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TRANSPORTATION ISSUES:

INSIGHTS FROM FLORIDA'S HISTORY

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TABLE OF CONTENTS

TRANSPORTATION ISSUES: INSIGHTS FROM FLORIDA'S HISTORY- TASK 2.2

I. INTRODUCTION

Among the various uses of history, one is to tell a story. Telling a story involves picking out main themes, weighing competing interpretations of events, and relating what happened, usually in something close to chronological order. That is not what we do here. Another role for history is to provide background on current issues, how we got to where we are, with the belief that understanding how conditions that are of concern developed is a source of insight into creating ways to improve them. That *is* the purpose of this part of our report: to use history to improve our grasp of current transportation issues by indicating their origins. We make no claim that history, and much less our interpretation of it, provides definitive lessons. We do think, however, that an historical perspective complements other approaches.

We have selected five issues that pervade current discussions of transportation in Florida. The five are: (1) highway congestion or the adequacy of transportation infrastructure; (2) related to that, whether there is a need for increased funding, especially through raising gasoline taxes; (3) the failure to protect major highways and roads from excessive local access; (4) related to that, avoiding sprawl through "smart communities;" and (5) intermodal transportation.

The salience of these issues can be illustrated from, as one of several possible sources, the *Final Report of the Transportation and Land Use Study Committee*, January 15, 1999. Regarding the adequacy of the road network the Commission states, "Information from FDOT, the Florida Transportation Commission, and the CUTR estimates a transportation funding shortfall of over $50 billion through 2010" (p. 45). Contributing to the shortfall is, "47 years of under-funding transportation needs . . ." Worried that inadequate transportation infrastructure will retard Florida's economic development, the committee recommends "a dedicated increase in state gas taxes," (recommendation #34) and that, "Counties should be rewarded if they have enacted all of their local option gas tax, enacted significant transportation impact fees, or adopted the 1-percent infrastructure surtax." For the state overall, "The Committee believes it is absolutely imperative that the state dedicate adequate funding to the FIHS [Florida Intrastate Highway System] " (p. 25).

Not only is there too little infrastructure, but much of what we have is used unwisely. "The FIHS," for example, "does not always serve an effective intercity function within urban areas" partly because of "an increasing reliance on the FIHS to serve local trips as communities develop" (p. 24). Again, "[i]n urbanized areas, much of the existing FIHS allows free and easy use by local traffic, resulting in high levels of congestion." At a smaller scale, too much access also reduces the usefulness of arterials, "Allowing excessive access on arterial roadways can severely limit their capacity" (p. 36).

The Committee also emphasized intermodal transportation, calling for "a fully integrated and interconnected multi-modal transportation system" (p. 25). In this call it continues a trend of at least a decade in state and national policy. In 1990, the Legislature expanded public transportation programs to provide intermodal access to airports and seaports. At the national level, the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 signaled a change toward integrating existing transportation models (airways, seaways, highways, and train networks) into a unified and coherent system. To achieve this end, ISTEA required metropolitan planning organizations (MPOs) to coordinate the different transportation models and state governments to incorporate the work of the MPOs into a state intermodal system.

In what follows, we discuss the five issues in turn. Section II discusses the adequacy of roadway infrastructure in Florida, emphasizing a shortfall of urban interstates compared to the rest of the country. Section III sketches a history of Florida's transportation resources and concludes by discussing raising the gasoline tax. Preliminary results indicated that less than two-thirds of the burden of the gas tax was borne by consumers, a finding with major policy implications. Because of the importance of the issue, we tested our early results with more difficult but more appropriate econometric techniques, and found they did not survive: the gas tax, it turns out, is fully borne by consumers. Consequently we relegate our extensive empirical work on the incidence of the gasoline tax to two appendices. Section IV treats the issue of excessive access, especially outside urban areas, where Florida has a shortage of collectors relative to local roads and arterials, and contains a brief discussion of "smart communities," or linking transportation and urban form. It also describes an appendix on intermodal transportation prepared for this report by Dr. Jill Herndon. Section V sketches a history of other transportation topics and concludes.

II. THE ADEQUACY OF ROADWAY INFRASTRUCTURE IN FLORIDA

Across states, per-resident total construction spending–on all types of buildings and structures, both public and private–has been higher in states with higher income per capita and also has been higher in states that are growing more rapidly. This can be illustrated with the following regression for 1986:

$$(3)\ \text{CONST} = \underset{(1.68)}{-9.55} + \underset{(0.18)}{0.98}\ \text{INCOME} + \underset{(0.26)}{2.07}\ \text{GROWTH}$$

$R^2 = 0.73$ n = 51 states

In equation (3) CONST is the log of the value of all construction contract in 1986, INCOME is the log of income per resident in 1986, and GROWTH is the percentage change in population during the 1980s. Parentheses contain estimated standard errors. The equation shows that the income elasticity of construction spending was approximately one. That is, a state with 10 percent higher income than average had 10 percent higher construction spending, other things the same. It also show that raising a state's population growth for the decade from 9 percent, the average, to 33 percent, the value for Florida, was associated with 50 percent more construction spending, other things the same. Across states, there has been a strong positive correlation between construction spending and population growth. This is true not just of 1986 but of other years as well, as is illustrated for three additional years in Table 7.

Roads, like other construction, are long-lived, depreciating slowly. As with other construction, one would expect that faster population growth would have been associated with more spending on roads. But this turns out not to be the case, as is illustrated by equation (4), also for 1986:

(4) SLROAD = -12.30 + 0.24 AREA + 0.76 POP + 1.08 INCOME - 1.07 GROWTH

(2.04) (0.02) (0.02) (0.21) (0.28)

$R^2 = 0.96$

In equation (4) SLROAD is the log of state and local spending on roads in 1986, AREA is the log of the state's land area, POP is the log of 1986 population. INCOME and GROWTH are the same as in equation (3). In contrast to equation (3), the dependent variable in equation (4) is not per capita. It seems reasonable to have total construction spending per capita be the dependent variable in equation (3) on the assumption that the value of construction spending varies one-for-one with population, other things the same. In effect, making the dependent variable the log of construction per resident imposes the constraint that the elasticity of construction spending with respect to population is one. If that constraint is removed, and equation (3) is re-estimated with the log of construction spending on the left-hand side and the log of population on the right-hand side, the coefficient turns out to be 0.94, quite close to 1.00. The constraint is reasonable *a priori* and is not strongly contradicted by the data (in 1986 or in other years).

Roads are slightly more complicated, since they not only provide space for people to travel but also link places. The larger the area of a state for a given population, the farther apart those places are likely to be. With roads, the intuitive constraint is replication. Suppose, conceptually, we found a way to divide Florida, probably along a north-south line, so that each half had 27,000 square miles and 8 million people. Then, as an approximation we would expect each half to possess half the roads. Another way of looking at it is that the land and people now known as Florida should have the same roads whether they constitute one state or, perhaps, six states, as they would if they were New England.[1] We impose the replication constraint by putting the log of road spending on the left-hand side and the logs of both area and population on the right-hand side and constraining their coefficients to sum to one in equation (4). When the constraint is not imposed, the sum of the coefficients is usually slightly less than one, suggesting slightly more funding when a given state is hypothetically split into two or more, possibly because increased relative power in the Senate boosts federal revenue sharing, or perhaps for other reasons. In any case, the data suggest that, controlling for income per capita and for population growth, the demand for road spending depends about one-fourth on area and about three-fourths on population.

With or without the sum constraint, we find in equation (4) and in similar equations for other years that total state and local road spending has an income elasticity of demand of approximately one. States with 10 percent higher per capita incomes spend around 10 percent more on roads, other things the same, not a surprising result and the same as the income elasticity of demand for all construction–the sum of houses, commercial buildings, and public infrastructure. The surprising result is that spending on roads varies *inversely* with population growth, just the opposite of spending on all construction. The negative coefficient is both statistically and economically significant. Raising the increase in population in the 1980s from 9 percent, the national average across states, to 33 percent, the figure for Florida, *reduces* state and local spending on roads by about 24 percent, other things the same.

This is a strange result. In contrast to the private sector, in which the production of long-lived assets varies positively with population growth, public spending on roads varies negatively with growth, controlling for population, area, and income. Let us assume, to make matters a little less

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[1]There is actually a reason we might expect New England, being six states with roughly the same area and population as Florida, to have more roads: New England has twelve senators versus only two from Florida. Not surprisingly, New England beats Florida in the contest for federal road funds. But we assume this is a second-order effect.

strange, that as an approximation, public spending on roads depends on current population, area, and income, but not at all on growth, either positively or negatively. Perhaps our finding of a negative coefficient simply reflects a lagged response of the political system to persistent growth, so that current spending reflects the population a few years back, which would result in a negative coefficient on the growth rate. The implied length of the political lag cannot be calculated easily from equation (4), because it depends on how road spending is split between new building and maintenance of existing roads, on the rate at which roads depreciate, and on how much right-of-way is purchased in advance and how fast the cost of road-building rises because land becomes more expensive as population density increases.

Suppose, for simplicity, we assume that spending on roads is simply *independent* of the rate of population growth, depending on, besides area, only current population and income. Does that contradict the finding, reported elsewhere in this document, that our best guess of the elasticity of population growth with respect to road capital stock is 0.4? That implies that if the value of the capital embodied in a state's road infrastructure rises by 10 percent relative to other states, that will boost its population by 4 percent relative to what it would have been otherwise. Although there is the complication that the value of the capital stock is a stock, whereas road spending in a given year is a flow variable, nonetheless the relationship would seem to contradict either an inverse relationship or the absence of a correlation between road spending and the rate of growth of population.

The seeming paradox is resolved by noting that our finding that extra road stock boosts population growth is based on a panel regression with fixed state effects. That is, controlling for everything else permanently associated with a given state–its climate, for example–the state's population will grow more rapidly in those decades in which its road capital stock rises more rapidly. The increase in its road stock may rise more or less rapidly than in other states during that decade. What matters is that it rises more rapidly in that particular decade relative to other decades, in comparison to what is happening in other states in that decade relative to other decades for the other states. If the major construction of the Interstate Highway System occurs in Florida in the 1970s, versus the 1960s in Pennsylvania, then Florida's *relatively* rapid growth will be in the 1970s and Pennsylvania's in the 1960s. Equation (4) does not imply that if Florida were to boost its road spending, the population response would be either negative or non-existent. The finding from the panel approach that it would be positive is valid.

A second seeming paradox has to do with migration. If road-building and population growth are not positively correlated across states, then both the level of service provided by the roads and the price of residential land should rise in the states that are growing rapidly relative to the states that are growing slowly. Both the falling level of service and the rising price of land should deter further migration, leading to slower growth. Yet the empirical evidence is clear that growth is persistent. Rapidly growing states, which are chiefly in the South and West, tend to keep growing rapidly. This seeming paradox can be resolved if there is a driving force that keeps growth going in spite of the rising land prices and growing congestion in the growth states.

That driving force appears to be this. As people become richer, they attach more value to amenities, in particular, living near the coast and in warmer, dryer climates. Moreover, the retiree share of the population has grown over the decades and retirees have become both healthier and more affluent, which has induced them to move to pleasant places. Technology has helped, as improved transportation and communications have in effect shrunk the country–moving no longer means separation from family and friends–and as cheaper air condition has reduced the burden of hot summers. The presence of retirees creates jobs providing services for them, inducing worker migration. A further part of the dynamics is that as people have left large cities in the Northeast and Midwest, their infrastructure and housing stock have endured. As a result, the level of service of their transportation networks has improved and the price of housing has fallen below replacement cost in many of them, inducing people to stay. As the stock of housing slowly depreciates, more people leave for high-amenity areas.

The major implication of the combination of growth-independent road funding and rising drawing power of amenities is that the most pleasant places to live become increasingly congested. A second implication is more subtle. The area of the high-amenity high-growth regions is not changing, only their population. Suppose, for simplicity, that there are two types of roads, those built as a function of area (uncongested, to link one place to another for infrequent trips) and those built as a function of population (congested, for daily commuting). As the population grows while the area remains the same in a high-amenity state, the population-linked or congested roads will become relatively scarce. The area-linked or uncongested roads will become relatively abundant. As a result, there will be a natural tendency to substitute the use of area-linked roads for congested roads. Put another way, new development will tend to sprawl. The formerly uncongested area-linked roads will serve more and more as local roads, as population-linked roads.

All of these things have been happening in high-growth, high-amenity states: land prices have been rising, roads have become increasingly congested, intercity roads have come to have characteristics of local roads, and development has sprawled. Although the discussion has not been couched in those terms, the same as been true in areas where rising productivity has been as important as amenities, Atlanta for example, in driving growth. With respect to Florida, the dynamics described have left the state with its well-documented shortfall in transportation funding.[2]

The transportation shortfall has a wide variety of aspects, of which we will consider two: roads in urbanized areas with populations exceeding 50,000, and roads in other areas. Deferring non-urbanized areas to section IV, we begin with urbanized areas. Even though they have only 14 percent of Florida's land area, these areas contain 78 percent of the state's population. Their major shortage relative to urbanized areas in the rest of the country is a scarcity of freeway lane-miles, especially interstate highways. Since the interstate system was largely federally funded, as background we begin by describing the history of federal funding.

Throughout the second half of the twentieth century, Florida received less than its per-resident share of transportation funding from the federal government, partly because funding was based on area as well as population, partly because its corner location limited through traffic, and perhaps for other reasons. Just as important, however, is that transportation infrastructure is highly durable but the allocation of federal funds was not boosted by anticipated growth. In 1950, Florida had 1.8 percent of the nation's land area in the contiguous states and also 1.8 percent of its residents. By 2000, Florida's share of land area was unchanged but its share of residents had tripled to 5.7 percent.

The consequence of the two effects, lower per resident spending and rising population share, Florida now has much less federal-funded roadway per resident than the rest of the nation. We estimate the shortfall by adjusting annual federal allocations for 1950 through 1996 for inflation and allowing for four percent annual depreciation.[3] We omit all spending before 1950, not an important omission since with population and income growth and four percent depreciation, the effect of spending before that year on current infrastructure is minor. The 4-percent depreciation, arguably a high figure for transportation infrastructure, matters more. At lower rates, Florida's shortfall compared to the nation would be larger by about 10 percent. Omitting spending after 1996 matters

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[2]Examples of the documents include the Zwick Report and the 1995 CUTR report.

[3]The data are from Bureau of Public Roads and, later, Federal Highway Administration, *Highway Statistics*, *1950* and later years. We had to interpolate 1970 and 1993.

more, and should be corrected. Doing so would probably yield about the same percentage shortfall for Florida.

To illustrate the calculation for 1987, in that year federal transportation funds to all states were $12,834 million. Florida's allotment was $505 million. Adjusting for inflation yields, in current (2002) dollars $16,667 million and $656 million. Allowing for 4-percent annual depreciation cuts those values almost in half, to $9,037 million and to $356 million. Dividing by 2002 population gives $31 per resident for the United States and $21 for Florida. Summing similar calculations over the years from 1950 through 1996, we calculate the 2002 value per resident of federally-funded transportation infrastructure to be $898 for the United States and $526 for Florida. The value for Florida is 59 percent of that for the nation.[4]

In view of this low percentage, it is perhaps surprising that Florida's 26 urbanized areas have 95 percent as many centerline miles per thousand residents as the 375 urbanized areas in the rest of the country. This figure alone would not suggest a severe relative road shortage. Of course, it does not take account of area. As noted, Florida's cities tend to spread out, having 38 percent more area per resident than those in the rest of the country. Consequently, they should have more center-line miles, not fewer. Just as important, however, is the composition of Florida's urban roads by type. The table below shows Florida's miles per thousand residents in its 26 urbanized areas compared to the 376 in the rest of the county. The numbers are weighted by population. Miami-Hialeah counts 34 times as much as Titusville.

Type of Road (miles)	Florida Relative Share per Resident (percentage)
Interstate lane	60
Other freeway and expressway lane	77
Total freeway lane	66
Principal arterial centerline	84
Minor arterial centerline	58
Collector centerline	112
Local road centerline	100

The substitution of collectors for arterials evident above is easily explained by the low density of Florida's urban development, especially since collectors are distinguished from local roads and arterials almost definitionally by daily vehicle-miles traveled.[5] The striking difference is that Florida's cities, though more than a third larger in area per capita than those in the rest of the nation, have only two-thirds the total freeway lane miles and, in particular, only 60 percent as many interstate lane miles. In the rest of the country, the interstate system plays a role in urban transportation that may be two-thirds larger per resident than in Florida. Allowing for the lower density of Florida's cities, their role in urban transportation in the rest of the country is almost twice as large.

[4] A similar analysis could be done for all state and local spending. For example, in 1987 all state and local governments spent $52.2 billion on roads. Florida's amount was $2.1 billion. Adjusting for inflation to current dollars yields $67.8 billion for all states and $2.7 billion for Florida. Depreciating at 4 percent reduces the amounts to $36.7 billion for all states and $1.5 billion for Florida, which serve as estimates of the contribution of 1987 spending to the current transportation stocks. The figure per current (2002) resident is $128 for all states and $89 for Florida. The number for Florida is 70 percent of that for the nation. Our guess is that if we were to do the calculation for 1950 through 2001 and sum, the number for Florida would also be about 70 percent that of the nation.

[5] The relative shortage of arterials may also stem from excessive allowance of curb cuts on roads that, had they been protected, would sustain enough traffic to be classified as arterials.

This shortfall is of sufficient significance to be worth documenting more fully than in the simple per-resident comparison in the short table above. Consequently, we have prepared two additional tables based on (1) regressions analyses and (2) on maps. We used log-log regressions of various types of roads on area and population for the nation's urbanized areas, then express Florida's urban lane-miles (interstates and other freeways) or centerline miles (arterials, collectors, and local roads) relative to the values predicted from the regressions. The results, shown in the first of the two tables, confirm the picture in the brief table above.

For the second of the two tables, we ranked the 401 urbanized areas by population. The we compared each of the 26 areas in Florida to the one above it and the one below it on a map. The exercise shows that largest urbanized areas in the rest of the country are more likely to enjoy the services of three interstates, two parallel and a third crossing them, or to have a beltway. Intermediate urbanized areas in the rest of the country are more likely to have at least two interstates crossing, instead of a single interstate as in Florida. Interestingly, the relatively few comparisons in which an urbanized area in Florida has more interstate lane miles than a comparison city involve a city in another rapidly-growing state.

Besides rapid growth, the coastal location of many of Florida's cities may deprive them of interstate lane miles. We test this idea with a regression using 1999 data for the 401 largest urbanized areas in the country:

(5) INTERSTATE = -0.46 + 1.01 AREA + 0.39 POP - 0.60 COAST

(0.36) (0.16) (0.14) (0.20)

n = 400 urbanized areas (one is missing data on lane miles)

In equation (5), INTERSTATE is the log of interstate lane miles, AREA is the log of urbanized land area in square miles, POP is the log of population, and COAST is a dichotomous variable that takes the value one if the urbanized area is on the coast and zero otherwise.[6] The regression suggests that a doubling of area is associated with twice the interstate lane miles, that a doubling of population is associated with about 40 percent more lane miles, and that coastal location is associated with about 60 percent fewer lane miles. Since 17 of the 26 urbanized areas in Florida are on the coast, compared to 42 of 375 in the rest of the country, this effect explains a good deal of the interstate shortfall in Florida's urbanized areas.[7]

In sum, Florida has a shortage of roads relative to the rest of the nation because the state is rapidly growing and perhaps because it is coastal. In the United States, the rate of growth did not affect road funding, except through the resulting current populations, at the state level (unless negatively) with respect to either state and local or federal funding. (The categories, federal and state and local are intertwined, of course.) Another cause may be its non-central, coastal location. The result has been that in the federal interstate funding boom, Florida's urbanized areas lost out. They are not able to make the same use of interstate highways as are urbanized areas in the rest of the country. There has been modest compensation in induced spending on other types of roads in compensation, but not enough to avoid increasing congestion. Another consequence of having fewer

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[6] Tobit was used to estimate equation (5), since there are no urbanized areas with negative interstate lane-miles. The log of zero was taken to be zero, making zero miles indistinguishable from one, a good enough approximation. There were 100 censored observations.

[7] It does not account for it fully, however. If a dichotomous variable for Florida is added to equation (5), its coefficient is significantly negative and quite large in magnitude at minus 0.74 (0.31), and the coefficient of coast declines in magnitude to minus 0.41.

parallel and crossing interstates relative to cities in the rest of the country, and thus more reliance on a single interstate running through an urbanized area, has been less centrality in urban form, or more sprawl.

