



# KENTUCKY LONG-TERM POLICY RESEARCH CENTER

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## *Future Transportation Issues*

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This annotated briefing is a companion document to Policy Note 19, “Future Transportation Issues,” January 2006.

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## National Context

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- Infrastructure Report Card 2005
  - Roads (D)
    - poor road conditions cost U.S. motorists \$54 billion a year in repairs and operating costs
    - Americans spend 3.5 billion hours a year stuck in traffic, costing the economy \$63.2 billion
  - Bridges (C)
  - Transit (D+)

Source: American Society of Civil Engineers, Infrastructure Report Card 2005

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Available online at: <<http://www.asce.org/reportcard/2005/index.cfm>>.



## Transportation and Economic Development

- Economy is dependent upon the efficient movement of people and products
  - Highways are associated with higher employment and increased wages
- Kentucky's economy is more "transportation dependent" than most states
  - Transportation dependent sectors account for 46% of Kentucky's economy compared to 36% nationally

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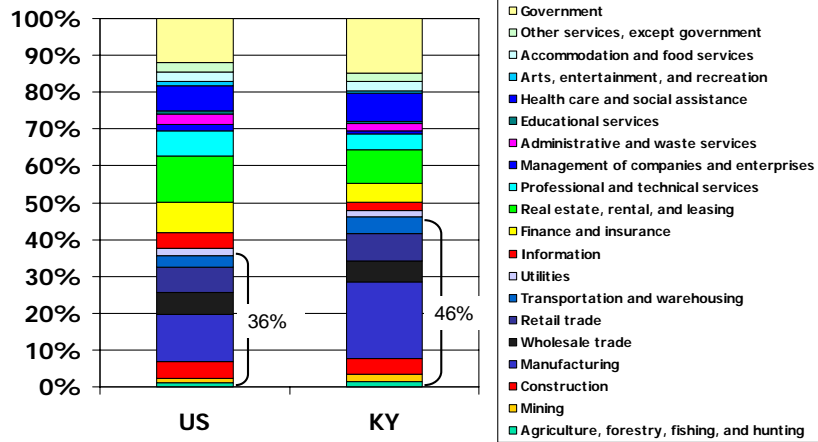
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Numerous studies have examined the relationship between the transportation system and economic development. See, for example, "Using Empirical Information to Measure the Economic Impact of Highway Investments," prepared for the Federal Highway Administration by the Economic Development Research Group, Inc., March 2001, <<http://www.edrgroup.com/hwy-impact.html>>.

Economic sectors that are relatively more dependent upon the transportation system include: agriculture, forestry, fishing, and hunting; mining; construction; manufacturing; wholesale trade; retail trade; and transportation and warehousing.

# Comparing Kentucky's Economy to the United States'



Source: BEA, 2003 Gross State Product

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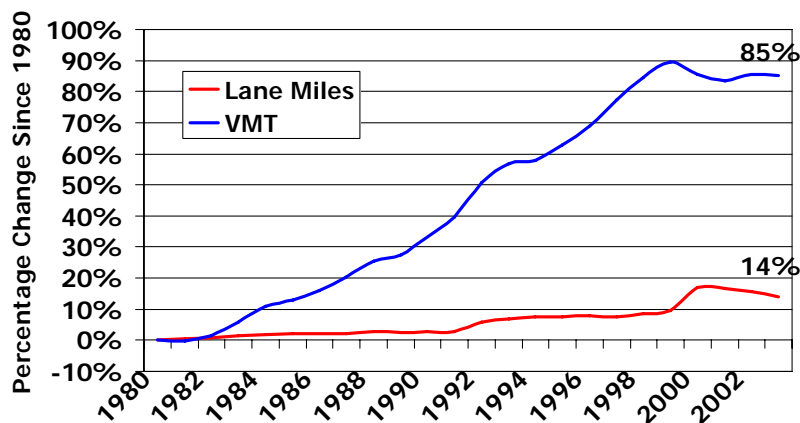
Available online at: <http://www.bea.doc.gov/bea/regional/gsp/>. Around 46 percent of Kentucky's economy is in sectors like agriculture and manufacturing that are highly dependent on transportation, compared to about 36 percent nationally.



## Increasing System Demands

- Vehicle miles traveled have increased
- Travel time to work is longer
- Delays have lengthened
- More truck traffic expected

## Estimated Lane Miles and Vehicle Miles Traveled (VMT), Kentucky, 1980-2003



Source: KLTPRC analysis of data from the Federal Highway Administration and Bureau of Transportation Statistics.

