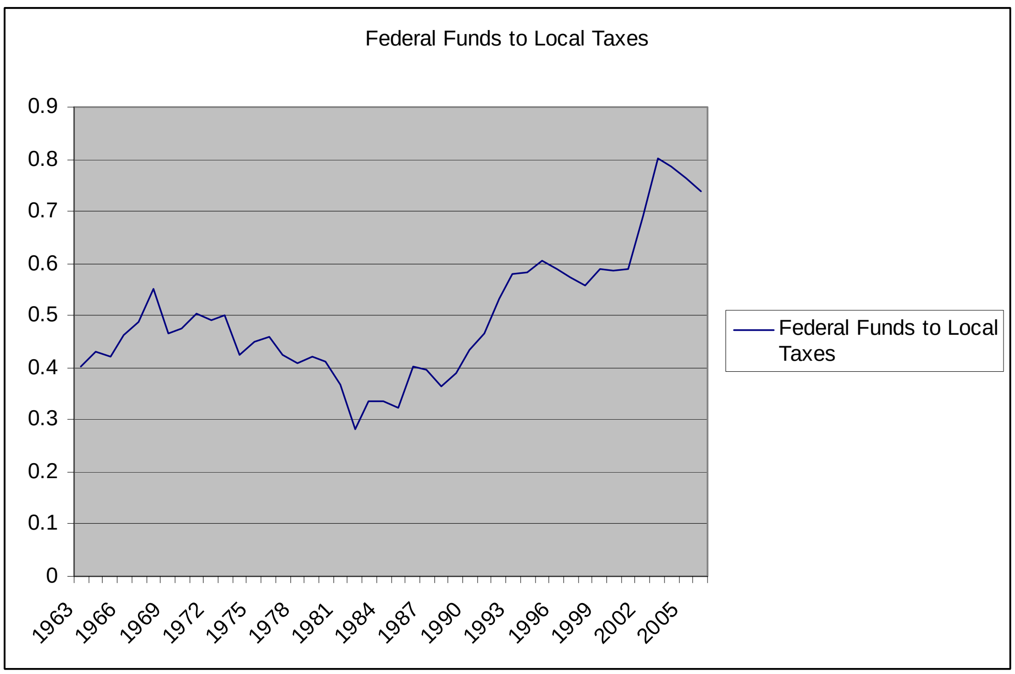
Graph 4: Potential GDP given actual Federal Funds growth rates



Tax revenues have also been negatively affected by the increasing size of the FMFs. In fact, this situation exhibits externality problems as well. Both current tax revenue and current FMFs are functions of past efforts and decisions. Tax collection in the current period is largely determined by past policy and tax stewardship and the current government has little control over it in the short term. Similarly, FMFs contracts are negotiated for prolonged periods of time and it is not unusual for several years to elapse between first initiating contact with the federal government and actually expending the money. The negative effects on the budget of increasing FMFs today might not be fully felt until the next legislature is elected. Thus, by making short-sighted decisions, current legislatures can pass budget problems down to future legislatures. Moreover, future legislatures can look for quick solutions to such problems by further increasing the size of FMFS and thus only augmenting the problem and passing it off to other future legislatures. This game of “hot potato” is another reason for the sharp increase in FMFs over the previous forty years. The consequence of not bearing the full costs of their decisions is to cause politicians in any given period to over-appropriate FMFs.

Our analysis suggests that the Texas government faces perverse incentives to increase the size of the FMFs, despite the fact that the prudent course of action would be to decrease their reliance on federal aid. Those perverse incentives would explain the trend of increasing FMFs over time, despite their negative effects on both the economy and the state budget. The graph below provides a visual summary of the size of FMFs expenditures relative to local tax revenues.

<u>Graph 5: The Relative Size of Federal Matching Funds Over Time</u>



The questions left unanswered in this analysis are well worth pursuing in future research. The data is clear on the negative relationship between FMFs and economic growth and the underlying theory explaining the relationship is strong and clear, but at the end it is just theory. Thus, it would be worthwhile to test empirically all other conclusions of the theoretical framework. For example, the theory suggests that increased FMFs expenditures influence growth negatively due to fundamental changes in the unemployment structure in the labor force. This theoretical claim can and should be tested empirically in future research. Other theoretical suggestions, like the effects on the size of the private and governmental sector respectively and the growth of sales taxes, should also be tested. Such future studies would help determine how robust the current theory is and may be able to point to ways of improving it.

Another interesting avenue for further analysis might be to delve further into details of the exact effects of FMFs on the Texas economy on a micro level. Data could be collected both on the specific nature of the FMFs expenditures (as in how much exactly was spent on welfare , how much on health services, how it was spent, etc.) and also on specific regional industries such as service, manufacturing and so on. Such a data set could be used to break down the aggregate negative relationship between FMFs and economic growth we found into effects specific to certain industries or geographic regions inside of Texas. Lastly, our research could also be built upon by simply expanding the data set. A logical next step would be to make a panel analysis including all fifty states. Expanding both the timeframe and the cross-sections in the analysis would have a beneficial effect on the reliability of the final results.

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