III. REVENUE FOR TRANSPORTATION INFRASTRUCTURE

In 1940 at seven cents per gallon, Florida citizens paid one of the highest state motor fuel taxes in the pre-World War II nation. The tax was divided into the first gas tax of four cents per gallon, the second gas tax of two cents, and the seventh cent gas tax. Proceeds from the first gas tax were allocated to the State Road Department for general expenditure, while the second and seventh gas taxes were distributed to counties according to distinct formulas. In 1942, the Legislature included the second gas tax apportionment formula in the state constitution. Section 16 of Article IX stipulated that motor fuel tax funds were to be allocated to counties based on the proportion of each county's population, of each county's area, and of each county's share of tax collection in 1931 to total state motor fuel receipts.

In 1932 the Legislature passed the seventh cent gas tax to provide debt relief for the counties. Previously, many Florida counties had issued bonds to finance road construction, and during the depression faced difficulty meeting financial obligations. Twenty percent of each county's share of the seventh cent funds was allocated for retiring debt. As counties paid off their debts, they became eligible to use the proceeds of the 20 percent share for building roads. After the addition of the seventh cent, forty years would pass before the state gas tax was changed.

During the Florida land boom of the 1920s, the State Road Department built roads to accommodate the influx of settlers. The depression of the 1930s, however, deprived the Department of the resources needed to repair and replace the aging road infrastructure. Following the outbreak of World War II, the federal government rationed gasoline, tires and automobiles and restricted state highway construction to the access roads for new military bases. That is, both the demand for and the supply of transportation were curtailed. The State Road Department accumulated a budgetary surplus of over $13 million by war's end. At that time, the Legislature allocated an additional $17 million for roads, providing a head start on post-war construction. But the surplus proved insignificant compared to spending in subsequent decades.

In the 1950s and early 1960s, the allocation of Florida's road spending was arguably distorted by imbalanced political representation. At the beginning of the 1960s, less than 15 percent of the population elected a majority of members of both the Florida Senate and House. Only after the Supreme Court mandated reapportionment could southern counties redress the imbalance of political power.

Reapportionment of the Legislature in 1967 affected high development strongly, though indirectly. This can be seen most clearly in the disbursement of the seventh-cent tax funds. Since 1932, proceeds from the seventh-cent had been distributed based on a formula that gave equal weight to the proportions of a county's size, amount of seventh-cent tax collections and total road mileage in 1931. While the peninsula underwent phenomenal population growth, highway funding became increasingly distorted to the rural panhandle counties, many of which had a well-developed road network in 1931. In effect, the seventh-cent tax formula transferred funds from the rapidly growing southern counties to the relatively static northern counties.

Maggiotto and co-authors (1981) support this theory by calculating hypothetical tax allocation formulas based solely on population. Contrasting the two scenarios, they note the least populous counties received over six times the funding they would have received from a per-resident disbursement. The most populous counties received 30 percent less than they would have. Following the legislative revision of 1967, the Legislature finally adjusted the seventh-cent tax to a more equitable distribution formula.

Returning to the role of the federal government in Florida's highway development, at mid-century the United States stood at the brink of the greatest road construction era in its history, the interstate system. First, background. Since the Federal Aid Road Act of 1916, the federal government has played a critical role in financing, planning, and developing the nation's infrastructure. The 1916 act initiated federal involvement in state road construction and established the patter for national road development. Prior to its passage, supporters divided along two views: one favored the construction of main arteries such as interstate highways while the other called for building capillary rural post roads. The victory of the post-road view determined that the nation's road network would begin at the farms.[8]

Toward the end of World War II, Congress expanded the federal role by enacting the Federal Highway Act of 1944. This act extended federal aid to include the farm-to-market roads and the urban extensions of primary roads. States bore some of the costs of these new highways, 50 percent for the secondary roads and 10 percent for the interstates. Also in 1944, Congress designated a National System of Interstate Highways. Funding, however, was delayed until 1956. During the Eisenhower administration, cold war fears of a Soviet attack prompted the creation of a national system of interstate and defense highways. The original interstate system stretched over 41,000 miles, had an estimated cost of $41 billion, and promised a completion date of 1972. All of these figures were repeatedly revised upward.

Florida's share amounted to over 1,100 miles of interstate highways: I-10 from Jacksonville to the Alabama border west of Pensacola; I-4 from Daytona Beach to Tampa; I-95 along the eastern seaboard; and I-75 from the Georgia border to Tampa (later extended to Naples). In accordance with the program, the state government bore 10 percent of the cost, while the remaining 90 percent came from motor fuel taxes collected by the Federal Highway Trust Fund. Construction of the interstate system progressed rapidly throughout the 1960s, with the completion of 80 percent of the original interstate mileage by 1970. The economic turmoil of the 1970s, however, slowed interstate progress to a crawl.

At the same time, the inflation of the 1970s placed FDOT in a budgetary crunch. In its 1979 annual report, FDOT reported that its composite cost index by 1979 had risen to 350 percent of its 1967 level, partly because of a shortage of petrochemical materials essential to road construction and partly because of the general inflation of those years. The gasoline tax, however, was fixed in nominal terms. As a result, inflation eroded FDOT's command over resources. The department faced a severe budget crunch.

To resolve the problem of declining inflation-adjusted revenues, state officials called for indexing the state motor fuels taxes to the Consumer Price Index. The tax would increase in step in prices overall. The Legislature, reluctant to raise taxes, instead allocated additional funds to FDOT. Although these extra funds did mitigate the funding shortfall temporarily, they did not halt the steady depreciation of real transportation revenues.

Finally, in 1983, and again in 1990, the Legislature took comprehensive action when it restructured and increased the state motor fuel tax. The state's four-cent share of the eight-cent tax

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[8]The fact that the Federal Bureau of Public Roads was created under the Department of Agriculture further illustrates the political influence of rural interests over road development.

was repealed and replaced with a statewide sales tax, whose proceeds went exclusively to FDOT. Additionally, the Legislature created the local-option fuel tax, which allowed counties to levy taxes on motor fuels. Originally, counties were limited to a tax of four cents for four years. Later the ceilings were increased to 11 cents for 30 years.

The local option gas tax, as it happens, allowed us to carry out what we think is the first definitive analysis of the incidence of the gasoline tax. Our preliminary work, as noted in the introduction, led us to believe that the pass-through to consumers was considerably less than 100 percent. That had the policy implications that the gasoline tax might be far less regressive than previously thought, if much of the burden would be placed on the owners of petroleum companies, and that much of the tax would be exported, falling on out-of-state residents. Because of the potential significance of these preliminary findings, we subjected them to rigorous testing in two ways. First, we hired UF doctoral candidate Samia Tavares to analyze the incidence of the gas tax across states. She discovered that the pass-through to consumers was only partial during the 1980s and early 1990s, but that it is now full. That is, the market has changed so that currently 100 percent of the burden falls on consumers. Second, we used both instrumental variables and panel methods to analyze the burden of Florida's local option tax across counties and cities. In contrast to our preliminary results, we found complete pass-through. The burden of the gasoline tax falls fully on consumers. Since our final results merely confirm the conventional wisdom, we relegate the analyses supporting them to appendices.

IV. INTERMODAL TRANSPORTATION, EXCESSIVE ACCESS TO ARTERIALS AND INTERSTATES, AND "SMART COMMUNITIES"

As noted in the introduction, the Florida Legislature, ISTEA, and influential participants in Florida's transportation policy-making all call for facilitating intermodal transportation. Because of the importance of this issue, BEBR hired Dr. Jill Herndon to prepare a separate report on it, which we attach to this document (Appendix C).

With respect to excessive access, more than a decade ago, Richard Stasiak and others emphasized Florida's shortage of collectors, or intermediaries between local roads and arterials.[9]

Regressing centerline miles of various types of roads subdivided into rural and urban on state population, land area, percent urban population, percent urban land area, and urban density across states, Stasiak and his co-authors estimated that Florida in 1988 had a shortage of about 8,500 miles of collectors, with the shortage being entirely rural. That is, given Florida's values for population, area, and so on, the state would be expected to have 8,500 more miles of rural collectors than it did. They attributed the shortfall to inadequate "revenue sources in both incorporated and unincorporated areas for secondary highway infrastructure supporting suburban development." The solution, they note, is to provide "better street grid systems in suburban activity centers, local street interconnections between development, and secondary highways that parallel major intercity facilities."

Trying to add to their contribution to the understanding of Florida's shortfall of collectors, we tested a number of variables across states to see whether they explained which states had more

[9] Richard Stasiak, Robert Hebert, Jr., and David Blodgett, "Local Use of the Intercity Highway System in Florida's Suburbs: Failing the Test of Suburban Mobility," Issue Paper, Economic Analysis Section, Office of Policy Planning, Florida Department of Transportation, April 1990.

collectors and which had fewer. We constructed an index of annexation, thinking that Florida's road-funding jurisdictions were misaligned with the areas collectors would serve, but found it to be insignificant. We tried the share of road funding that is bonded, thinking that collectors served largely to benefit future residents and would be approved by local governments if those future residents were explicitly designated to pay a larger share of the cost, as the bonds became due. But that, too, proved insignificant. We also tried such normal transportation-related variables as population density and income, with little success.

The one variable that proved robust across specifications and econometric methods was the rate of population growth: the higher the rate of population growth the lower the centerline mileage of collectors. Among the possible explanations for this inverse relationship, we favor two, according to two road configurations that are designated as collectors. The simpler case consists of a road that runs, say, east-west, passing through an urbanized area. Often in such cases the road is designated either arterial or collector according to its traffic volume. As the road goes past suburban developments it is a collector, picking up more and more traffic until it passes the volume threshold required to become an arterial. It may pass through the heavily urbanized area as an arterial and then at some point in the suburbs on the other side be demoted once more to collector status.

Our hypothesis for this type of road is that Florida has a shortage because Floridians tend to use the Florida Intrastate Highway System, including interstates, for the purpose such roads would normally serve. Within the largest of the states 26 urbanized areas with populations exceeding 50,000, this, coupled with the shortage of interstates, forces what would otherwise be local roads into collector status. Consequently, there is no measured shortage in those areas. In the rural areas, however, people who in more slowly growing states would use rural collectors are instead funneled onto the FIHS. Current residents are reluctant to fund the parallel roads that would be collectors because building them would simply lead to further population growth, reducing the level of service back to the original congestion, as more developments are put in place to take advantage of the new roads. Land owners and developers would benefit, but the typical voter would not.

A second type of collector occurs when access to an arterial is limited in order to raise its level of service. Instead of having a network of local roads in which each north-south road in the grid is granted access to an east-west arterial, access is granted only for every tenth, say, north-south road in the grid, which by virtue of its increased volume becomes a collector. The cost of reducing access is the extra travel required for residents on the grid of local roads to gain access to the arterial. The benefit is the improved traffic flow on the arterial. If planning is optimal, the frequency of access to the arterial would be set where the marginal benefit of greater access equals its marginal cost.

A related issue is "smart communities," a phrase that has many policy-associated resonances, one of which is coupling transportation planning with encouraging denser, less sprawling development. In many policy discussions, the tendency is to encourage denser development through regulation. An alternative is to use price incentives. If low-density development has negative externalities, then it should be taxed. For example, if people buy large residential lots, they may either cause more congestion on existing roads (since the average trip will be a longer distance) or require the construction of more roads. The purchase of a larger lot does normally lead to paying a higher property tax, while not requiring more services from the schools (except perhaps for longer bus routes) or the police (except perhaps for patrolling a larger area) or from the welfare system. To the extent that is true, the lot owner internalizes the externality.

But it may well be that the lot owner does not bear the full cost of the larger area, if the costs of providing public services rise sharply with as density becomes lower. Another consideration is the federal government's tax treatment of housing. Both the exemption of mortgage interest and the failure to tax implicit income from home ownership lead to excessive lot sizes. This could be offset at the state and local level either through regulations imposing smaller lot sizes or through taxes that change incentives. A possibility would be to set millage rates on residential land, but not structures, that rise with distance from urban centers. To the extent that land prices fall with distance from urban centers, the current system encourages sprawling settlement.

The effect of such a tax, or other change in price incentives, depends on the price elasticity of demand for residential land. Imposing a tax with a present value of $5 per square foot, for example, would shift the demand for residential land down by $5 per square foot. If the demand is inelastic, that would result in a small reduction in average lot size (Figure 1 panel A). If it is elastic, the reduction in average lot size would be larger (Figure 1 panel B). But in either case, provided the tax is indeed offsetting negative externalities of large lot size, the community wins. Either it raises substantially more revenue (inelastic demand), enabling it to provide the necessary public services, or it encourages more compact development (elastic demand), avoiding the need for more public services.

With the imposition of smaller lot size through regulation, in contrast, communities (1) give up the revenue that could be gained through tax incentives, and (2) cause a large loss of household satisfaction if the demand for residential land is inelastic. By definition, inelastic demand means that households will keep buying large lots even if the price is high. Their willingness to do so signals that having large lots is important to them. Forcing them not to requires their giving up something that adds a great deal to their well-being.

The magnitude of the price elasticity of demand for residential land is not known with assurance. The best study, by Richard Voith, recent and unpublished, analyzes a single market, Montgomery county in Pennsylvania, and finds an elasticity with magnitude of approximately two. That is, raising the cost of residential land by 10% would reduce average lot size by 20%. His work, however, needs to be applied to other areas before the result warrants sufficient confidence for policy application.

More generally, an advantage of tax incentives over regulation is that taxes better accommodate differing preferences. Those who strongly value large lots can still enjoy them, as long as they are willing to pay the tax. Those who do not care as much can reduce their taxes by living on smaller lots. The practical difficulty will be finding a way to tax large lots that is politically acceptable. Creative thinking to restructure incentives in ways that are feasible politically could provide useful in encouraging "smart communities."

V. CONCLUSION

The first institution creating professional management of Florida's transportation network was the State Road Department (SRD), administered by the State Road Board. Compared to other states' road departments, the SRD was relatively independent from political machinations. According to the Friedman classification system, Florida was one of 22 states whose road department was headed by a multi-member body, the Florida State Road Board (SRB). Besides institutional checks, beginning in 1955 the SRD operated under a merit system of employment, where promotion was based on education and examinations. Critics noted, however, that the SRB was not impervious to political influences. Most of the men who chaired the SRB had worked as lawyers, politicians and developers. Few had any experience in highway construction or transportation policy. Likewise, the SRB represented and served their respective constituencies, which may have encouraged pork-barrel politics and discouraged consistent and continuous statewide planning.

As demand for more and better highways increased, the SRD expanded and adapted to streamline and accelerate construction projects. In 1955, the Florida Highway Code reorganized the SRD into two divisions: engineering, managed by the newly created position of State Highway Engineer; and administrative, lead by the Executive Director. That same act further split the Engineering Division into Planning, Maintenance, and Construction subdivisions.

In 1961, the Florida Legislative Committee on Public Roads and Highways released its report on the quality of state road construction. Their report raised concerns of fiscal mismanagement, conflicts of interest of state employees, exorbitant right-of-way costs, inferior road construction and lack of continuity and planning. To remedy these problems, committee members recommended administrative and legal changes in the SRD. Their report recommended more stringent conflict of interest laws, creation of a Highway Commissioner to oversee the secondary road program, creation of an Assistant Highway Engineer to monitor road quality, and the requirement that the Department acquire land titles before accepting construction bids.

Some of these proposals were implemented in 1967 when the Legislature reorganized the SRD and created the office of Road Commissioner to oversee day-to-day operations. By law, this position was limited "to professional highway engineers with at least ten years experience." Furthermore, responsibility for administering the SRD Districts was transferred from Board members to the respective District Engineers. Thereafter, the SRB focused primarily on transportation policy and budget. In response to the criticism of lack of continuity and planning, the terms of the Board members were staggered to avoid complete turnover with each new governor. The State Road Department introduced five-year plans that prioritized projects.

The most dramatic and far-reaching reform came in 1969 when the Legislature created the Florida Department of Transportation. The Executive Reorganization Act consolidated the SRB, the SRD and many other transportation-related organizations into a single body. By law, the Secretary of FDOT had to "be a professional engineer or other person qualified by education and experience." No longer would political allies head Florida's highway institutions.

The emphasis on qualified leadership contrasts, however, with the evaluation of a governor's commission in 1974. The Governor's Management and Efficiency Study Commission reported that FDOT "has become engineer-oriented to a degree which tends to suppress development of professions [in other fields]. With fund accounting, and a goal to use all funds, there is little emphasis on cost controls." To alleviate this deficiency, the commission recommended that professional managers, rather than engineers, head operational groups and that a cost-reduction program be introduced.

In the 1980s and 1990s, FDOT was asked to broaden its perspective even more, involving itself more closely in such issues as controlling environmental damage, growth management, inter-modal planning, and, now in the new century, "smart communities." As the state becomes larger and more densely settled, the management of its transportation system has evolved from simply laying the concrete, perhaps in the politically appropriate counties, to engineering to cost control, to economic development, and to full integration with urban form and other broad social concerns. The discussion of some of these issues in this report hints at how broad and complex the issues intertwined with transportation planning have become.

Table 1. Road-Miles in Florida Cities, 1999, Compared to the 400 Largest U.S. Cities, Controlling for Population

		Relative road-miles (percentage)					
Urbanized area	Population (1,000)	Freeways[1]	Principal arterials	Minor arterials	Collectors	Local	Total
Miami-Hialeah	2,102	62	54	56	66	85	77
Tampa-St. Petersburg[2]	1,894	59	91	56	114	124	111
Ft. Lauderdale[2]	1,470	84	58	52	93	84	79
Orlando	1,185	102	103	80	95	77	80
West Palm Beach[2]	959	81	79	46	105	69	70
Jacksonville	851	141	78	69	131	114	109
Sarasota[2]	522	19	80	33	146	101	93
Melbourne[2]	364	22	152	58	113	78	81
Pensacola	298	54	127	93	117	132	122
Ft. Myers[2]	275	9	87	76	213	104	107
Daytona Beach	255	48	181	68	117	94	96
Tallahassee	192	48	122	106	91	90	91
Lakeland	173	79	80	58	157	140	126
Ft. Pierce	157	178	153	88	201	112	120
Gainesville	150	50	112	68	84	108	98
Ft. Walton Beach	141	0	125	30	64	114	96
Naples	136	15	53	24	93	94	80
Panama City	123	0	158	70	143	140	128
Winter Haven	101	0	155	71	255	188	173
Stuart	97	67	103	71	60	74	74
Ocala	87	63	95	109	127	115	110
Punta Gorda	83	36	73	61	294	109	118
Vero Beach	79	8	125	53	183	111	109
Deltona	67	55	17	83	67	105	90
Spring Hill[2]	66	0	66	46	58	37	41
Titusville	61	65	146	22	102	149	126
Urban, Florida	11,888	69	86	60	108	97	92

[1]Freeway miles are lane miles.

[2]The abbreviated urbanized areas are Tampa-St. Petersburg-Clearwater, Ft. Lauderdale-Hollywood-Pompano Beach, West Palm Beach-Boca Raton-Delray Beach, Sarasota-Bradenton, Melbourne-Palm Bay, and Ft. Myers-Cape Coral. Spring Hill centers a largely unincorporated urbanized area in Hernando County.

Notes:

The percentages are center-lane miles of types of roads for Florida's largest urbanized areas relative to predicted values from log-log regressions of center-lane miles on population for the 401 largest U.S. urbanized areas. For example, the 93 center-lane miles of freeway in the Miami-Hialeah urbanized area are 62 percent of the 150 miles predicted for a U.S. city with 2,102,000 people in 1999.

Calculated from data in U.S. Highway Administration "Urbanized Areas—1999," Tables HM-71 and HM-72. The 26 urbanized areas in Florida contain 78 percent of the state's population and 14 percent of its land area.