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Total estimated lane miles data are from US Department of Transportation, Federal Highway Administration, *Highway Statistics* (various years). Available online at: <http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.htm>.

Vehicle miles traveled data are available online at: [http://www.transtats.bts.gov/DL\\_SelectFields.asp?Table\\_ID=507&DB\\_Short\\_Name=VMT](http://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=507&DB_Short_Name=VMT)



## Travel Time to Work (minutes)

Resident County	1990	2000	Increase	% Change
Boone	24.0	26.0	2.0	8%
Campbell	24.8	25.1	0.3	1%
Christian	17.4	18.9	1.5	9%
Daviess	19.2	20.8	1.5	8%
Fayette	19.4	20.7	1.4	7%
Hardin	19.0	24.2	5.1	27%
Jefferson	22.8	23.1	0.3	1%
Kenton	23.5	24.2	0.6	3%
Madison	21.8	24.6	2.8	13%
Warren	19.0	20.7	1.8	9%
Kentucky	22.9	24.6	1.7	7%

*Source: KLTPRC analysis of data from the US Census Bureau Summary File 3 (SF3), 1990 and 2000.*

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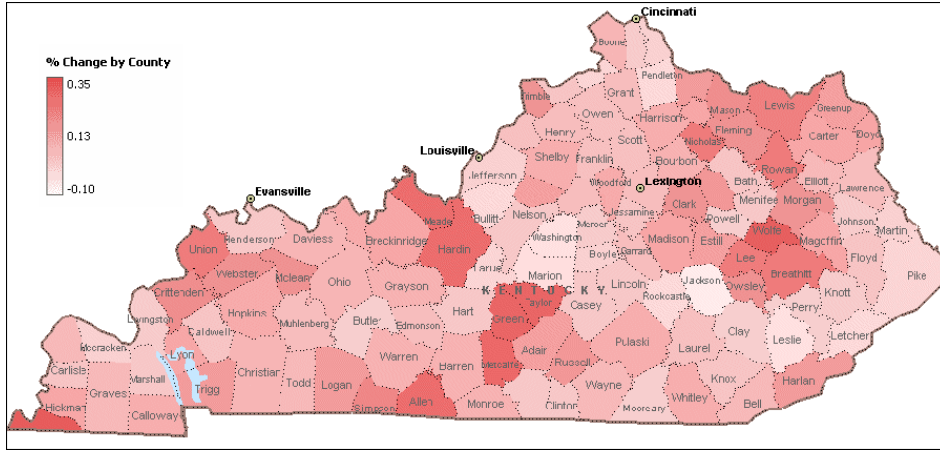
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These ten counties are the most populous and account for 42% of the state's population.

The times are estimated using the US Census Bureau Summary File 3 (SF3) estimates.

# Percentage Change in Travel Time to Work, 1990-2000



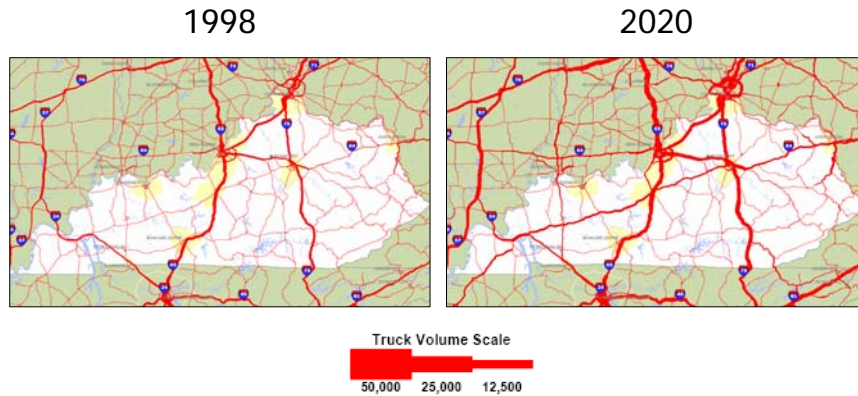
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## Estimated Average Annual Daily Truck Traffic



Source: US Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework.

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The US Department of Transportation estimates that truck-carried freight tonnage will increase by 84 percent in Kentucky between 1998 and 2020.

Maps are available online at: [http://ops.fhwa.dot.gov/freight/freight\\_analysis/state\\_info/kentucky/freightflow\\_ky.htm](http://ops.fhwa.dot.gov/freight/freight_analysis/state_info/kentucky/freightflow_ky.htm).

Data on freight flows is available at U.S. Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework Tonnage Origin-Destination Database, Final 2002, [http://www.ops.fhwa.dot.gov/freight/freight\\_analysis/faf/fafstate2state.htm](http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/fafstate2state.htm).



## Recommendations

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- Make adequate investments in transportation
- Modernize the revenue system that funds transportation
- Educate and inform policymakers and the public about the importance of the transportation system for economic development

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At the Center's November 2005 conference on generating economic development ideas these three recommendations were put forward concerning Kentucky's transportation system.



## Make Adequate Investments in Transportation

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- Two elements of adequacy
  - Extent
    - Is the extent of the road system sufficient?
  - Condition
    - Given what we have, what is its condition?



## Extent

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- Does Kentucky have “enough” roads?
  - How does Kentucky’s road system compare to other states with similar demography, geography, and economy?



## Approach

- Multiple regression analysis
  - Total lane miles (TLM) is the measure of extent
  - Statistical model predicts the expected TLM
- Three categories of variables
  - Population
    - Number of local govts, developed land, density
  - Geography
    - land area (total size, topography)
  - Economy
    - economy (farming, manufacturing, personal income)
- Tested 23 models using data from 44 states

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We excluded these states from the analysis because they were outliers or data was not available to test all models: Alaska, California, Hawaii, Texas, Delaware, and Rhode Island.

We tested 23 models with different combinations of variables. Each model had a least one variable from the population, geography, and economy categories. The variables are:

(1) LTOTGOV – Total number of local governments (county, city, special districts, and school systems) logged. See Government Organization, 2002 Census of Governments, Vol. 1, No. 1, Table 3, December 2002, <<http://www.census.gov/prod/2003pubs/gc021x1.pdf>>.

(2) NFLDEV – Nonfederal developed land, 1997, (acres, 1000s). See Summary Report, 1997 National Resources Inventory, Revised December 2000, Table 1 - Surface area of nonfederal and federal land and water areas, by state and year (data per 1,000 acres), <[http://www.nrcs.usda.gov/technical/NRI/1997/summary\\_report/table1.html](http://www.nrcs.usda.gov/technical/NRI/1997/summary_report/table1.html)>.

(3) LOGDEN – Population density per square mile of land area (2000), logged. US Census Bureau, GCT-PH1. Population, Housing Units, Area, and Density, 2000, <<http://factfinder.census.gov>>.

(4) LSC – Land surface code. US counties have been categorized by their geographic relief into 21 separate codes, where 1 equals flat plains and 21 equals high mountains. We create state values by calculating a weighted average based on a county's percentage of a state's total land area. Available in the USDA Natural Amenities Scale, <<http://www.ers.usda.gov/data/NaturalAmenities/>>.

(5) LAREA – Total Land Area (in square miles) logged. US Census Bureau, (GCT-PH1. Population, Housing Units, Area, and Density: 2000), <<http://factfinder.census.gov>>.

(6) LFARMCR – Farm cash receipts, all commodities, 2003, logged, <[http://www.ers.usda.gov/Data/FarmIncome/Zip\\_files.htm](http://www.ers.usda.gov/Data/FarmIncome/Zip_files.htm)>.

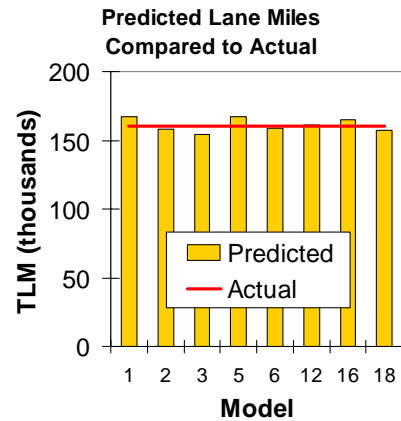
(7) LMANF – Personal income from the manufacturing sector, 2003, logged. Bureau of Economic Analysis, Income and employment tables by NAICS industry 2001-2003 (table SA05N), <<http://www.bea.doc.gov/bea/regional/spi/>>.

(8) LOGPI – Personal income, 2003, logged. Bureau of Economic Analysis, Income and employment tables by NAICS industry 2001-2003 (table SA05N), <<http://www.bea.doc.gov/bea/regional/spi/>>.