Table 2. Road-Miles in Florida Cities, 1999, Compared to the 400 Largest U.S. Cities, Controlling for Population and Density

Urbanized area	Area (square miles)	Relative road-miles (percentage) Freeways	Principal arterials	Minor arterials	Collectors	Local	Total
Miami-Hialeah	545	73	65	68	81	104	94
Tampa-St. Petersburg	1,294	49	74	45	90	100	88
Ft. Lauderdale	489	93	65	58	105	94	88
Orlando	667	94	94	73	86	70	73
West Palm Beach	556	75	72	42	95	63	63
Jacksonville	727	114	61	54	100	89	84
Sarasota	464	16	64	27	114	80	74
Melbourne	532	15	102	39	73	51	53
Pensacola	337	43	96	70	86	98	91
Ft. Myers	254	8	72	63	174	85	88
Daytona Beach	232	41	151	57	97	78	80
Tallahassee	148	45	112	98	84	82	83
Lakeland	162	69	68	50	133	118	107
Ft. Pierce	200	139	115	67	149	83	89
Gainesville	75	56	125	77	96	121	111
Ft. Walton Beach	129	0	109	26	56	99	83
Naples	145	13	44	20	76	76	66
Panama City	149	0	124	55	111	108	99
Winter Haven	140	0	117	54	188	139	128
Stuart	104	58	86	69	50	62	62
Ocala	80	58	86	100	115	103	100
Punta Gorda	67	35	70	59	284	104	114
Vero Beach	64	8	120	51	177	106	106
Deltona	64	51	16	76	60	95	82
Spring Hill	58	0	62	44	55	35	39
Titusville	67	58	125	19	88	127	108
Urban, Florida	7,749	65	78	57	98	90	84

Notes:

See Table 1 for abbreviated urbanized area designations.

The percentages are center-lane miles of types of roads (except for freeways, which are total lane miles) for Florida's largest urbanized areas relative to predicted values from regressing the log of miles on the logs of population and density. For example, the 93 lane-miles of freeway (interstate and other) in the Miami-Hialeah urbanized area are 73 percent of the 127 lane-miles predicted for a U.S. urbanized area with 545 square miles and 2,102,000 people in 1999.

Calculated from data in U.S. Highway Administration "Urbanized areas—1999," Tables HM-71 and HM-72.

Table 3. Daily Vehicle Miles Traveled per Resident in Large Urbanized areas, 1999

Roadway type	U.S.	Florida	FL/US (percentage)
Interstate	5.8	3.9	67
Other Freeways and Expressways	2.6	1.8	69
Principal Arterials	5.3	6.4	121
Minor Arterials	4.3	3.8	88
Collectors	1.7	2.6	153
Local Roads	3.2	4.1	128
Total	22.9	22.6	99

Notes:

The population-weight average daily vehicle-miles traveled per resident in Florida's 11 largest urbanized areas was 22.6 in 1999, of which 3.9 were on interstate highways. The Florida urbanized areas are Miami-Hialeah, Tampa-St. Petersburg-Clearwater, Ft. Lauderdale-Hollywood-Pompano Beach, Orlando, West Palm Beach-Boca Raton-Delray Beach, Jacksonville, Sarasota-Bradenton, Melbourne-Palm Bay, Pensacola, Ft. Myers-Cape Coral, and Daytona Beach.

Calculated from data in U.S. Highway Administration "Urbanized Areas—1999," Tables HM-71 and HM-72.

The 11 urbanized areas in Florida contain two-thirds of the state's population.

Table 4. Share of Urban Vehicle Miles Traveled in Florida and the United States, 1999
(percentage)

Urbanized area	Interstates	Other freeways	Principal arterials	Minor arterials	Collectors	Local	Total
Miami-Hialeah	11	23	22	19	9	17	100
Tampa-St. Petersburg	18	3	30	14	13	22	100
Ft. Lauderdale	27	8	23	15	12	14	100
Orlando	18	11	31	19	10	12	100
West Palm Beach	30	7	24	12	13	13	100
Jacksonville	28	11	19	17	8	17	100
Sarasota	7	0	33	17	19	24	100
Melbourne	5	1	47	18	13	16	100
Pensacola	13	0	28	26	10	23	100
Ft. Myers	3	0	28	28	20	21	100
Daytona Beach	13	0	48	11	9	19	100
Florida	18	9	27	17	12	17	100
United States	25	12	24	19	8	14	100

Notes:

See Table 1 for abbreviated urbanized area designations.

In Miami-Hialeah, for example 11 percent of the vehicle miles traveled in 1999 were on interstate highways and 23 percent on other freeways and expressways.

The shares for Florida and for the United States are population-weighted averages (for the urbanized areas shown, in the case of Florida).

Calculated from data in U.S. Highway Administration "Urbanized Areas—1999," Tables HM-71 and HM-72.

Table 5. Vehicle Miles Traveled in Florida Urbanized Areas Compared to U.S. Urbanized Areas Controlling for Population

	Vehicle miles traveled (percentage)					
Area	Interstate	Principal arterials	Minor arterials	Collectors	Local	Total
Miami-Hialeah	31	84	85	99	109	79
Tampa-St. Petersburg	63	134	74	172	161	92
Ft. Lauderdale	104	106	83	166	111	98
Orlando	80	165	113	148	103	111
West Palm Beach	120	108	64	160	95	95
Jacksonville	144	104	108	122	160	120
Sarasota	25	119	72	195	147	81
Melbourne	23	209	98	162	118	102
Pensacola	77	144	160	142	202	119
Ft. Myers	16	128	156	265	161	107
Daytona Beach	68	215	61	121	145	106

Notes:

In the Miami-Hialeah urbanized area, for example, vehicle miles traveled per resident on interstate highways were 31 percent of the population-weighted average for large U.S. urbanized areas in 1999.

See Table 1 for abbreviated urbanized area designations.

Calculated from data in U.S. Department of Transportation "Urbanized Areas—1999," Tables HM-71 and HM-72.

Table 6. Interstate Lane-Miles in Selected Areas

	Urbanized Areas	1999 Population	Land Area	Interstate Miles
1.	Miami-Hialeah, FL	2,102	545	28
	Baltimore, MD	2,154	712	134
	Seattle, WA	1,994	844	112
2.	Tampa-St. Petersburg	1,894	1,294	90
	St. Louis, MO	1,971	1,123	245
	Denver, CO	1,861	720	98
3.	Ft. Lauderdale, FL	1,470	489	54
	Norfolk, VA	1,471	952	115
	Milwaukee, WI	1,459	512	75
4.	Orlando, FL	1,185	667	44
	Cincinnati, OH	1,199	630	147
	Buffalo, NY	1,066	564	73
5.	West Palm Beach, FL	959	556	46
	Oklahoma City, OK	1,039	647	121
	Memphis, TN	929	415	78
6.	Jacksonville, FL	851	727	83
	Salt Lake City, UT	888	353	73
	Louisville, KY	809	384	117
7.	Sarasota-Bradenton, FL	522	464	10
	Fresno, CA	525	168	0
	Oxnard-Ventura, CA	521	190	0
8.	Melbourne, FL	364	532	9
	Knoxville, TN	365	355	51
	Bakersfield, CA	361	176	0
9.	Pensacola, FL	298	337	24
	Lawrence-Haverhill, MA	303	205	47
	Corpus Christi, TX	296	164	17
10.	Ft. Myers, FL	275	254	4
	Greenville, SC	277	148	28
	Davenport, IL	266	164	43
11.	Daytona Beach, FL	255	232	16
	Modesto, CA	257	64	0
	Canton, OH	250	160	13
12.	Tallahassee, FL	192	148	14
	Hesperia, CA	193	190	15
	Stanford, CT	192	82	13
13.	Lakeland, FL	173	162	13
	Huntington, WV	174	104	19
	Salem, OR	173	69	12

Continued . . .

Table 6. Interstate Lane-Miles in Selected Areas (Continued)

	Urbanized Areas	1999 Population	Land Area	Interstate Miles
14.	Fort Pierce, FL	157	200	18
	Macon, GA	157	97	34
	Lewisville, TX	154	84	13
15.	Gainesville, FL	150	75	7
	Richland, WA	152	170	14
	Fort Collins, CO	149	84	8
16.	Ft. Walton Beach, FL	141	129	0
	Topeka, KS	142	85	25
	Racine, WI	139	39	0
17.	Naples, FL	136	145	3
	Simi Valley, CA	137	50	0
	Fargo, ND	136	67	14
18.	Panama City, FL	123	149	0
	Hemet-San Jacinto, CA	123	48	0
	Lake Charles, LA	122	88	27
19.	Winter Haven, FL	101	140	0
	Yakima, WA	102	52	8
	Billings, MT	101	52	16
20.	Stuart, FL	97	104	1
	Albany, GA	97	103	0
	Vineland, NJ	96	128	0
21.	Ocala, FL	87	80	5
	Alexandria, LA	88	64	17
	Jackson, MI	87	78	9
22.	Punta Gorda, FL	83	67	5
	Vacaville, CA	84	24	13
	Battle Creek, MI	83	79	13
23.	Vero Beach, FL	79	64	1
	Mansfield, OH	80	63	0
	Annapolis, MD	79	52	6
24.	Deltona, FL	67	64	6
	Oshkosh, WI	67	21	0
	Cheyenne, WY	67	100	24
25.	Spring Hill, FL	66	58	0
	Pascagoula, MS	66	81	2
	Wausau, WI	66	40	6
26.	Titusville, FL	61	57	6
	Dubuque, IA	61	51	0
	Lodi, CA	61	17	0

Table 7. Regressions Explaining Variations Across States in the Value of All Construction Contracts and in State and Local Government Road Spending

Dependent Variable	(1) 1988 Construction	(2) 1995 Construction	(3) 1988 Roads	(4) 1996 Roads
Independent Variable				
Area			0.27	0.23
			(0.03)	(0.02)
Population			0.79	0.77
			(0.02)	(0.02)
Income	1.12	0.50	1.23	0.93
	(0.16)	(0.23)	(0.23)	(0.23)
Growth	1.62	3.33	-0.75	-1.17
	(0.25)	(0.43)	(0.31)	(0.40)
Constant	-11.00	-5.07	-13.74	-10.91
	(1.51)	(2.32)	(2.27)	(2.37)
R^2	0.73	0.55	-	-
Observations	51	51	51	51

Notes:

Column (1) shows a regression of the logarithm of the 1988 values of construction contracts on the income per resident in 1988 and the fractional change in population in the 1980s. Column (2) shows the same regression for 1995. Column (3) shows a regression of the 1985 state and local road spending on the logs of area, population, and income per resident, the fractional change in populations, and in the 1980s. Column (4) shows the same regression for 1996.

In columns (3) and (4) the coefficients of area and population are constrained to sum to one, which imposes the assumption that a state with twice the area and population of another would have twice the road spending. Equations (1) and (2), by using per capita dependent variables and omitting area implicitly impose the constraints that doubling population doubles construction spending and that area does not matter. In all four cases, unconstrained regressions come close to the same results.

Table 8. Regressions Explaining Variations Across State and Federal Highway Funding

Dependent Variable: Log of Federal Highway Funds to Each State

	(1) 1959	(2) 1969	(3) 1979	(4) 1989
Area	0.24	0.21	0.28	0.14
	(0.03)	(0.06)	(0.03)	(0.04)
Population	0.76	0.79	0.72	0.86
	(0.03)	(0.06)	(0.03)	(0.04)
Growth	-0.28	-0.41	0.17	-0.33
	(0.24)	(0.74)	(0.35)	(0.53)
Constant	2.40	2.77	3.00	3.84
	(0.09)	(0.20)	(0.08)	(0.11)
Observations	51	51	51	51

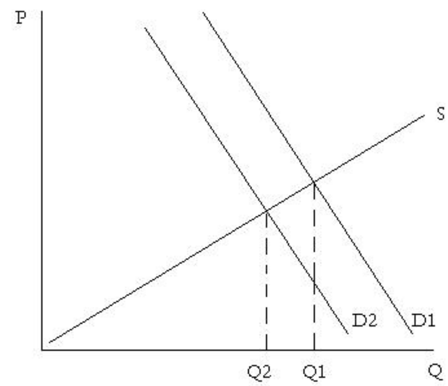
Notes:

These columns display regression for the years shown of the log of federal highway funds to the states on the logs of area and population and on the fractional growth in population in the 1950s, 1960s, 1970s, and 1980s, respectively. The chief point of the regressions is that in each of the four years federal funding for highways is unrelated to growth. In every case the t-statistic for the growth coefficient is less than one in magnitude.

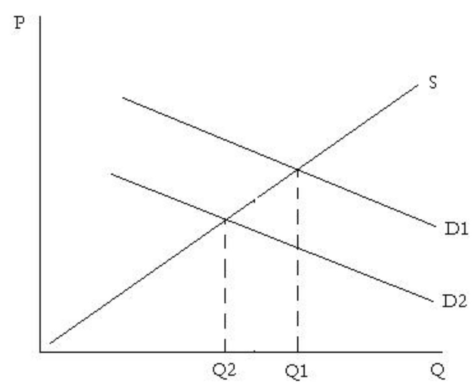
The coefficients on the logs of area and population are constrained to sum to one, which implies that a state with twice the area and population of another should have received twice the funds. Relaxing the constraint results in no significant differences.

Figure 1. Hypothetical Demand Curves for Residential Land

A. Absolute Demand



B. Elastic Demand



Note: Both diagrams display the size (quantity) of a residential lot on the horizontal axis and the price per square foot on the vertical. In both A and B a tax worth present value of $X per square foot is imposed, shifting the demand curve down by $X.

TECHNICAL APPENDIX A:

FLORIDA'S LOCAL OPTION GASOLINE TAX IS FULLY SHIFTED TO CONSUMERS

I. INTRODUCTION

In January 2000, locally imposed fuel taxes varied across Florida from 5.6 cents a gallon in Hamilton County to 17.1 cents in Collier, De Soto, Lee, Palm Beach, Polk, St. Lucie, and Volusia counties, with others arrayed between.[1] Later that year, the Bureau of Economic and Business Research (BEBR) at the University of Florida, as part of its calculation of the Florida Price Level Index, surveyed the prices of regular gasoline at self-service pumps at 438 stations throughout the state. Of the 438 stations, 160 were in the 24 counties that imposed a tax of 11.1 cents and 53 in the seven counties where the local tax was 17.1 cents.

At first thought, you would expect that there would be full pass-through of the tax to consumers. Given the six-cent difference in the tax between the two groups of counties, you would expect a six-cent difference in the pump price. Wholesalers can direct supplies to retailers who pay them the highest price. As a result, aside from minor differences in transportation costs, retailers should pay the same in all counties. At the retail level, competition should prevent above-normal profits, since consumers can choose stations that charge the least. We do, in fact, find a higher average price in the counties with the higher tax, $1.510 a gallon versus $1.484. But the difference, perhaps surprisingly, is only 2.6 cents, not six. Can it be that the oil industry and service stations pass through to consumers less than half of the difference in taxes?

If so, the implications are rather striking. Florida's state and local governments' annual revenue from the gasoline tax now exceeds a billion dollars, over $140 per household. Some groups advocate increasing this amount significantly. Some advocates think that hiking the tax rate, now far below European levels, would reduce the congestion and pollution externalities associated with driving, discourage urban sprawl, and slow global warming by reducing vehicle miles traveled and by encouraging the use of more fuel-efficient cars and trucks. Others want to fight congestion by raising more funds for building roads or for subsidizing public transit. Opponents of raising the tax usually cite its regressivity, which stems from the fact that lower-income households pay higher shares of their income for gasoline than do the affluent. Others worry that boosting the tax will deter tourists or industry, which among economic sectors bears a large share of the tax, from coming to Florida.

Both advocates and opponents of raising state or local gasoline taxes usually assume implicitly that there is full pass-through to consumers. And economic theory does justify assuming that the pass-through of either excise or ad valorem taxes is 100 percent, subject to the proviso that the petroleum industry is perfectly competitive. But it is not. At the retail level familiar to most of us, there is spatial differentiation, the effect of which is strengthened by branding. That is, stations differ in how conveniently located they are to us and brands, to reduce the competition between stations that share the same route to work, try to persuade us that they offer superior products. In addition more and more stations are linked to convenience stores and fast-food outlets, further differentiating what they offer. At the wholesale level, frequently a few suppliers account for large market shares. The larger the market share controlled by a few suppliers, in general the higher the wholesale price.

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[1]Local option tax rates are from the Florida Department of Revenue web site, table titled "Local Option and SCETS Motor Gasoline Tax Rates by County: Florida January 1991 - January 2000," last column.

When industry structure is oligopolistic rather than perfectly competitive, theory has little to say *a priori* about who will bear the burden of an excise tax. It could be under-shifted, completely shifted, or even over-shifted, with the price to consumers rising by more than the tax. The issue becomes empirical. The amount of the shift must be measured. To do that a bit more formally for Florida, we regress the price charged by each of the 798 stations surveyed by UF's BEBR in 2000 or in 2001 on the gasoline tax in that station's county, with the result:

(1) Price = 133.04 + 0.57 Tax + 7.89 Y2000 + Brand Effects

(1.54) (0.12) (0.56)

$R^2 = 0.27$ n = 798 retail stations

Equation (1) combines observations for 2000 and 2001 and includes dichotomous variables for the major brands.[2] Parentheses contain estimated standard errors of the coefficients. The equation indicates that on average the price (Price) was about eight cents a gallon higher during the 2000 survey than during the 2001 survey (Y2000 is a dichotomous variable that takes the value one for the year 2000 and zero for 2001). It also rejects the hypothesis that there was full pass-through of the local option tax (Tax). The point estimate is 57 percent, and the probability that the true value is 100 percent or greater is less than one out of a thousand, according to this regression. The point estimate is that 57 percent of the local option tax is passed through to consumers, with the remaining 43 percent split between station owners and oil companies.

There are (at least) two serious problem with equation (1), however, and to complicate matters the two are intertwined. The first problem is that it omits important variables that affect the price of gasoline. If those variables are correlated with the tax rate, then the coefficient of Tax will be biased. The second problem is that the tax rate is endogenous; that is, it is not independent of the other variables.

A couple of illustrations of how the two problems interact may be useful. First, suppose that older households are more effective consumers of gasoline. From long experience, they are savvy about judging product quality and, if retired and not caring for children, they may devote more time to comparison pricing. A large presence of older households may force stations to price more competitively. At the same time, older residents may favor higher gasoline taxes as a substitute for higher property taxes, since they consume less gasoline per person and are more likely to own their houses and thus perceive the burden of the property tax more directly. In that case, retirement counties may have both low gasoline prices and high gasoline taxes. The direct effect of the elderly on reducing the price might partially offset their indirect effect through the higher tax, with the result that the estimated coefficient on the tax might be biased downward.

In that case, the cure is evident: add a variable representing the share of the population elderly to equation (1). Their direct impact on the price will be picked up as a negative coefficient on the share elderly, leaving the tax effect on the price intact. But the simple expedient of adding variables will not always work, as illustrated by a second example. Suppose that for reasons we ot have no good way to measure, a county is both small and isolated. In that case, the county's few stations, protected by spatial and product differentiation, may set high prices. At the same time, the county government is able to impose a high tax with little fear of inducing consumers to buy gasoline elsewhere, and thus

[2]Amoco, BP, Chevron, Exxon, Mobil, Shell, and Texaco. A test that the brand effects are jointly insignificant yields F(7, 788) = 5.01, with a probability greater than F of 0.0000. That is, the brand effects are highly significant. The differences among brands, whether actual or merely perceived, reduces competition among wholesalers and among retail outlets.

reduce the county's revenue from the tax. That is, because of the isolation, the elasticity of demand for gasoline from that particular county is relatively low, and doubling the gasoline tax results in close to a doubling of revenue. For reasons we may be unable to measure, therefore, the county imposes a high tax and stations set high prices. If that relationship is widespread, it would bias the coefficient on Tax in equation one upward seriously, perhaps making it appear that the tax is fully passed through when in general it is not.

We face, then, the econometric trap known as the identification problem. If we cannot quantify every variable that might affect both the price of gasoline directly and the level of the tax, the error term in equation (1) is correlated with Tax. As a result, the coefficient of Tax is biased. We cannot estimate it correctly. Aside from the impossible task of finding every possibly relevant variable, however, there is a potential solution to the identification problem. It is to find one or more variables that significantly influence the level of the tax but have no noticeable direct effect on the price of gasoline. Then a second equation can be constructed that includes those variables and used to obtain a predicted value of the tax. When that predicted value is substituted for the actual value in equation (1), its coefficient is an unbiased estimate of the true effect of the tax. The instruments are like tools that solve the identification problem.