## Results of Eight Models

- Kentucky has about 160,000 lane miles
- Eight models yield slightly different results
  - Yet the predicted values are very close to the actual value
- Model results suggest Kentucky has a comparable number of miles





# Results of 8 Models

	1	2	3	5	6	12	16	18
$r^2$	.84	.75	.76	.76	.76	.92	.88	.92
p:a	.95	1.01	1.04	.95	1.01	.99	.97	1.02
Local Govt's	+	+	+	+	+	+	+	+
Dev Land						+		+
Pop Density						-		
Topography	-	-	-			-	-	-
Area				+	+		+	+
Farm	+					+	+	+
Manufacturing		+		+			+	
Income			+		+			

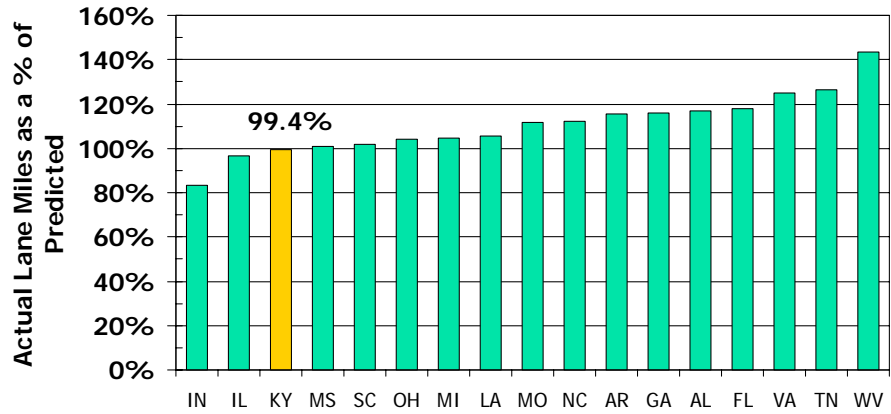
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		MODELS																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
VARIABLES	(1) LTOTGOV	+	+	+	+	+	+						+	+	+	+	+	+	+	+	+	+	+	+	+
	(2) NFLDEV							+	+			+	+	+	+					+	+				+
	(3) LOGDEN																								
	(4) LSC																								
	(5) LAREA																								
	(6) LFARMCR	+																							
	(7) LMANF																								
	(8) LOGPI																								
R-squared (adj.)		0.835	0.750	0.762		0.764	0.755						0.917				0.876		0.920						
Root MSE		30,865	38,005	37,070		36,950	37,600						21,961				26,813		21,537						
F-value		73.6	44.0	46.9		47.3	45.3						95.4				61.5		99.5						
TLM_P TLM		0.955	1.013	1.039		0.955	1.009						0.993				0.971		1.019						
NOTES:																									
		indicates that the coefficient is not statistically significant at the .10 level																							
		indicates that the coefficient is statistically significant at the .10 level, but not the .05 level.																							
		indicates that the coefficient is statistically significant at the .05 level																							
		"+" and "-" indicate the direction of the relationship with total lane miles																							

## Actual Lane Miles Compared to Predicted, Kentucky and Selected States



*Note: Percentage is the average of the eight models.*

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## Caveats

- Results are “suggestive” despite precision
  - Slightly different models show different results
- Relative instead of absolute comparison
  - In other words, we’re grading on a curve
    - by some assessments, a low benchmark
- Location, location, location
  - Model does not assess whether the lane miles are in the “right” place
- Assessing lane miles only
  - Not other elements of the transportation system
- Does not address future adequacy



## Condition and Performance

- Rural interstate, % poor condition
- Urban interstate, % poor condition
- Rural primary, % poor condition
- Urban interstate, % congested
- Bridges, % deficient
- Rural primary, % narrow lanes
- Fatality rate

Source: Corporation for Enterprise Development, *Development Report Card for the States, ("TEA-21's Impact: Performance of State Highway Systems, 1984-2003."* David T. Hartgen, Department of Transportation Studies, University of North Carolina at Charlotte, February 23, 2005.)

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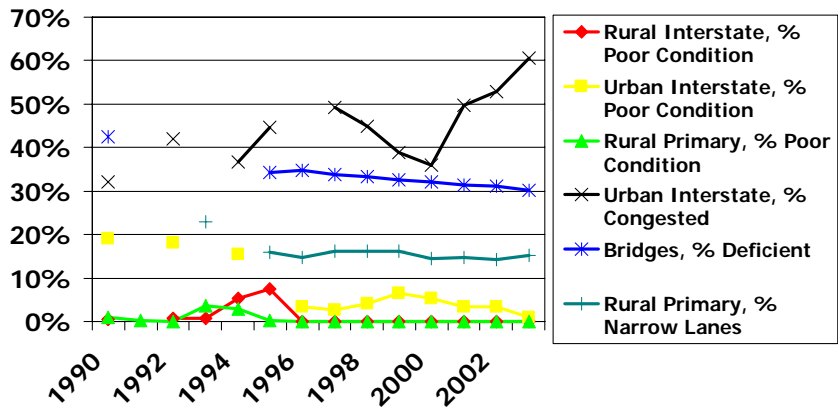
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Available online at:

<[http://www.johnlocke.org/acrobat/policyReports/2005\\_highway\\_performance\\_report.pdf](http://www.johnlocke.org/acrobat/policyReports/2005_highway_performance_report.pdf)>.

# Kentucky's Road System



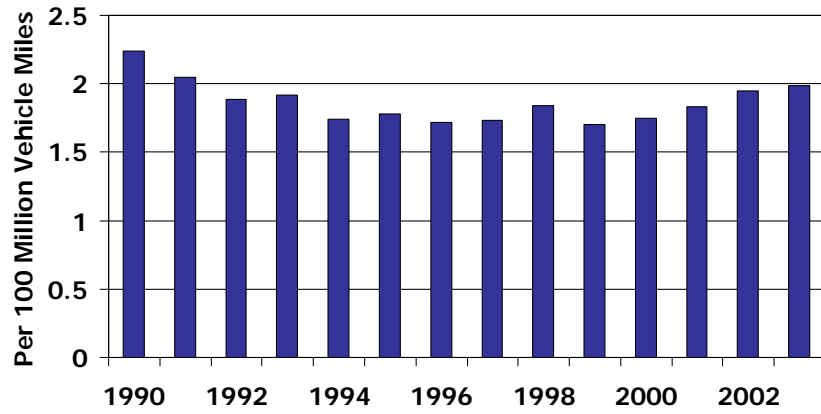
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## Kentucky's Fatality Rate

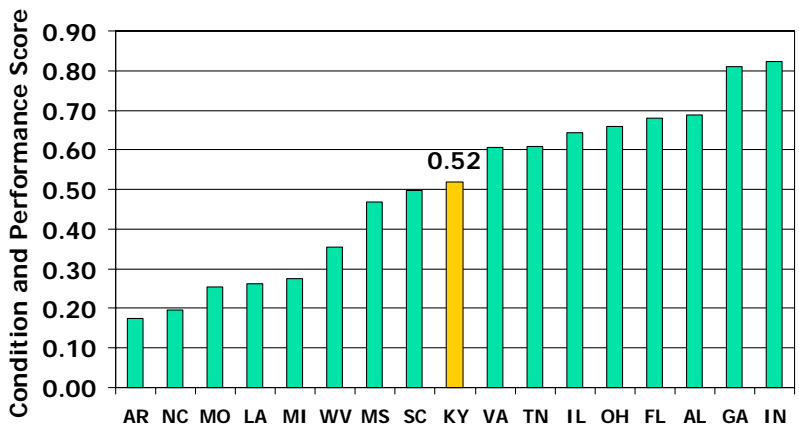


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# Regional Comparison



Note: This represents the average of 2002 and 2003.

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We calculate Z-scores using 2002 and 2003 values for each of the seven condition indicators. We then determine the average Z-score for each state using all seven indicators and determine the p-value using a cumulative standard normal distribution. The value shown above is the p-value for Kentucky (.52).