The problem, of course, is to find instruments. In a recent study of excise taxes in general, Timothy Besley of the London School of Economics and Harvey Rosen of Princeton state that the empirical evidence on tax incidence is still quite meager, "although the question is just as important to policymakers as it is to academics."[3] Analyzing state and local taxes on 12 commodities in 155 cities from 1982 through 1990, they find that for half the items the pass-through is approximately 100 percent and for the remaining half it exceeds 100 percent significantly. They are well aware of the identification problem but figuratively throw up their hands, saying that to solve it "one would need an instrument that, on a city-by-city basis, is correlated with tax rates and not with prices. It is hard to think of such an instrument."[4]

With respect to the incidence of the gasoline tax, however, Florida provides an almost unique opportunity to solve the identification problem, through its local option allowing taxes on gasoline to vary across counties. There are other states that allow local option taxes as well, but in most of them the variation is quite limited. Alabama allows one to three cents, South Dakota and Tennessee a penny, and Virginia two cents. In Illinois, Chicago adds a nickel and Cook County six cents. Hawaii permits variation from eight to 11.5 cents, but has only four counties. After Florida, Nevada has the most variation, from 1.75 to 7.75 cents, but Nevada has only 16 counties, compared to 67 in Florida.

The next step is to find instruments, characteristics that influence the level of the tax but do not affect the price of gasoline directly. We have found two: land area and the share of the county real estate value represented by manufacturing activities. Land area affects the gasoline tax because physically large counties internalize more of the gain in land value from building or improving roads. As a consequence, building roads raises their revenue from the property tax more than is the case with small counties. Suppose Franklin county, 485 square miles on the Gulf in the Panhandle, were to extend a connector west from Buck Siding on route 65 to the county line, bridging the Apalachicola river. By extending access to the beach at Green Point, in Franklin, it would raise its property values by doing so. But it would also, and possibly even more, raise property values in Howard Creek, by making that Gulf county settlement less isolated, giving it a twenty-mile drive to the coast. In contrast, Palm Beach county, with 1,974 square miles five times as large as Franklin, by

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[3]"Sales Taxes and Prices: An Empirical Analysis," *National Tax Journal*, June 1999, pp. 157-178.

[4]Besley and Rosen, 1999, their note 19.

improving roads west from the coast, encouraged the growth of the upscale inland communities of first Wellington and now Jupiter West, adding $200,000 houses to its own tax rolls. That incentive to spend more on roads may be one reason the local option gasoline tax is 17.1 cents in Palm Beach county, compared to 9.3 cents in Franklin.

The second instrumental variable, the manufacturing share of real estate value, was chosen because manufacturing bears a disproportionate share of the burden of the gasoline tax. Consequently, manufacturers would lobby against raising the tax. Adjusting estimates for Texas by that state's Comptroller, we estimate that manufacturing, which accounts for less than 8 percent of earnings in Florida, may bear over 40 percent of that portion of the tax that falls on producers of goods and services. The service sector, in contrast, with 34 percent of earnings, may bear less than 1 percent of producers' part of the tax.[5] Counties that want to retain existing manufacturing firms and that make an effort to attract manufacturing would keep gasoline taxes low.

To anticipate our results, our best estimate is that the local option gasoline tax in Florida is fully shifted to consumers. From simply looking at graphs of the tax rates and prices, we had thought otherwise. We had thought that the tax was roughly half shifted. The implications of that partial shifting, if it were true, would be striking. But apparently it is false. From two different data sets for Florida and using two different methods, we fail to reject the hypothesis that the tax is fully shifted. We proceed as follows. Section II summarizes a few earlier but mostly recent results on the structure of the petroleum industry and the incidence of excise taxes, with emphasis on gasoline. Section III estimates the determinants of variations in the gasoline tax across Florida's counties. Section IV estimates the incidence of the local option gasoline tax across Florida's counties in 2000 and 2001, adding other variables to equation (1) and using the predicted gasoline tax from section III as an instrument. Section V uses panel regressions to estimate the incidence of the local option tax in 28 Florida cities using AAA data for 1991 through 2000. Section VI discusses limitations and implications of our study and concludes.

II. EARLIER RESULTS

The major oil firms produce 88 percent of U.S. gasoline.[6] During the 1990s, refineries have become more regionally focused, reducing competition. The majors supply gasoline directly to 30 percent of all retail outlets, and these outlets account for 62 percent of sales. The number of residents per outlet rose from 1,187 in 1990 to 1,550 in 2000, as population rose and the number of outlets fell. The decline in the number of outlets stems from several causes. Vehicles have become both more reliable and more complex, with the result that fewer stations repair them. Outlets increased their capital intensity, both to differentiate their product by offering convenience sales and sometimes joining with fast-food stores and to meet underground storage tank requirements. Marginal outlets, finding these new capital needs too onerous, shut down. The likely consequence of these changes is a reduction in price competition.

[5]Texas Comptroller of Public Accounts, *Texas Taxes*, Fiscal Year 2002, Table 33, presents the estimated incidence for Texas. We adjust the Texas numbers for Florida by apportioning each sector's relative share of total state earnings in Florida compared to Texas. The shares of earnings are calculated from U.S. Department of Commerce, *Survey of Current Business*, October 2001, Table 3, and are estimates for the year 2000.

[6]This paragraph is based on Energy Information Agency, "Restructuring: The Changing Face of Motor Gasoline Marketing," March 2002 Internet paper.

At the wholesale level, a thorough recent study is one by Richard Gilbert and Justine Hastings of Berkeley.[7] Analyzing 26 metropolitan areas from January 1993 through June 1997, they find that when a few wholesalers control a larger market share, the price is higher. In addition, the larger the share of independents in retail sales, the lower the price. Finally, they show that when wholesalers control a larger share of retail outlets by sales, the wholesale price to other retailers is higher. In addition to the panel study of Metropolitan Statistical Areas (MSAs), they look in detail at the 1997 merger of Tosco and Unocal, which increased market concentration in thirteen MSAs on the west coast. They find that each five percent increase in retail market share boosted the price of gasoline by a penny a gallon. Both analyses provide convincing evidence of market power in gasoline sales, demonstrating for our purposes that perfect competition is an inappropriate model for studying the effect of excise taxes.

The Federal Trade Commission (FTC) also asserts that the industry is oligopolistic. Motor fuel suppliers, according to the FTC, vary their prices across locations based on the prices of competitors, not on their own costs, pricing that serves as "an earmark of oligopolistic market behavior."[8] In California, stations in San Francisco charged more than those in Los Angeles because of zoned pricing by Arco, Chevron, and other refiners. The California Service Station and Automotive Repair Association claimed the difference was due not to cost differences, but to price discrimination by wholesalers.[9] In the summer of 2000, according to the FTC, Marathon Ashland Petroleum reduced supply to Chicago and Milwaukee in order to boost prices.[10]

Unable to rely on the assumption that the petroleum industry is perfectly competitive and thus taxes are fully passed through, we turn to empirical studies. An early study by Howard Marvel of the effect of industry concentration on retail prices incidentally found less-than-full pass-through of the excise tax.[11] He reported coefficients ranging from 0.38 to 0.92, but did not comment on their significance nor did he attempt to solve the identification problem by finding instruments for the tax rate. More recently, Chouinard and Perloff examine which factors explain retail and wholesale gasoline price changes and price differentials.[12] They estimate a reduced-form model to explain how prices vary with demand, cost, seasonal factors, taxes, market power, pollution controls, and government restrictions on vertical integration. Using a panel of 48 states and the District of Columbia from January 1989 through June 1997, they find that state gasoline excise taxes are almost exactly fully shifted to consumers (their coefficient is 1.00) and that state ad valorem taxes are significantly under-shifted, with 72 percent pass-through. Their specification of ad valorem taxes is

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[7]"Vertical Integration in Gasoline Supply: An Empirical Test of Raising Rivals' Costs," working paper presenting research funded by the University of California Energy Institute, June 2001.

[8]Federal Trade Commission review of merger of Exxon and Mobil, cited by reporter Alexei Barrionuevo, *Wall Street Journal*, date (probably 2001). According to Barrionuevo, "Refining companies actually map out areas and charge dealers different wholesale prices based on secret formulas that often factor in location, the area's affluence or simply what the local market will bear."

[9]Kenneth Howe, "Bay Area Pays More for Gas," *San Francisco Chronicle*, May 9, 1997, A1, A17, cited by Hayley Chouinard and Jeffrey M. Perloff, "Gasoline Price Differences: Taxes, Pollution Regulations, Mergers, Market Power, and Market Conditions," Working Paper, Berkeley, August 2001.

[10]Cited by Alexei Barrionuevo and John R. Wilke, *Wall Street Journal*, June 11, 2001.

[11]"Competition and Price Levels in the Retail Gasoline Market, *Review of Economics and Statistics*, May 1978, pp. 252-258. The BLS gave Marvel only the high and low prices for each city, for regular and for premium.

[12]"Vertical Integration in Gasoline Supply: An Empirical Test of Raising Rivals' Costs," working paper presenting research funded by the University of California Energy Institute, June 2001.

preliminary, however. More importantly, they make no effort to solve the identification problem by finding instruments for state tax rates. It is possible, however, that by conditioning on a large number of variables and by using panel data methods, they closely approximate results that would be obtained by using instrumental variables. It may be that across states, relative tax rates changed as a result of swings in public opinion or other forces that did not affect the pricing policies of oil companies or service stations more than slightly. If that is the case, as a practical matter Chouinard and Perloff achieve identification.

In a study commissioned for our project, University of Florida graduate student Maria Tavares analyzes the incidence of state and local gasoline taxes across cities from 1983 through 1999.[13] She uses gasoline prices from the surveys conducted quarterly by the American Chamber of Commerce Research Association (ACCRA), with the number of metropolitan areas varying by year from 179 to 236. In contrast to most studies of gasoline prices, which emphasize the effect of demand on price, Tavares takes a cost approach. Besides the gasoline tax rate, her independent variables are indexes of rent and wages, which represent costs, and population, an indicator of economies of scale. Her purpose in taking a cost approach was that under the assumption of perfect competition, only cost variables would matter. Finding other-than-full shifting of taxes in the context of a model based on perfect competition would show that the assumptions of that model were violated. That is, rejection of full pass-through would show that using an oligopolistic framework, in which demand variables matter, was necessary.

Tavares' cost variables are significant and have the expected signs. She finds an intriguing pattern of shifting of the gasoline tax. In annual regressions, she finds close to full shifting in 1983. But that trends down to only 27 percent in 1988, before gradually rising again to nearly full shifting in 1998 and 1999. Her work implies that Florida's boosting taxes in 1991 was a good action, with much of the burden being borne by oil companies. Open for further research is figuring out why q swing from full to partial shifting and back again to full characterized the past two decades. Does this raise the possibility that the structure of the industry changed from competitive to oligopolistic and back again?

In summary, the existing literature does not, to our knowledge, solve the identification problem. Consequently it does not provide a definitive answer to the issue of whether gasoline excise taxes are under-shifted, fully shifted, or over-shifted. Moreover, conclusions drawn from state data may not apply at the county level. Differentiation of wholesale and retail markets may not be the same at the two levels of spatial aggregation. The nearly unique experiment provided by Florida's 67 counties in imposing widely varying local option taxes allows us to address this topic.

III. DETERMINANTS OF LOCAL OPTION GASOLINE TAXES IN FLORIDA

As noted, the first step in identifying the incidence of the gasoline tax is to find instruments, variables that affect the tax level but not the price of gasoline directly. For Florida's counties, we have suggested land area and dominance of manufacturing as two such instruments. These two instruments will be more effective if they are embedded in an accurate model of how taxes are set, including other variables that may affect gasoline prices directly as well.

[13]Maria Tavares, "The Incidence of the Gasoline Tax," study prepared for the Florida Department of Transportation, December 2001. It is included as an appendix to this report.

One purpose for raising the gasoline tax is to reduce externalities, such as pollution and congestion. Both externalities are likely to be more significant in urban counties. Consequently we expect gasoline taxes to be higher in urban than in non-urban areas. The dichotomous variable Urban takes the value one for counties included in metropolitan statistical areas and zero for others, and should have a positive coefficient.

As noted before, counties with larger physical area have more incentive to build roads because they are able to tax a larger portion of the land wealth created by those roads. Moreover, land owners and developers in those counties are more likely to encourage road building and improvement. A higher gasoline tax provides funding for more roads. In smaller counties widening a road may create additional traffic from new developments in neighboring counties, whose residents do not vote in local elections. The variable Area represents county land area in square miles.

Also as noted before, we expect manufacturers to oppose higher gasoline taxes, since the burden of the tax falls heavily on them. We measure the influence of manufacturers as the share of total county assessed land value represented by manufacturing industry. The variable name is Industry.

We expect those over 65 to favor higher gasoline taxes because they use less gasoline than other adults[14] and because they are likely to be homeowners and thus perceive property taxes directly. To the extent that gasoline taxes substitute for higher property taxes, they may prefer taxing gasoline. We use Retired to represent the share of the population 65 and older. This variable may have another interpretation. Some Florida counties may actively recruit retirees, by building retirement communities for example. To do so, they need to build roads to sites where plenty of land can be assembled. The variable Retired could represent counties that have been encouraging the development of such communities, and use gasoline tax revenue to build the roads serving them. In this sense, the effect of Retired may resemble that of Area. This notion suggests that counties in the Florida panhandle soon may raise gasoline taxes in response to the development of large retirement communities by the St. Joe corporation.

[14]Richard Schmalensee and Thomas M. Stoker, "Household Gasoline Demand in the United States," *Econometrica*, May 1999, pp. 645-662, find that those over 65 consume about 75 percent as much gasoline as younger adults, judging from their Figure 2.

With these variables, we estimate:

(3) Tax = 9.11 + 0.80 Urban + 2.70 Area - 26.05 Industry + 7.51 Retired

(0.80) (0.47) (0.63) (9.84) (3.18)

$R^2 = 0.41$ n = 67 Florida counties

The equation was estimated using tobit, a method which allows for censoring of the dependent variable. In this case we observe no tax rates above the maximum 17.1 cents a gallon. Results from ordinary least squares are almost identical. Urban is significant at the 10 percent level, and the other variables at 5 percent or better. Taken at face value, the coefficients suggest that urban counties tax almost a penny more, that Polk with 1875 square miles would tax two cents more than Orange with 908, that increasing the industry share of assessed land value from Duval's 6.5 percent to Hamilton's 16.2 percent would reduce the tax by 2.5 cents, and that raising the share of the population 65 and over from Hillsborough's 13 percent to Collier's 24 percent would raise the tax by about a penny.

Others who have estimated the causes of variation in gasoline taxes across states have included a number of other variables as regressors. Besley and Rosen include the percentage of the population aged 5 through 17, arguing that children require more spending for schools, resulting in a higher gasoline tax.[15] They find that taxes are higher as a result of a Democratic governor, lower as a result of a Democratic senate, and that a Democratic house has no effect. They also include state population and income per resident as regressors, in quadratic form. Using annual data on states for 1975 through 1989, they had more degrees of freedom than we do. We did try income per resident, supposing that more affluent counties would be willing to pay higher gasoline taxes to pay for higher levels of service from their roads, but it was insignificant. We also tried political variables, with no significant results.

Shmanske uses other variables as well to explain state-by-state variations in gasoline tax rates.[16] He uses carbon monoxide levels as a measure of pollution externalities, the shares of the states' highways that are classified as "urban high volume" to measure congestion externalities, tolls collected as an indicator of an alternative revenue source, the significance of the oil industry and the trucking industry to the state economy to indicate lobbying pressure against gasoline taxes, and the percentage of the population who do not own cars as an inverse indicator of the extent to which the burden of the gasoline tax falls on the poor. Using data for 1973 to 1980, he finds all his variables to be significant except for the truck lobby. His congestion measure, however, has the wrong sign. We did not try any of these measures across Florida counties, except that our variable Urban may indicate pollution and congestion externalities. It could also indicate higher construction costs. Florida has no significant oil industry. It may be that the gasoline tax is relatively low in Orange county at 11.1 cents partly because it collects revenue from tolls, but we did not attempt to quantify that. Finally, Florida has no counties where public transit is used enough to reduce car ownership significantly.

[15]Timothy Besley and Harvey Rosen, "Vertical Externalities in Tax Setting: Evidence from Gasoline and Cigarettes," *Journal of Public Economics* 70 (1998), pp. 383-398.

[16]Stephen Shmanske, "The Determinants of State Gasoline Taxation in the 1970s," *Resources and Energy* 12 (1990), pp. 339-351.

To estimate the incidence of the local option gasoline taxes in Florida, we use the predicted value of the tax from equation (3) in a regression in which the dependent variable is the price level and the observations are the prices for self-service unleaded charged by the 798 stations surveyed by the Bureau in 2000 and 2001. Of course the tax is not the only source of price variations across counties and outlets, and we include other variables as well. The variable Brand takes the value one if the outlet has a major brand name and zero otherwise. Many customers are willing to pay a premium for a brand name. Y2000 takes the value one for the year 2000 and zero for 2001, to allow for the fact that prices were higher in 2000. Density is the logarithm of population density. Greater density is associated with a lower price because of greater competition among stations.

HS, the share of the population 25 and older who are high school graduates, and Retired, the share of the population 65 or older, are both used to represent better-informed consumers and also, in the case of Retired, consumers who are willing to spend more time comparing prices. Income is the logarithm of income per resident. Higher-income households may have a higher opportunity cost of time and be less likely to comparison shop for lower prices. Higher income may also reflect a higher cost of living, in which case service stations would have to pay higher wages and rent. AgLand represents the share of agricultural land in the county's total assessed land value. The coefficient of AgLand is expected to be positive because there are likely to be low-volume stations serving a scattered rural population.

The variable Choice, a measure of competition, is defined as

(4) Choice = (DriveOut + DriveIn)/(DriveOut + DriveIn + LiveWork)

where DriveOut is the number of county residents who work outside the county, DriveIn is the number of residents of other counties who work in the county, and LiveWork is the number of county residents who work in the county. Choice is an indicator of the share of the work force with relatively long commutes, and thus more choice of service stations. Higher values of Choice should reduce gasoline prices. Coast and Georgia are dichotomous variables representing counties on salt water and bordering Georgia, respectively. Coast is expected to have a positive coefficient for a mixture of reasons: some coastal counties are isolated, and the isolation is enhanced by having one direction fully blocked. In other counties coastal land is very expensive, raising the cost of running a station. Many coastal counties are rich in tourists, for whom searching for low prices is expensive. Georgia is expected to have a negative sign, because Florida stations along the Georgia border would have to reduce prices to compete with outlets in Georgia, where there are no local taxes and the state tax was only 7.5 cents a gallon in January 2000, compared to 18 cents in Alabama and 13.3 cents plus local option taxes in Florida.

Finally Est Tax is the value of the gasoline tax we would estimate the county to have from equation (3), if we did not know its actual tax rate. It is the predicted tax rate from equation (3).

The result is

$$\text{(5) Price} = \underset{(3.93)}{129.92} + \underset{(0.21)}{1.03}\ \text{Est Tax} + \underset{(0.49)}{8.59}\ \text{Y2000} - \underset{(0.29)}{1.47}\ \text{Density} - \underset{(3.81)}{7.77}\ \text{HS} - \underset{(4.07)}{19.61}\ \text{Retired}$$

$$+ \underset{(3.79)}{19.70}\ \text{AgLand} - \underset{(1.97)}{4.03}\ \text{Choice} + \underset{(0.60)}{4.05}\ \text{Coast} + \underset{(0.97)}{4.04}\ \text{Georgia} + \underset{(1.94)}{12.44}\ \text{Monroe} + \text{Brand Effects}$$

$R^2 = 0.42$ n = 798 retail stations

According to equation (4), the local option gasoline tax is fully shifted to customers. The other variables are all statistically and economically significant, partly as a result of specification search. The specification search consisted of (1) dropping the logarithm of personal income per resident because of insignificance; and (2) adding a dummy variable for Monroe (the Florida keys) after noting that the residuals for that county were large and positive. Monroe has multiple reasons for higher gasoline prices, including expensive land for stations, limited retail competition, and costly wholesale delivery.

One variable, Georgia, has an unexpected sign. Other things the same, stations along the Georgia border charge four cents a gallon more than others. Even not controlling for other things, border stations charge more. In 2000, the average price at the 31 border stations was 1.52, compared to 1.49 elsewhere. In 2001, the border price (37 stations) was $1.46 and the average price in other counties was $1.40.[17] There are at least two possible explanations for the surprise result. First, the stations in the border counties may be relatively isolated, even after allowing for their low population density, reducing competition. Second, there may be two types of customers, those whose demand is price-elastic and those whose demand is price-inelastic. Because of the low Georgia taxes, there is not much the border stations can do to keep the price-sensitive customers. That leaves them with the price-insensitive group. Since that group has low elasticity, to maximize profits they charge them an extra four cents. The effect could be analogous to the increase in the price of brand drugs that sometimes occurs when generics enter the market. Purchasers who stick with the brand in spite of the entry of the cheaper substitute are those whose demand is inelastic. In response, the producers raises the price of the branded product.