2002 - 2003 AVERAGE from the data in The Looming Highway Condition Crisis, by David Hartgen												
State	Rural Interstate, % Poor Condition	Urban Interstate, % Poor Condition	Rural Primary, % Poor Condition	Urban Interstate, % Congested	Bridges, % Deficient	Fatality Rate	Rural Primary, % Narrow Lanes					
AL	0.00%	1.83%	0.00%	40.76%	28.25%	1.752	3.11%					
AR	11.83%	16.03%	1.09%	37.77%	25.32%	2.087	30.55%					
FL	0.00%	0.10%	0.16%	56.65%	19.10%	1.732	14.49%					
GA	0.00%	0.00%	0.00%	39.87%	20.49%	1.437	1.98%					
IL	0.00%	8.05%	0.77%	56.37%	18.35%	1.352	7.45%					
IN	0.00%	2.53%	0.17%	25.40%	22.23%	1.121	5.93%					
KY	0.00%	2.22%	0.00%	56.66%	30.75%	1.969	14.65%					
LA	5.92%	10.79%	1.28%	43.89%	32.87%	2.023	13.99%					
MI	8.98%	16.16%	1.18%	47.75%	29.04%	1.274	19.75%					
MO	1.31%	8.35%	2.10%	59.83%	34.18%	1.760	14.04%					
MS	6.38%	4.38%	0.08%	36.97%	28.43%	2.377	6.83%					
NC	7.73%	10.77%	1.87%	74.20%	30.96%	1.664	12.79%					
OH	0.12%	0.84%	0.07%	66.96%	24.56%	1.244	14.84%					
SC	2.57%	4.66%	0.78%	50.99%	23.90%	2.120	6.19%					
TN	0.15%	1.80%	0.14%	51.18%	21.15%	1.724	26.08%					
VA	0.00%	3.70%	0.48%	47.93%	22.97%	1.204	31.53%					
WV	0.99%	3.73%	1.02%	5.35%	37.21%	2.078	44.92%					
Mean	2.70%	5.63%	0.64%	46.96%	26.46%	1.70	15.82%					
StdDev	3.9%	5.2%	0.7%	16.0%	5.6%	0.38	11.6%					
Z-Scores								TOTAL	RANK	Avg Z-Score		
AL	0.697	0.731	0.984	0.358	-0.323	-0.130	1.096	3.444	3	0.492	0.689	
AR	-2.353	-1.999	-0.673	0.575	0.205	-1.018	-1.271	-6.535	17	-0.934	0.175	
FL	0.697	1.063	0.748	-0.608	1.324	-0.078	0.115	3.281	4	0.466	0.679	
GA	0.697	1.083	0.984	0.443	1.074	0.705	1.194	6.180	2	0.883	0.811	
IL	0.697	-0.465	-0.192	-0.588	1.459	0.930	0.722	2.563	6	0.366	0.643	
IN	0.697	0.597	0.726	1.348	0.760	1.541	0.853	6.521	1	0.932	0.824	
KY	0.697	0.656	0.984	-0.606	-0.773	-0.706	0.101	0.353	9	0.050	0.520	
LA	-0.829	-0.992	-0.983	0.192	-1.155	-0.849	0.158	-4.438	14	-0.634	0.263	
MI	-1.613	-2.025	-0.818	-0.049	-0.465	1.135	-0.339	-4.174	13	-0.596	0.275	
MO	0.359	-0.523	-2.216	-0.792	-1.390	-0.230	0.153	-4.639	15	-0.663	0.254	
MS	-0.947	0.240	0.862	0.625	-0.355	-1.787	0.793	-0.568	11	-0.081	0.468	
NC	-1.295	-0.988	-1.867	-1.703	-0.809	0.102	0.262	-5.997	16	-0.857	0.196	
OH	0.666	0.960	0.878	-1.250	0.341	1.216	0.085	2.894	5	0.413	0.660	
SC	0.034	0.186	-0.199	-0.252	0.459	-1.105	0.831	-0.045	10	-0.006	0.497	
TN	0.659	0.737	0.778	-0.264	0.954	-0.055	-0.886	1.925	7	0.275	0.608	
VA	0.697	0.372	0.258	-0.061	0.628	1.322	-1.356	1.861	8	0.266	0.605	
WV	0.442	0.366	-0.574	2.801	-1.936	-0.965	-2.511	-2.606	12	-0.372	0.355	



## Revenue System

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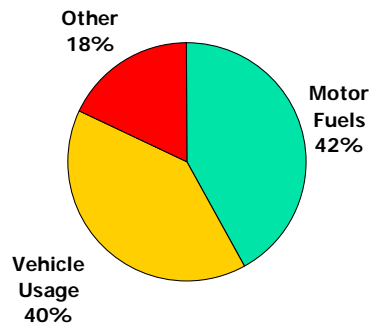
- Modernize the revenue system that funds transportation
  - Road Fund