The conclusion that the gasoline tax is fully shifted is robust to changes in the estimation of equation (4). Using robust regression, which downweights outliers, the coefficient on EstTax is 0.85, with an estimated standard error of 0.18. If the actual tax rate is used in place of the predicted rate, the coefficient is still 1.03 and the estimated standard error drops to 0.11. If the coefficient of Georgia is constrained to zero (that is, the variable is dropped), the coefficient of Est Tax is 0.81 with an estimated standard error of 0.20. Allowing for the possible correlation of error terms within counties to calculate estimated standard errors leaves all variables still significant (and does not change the coefficients).

In summary, there is a reasonable set of county correlates which, when used to condition a regression with instrumented values for the local option gasoline tax, result in a coefficient indicating that the local option tax is fully passed on to consumers. The conclusion that there is full shifting also holds if the actual tax is used instead of its instrumented value.

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[17]The figures are sample averages. Small counties are over-sampled relative to population.

V. GASOLINE TAX SHIFTING FOR SELECTED FLORIDA CITIES, 1991-2000

As an additional test, we use AAA prices of regular gasoline for 28 Florida cities for the month of January each year from 1991 through 2000 (not every city was priced each year).[18] Instead of finding instruments for the tax rates, we control for county effects by using a fixed effects panel regression. This method implicitly assumes that any variables that would affect either relative tax rates or relative gasoline prices have constant relative values over the decade across the 23 counties in which these cities are located. That assumption is of course only an approximation, but a reasonable one relative to the changes in gasoline taxes. From 1991 through 1994, the local option tax in each city was either 6 cents or 7 cents. Starting in 1995, the upper limit rose and across counties the tax rates began to spread out, in a pattern that remained fairly stable through 2000.

Before 1995, state law constrained counties to a maximum tax of seven cents. As that constraint was lifted, counties adjusted to the removal. In this way the identification of the effect of the tax comes from the imposition followed by the lifting of the constraint. Several cities would have had higher taxes before the lifting of the constraint had that been permitted. When the constraint was lifted, they raised taxes not because their characteristics had changed but simply because now they could. Higher tax rates that had been latent before were allowed to become real. This serves as an approximate means of identification that provides useful information.

The result is:

(6) Price = 104.28 + 0.97 Tax

(2.07) (0.20)

$R^2 = 0.13$ n = 264 city-year pairs

An unresolved issue concerning panel regressions is under what circumstances is it better to assume random effects instead of fixed effects. We do not need to consider the issue here, since it does not matter. Assuming random effects, equation (6) becomes:

(7) Price = 102.93 + 1.10 Tax

(1.92) (0.18)

$R^2 = 0.13$ n = 264 city pairs

With either method, the coefficient of Tax is well within an estimated standard deviation of one. Neither method rejects the hypothesis that the local option gasoline tax is fully shifted.

VI. CONCLUSIONS AND LIMITATIONS

We began this study, as noted earlier, after looking at scatter diagrams and simple regressions that suggested that the burden of local option gasoline taxes in Florida was split about fifty-fifty

[18]Both the prices and the tax rates are available on the Florida Department of Transportation's web site.

between customers on the one side and service stations and oil companies on the other. If that split had stood up to fuller analysis, the case for raising local option taxes would have been strengthened. In addition to the customary arguments for raising gasoline taxes there would be new ones. The tax would not be as regressive as thought, and a portion of it would incide on oil companies who obtain above-normal profits partly as a consequence of the transportation network funded by the tax.

We find instead, using two sets of Florida data, that we cannot reject the hypothesis that the tax is fully shifted to consumers. We cannot claim that any of the burden is borne by oil companies. Clearly the gasoline is not perfectly competitive, at either the wholesale or the retail level. At the wholesale level, a few major suppliers dominate the market. At the retail level, both spatial differentiation and product branding limit competition. But neither market imperfection appears to result in less-than-full shifting of county option gasoline taxes. With respect to the wholesale level, the tax applies both to gasoline supplied by both large and small companies, and there may be no reason it would affect the price differential between them.

At the retail level, the population characteristics that result in spatial price differences may operate almost entirely at the sub-county level. That is, prices may be higher in isolated locations, near affluent neighborhoods, and where costs are high. They may be low where there are large numbers of retirees or along well-traveled commuter roads. Some counties have higher or lower prices on average because they have differing preponderances of such locations, neighborhoods, retirees, or roads. But competition among stations located in different counties is slight.[19]

There is a policy implication from our results. When counties raise gasoline taxes, there is a gain in revenue from the higher tax partially offset by a loss in revenue from a lower quantity of gasoline sold. At the state level, the loss is slight because the elasticity of demand for gasoline is low. Consumers are not very sensitive to small changes in the price, and most states are large enough that they have little to fear from consumers' switching to outlets in neighboring states. Our finding suggests that this is true at the county level as well, at least for the relatively large counties in Florida. The full shifting of each county's gasoline tax demonstrates that service stations do not respond to either lower or higher taxes (and thus prices) in surrounding counties. Their non-response tells us that they perceive the spatial differentiation in the retail gasoline market to occur at a finer scale than the county.[20]

Counties seem to be aware of this, or at least they do appear to take little account of neighboring counties in setting tax rates. We have two bits of empirical evidence confirming this hypothesis. First, the R2 between gasoline tax rates is a given county and the average rate in surrounding counties is low, only 0.18. One would expect a relationship that strong just from the similarity of neighboring counties in area, age distribution, and density. If the average tax rate in bordering counties is added to equation (3) explaining county tax rates, the coefficient is positive (0.23) but insignificant at

[19]When, for the 2000-01 sample of stations in Florida, we regress the gasoline price on the year, the regression root mean squared error is 7.88 cents. If we add a set of dichotomous variables for the counties, the root MSE falls to 6.10 cents, a drop of only 23 percent. That is, at least in this sample, 77 percent of the variation in gasoline prices across stations in Florida cannot be accounted for by *any* county variables. Most of the variation is at a smaller geographic scale. (We need to check, however, whether there are day effects on the prices; did prices overall vary during the time of the survey.)

[20]An exception to this conclusion might be the significantly negative coefficient on the variable Choice, a measure of inter-county commuting, in equation (5). That variable surely indicates some inter-county competition but more importantly, we think, the existence of relatively long commuting routes along which there would be price competition. In any case, when Choice is dropped from equation (5), the coefficient on Est Tax still indicates full shifting.

conventional levels. The second bit of evidence is that the variable choice, measuring the flows of commuters to work in counties and residents to work elsewhere, also has no significant effect on county tax rate decisions. When added to equation (3) it has the wrong sign (positive) with a t-statistic less than one.

A second policy implication of our work is that more states may want to follow Florida's example in allowing wide-ranging local option gasoline taxes. An argument against allowing localities to set taxes is that tax competition prevents their setting taxes at optimal levels. County A may wish to raise an excise tax but is reluctant to do so for fear it will drive customers to county B, with a lower tax. County B may be in the same fix. Our finding suggests that at least for the gasoline tax, and for states with counties as large as those in Florida, this need not be a concern. Allowing counties to set tax rates would encourage the efficiency known in economics as Tiebout sorting, whereby residents (retirees deciding where to live, for example) can better match their own preferences with respect to tax rates and levels of public services. States with smaller counties than Florida's might be advised to establish groups of counties as gasoline taxing districts. At the very least, we can state that our results support the position that Florida should continue to allow its counties to set local option tax rates, and perhaps should give them even more latitude in doing so.

TECHNICAL APPENDIX B: THE INCIDENCE OF THE GASOLINE TAX

ABSTRACT

This paper tests whether the state gasoline tax has been fully shifted to consumers. Using a dataset of gasoline prices at the Metropolitan Statistical Area (MSA) level and state taxes from 1983-1999, we perform yearly regressions to determine whether the tax has been fully passed on, and how the degree of shifting has changed over time. Results indicate that though the tax is fully shifted at the end of the period, it has experienced periods of under-shifting. These results are robust to eliminating states with ad valorem sales taxes on gasoline.

I. INTRODUCTION

Are state and local gasoline taxes fully passed on to consumers? This is a question of great interest to both consumers and policymakers, but which has received scant attention in the empirical literature. Theory suggests that when markets are imperfectly competitive, various degrees of shifting are possible in the long run,[1] whereas in perfectly competitive markets, the tax is fully shifted towards consumers if the long run supply curve is horizontal, and under-shifted if the supply curve is upward sloping. Previous empirical studies on the incidence of taxes have examined whether increases in *ad valorem* or in per-unit taxes increase after-tax prices by just the amount of the tax. Besley and Rosen (1999), for instance, use information on the prices of specific commodities in various U.S. cities to examine the extent to which differences in tax rates and bases are reflected in prices. They find that while for some commodities they cannot reject that taxes are shifted on a one-for-one basis, for others, commodity taxes are over-shifted. This indicates that retail markets are not perfectly competitive. Poterba (1996) tests whether state and local retail sales taxes are fully passed on to consumers. He focuses on city-specific clothing price indices for eight cities in the post-war period, and fourteen in the period from 1925 to 1939, and finds evidence supporting the view that retail sales taxes are fully passed on to consumers, with mild over-shifting in the postwar period and less-than-complete forward shifting in the interwar period.

There have also been studies analyzing whether changes in product-specific excise taxes are fully passed on to consumers. Browlee and Perry (1967) and Woodard and Spiegelman (1967), examining the 1965 reduction in federal excise taxes, found that while in most cases prices were reduced by the full amount of the tax, there were also cases of under-shifting. Harris (1987), for his part, found evidence of over-shifting when analyzing the change in cigarette prices that resulted from the 1983 increase in the federal cigarette excise tax.

In terms of studies specifically focusing on the gasoline tax, Shmanske (1990), when looking at the determinants of the levels of state gasoline taxes, finds that gasoline taxes are about 49 cents too low. Besley and Rosen (1998), for their part, examine the effect of changes in the federal excise tax rates upon state taxing decisions. Their focus is on increases on the federal tax rates on gasoline and cigarettes that were implemented in 1983. Their results indicate that there is a significant positive response of state taxes resulting from increases in federal taxes. For instance, a 10-cent per gallon increase in the federal tax rate on gasoline leads to a 3.2-cent increase in the state tax rate. Finally,

[1] See, for instance, Besley (1989), Delipalla and Keen (1992), Katz and Rosen (1985), Kotlikoff and Summers (1987), and Stern (1987).

Chouinard and Perloff (2001) examine which factors explain retail and wholesale gasoline price changes and price differentials. They estimate a reduced-form model to explain how prices vary with demand, cost, seasonal factors, taxes, market power, pollution controls, and government restrictions on vertical integration. Using a panel for 48 states and the District of Columbia from January 1989 through June 1997, they find that state gasoline taxes are fully passed on to consumers. It is evident, then, that the question as to whether gasoline taxes are fully shifted towards consumers is still open to debate.

This paper then seeks to answer this question. To that end, we assembled a dataset containing retail gasoline prices at the MSA level for the 1983-99 period, as well as state gasoline taxes over the same period. Because gasoline prices are not a function solely of taxes, we also include a rent measure, wages, and population as control measures. To see how the tax-shifting coefficient has changed over time, we run separate regressions for each year in the sample period. Results suggest that though the gasoline tax has been fully passed on to consumers at the end of the period, there were instances of under-shifting as well throughout most of the period.

One issue that emerges is that some states levy *ad valorem* sales taxes in addition to per-unit taxes. If one translates these taxes into unit taxes, it creates an endogenous problem, for, since *ad valorem* taxes are expressed as a percentage, increases in prices would mean an increase in taxes. As a robustness check for our results, then, we perform the same analysis excluding those states, and find that the conclusions reached are unchanged.

The paper is divided into five sections. Section 2 presents the empirical framework for the analysis. The following section discusses the sources of the data, while Section 4 presents the results. The last section concludes.

II. EMPIRICAL FRAMEWORK

Though this paper is strictly empirical, in that we are interested solely in estimating the effect of gasoline taxes on prices, it is still useful to go over a simple model of tax incidence in imperfectly competitive markets, as presented in Poterba (1996). Consider an industry with n firms, constant marginal cost c, and inverse demand function $q(X)$, where X is the total quantity produced by all firms and q is the tax-inclusive consumer price. Firm i chooses x_i to maximize profits, which is the difference between costs cx_i and revenues $[q(X)-t]x_i$, where t denotes a specific tax rate. The first-order condition is then

$$q(X) - t - c + x_i q'(X)(1+\alpha) = 0 \quad (1)$$

where α_i is firm i's conjectural variation, in other words, how much the firm expects the aggregate output of all other firms expects to change due to a one-unit change in its output. The tax effect on prices is then

$$\frac{dq}{dt} = q'(X)\sum_{i=1}^{n}\frac{\partial x_i}{\partial t} \quad (2)$$

As shown by Katz and Rosen (1985), dq/dt depends on industry conditions and demand elasticity. In the presence of perfect competition, α_i = –1 for all firms, so that equation (1) reduces to

$q = c + t$, indicating that consumer prices are equal to producer prices plus the tax. In other words, with perfect competition, the tax is fully passed on to consumers.

Because we are interested in the effect of a change in the state gasoline tax rate on gasoline prices, it is necessary to control for other factors that might affect prices independent of the tax rate. In particular, the model suggests controlling for industry costs and demand elasticity. Since we are concerned with the price charged at the pump, industry costs are the costs faced by gas stations, which include the rent paid by each gas station, and the wages paid. Higher costs should result in higher prices, so we expect the coefficient on those two variables to be positive. Finally, we also include population as a proxy for demand. Higher demand, again, should result in higher prices. On the other hand, a highly populated area also indicates the presence of a higher number of gas stations. More gas stations in turn imply a greater degree of competition, meaning that it becomes more difficult for gas stations to charge a price higher than their marginal costs. This means that the coefficient on the population measure could also be negative.

The equation estimated for each year, then, is

$$price_{it} = \beta_1 + \beta_2 tax_{it} + \beta_3 \ln(rent_{it}) + \beta_4 \ln(wage_{it}) + \beta_5 \ln(pop_{it}) + \varepsilon_{it} \qquad (3)$$

where $price_{it}$ refers to gasoline prices for MSA i and year t; tax_{it} is the state gasoline tax, $ln(rent_{it})$ is the natural logarithm of the rent measure; $ln(wage_{it})$ is the natural logarithm of the wage; $ln(pop_{it})$ is the natural logarithm of MSA population; and ε_{it} is an error term. Though all control variables are expressed in logs, their functional form does not alter the results. The coefficient of interest in terms of tax shifting is then β_2. If $\beta_2 = 1$, the tax is fully passed on consumers; if $\beta_2 < 1$, the tax is undershifted, and if $\beta_2 > 1$, the tax is over-shifted.

III. DATA

Gasoline prices are obtained from ACCRA's Cost of Living Index. Data are at the MSA-level, and pertain to regular, unleaded gasoline. All taxes are included, whether or not they are part of the stated pump price. Prices included in the survey come only from recognized national brands, such as Texaco, Exxon, Mobil, Shell, Phillips 66, and Citigo (ACCRA Cost of Living Index Manual, April 2000). The ACCRA data are quarterly, but because data on control variables are yearly, gas prices were averaged across quarters.

Figure 1 plots gasoline prices over the sample period. In it, it is seen that prices have on average remained above one dollar, but dipped below that level between 1986-88.

State gasoline taxes come from *Highway Statistics, 1998* for 1983-98, while taxes for 1999 come from the 1999 edition. Data are tax rates for motor fuel as of December 31 for each year, and were converted from cents per gallon to dollars per gallon. Figure 2 shows that the state gasoline tax has doubled over the period, going from about 10 cents per gallon in 1983 to 20 cents per gallon in 1999.

The rent paid by gasoline stations is proxied by the apartment rent measure provide in ACCRA's Cost of Living Index. The survey covers unfurnished, two bedrooms, 1 1/2 or two baths, stove and refrigerator furnished. Rent excludes all utilities except water and sewer. Data is at the MSA level, and was averaged across quarters.

Wage is average wage per job, from the Bureau of Economic Analysis (BEA), Regional Accounts Data, Local Area Personal Income. Population is also obtained from BEA. Data in both cases is at the MSA level.

The sources of data are summarized in Table 1. Summary statistics are provided in Table 2.

IV. RESULTS

The results are presented in Tables 3A and 3B. In all years, the coefficient on the tax rate is highly significant. The rent measure is significant in all years except for 1983-84, while population is significant in 1984-93. The coefficients also have the expected sign. Higher gasoline taxes translate into higher prices, as do a higher rent (reflecting higher cots), while an increase in population, which indicates more drivers and more gas stations, and hence more competition, causes prices to fall.

In terms of whether taxes are fully shifted to consumers, it is seen that the tax has been less than fully shifted throughout the period, ranging from 27.2 cents per gallon increase resulting from a 1 dollar increase in the tax in 1988, to 87 cents per gallon in 1999. Between 1985-1990, a one dollar increase in the tax would cause less than a 50 cents increase in the price of gasoline.

Now, because the data include states that also levied *ad valorem* sales taxes on gasoline, it is possible that the results are biased. Because *ad valorem* taxes are charged as a percentage of the price, it can increase or decrease depending on the price of gasoline. This then creates an endogenous problem, for the tax in that case becomes dependent on the price. What this means, then, is that (3) is only one equation of a two-equation system, with the second equation being

$$tax_{it} = \alpha_1 + \alpha_2 price_{it} + v_{it}$$

Substituting (4) into (3) yields

$$price_{it} = \beta_1 + \beta_2(\alpha_1 + \alpha_2 price_{it}) + \beta_3 \ln(rent_{it}) + \beta_4 \ln(wage_{it}) + \beta_5 \ln(pop_{it}) + \varepsilon_{it} \quad (5)$$

If α_2 is non-zero, as in the case of an *ad valorem* tax, then β_2, which is the coefficient of interest, becomes more difficult to interpret. To circumvent that problem, we exclude the five states that levy *ad valorem* taxes[2] over the sample period and re-estimate the equations.

The results are presented in tables 4A and 4B. Once again, in all years, the coefficient on the tax rate is highly significant. The rent measure is significant in all years except for 1983-85, while population is significant in 1984-87 and 1990-97. The coefficients also have the expected sign.

In terms of whether the tax is passed through to consumers, it is seen that in both 1983 and 1999, the tax was fully passed on, meaning that a one dollar increase in the tax resulted in a one dollar increase in the price. This time, though, the tax is not as severely under-shifted as in the full sample case, as the least amount that is passed through as a result of a one dollar increase is 47.8

2 The five states are California, Georgia, Illinois, Michigan, and New York

cents in 1986 and 1987. This becomes more evident in Figure 3, which plots the amount that is shifted towards consumers under the full sample, and when the states levying ad valorem taxes are excluded. In it, it is seen that the tax was fully passed on at the beginning of the period, only to exhibit increasing under-shifting in the 1980s, and slowly move towards becoming fully shifted again in 1999.

V. CONCLUSION

This paper used MSA-level data to test whether state gasoline taxes are fully shifted towards consumers. Theory suggests that when markets are imperfectly competitive, various degrees of shifting are possible in the long run, whereas in perfectly competitive markets, the tax is fully shifted towards consumers if the long run supply curve is horizontal, and under-shifted if the supply curve is upward sloping.

To answer this question, we assembled a dataset containing retail gasoline prices at the MSA level for the 1983-99 period, as well as state gasoline taxes over the same period. Because gasoline prices are not a function solely of taxes, we also include a rent measure, wages, and population as control measures. To see how the tax-shifting coefficient has changed over time, we run separate regressions for each year in the sample period. Results suggest that though the gasoline tax has been fully passed on to consumers at the end of the period, there were instances of under-shifting as well throughout most of the period. These results were robust to excluding states levying *ad valorem* sales taxes in addition to specific taxes.