## Road Fund

- Nearly 100 elements go into the road fund
  - Motor Fuel Tax
  - Motor Vehicle Usage
  - Tolls
  - Personalized License Plates
  - Traffic School Fees

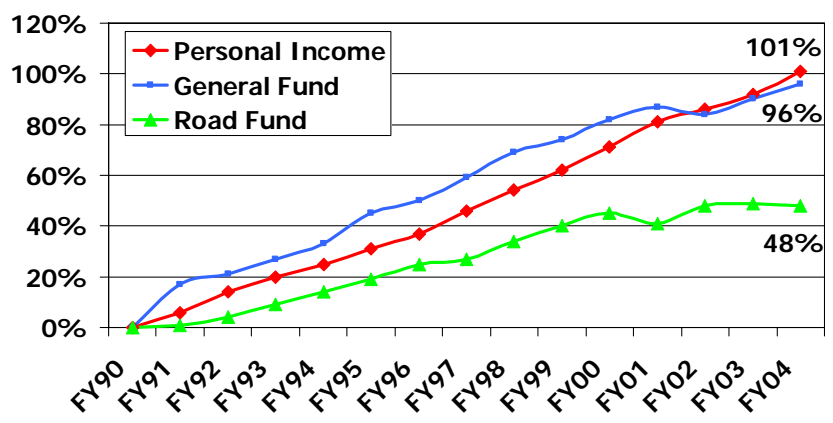
**Composition of the FY04 Road Fund (\$1.1 billion)**



Source: 2003-2004 Kentucky Department of Revenue Annual Report



# Road Fund Has Lagged Behind

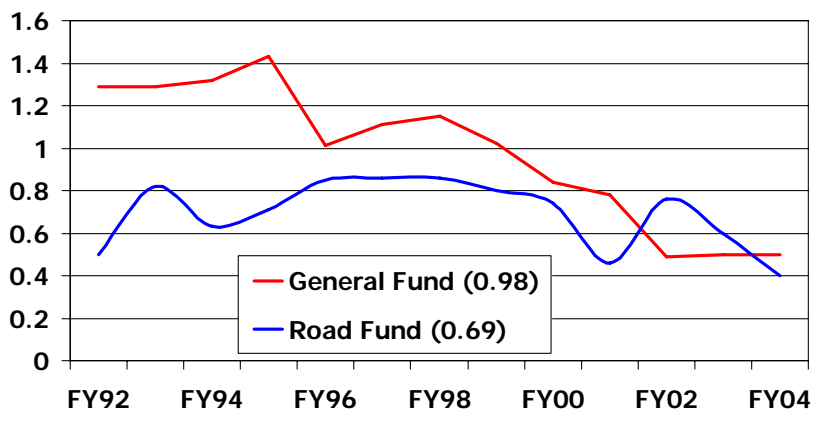


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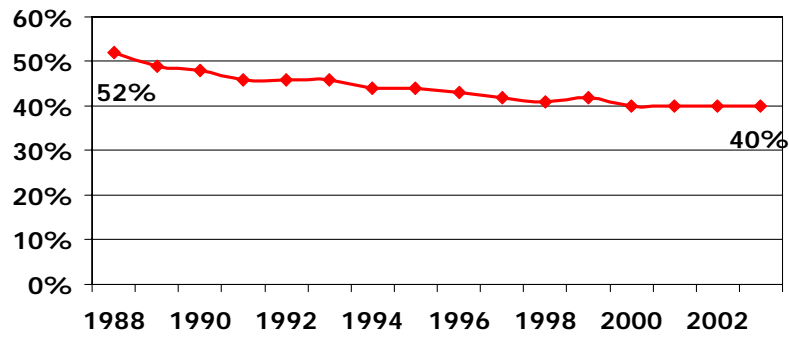
# Revenue Elasticity (5-Year Average)