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Table 1: Sources of Data

Variable	Definition	Source	Years
Gas Prices ($/gallon)	Price of regular gasoline, by MSA	ACCRA	1983-1999
Tax ($/gallon)	State gasoline taxes	*Highway Statistics*	1983-1998
		Lundberg	1999
Rent ($)	Apartment rent	ACCRA	1983-1999
Wage ($)	Average wage per job	Bureau of Economic Analysis, Regional Accounts Data	1983-1999
Population	MSA population	Bureau of Economic Analysis, Regional Accounts Data	1983-1999

Table 2: Summary Statistics

Variable	Mean	Std. Deviation	# Obs
Gas Prices ($/gallon)	1.092	0.124	3326
Tax ($/gallon)	0.167	0.049	3326
Rent ($)	483.695	177.565	3312
Wage ($)	22,384.91	4,881.699	3326
Population	712,379.9	1,152,978	3326

Table 3A: Yearly Regressions Explaining Gas Prices

Dependent Variable: Gas Prices ($/gallon)

	Year							
Variable	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1990**	**1991**
Tax ($/gallon)	0.879**	0.627**	0.567**	0.372*	0.421**	0.272*	0.456**	0.617**
	(0.113)	(0.109)	(0.121)	(0.189)	(0.110)	(0.132)	(0.136)	(0.097)
ln(rent)	0.024	0.031	0.052**	0.112**	0.081**	0.097**	0.100**	0.067**
	(0.019)	(0.017)	(0.019)	(0.031)	(0.018)	(0.020)	(0.030)	(0.024)
ln(wage)	-0.037	0.045	0.011	-0.030	-0.025	0.000	-0.060	0.039
	(0.031)	(0.032)	(0.036)	(0.057)	(0.034)	(0.039)	(0.066)	(0.062)
ln(population)	-0.001	-0.008*	-0.010**	-0.014*	-0.014**	-0.011*	-0.018**	-0.014**
	(0.004)	(0.003)	(0.004)	(0.006)	(0.004)	(0.005)	(0.006)	(0.005)
Obs.	179	187	184	189	190	180	211	212
Adj. R-squared	0.245	0.165	0.138	0.058	0.146	0.108	0.128	0.207

Note: Each column represents OLS regressions of gas prices against the independent variables listed for the year indicated. Heteroskedastic-consistent standard errors are in parenthesis. * Denotes significance at the 5-percent level; ** denotes significance at the 1-percent level. See Table 1 for sources.

Table 3B: Yearly Regressions Explaining Gas Prices

Dependent Variable: Gas Prices ($/gallon)

	Year							
Variable	1992	1993	1994	1995	1996	1997	1998	1999
Tax ($/gallon)	0.813**	0.690**	0.822**	0.731**	0.841**	0.763**	0.874**	0.897**
	(0.105)	(0.104)	(0.126)	(0.122)	(0.124)	(0.119)	(0.144)	(0.149)
ln(rent)	0.153**	0.203**	0.236**	0.200**	0.199**	0.221**	0.168**	0.206**
	(0.024)	(0.028)	(0.027)	(0.037)	(0.038)	(0.035)	(0.033)	(0.050)
ln(wage)	0.011	-0.005	-0.053	0.014	0.008	-0.056	-0.062	-0.142
	(0.047)	(0.055)	(0.056)	(0.045)	(0.060)	(0.055)	(0.065)	(0.085)
ln(population)	-0.014**	-0.012*	-0.012*	-0.011	-0.009	-0.009	-0.001	0.007
	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.010)
Obs.	203	209	222	225	236	232	229	224
Adj. R-squared	0.396	0.376	0.392	0.408	0.378	0.376	0.310	0.238

Note: Each column represents OLS regressions of gas prices against the independent variables listed for the year indicated. Heteroskedastic-consistent standard errors are in parenthesis. * Denotes significance at the 5-percent level; ** denotes significance at the 1-percent level. See Table 1 for sources.

Table 4A: Yearly Regressions Explaining Gas Prices
States with *ad valorem* Taxes Excluded

Dependent Variable: Gas Prices ($/gallon)

	Year							
Variable	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1990**	**1991**
Tax ($/gallon)	0.995**	0.812**	0.860**	0.478*	0.478**	0.536**	0.518**	0.595**
	(0.105)	(0.112)	(0.126)	(0.231)	(0.167)	(0.165)	(0.154)	(0.113)
ln(rent)	0.014	0.029	0.028	0.094*	0.084**	0.100**	0.075**	0.048*
	(0.017)	(0.018)	(0.018)	(0.043)	(0.022)	(0.023)	(0.028)	(0.024)
ln(wage)	-0.050	0.022	0.025	-0.006	-0.024	0.022	0.020	0.046
	(0.031)	(0.035)	(0.034)	(0.069)	(0.041)	(0.045)	(0.056)	(0.062)
ln(population)	-0.005	-0.009*	-0.012**	-0.015*	-0.012*	-0.011	-0.025**	-0.014**
	(0.003)	(0.004)	(0.003)	(0.006)	(0.005)	(0.006)	(0.007)	(0.005)
Obs.	149	156	153	155	156	149	174	178
Adj. R-squared	0.378	0.258	0.260	0.051	0.128	0.165	0.146	0.172

Note: Each column represents OLS regressions of gas prices against the independent variables listed for the year indicated. Heteroskedastic-consistent standard errors are in parenthesis. * Denotes significance at the 5-percent level; ** denotes significance at the 1-percent level. See Table 1 for sources.

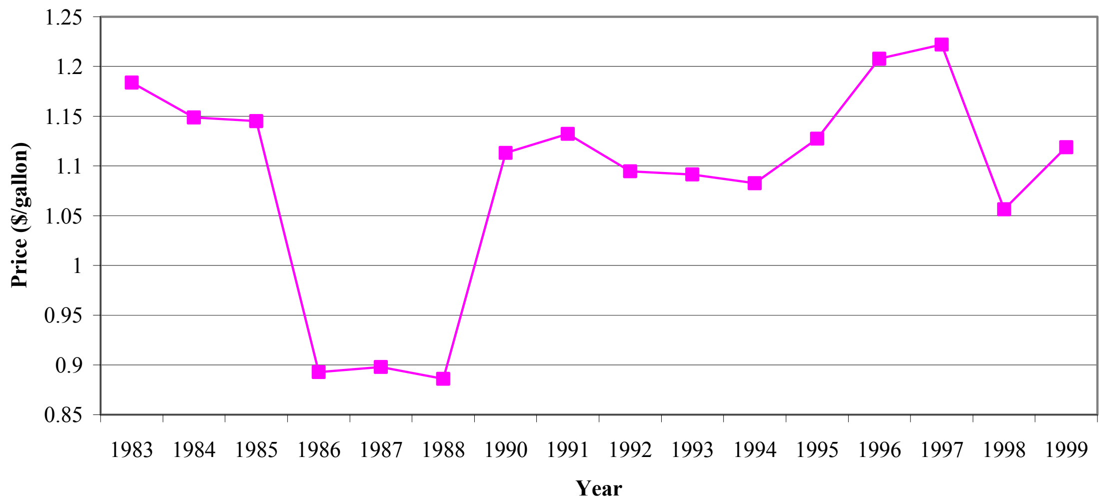
Table 4B: Yearly Regressions Explaining Gas Prices
States with *ad valorem* Taxes Excluded

Dependent Variable: Gas Prices ($/gallon)

	Year							
Variable	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Tax ($/gallon)	0.725**	0.637**	0.727**	0.579**	0.772**	0.726**	0.853**	0.995**
	(0.141)	(0.137)	(0.161)	(0.143)	(0.136)	(0.148)	(0.182)	(0.183)
ln(rent)	0.126**	0.188**	0.233**	0.219**	0.216**	0.224**	0.188**	0.236**
	(0.030)	(0.033)	(0.035)	(0.045)	(0.039)	(0.032)	(0.032)	(0.043)
ln(wage)	0.026	0.019	-0.015	0.049	0.054	-0.025	-0.011	-0.031
	(0.049)	(0.060)	(0.063)	(0.046)	(0.063)	(0.060)	(0.065)	(0.077)
ln(population)	-0.018**	-0.018**	-0.019**	-0.017**	-0.016*	-0.016*	-0.010	-0.011
	(0.005)	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.010)
Obs.	174	178	190	192	202	198	198	196
Adj. R-squared	0.282	0.299	0.309	0.352	0.360	0.312	0.313	0.260

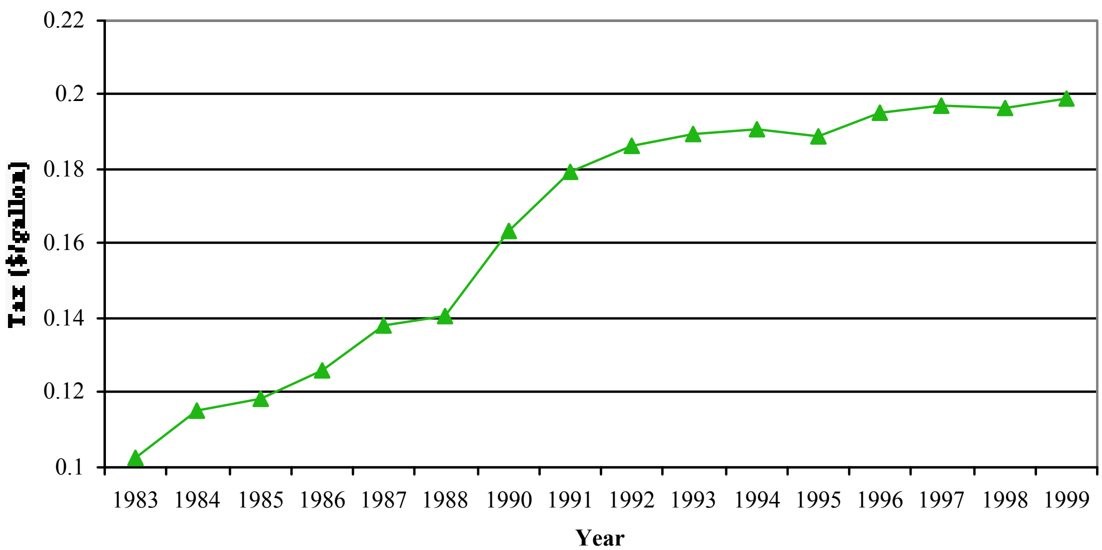
Note: Each column represents OLS regressions of gas prices against the independent variables listed for the year indicated. Heteroskedastic-consistent standard errors are in parenthesis. * Denotes significance at the 5-percent level; ** denotes significance at the 1-percent level. See Table 1 for sources.

Figure 1: Evolution of Gasoline Prices, 1983-99

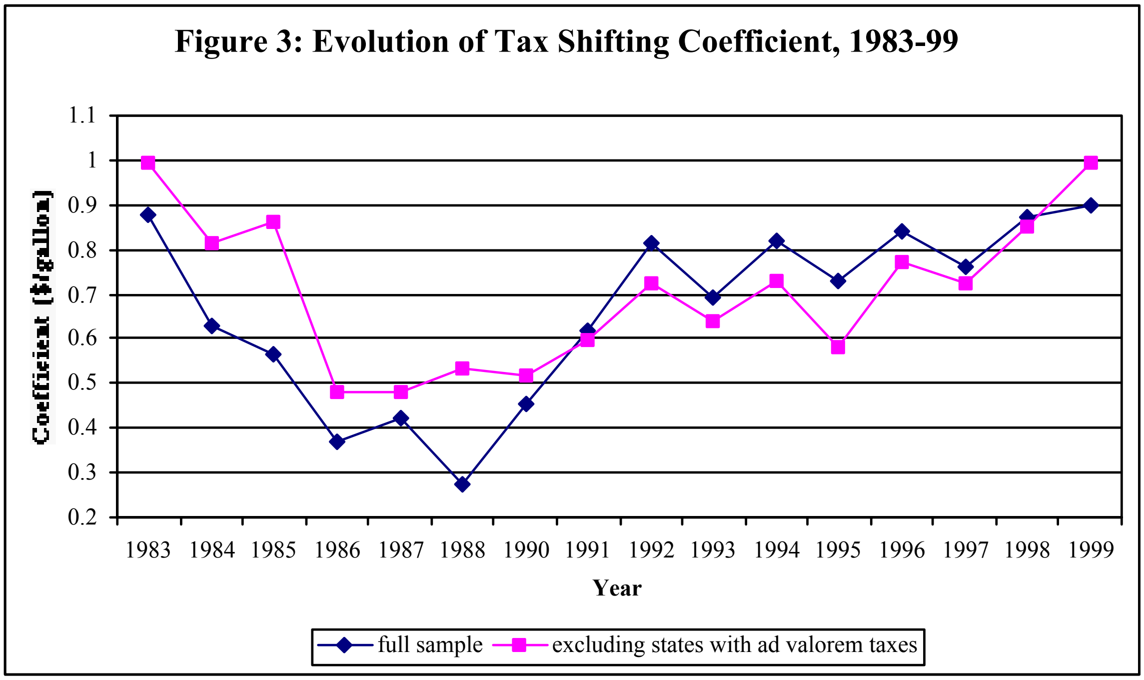


Source: ACCRA

Figure 2: Evolution of State Gasoline Taxes, 1983-99



Source: *Highway Statistics*



Note: Tax shifting coefficient refers to degree to which taxes are passed on to consumers.

TECHNICAL APPENDIX C - INTERMODAL TRANSPORTATION

I. WHAT IS INTERMODAL TRANSPORTATION?

There are multiple definitions of the term "intermodal transportation."[1] The development of containerization in the middle of the 20th century facilitated the use of multiple modes of transportation for a single shipment.[2] As a result, containerization is often associated with intermodal transportation. But intermodal transportation extends well beyond the use of containers. Much freight is shipped intermodally without containers. For example, freight that falls under the category of *bulk freight* (such as coal) typically is shipped without using containers. Moreover, the movement of freight is not the only function of intermodal transportation; intermodal transportation also plays a key role in moving *people* between destinations. Therefore, a useful definition of intermodal transportation is the movement of goods and people employing more than one form of transportation for a single delivery or trip.[3]

The *Year 2020 Florida Statewide Intermodal System Plan*[4] offers the following definitions:

Intermodal - Carriage by more than a single mode with a transfer(s) between modes to complete a trip or a freight movement. In passenger transportation intermodal usually refers to trips involving more than one mode. For freight and goods movement, the definition refers to transfers between all freight modes including ships, rail, truck, barge, etc. taken as a system for moving freight. Also refers to the movement of an intermodal container.

Intermodal Transportation - Transportation movement involving more than one mode (e.g. rail/motor, motor/air, or rail/water). It has been defined as a process of addressing the linkages, interactions and movements between modes of transportation.

[1] See W. Brad Jones, C. Richard Cassady, and Royce O. Bowden, "Developing a Standard Definition of Intermodal Transportation," in: *Symposium on Intermodal Transportation*, 27 *Transportation Law Journal* 345 (Summer 2000).

[2] For an overview of the development and growth of containerization, see John H. Mahoney, *Intermodal Freight Transportation* (Westport, CT: Eno Foundation for Transportation, Inc., 1985) at pp. 13-24. Paul Dempsey credits the "container revolution" as having "done more to foster the growth of international trade than any other single intermodal breakthrough." See Paul S. Dempsey, "The Law of Intermodal Transportation: What It Was, What It Is, What It Should Be," in: *Symposium on Intermodal Transportation*, 27 *Transportation Law Journal* 367 (Summer 2000) at pp. 368-369.

[3] Both narrow and broad characterizations are included in the following definition of *intermodalism* provided by the U.S. Department of Transportation's Bureau of Transportation Statistics:

1) [M]ost narrowly, [intermodalism] refers to containerization, piggyback service, or other technologies that provide the seamless movement of goods and people by more than one mode of transport. 2) [M]ore broadly, intermodalism refers to the provision of connections between different modes, such as adequate highways to ports or bus feeder services to rail transit. 3) In its broadest interpretation, intermodalism refers to a holistic view of transportation in which individual modes work together or within their own niches to provide the user with the best choices of service, and in which the consequences on all modes of policies for a single mode are considered. This view has been called balanced, integrated, or comprehensive transportation in the past.

Available at: http://www.bts.gov/btsprod/expr/expsearch.html.

[4] Year 2020 Florida Statewide Intermodal System Plan: Interim Final Report, Florida Department of Transportation (March 1, 2000) at p. G-4.

The greatest challenge facing intermodal transportation lies in the *inter*-mode aspect. That is, the development and maintenance of effective connections *between* modes is integral to realizing efficient and successful intermodal transportation systems. Transportation planners often cite the *seamless* movement of goods and people between destinations as a key goal.

II. THE RELEVANCE OF INTERMODAL TRANSPORTATION

A. HOW MUCH FREIGHT TRAFFIC MOVES INTERMODALLY?

According to the *1997 Commodity Flow Survey*, intermodal transportation accounts for a small portion of freight traffic.[5] Nationally, intermodal transportation accounted for approximately two percent of the 11.1 billion tons of freight shipped in 1997. In Florida, approximately one percent of the 397 million tons of freight originating in Florida was shipped intermodally.[6]

When measured in ton-miles, these shares rise to approximately seven percent. Not surprisingly, intermodal transportation is more likely to be employed for longer distances. For shipments originating in Florida, for example, 65.1 percent of all tons shipped by a single mode were for trips less than 50 miles; expanding the trip distance to 99 miles or less accounts for 84 percent of all tons shipped by a single mode. Only 3.4 percent of all tons shipped by a single mode were for trips greater than 750 miles. In contrast, less than 10 percent of all tons shipped intermodally were for distances less than 99 miles, whereas approximately 53 percent traveled distances of 750 miles or more.[7]

Most of the shipments that originate in Florida also have Florida destinations. Approximately 85 percent of all tons originating in Florida go to destinations within the state.[8] When shipments are measured in terms of dollar value, this percentage is still high but lower, falling to 64.3 percent of shipments valued at approximately $214 billion. Similarly, most of the inbound shipments originated in Florida: approximately 73.1 percent of the 465 million tons of freight with Florida destinations also originated in Florida.[9] Thus, it is not surprising that most of the freight that moves through Florida does so employing a single mode of transportation.

Despite the small share of freight that moves through the state intermodally, Florida's position as a major gateway for international trade makes its intermodal connections at these points of entry/exit

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[5] 1997 Commodity Flow Survey, Bureau of Transportation Statistics and Bureau of the Census, available at: http://www.bts.gov/ntda/cfs/prod.html.

[6] Id.

[7] The comparable figures for the U.S. overall are as follows: 58.3 percent of all tons shipped by a single mode were for distances less than 50 miles, 68.4 percent for distances equal to 99 miles and less, and 6.8 percent for distances of 750 miles and greater. For all tons shipped intermodally, approximately 15 percent was shipped less than 100 miles and approximately one-third was shipped more than 750 miles. Id.

[8] Id.

[9] If shipments are measured by value instead, approximately 45 percent of all freight with a Florida destination also originated in Florida. Id.

of particular interest.[10] Although Florida's share of total U.S. international trade decreased from 4.1 percent in 1999 to 3.7 percent in 2000,[11] Florida ranks 8th in terms of the total dollar value of state exports.[12]

B. WHY IS THERE SO MUCH INTEREST IN INTERMODALISM?

Despite the small share of all freight traffic that intermodal transportation accounts for, there has been a growing interest in intermodalism during the past decade. Several factors that help to explain this: changes in inventory management, improvements in information and communication technologies, concern over environmental quality, and increased congestion.

Inventory Management. Many businesses that traditionally warehoused a large amount of inventory now embrace just-in-time inventory systems that minimize inventory holdings and increase flexibility for both production and product offerings. For this approach to be successful, timely shipments are crucial.[13] Failure to receive necessary parts on time can result in costly production slowdowns. Retailers who have insufficient stock on their shelves lose both sales and consumer goodwill, yet holding excess inventory also is costly due to the explicit costs of storing inventory as well as the risk of ending up with products that have become obsolete. Transportation providers, recognizing the importance of timely deliveries, have responded by offering just-in-time services. For example, FedEx and United Parcel Service (UPS) have their own integrated air and motor carrier fleets to provide door-to-door service with guaranteed delivery times and close tracking of shipments. CSX Transportation markets its rail service to paper shippers by offering a network of warehouses that allows it to offer just-in-time delivery.[14] Intermodalism expands the scope of shipping alternatives, allowing shippers to weigh the timeliness and cost of the different transportation options and choose the option that best meets their needs.

Information and Communications Technology. The growth of just-in-time delivery systems has been facilitated by improvements in information and communications technology. Information and communication technologies provide better tracking of shipments. Shippers, carriers, and recipients are able to obtain real-time information about the location of shipments in transit as well as expected delivery times. Technology also enables companies to decrease the transit time for shipments. For example, laser technology has increased the speed with which FedEx can transport packages.[15] FedEx has installed ceiling-based lasers at loading sites to scan package bar codes,

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[10] The Transportation Research Board has commented that "intermodal freight is critical in international trade." See Transportation Research Board, Special Report 252: Policy Options for Intermodal Freight Transportation (Washington D.C.: National Research Council, 1998), p. 14.

[11] See Florida's International Trade 2000, Enterprise Florida (April 2001) at p. 2, available at: http://www.eflorida.com/all_facts.html.

[12] The total dollar value of Florida's exports in 2000 was $26.5 billion. In 2001, it was $27.2 billion. These data were obtained from MISER: Massachusetts Institute for
Social and Economic Research, available at: http://www1.miser.umass.edu/trade/strank.html.

[13] See Marilyn M. Helms and Lawrence P. Ettkin, "Time-Based Competitiveness: A Strategic Perspective," 10 Competitiveness Review 1 (Summer-Fall 2000) for a discussion of the importance of time management as a competitive advantage in each stage in the production-distribution supply chain.

[14] For more detail, see http://www.csxt.com/com/pap/partners.htm.

[15] See Mary Hayes, "Mobility is Up, Costs are Down – Creative IT Shapes Transportation's Future," Information Week (September 14, 1998, p. 251).

replacing the more cumbersome process of individuals using scanning guns. This new scanning procedure decreases the time spent on sorting and loading packages. Information and communication technologies similarly facilitate the use of intermodal transportation by decreasing the reliability problems that arise when the amount of handling and the number of parties involved in a particular freight movement increases. The efficiency and success of intermodal operations depends heavily on strong coordination between modes and the efficient transfer of information. Information and communication technologies make it easier to track and transfer shipments, and they allow better communication between freight handlers and shippers.

Environmental Concerns. The 1990 Clean Air Act Amendments require that areas meet certain air quality standards.[16] Areas that have been identified as "areas of nonattainment" – those areas failing to meet the National Ambient Air Quality Standards (NAAQS) – must reduce the amount of pollutants in the air and, therefore, are under pressure to reduce emissions. Motor vehicle usage is a significant contributor to air pollution in the United States,[17] particularly with respect to carbon monoxide, particulate matter, and ground-level ozone,[18] three of the six "criteria" air pollutants.[19] The following six Florida counties originally were designated as nonattainment areas with respect to ground-level ozone: Broward, Dade, Duval, Hillsborough, Palm Beach, and Pinellas.[20] All six counties currently are in compliance with the NAAQS and are classified as "maintenance" areas.[21]

The Clean Air Act (CAA) requires a strong connection between transportation planning and air quality control programs. Specifically, "transportation conformity" is required under the CAA – that is, transportation plans and programs must "conform" to the state's air quality improvement plans for nonattainment and maintenance areas. Thus, metropolitan planning organizations that fall within areas of nonattainment are required to coordinate their transportation planning with their plans for improving air quality.[22] A year after the enactment of the Clean Air Act Amendments these air quality improvement goals were reinforced with the passage of major transportation legislation, the

[16] For more information, see "Clean Air Act," U.S. Environmental Protection Agency, available at: http://www.epa.gov/oar/oaq_caa.html.

[17] See "The Problem," Congestion Mitigation and Air Quality Improvement Program, Federal Highway Administration, U.S. Department of Transportation, available at: http://www.fhwa.dot.gov/environment/cmaq/problem.htm.

[18] Although upper-atmosphere ozone protects the earth by shielding it from ultraviolet radiation, ground-level ozone causes harm to human health and the environment. See "Ground-Level Ozone: What is it? Where does it come from?" and "Health and Environmental Impacts of Ground-level Ozone," U.S. Environmental Protection Agency, available at: http://www.epa.gov/air/urbanair/ozone/index.html.

[19] The other three criteria pollutants are nitrogen oxides, sulfur dioxide, and lead. See "What Are the Six Common Air Pollutants?" U.S. Environmental Protection Agency, available at: http://www.epa.gov/air/urbanair/6poll.html.

[20] Ground-level ozone was the only criteria pollutant for which Florida had nonattainment areas. See "Green Book: Nonattainment Areas for Criteria Pollutants," U.S. Environmental Protection Agency, available at: http://www.epa.gov/air/oaqps/greenbk/index.html. Duval county was classified as a Section 185A, or "transitional" area, with respect to ground-level ozone, which is an area designated as a nonattainment area as of the date of enactment of the Clean Air Act Amendments of 1990 but did not violate the national primary ambient air quality standard for ozone for the 36-month period beginning on January 1, 1987 and ending on December 31, 1989. See "Sections of the Clean Air Act," U.S. Environmental Protection Agency, available at: http://www.epa.gov/air/oaqps/greenbk/caa-t1p.html.

[21] A maintenance area is an area that was formerly a nonattainment but has subsequently attained the NAAQS and was officially redesignated to attainment by the EPA.

[22] See United States Code, Title 23 (Highways), Section 134 (Metropolitan Planning), available at: http://www.access.gpo.gov/uscode/uscmain.html.

Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), which included the Congestion Mitigation and Air Quality Improvement Program (CMAQ) among its provisions. CMAQ was reauthorized in 1998 under the Transportation Equity Act for the 21st Century (TEA-21) and has allocated over $14 billion (through both ISTEA and TEA-21) for states and localities with the poorest air quality to fund projects designed to improve air quality and reduce congestion.[23] CMAQ was designed to allow nonattainment areas[24] to implement transportation control measures (TCM) in compliance with the mandates of the Clean Air Act in addition to other projects that reduce transportation emissions.[25]

Intermodalism can play an important role in reducing motor vehicle emissions. Improving intermodal connections, for example, could increase the use of public transportation since passengers are more likely to use transit services to get to rail or air terminals when there are direct connections. Growing recognition of the bicycle as a viable mode of transportation has led many communities to include bicycle facilities into their transportation plans. Long Beach Bikestation in California is a case in point. This is a transfer point for bicyclists connecting to the light rail line, and the facility provides bike lockers, rental bikes, and bicycle mechanics.[26] With respect to freight movements, increased use of truck-rail movements instead of truck-only movements may decrease pollution since rail transport has lower emissions per ton-mile than truck transport.[27]

Congestion. As CMAQ's name implies, congestion is a related concern. Vehicle miles traveled have increased at a much greater pace than lane miles, resulting in increased congestion. In Florida, this is evident at both the state and local level. Daily vehicle miles traveled per lane mile have increased on Florida's State Highway System:[28]

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[23] See "CMAQ Funding," Congestion Mitigation and Air Quality Improvement Program, Federal Highway Administration, U.S. Department of Transportation, available at: http://www.fhwa.dot.gov/environment/cmaq/funding.htm.

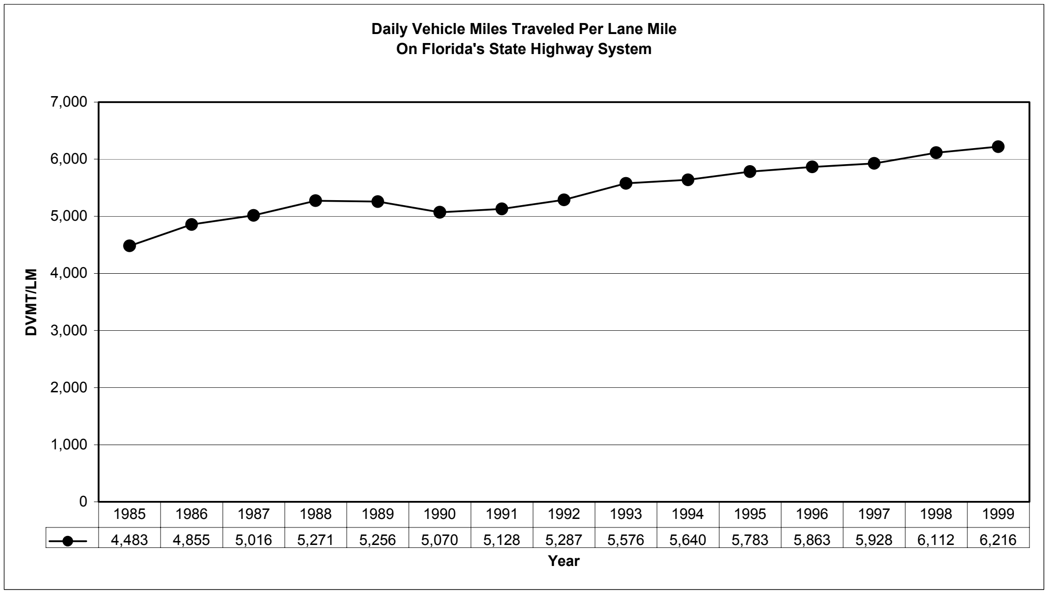
[24] TEA-21 expanded CMAQ eligibility to "maintenance" areas. The requirements to apply for CMAQ funds vary by metropolitan area and state. See "What's New," Congestion Mitigation and Air Quality Improvement Program, Federal Highway Administration, U.S. Department of Transportation, available at: http://www.fhwa.dot.gov/environment/cmaq/whatsnew.htm.

[25] For example, eligible nonattainment and maintenance areas may use CMAQ funds to support public transportation, improve traffic flow, and develop bicycle and pedestrian programs. See "Eligibility," Congestion Mitigation and Air Quality Improvement Program, Federal Highway Administration, U.S. Department of Transportation, available at: http://www.fhwa.dot.gov/environment/cmaq/eligblty.htm.

[26] Id.

[27] See Transportation Research Board, supra note 10 at p. 16.

[28] Source: Florida Highway Data Source Book (April 2000) at p. D-3, available at: http://www11.myflorida.com/planning/statistics/sourcebook/default.htm.



Similarly, congestion generally has increased over the past 15 years in the four Florida urban areas included in the Texas Transportation Institute's *Urban Mobility Study*:

Daily Vehicle Miles Traveled Per Lane Mile[29]
1985-1999

	Ft. Lauderdale-Hollywood-Pompano Beach		Jacksonville		Miami		Orlando		Tampa	
	Freeway	**PAS**	**Freeway**	**PAS**	**Freeway**	**PAS**	**Freeway**	**PAS**	**Freeway**	**PAS**
1985	8,020	5,775	10,665	4,975	12,575	6,155	10,905	6,980	10,135	6,285
1986	8,990	5,990	11,105	5,200	12,455	6,185	11,560	6,335	10,685	6,250
1987	9,620	6,605	10,965	5,110	13,450	6,465	11,390	6,690	11,785	6,360
1988	10,280	6,610	12,105	5,250	14,710	6,750	11,390	7,085	11,860	6,505
1989	10,420	6,365	11,650	5,715	16,435	7,000	11,495	7,145	11,965	6,795
1990	11,000	6,400	12,215	6,045	15,985	7,145	11,145	7,000	12,305	7,195
1991	11,925	6,565	11,890	6,505	15,145	7,110	11,155	7,210	13,065	7,465
1992	13,200	6,900	12,000	6,810	16,125	7,065	10,870	7,455	13,000	7,715
1993	13,595	6,900	12,130	6,965	15,810	7,035	10,805	7,415	12,750	7,975
1994	13,605	6,525	12,300	7,225	16,795	6,910	10,985	7,110	12,705	8,110
1995	14,600	6,010	12,725	7,340	17,430	6,870	10,865	7,340	13,845	7,490
1996	14,825	6,100	13,585	6,360	16,900	6,945	11,315	7,485	13,390	7,445
1997	15,765	5,975	13,310	6,470	17,015	6,950	12,215	7,460	13,200	7,400
1998	15,735	5,995	13,370	6,430	16,840	6,865	12,650	7,415	13,455	7,245
1999	16,575	6,055	13,365	6,455	17,225	6,710	12,375	7,555	13,795	7,345

[29] Source: *2001 Urban Mobility Study*, Texas Transportation Institute, available at: http://mobility/tamu.edu. PAS refers to "principal arterial streets."

Congestion not only contributes to delays in travel times, but it also results in wasted fuel. The Texas Transportation Institute provides estimates of the amount of wasted fuel by calculating the annual excess fuel consumed per person due to congestion delays. In Miami, the wasted fuel was estimated to be 61 gallons per person in 1999. The comparable amounts for the Ft. Lauderdale, Jacksonville, Orlando, and Tampa areas are 44, 46, 61, and 50 gallons per person, respectively.[30]

One solution to the problem of congestion is to build more highways.[31] Building highways involves large capital expenditures, however. In the most densely populated areas, there may not be sufficient land available for highway expansion. Land-use policies and zoning restrictions also may limit the land available for highway expansion. Air quality regulations and other environmental concerns, such as preserving environmentally sensitive areas and ecological diversity, also presents opposition to building more highways. Thus, policymakers and planning organizations may increasingly look to other alternatives for reducing congestion. Intermodal transportation has been viewed as part of the solution. For example, increasing the use of truck-rail intermodal movements is viewed as one way to decrease the demands on state highway systems. Moreover, investing in intermodal facilities may be less costly than expanding highways.[32]

III. RECENT LEGISLATION

Although intermodalism has existed for over half a century, it has not been a primary focus of transportation policy until recently.[33] Legislation at both the federal and state levels has made the development and enhancement of intermodal transportation policy a priority for policy makers and planning organizations.

A. FEDERAL LEGISLATION

Historically, federal transportation programs concentrated largely on providing funding for highways.[34] The passage of the Intermodal Surface Transportation Efficiency Act of 1991, however, increased the flexibility of states in their selection of transportation projects eligible for federal funding.[35] Moreover, ISTEA specifically identified intermodalism as a priority. Section 2 of ISTEA states:

[30] Id.

[31] Highway expansion would not be eligible for CMAQ funding, however, since such efforts is not likely to contribute to air quality improvement. See "Eligibility," Congestion Mitigation and Air Quality Improvement Program, Federal Highway Administration, U.S. Department of Transportation, available at: http://www.fhwa.dot.gov/environment/cmaq/eligblty.htm.

[32] See Transportation Research Board, supra note 10 at pp. 15-16.

[33] For a detailed overview of U.S. transportation regulation and law with a focus on intermodal transportation, see Dempsey, supra note 2.

[34] Paul Dempsey notes that "the Intermodal Surface Transportation Efficiency Act of 1991 was the first highway bill in the nation's history to have expunged the word 'highway' from its title." See Dempsey, supra note 2 at p. 391.

[35] ISTEA authorized federal programs from 1992 to 1997. The Transportation Equity Act for the 21st Century (TEA-21) is the successor legislation that effectively reauthorized ISTEA and continues many of the federal transportation programs begun under ISTEA for fiscal years 1998-2003. The Department of Transportation's Office of Intermodalism also was
(footnote continued)

It is the policy of the United States to develop a National Intermodal Transportation System that is economically efficient and environmentally sound, provides the foundation for the Nation to compete in the global economy, and will move people and goods in an energy efficient manner.

The National Intermodal Transportation System shall consist of all forms of transportation in a unified, interconnected manner, including the transportation systems of the future, to reduce energy consumption and air pollution while promoting economic development and supporting the Nation's preeminent position in international commerce.[36]

As the above passage indicates, ISTEA encompassed many goals. It sought to improve the interconnectedness of transportation systems in order to enhance economic competitiveness. But, as noted previously, it also required that transportation planning take into account the environmental impacts of transportation systems with an eye towards meeting the mandates of the 1990 Clean Air Act Amendments. On a related note, the wording of ISTEA also places importance on developing transportation systems that decrease energy consumption to promote both fuel conservation and energy independence.

ISTEA also took a more decentralized approach by placing responsibility for transportation planning policies in the hands of states and localities and by requiring coordinated planning efforts between the states and their respective metropolitan planning organizations. ISTEA required states to develop statewide transportation plans and planning processes.

ISTEA's emphasis on intermodalism presumably changes the focus of transportation planning. Rather than focusing on particular *modes* of transportation, the focus is on the efficient and safe *movement* of people and goods. An emphasis on intermodalism suggests a more comprehensive approach to transportation planning as does the breadth of requirements contained in ISTEA – enhancing economic competitiveness, improving air quality, reducing energy consumption, and increasing coordination between state and local planning efforts.

B. STATE LEGISLATION

Prior to the enactment of ISTEA, Florida had passed its own intermodal legislation in 1990, establishing an Intermodal Development Program.[37] The purpose of this program was, and continues to be, to provide funding for intermodal facilities and projects and to encourage the development of stronger intermodal networks within the state. Consistent with the requirements of ISTEA and TEA-21, Florida legislation currently requires that the Florida Department of Transportation develop a

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created pursuant to ISTEA. Information about the Office of Intermodalism can be obtained at: http://www.dot.gov/intermodal/.

[36] See "Laws and Regulations Pertaining to the Bureau of Transportation Statistics," Bureau of Transportation, U.S. Department of Transportation, available at: http://www.bts.gov/lawlib/docs/istea1.htm

[37] Florida Statutes, § 341.053 (Intermodal Development Program): "There is created within the Department of Transportation an Intermodal Development Program to provide for major capital investments in fixed-guideway transportation systems, access to seaports, airports and other transportation terminals, providing for the construction of intermodal or multimodal terminals; and to otherwise facilitate the intermodal or multimodal movement of people and goods." See The 2001 Florida Statutes, available at: http://www.leg.state.fl.us/Statutes/index.cfm.

statewide transportation plan with a planning horizon of at least 20 years. This plan is based upon the principles outlined in ISTEA: "preserving the existing transportation infrastructure; enhancing Florida's economic competitiveness; and improving travel choices to ensure mobility. The Florida Transportation Plan shall consider the needs of the entire state transportation system and examine the use of all modes of transportation to effectively and efficiently meet such needs."[38] In addition, the legislation encourages projects that will "[e]nhance the integration and connectivity of the transportation system, across and between modes throughout Florida, for people and freight."[39] The statewide plan is developed in conjunction with the transportation plans of Florida's metropolitan planning organizations and in consultation with officials from nonmetropolitan areas. The legislation similarly requires metropolitan planning organizations to develop long-run plans with these broad principles in mind, including a focus on intermodalism.[40]

IV. OVERVIEW OF THE INTERMODAL TRANSPORTATION NETWORK[41]

The major modes of transportation for freight are truck and rail for surface transportation, air transportation, and water transportation. Bordering two major bodies of water, the Gulf of Mexico and the Atlantic Ocean, Florida represents an important gateway for international trade in addition to domestic trade. Thus, in contrast to many states, Florida's transportation network includes a significant role for water transportation in addition to surface and air transportation.

A. SURFACE TRANSPORTATION

The major modes of surface freight transportation are trucks and rail, which use highways and railroads as their respective networks. Prior to ISTEA, highways were the primary focus for government funding, and they continue to receive substantial funding. Motor carriers are primary beneficiaries of this funding since they do not bear the full cost of their use of the roads, including the wear and tear that they impose on highways. The trucking industry has two major sectors, less-than-truckload (LTL) and truckload. The less-than-truckload segment employs a hub-and-spoke system that is used to consolidate shipments of multiple shippers' goods on one truck. Truckload, on the other hand, refers to the door-to-door transportation of a single shipper's goods that fill a truck.[42]

Rail transportation typically involves a lower cost per ton-mile that shipping by truck, and railroads are most efficient for transporting bulk commodities.[43] Railroads are largely privately

[38] See Florida Statutes § 339.155 (Transportation planning), Section 1 (The Florida Transportation Plan).

[39] Id. at Section (2)(e).

[40] See Florida Statutes § 339.155 (Transportation planning) and § 339.175 (Metropolitan planning organizations).

[41] Although intermodal transportation is applicable to both freight movement and passenger travel, the focus here will be on freight movement. Many of the issues confronting intermodal freight transportation, such as bottlenecks and congestion at major intermodal connections, are also applicable to intermodal passenger travel. Because policymakers and planning organizations have typically understood the issues associated with freight movement less well than those associated with passenger travel, there have been calls for more emphasis on freight movement issues.

[42] See Clifford Winston, "U.S. Industry Adjustment to Economic Deregulation," 12 Journal of Economic Perspectives 89 (Summer 1998) at p. 94.

[43] For an overview of the railroad industry, see General Accounting Office, "Railroad Competitiveness: Federal Laws and Policies Affect Railroad Competitiveness," GAO/RCED-92-16 (November 1991), available at: http://www.gao.gov/.
(footnote continued)

financed. The infrastructure is privately owned and maintained, i.e., freight railroads incur the expenses of maintaining their own rights-of-way on tracks and structures. This is in contrast to highways (and waterway infrastructure as well), which are built and maintained by public authorities.

The ability of private transportation providers to compete has been heavily influenced by regulation. The impact of both regulation and subsequent deregulation in the motor carrier and railroad industries is evident.[44] Regulation of motor carriers began at the state level in the 1920s when motor carriers were required to demonstrate necessity for their services. The Motor Carrier Act of 1935 imposed the necessity requirement at a federal level. This legislation resulted in regulation of prices and entry. Under regulation, motor carrier entry was limited. Entry into new markets by both new carriers and incumbents had to be justified on the basis of convenience and necessity. Approval included specification of both the commodities to be carried as well as the routes that could be employed. Incumbent firms could block entry by arguing that they would be harmed by the new competition or by deciding to offer the service themselves.[45] This route regulation effectively operated as market division among carriers, shielding them from competition.

Beginning in the 1970s, there was extensive deregulation in the transportation industries. During the 1970s, the Interstate Commerce Commission adopted a number of changes in its regulation of the motor carrier and railroad industries. These changes generally increased rate setting ability by motor carriers and railroads and eased entry restrictions. In 1980, Congress passed the Motor Carrier Reform Act, which provided significant deregulation in the trucking industry by increasing pricing flexibility and reducing barriers to entry. This legislation was designed, in part, to target the high rates in the less-than-truckload segment. Entry was eased by transferring the burden of proof from entrants, who previously had to justify their entry, to incumbents who now had to justify why entry should not be permitted. And, in fact, motor carrier entry increased substantially after deregulation.[46]

Interestingly, Florida also deregulated intrastate trucking in 1980 before the effects of the Motor Carrier Reform Act could be felt. In fact, Florida was the first state to completely deregulate the trucking industry.[47] Prior to deregulation, rates had been determined by rate bureaus subject to approval by the Public Service Commission, entry was heavily regulated by the Public Service Commission, there were operating restrictions on geographic service areas, and motor carriers were required to serve unprofitable markets. In an empirical analysis of the effects of Florida's motor carrier deregulation, Blair, Kaserman, and McClave found a significant decrease in rates; specifically, they found that "the removal of state regulatory constraints on the pricing and provision of the motor transport service resulted in an average reduction in rates on the order of 14 percent.[48]

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[44] For overviews of the economic effects of regulation (and deregulation) of surface freight transportation, see Clifford Winston, Thomas M. Corsi, Curtis M. Grimm, and Carol A. Evans, The Economic Effects of Surface Freight Deregulation (Washington, D.C.: The Brookings Institution, 1990) and W. Kip Viscusi, John M. Vernon, and Joseph E. Harrington, Jr., "Economic Regulation of Transportation: Surface Freight and Airlines," in Economics of Regulation and Antitrust, 2d ed. (Cambridge, MA: The MIT Press, 1995), pp. 551-602.

[45] Winston et al., *id.*, at pp. 7-8.

[46] *Id.* at pp. 11-12.

[47] See Roger D. Blair, David L. Kaserman, and James T. McClave, "Motor Carrier Deregulation: The Florida Experiment," 68 *The Review of Economics and Statistics* 169 (1986).

[48] *Id.* at p. 163.

Similarly, regulation had adverse effects on pricing, entry, and exit in the railroad industry. Railroads were unable to adjust their rates in the face of changing market conditions. This became increasingly problematic as railroads encountered growing competition from trucks as well as from barges and pipelines.[49] The development of the interstate highway system in the 1950s greatly decreased the delivery time by motor carriers, making them much more formidable competitors. The road quality was also better, allowing trucks to carry heavier and larger loads. Thus, unlike motor carriers, railroads faced financial ruin because of regulation. Specifically, there were significant exit barriers due to the substantial obstacles railroad companies faced in eliminating less profitable portions of tracks. Naturally, this created significant excess capacity in the industry. These regulations caused the profitability of railroad companies to plummet as evidenced by low rates of return. As a result, many railroad companies faced bankruptcy. The major piece of legislation that brought meaningful deregulation to the railroad industry was the Staggers Rail Act of 1980.[50] The Staggers Act gave railroads greater pricing flexibility. It also made it easier for railroads to abandon unprofitable routes and to merge with other carriers.[51]

Deregulation permitted greater negotiation between shippers and carriers and substantially increased in the amount of rail traffic transported under contract rates. This allowed the railroads to make better use of capacity and to more effectively meet shippers' needs.[52] Railroads divested themselves of substantial amounts of tracks, often through sales to regional and local railroads. Abandonment was accompanied by consolidation and resulted in a long overdue reduction in excess capacity.

Although railway lines and motor carriers have been longtime competitors, they also serve complementary functions since, at the very least, trucks are required to transfer freight between the rail terminal and the shipment's point of origin or final destination. This complementarity provides the basis for intermodal relationships between the two industries.

Intermodal connections between motor carriers and railroads are typically *piggyback*, which refers to loading highway trailers on flatcars (trailer on flat car, or TOFC), or *container* (container on flat car, or COFC). The surface transportation connections have developed in many areas into hub operations with the TOFC/COFC transfers being consolidated in a few areas.[53] In Florida, TOFC/COFC facilities are located in Ft. Lauderdale, Jacksonville, Miami, Orlando, and Tampa.[54] The other major type of intermodal connection is the bulk transfer facility, which – as the name implies – is used to transfer bulk materials. Florida has seventeen bulk transfer facilities.[55]

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49 See Winston et al., *supra* note 44 at pp. 1-6.

50 Previous legislation included the Regional Rail Reorganization Act (the 3R Act) of 1973, which was designed to address bankruptcies in the industry, and the Railroad Revitalization and Regulatory Reform Act of 1976 (the 4R Act). But these acts were inadequate to dismantle the bulk of regulation facing the industry. See Winston et al., *supra* note 44 at 3.

51 The effect of mergers on social welfare is not always clear. Mergers that enhance efficiency through economics of scale and scope and by eliminating excess capacity represent welfare improvements. Mergers that result in increased market power are welfare decreasing. Many mergers, however, simultaneously improve efficiency and significantly increase industry concentration. The welfare effects in such cases are ambiguous.

52 See Winston, *supra* note 42 at p. 96.

53 See, "Chapter 2: Freight Intermodal Transportation," *Year 2020 Florida Statewide Intermodal System Plan: Interim Final Report*, Florida Department of Transportation (March 1, 2000) at pp. 10-11.

54 *Id.* at p. 11.

55 *Id.*

There has been substantial growth in intermodal rail-truck service. According to the Association of American Railroads, intermodal rail traffic grew from 3.1 million trailers and containers in 1980 to more than 9 million units in 2000, and intermodal transport is the second largest generator of rail revenue at 18 percent of rail revenues.[56]

Alliances between traditional motor carriers and railroads in the 1990s contributed to this growth. Consolidated Freightways Corp., J.B. Hunt, and Schneider National all formed alliances with railroads during the early 1990s.[57] J.B. Hunt, for example, now has alliances with eight rail service providers and touts its intermodal service to its freight customers.[58]

Intermodal rail-truck service can take advantage of high-volume, long haul economies of scale achieved by railroads while still enjoying the convenience of door-to-door service offered by motor carriers that transport the products between the rail terminals and the origin and destination points.[59] This allows shippers to experience both the convenience offered by motor carriers and the cost savings from employing rail for longer trips. In this way, the intermodal movement capitalizes on the advantages of the two modes of transportation, and motor carriers and railroads become complements in the production of transportation services.

Despite these advantages and the growth in intermodal rail-truck freight shipments, intermodal rail-truck service providers must overcome several difficulties:[60]

- The intermodal transit time may be slower than truck-only service due to poor connections, infrequent train scheduling, and indirect routing.

- The additional handling increases the likelihood of damage, and the determination of liability in event of loss or damage is complicated by multiple carriers.

- Some types of commodities do not lend themselves as well to intermodal movements; for example, bulk freight, which accounts for a large proportion of freight, does not transfer as easily as containerized freight.

In general, many shippers often perceive intermodal transportation to be inferior to using a single mode, particularly motor carriers, for the above reasons.[61]

Intermodal transportation providers are working to overcome these barriers. For example, Schneider National recently introduced a "TruckRail Express" service that explicitly targets shippers'

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56 Coal transport generates 21 percent of rail revenues. See "Intermodal Transport," Association of American Railroads, available at: http://www.aar.org/ViewContent.asp?Content_ID=277.

57 See Mitchell E. MacDonald, "The New Intermodal Alliances," 31 *Traffic Management* 60 (October 1992).

58 See J.B. Hunt, "What We Do: Intermodal," available at: http://www.jbhunt.com/what_we_do/intermodal/index_intermodal.html.

59 See Donald V. Harper and Philip T. Evers, "Competitive Issues in Intermodal Railroad-Truck Service," 32 *Transportation Journal* 31 (Spring 1993).

60 *Id.*

61 *Id.* For related work, see Philip T. Evers, Donald V. Harper, and Paul M. Needham, "The Determinants of Shipper Perceptions of Modes," 36 *Transportation Journal* 13 (Winter 1996).

concerns with slower time transit and handling concerns associated with truck-rail service relative to truck-only service:

> *TruckRail Express includes a national network of on-site representatives who help ensure Schneider trailers are moving quickly through rail yards; more than 40,000, 53 foot trailers available to move shipments; the flexibility to load trailers for both over-the-road and intermodal shipping; and 24/7 customer service availability.*
>
> *The target market for this service are shippers who want to use intermodal for its cost savings but who choose not to because of service or transit considerations. Now customers can achieve both cost savings and in many cases save a day or two in transit time compared to standard intermodal transit.*[62]

Improvements in the timeliness and quality of service will help intermodal service providers to overcome negative shipper perceptions.

B. WATERPORTS

As mentioned previously, Florida's seaports are important points of entry and exit for international trade. Collectively, Florida's fourteen seaports handle liquid, bulk, containerized, and non-containerized general cargo in addition to agricultural products.[63] During the 1997-1998 fiscal year, Florida's seaports handled 111 million tons of cargo. The number of containers traveling through Florida's seaports increased from just under a million TEUs (twenty-foot equivalent units) during the 1989-1990 fiscal year to approximately 2.5 million TEUs during the 1997-1998 fiscal year.[64]

Most general cargo terminals are publicly owned but many bulk commodity terminals are privately owned.[65] General cargo refers to a variety of consumer goods, typically manufactured or processed. General cargo is frequently containerized and shipped on liners.[66] Bulk cargo is typically raw materials and may be either dry or liquid, such as grain or oil, shipped in lots.[67] Because bulk materials typically have low value per ton, transportation costs make up a greater proportion of the overall cost than for other types of freight; therefore, the cost of transportation is an important consideration when choosing the method of shipment. In addition to playing an important role in

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[62] http://www.schneider.com/newsAndEvents/sninews/truckrail_express_service.html.

[63] See "Chapter 2: Freight Intermodal Transportation," *Year 2020 Florida Statewide Intermodal System Plan: Interim Final Report*, Florida Department of Transportation (March 1, 2000) at pp.
13-20.

[64] *Id.* at pp. 16-17.

[65] See Transportation Research Board, *Special Report 238: Landside Access to U.S. Ports*, (Washington D.C.: National Research Council, 1993) at p. 30.

[66] Liners refer to shipping services provided by regular line operators that have predetermined itineraries and sailing schedules. *Id.* at p. 191.

[67] *Id.*

domestic and international commerce, waterports play a critical role in military equipment and troops deployment.[68]

Waterports inherently involve intermodal transportation since goods and people must be transported to the port and then transfer between modes at the port. Motor vehicles and railroads provide these connections. The major intermodal issues facing ports are congestion of connecting truck routes, numerous at-grade crossings of local streets (where rail lines intersect local streets), and acquiring available land.[69] At-grade crossings increase congestion on local streets. Ports face difficulty increasing access and expansion because they are in competition with other highly-valued commercial uses for the land, and the ports may meet resistance from various local interest groups. For example, environmental groups object to port expansion efforts that encroach upon wetlands, and historical preservation groups will oppose port expansion efforts that encroach upon historic districts. These access issues are cited as key intermodal concerns both nationally and in Florida.[70]

C. AIR

Airfreight may be carried on cargo-only carriers, integrated carriers – such as FedEx and UPS – which own and operate their own fleet, and passenger airlines that carry some cargo.[71] The intermodal connections at airports involve cargo transfer to and from trucks. Thus, the major intermodal issues deal with highway access and congestion. In Florida, six airports account for 99 percent of the state's air cargo: Miami International, Orlando International, Fort Lauderdale-Hollywood International, Jacksonville International, Tampa International, and Palm Beach International.[72]

V. THE ROLE OF GOVERNMENT

Government involvement in transportation planning and investment should proceed thoughtfully and cautiously. Specific project proposals should be evaluated based on a set of clearly specified criteria. Policy makers must determine when it is appropriate for the government to be involved in transportation markets. Government intervention in economic activity is typically justified on efficiency or equity grounds. For example, government may be called upon to correct market failures. A *market failure* occurs when private markets do not achieve an efficient allocation of resources.

For example, externalities are a source of market failure. An *externality* occurs when the actions of one entity affects the welfare of another in a way that is outside of the market. That is, the external effects are not reflected in market prices. For example, a *negative externality* occurs when the activity of

[68] *Id.* at pp. 1-3.

[69] *Id.* at pp. 4-7.

[70] See *id.* at pp. 3-10 and "Chapter 2: Freight Intermodal Transportation," *Year 2020 Florida Statewide Intermodal System Plan: Interim Final Report*, Florida Department of Transportation (March 1, 2000) at p. 20.

[71] See "Chapter 2: Freight Intermodal Transportation," *Year 2020 Florida Statewide Intermodal System Plan: Interim Final Report*, Florida Department of Transportation (March 1, 2000) at p. 34.

[72] *Id.*

an economic agent imposes *external costs* – costs that are not reflected in market transactions – on society. When these external costs arise, then the marginal social cost to society is greater than the marginal private cost to the entity producing the externality. The result is that private markets will tend to overproduce goods and services that have negative externalities – that is, the amount produced is inefficiently high.

Pollution is a common example of a negative externality that occurs from production and consumption processes. With respect to transportation, one significant source of pollution is motor vehicle emissions. Businesses and individuals tend to take into account only the costs that they explicitly incur in motor vehicle usage – the cost of purchasing or leasing the vehicle, maintenance and repair costs, and the cost of fuel, for example. The external pollution costs are either ignored or underestimated when making transportation decisions. Thus, motor vehicle usage will be inefficiently high from a social welfare standpoint. Government actions may help to move the market towards a more efficient level. For example, government subsidization of other transportation alternatives, ones that result in lower emissions, can induce business and consumers to substitute these other modes for individual motor vehicle usage. Alternatively, the government might levy taxes to raise the cost of motor vehicle usage and thereby decrease the amount of use (and the resulting emissions).

Government may also involve itself in economic activity for equity reasons, e.g., to redistribute income and wealth. For example, the government might subsidize the cost of transportation services to low-income households in order to increase access to jobs, medical services, and so forth. Government involvement in markets might also reflect the influence of special interest groups. Importantly, government involvement in markets almost always has some redistributive implications – some individuals and groups will benefit and others will bear the costs.[73]

As noted above, government funding for transportation projects had previously been restricted to specific modes of transportation or for narrowly-designated purposes, and the emphasis typically was on highway funding. Recent federal legislation, notably ISTEA and TEA-21, increased the scope of transportation projects that are eligible for federal funds. This increased flexibility, combined with the explicit emphasis on intermodalism, expands the range of projects that might be eligible for federal funds. Thus, the scope of alternatives that policy makers and planning organizations may consider to address transportation concerns, such as the external costs imposed by motor vehicle emissions, has been expanded.

But when considering government involvement in the development of intermodal projects, it is important (as is the case with government intervention in any market) to ask why the public sector should be involved rather than relying on the private sector. Is there a market failure to be corrected? Is there an inequity that needs to be addressed? If it is determined that government involvement is the best way to correct a market failure or an inequity, then alternative methods for achieving the proposed public policy goal should be identified and evaluated. A cost-benefit analysis should be employed to compare the relative payoffs and costs of the different projects. After a selected project has been implemented, there should be a post-investment evaluation to determine whether the anticipated benefits were realized in a cost-efficient manner. The findings of these follow-up evaluations can be used to inform future investment decisions and to improve the processes and outcomes of subsequent projects.

[73] User fees can be employed to make the beneficiaries also be the bearers of cost. Designing optimal user fees, however, is difficult; thus, redistribution necessarily will occur. Moreover, user fees often are not employed. Many projects are financed through general tax revenues, for example.

In addition, government project planning must take into account the needs of the private sector, changing market conditions, and changing technologies.

Although recent federal legislation has reoriented the focus of transportation towards a greater emphasis on intermodalism, the fundamental questions regarding the government's role in transportation planning has not changed. The Transportation Research Board has noted that

> *intermodal movements use the same infrastructure, equipment, and organizational systems as single-mode freight, with the exception of certain terminal and transfer facilities. Thus, for example, a well-functioning highway system is an asset to truck-rail intermodal freight as well as to all truck transport. Analogously, the questions concerning government programs and investment decisions that are most important for intermodal freight efficiency are, for the most part, the same questions that are most important for the efficiency of all freight services.*[74]

Randall Eberts argues that "[i]t is not simply the issue of whether the private sector or the government should take sole responsibility for intermodal freight activity. The private sector has taken the lead in intermodal development, and partnerships between the two sectors have already been formed."[75] Rather, he frames the question as "whether the government needs to modify its established transportation programs to further accommodate and enhance the private sector's move towards intermodalism as the demand for less costly, more efficient freight shipments increases."[76]

Policy makers and planning organizations would be well-advised to consider the following when determining the role of government involvement in intermodal transportation planning:[77]

1) Determine whether there is a market for the proposed project. For example,

   - Does it create capacity where there are congestion/bottleneck problems?

   - Does it create new transportation linkages that will facilitate a more efficient movement of freight or people?

   - Is the proposed project the best way to address the transportation needs that have been identified?

   If the answer to one or more of these questions is yes, then determine whether the project is self-financing by estimating the private benefits and costs. If the private

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74 See Transportation Research Board, *supra* note 10 at p. 17.

75 See Randall W. Eberts, "Principles for Government Involvement in Freight Infrastructure," in: Transportation Research Board, *Special Report 252: Policy Options for Intermodal Freight Transportation* (Washington D.C.: National Research Council, 1998) 117-152 at p. 122.

76 *Id.*

77 These considerations are adapted from Transportation Research Board, "Principles for Government Involvement," in *Special Report 252: Policy Options for Intermodal Freight Transportation* (Washington D.C.: National Research Council, 1998) 20-45 at pp. 38-44.

benefits exceed the private costs, then why is government involvement needed? In the event of a deficit, it is necessary to determine whether there are external benefits that merit government involvement.

2) Determine whether there are external benefits or costs that are not reflected in the above calculations.

   - Will the project reduce negative externalities associated with transportation, such as pollution and congestion? (A project that results in a lower level of emissions in an area reduces a negative externality, thereby conferring an external benefit.)

   - Does the project confer *unique* and *external* benefits to local economic growth and development (as opposed to a redistribution or rearrangement of resources)?

   - Does the proposed project contribute to the transportation system's role in national defense or other public safety (e.g., evacuation routes)?

   If the answer to one or more of these questions is yes, then estimate the external benefits (including reductions in external costs) associated with the project.[78] In the event of a deficit in (1) above, how does the magnitude of these external benefits compare to the shortfall under private financing?

3) Compare the proposed project to other uses of public resources.

   - How does the proposed project compare to other local infrastructure projects or public services in terms of the net benefits?

   - Are there less costly ways to achieve the desired benefits?

4) Identify the distributional effects of the project.

   - Who are the primary beneficiaries of the anticipated benefits?

   - How are the costs of the project distributed?

5) If government financing is justified, determine:

   - What level(s) of government should provide the financing?

   - What method of finance will be employed – user fees, general tax revenues, or bond financing?

6) Undertake post-investment analysis: how do the actual results compare with the projections?

   - Use the findings of the post-investment analysis to guide future decisions.

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[78] External benefits can be difficult to estimate, and their magnitude is often uncertain. Thus, it is important that policy makers carefully evaluate the likelihood that claimed benefits will be realized and their magnitudes. Otherwise, there may be a great deal of inefficient public investment in projects that fail to produce net benefits.