## Why the low elasticity?

**Kentucky's Motor Fuels Taxes as a Percentage of the Road Fund**

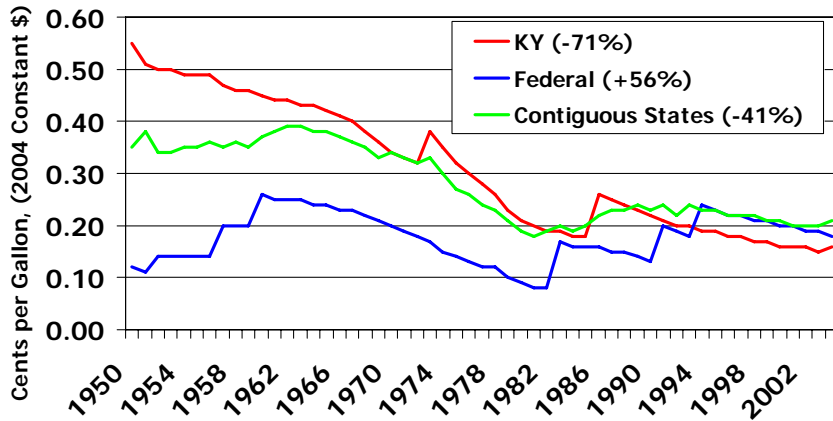


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# Inflation Has Eroded the Gasoline Tax



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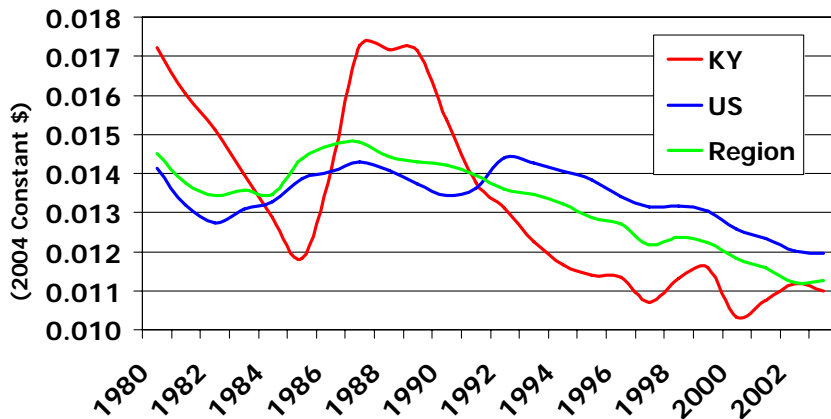
Kentucky's gasoline tax has decreased in real terms by 71 percent since 1950.

Contiguous states are IL, IN, MO, OH, TN, VA, and WV.

Gasoline tax data are from the University of Michigan, Ross School of Business, World Tax Database, <<http://www.bus.umich.edu/otpr/otpr/introduction.htm>>.

CPI data from the Federal Reserve Bank of Minneapolis, <<http://minneapolisfed.org/Research/data/us/calc/hist1913.cfm>>.

## Motor-Fuel Taxes and Related Receipts per VMT



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Region is the 17 state competitor states: AL, AR, FL, GA, IL, IN, KY, LA, MI, MO, MS, NC, OH, SC, TN, VA, and WV.

Motor-fuel taxes and related receipts data from "Highway Statistics," US Department of Transportation, Federal Highway Administration (various years), Table MF-1, <<http://www.fhwa.dot.gov/policy/ohpi/hss/index.htm>>.

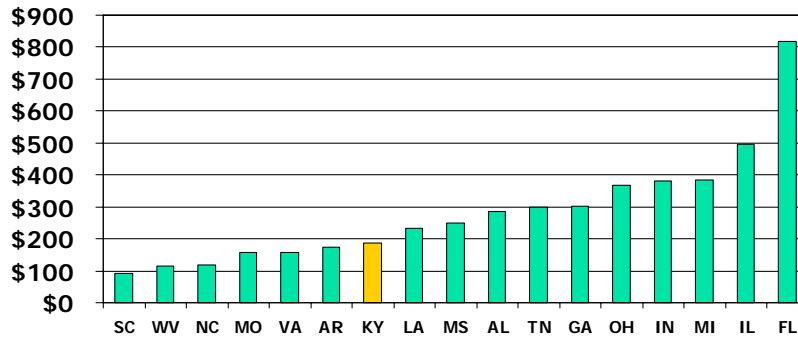
Vehicle miles traveled (VMT) data available at <[http://www.transtats.bts.gov/DL\\_SelectFields.asp?Table\\_ID=507&DB\\_Short\\_Name=VMT](http://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=507&DB_Short_Name=VMT)>.

Deflators are from the Federal Reserve Bank of Minneapolis, <<http://minneapolisfed.org/Research/data/us/calc/hist1913.cfm>>.



## Regional Comparison

**Cumulative State Expenditures, 1993-2002, per lane mile (current thousands)**



*Note: Lane miles refers to the state highway agency-owned public roads. In 2003 Kentucky had 60,844 (38% of total lane miles).*

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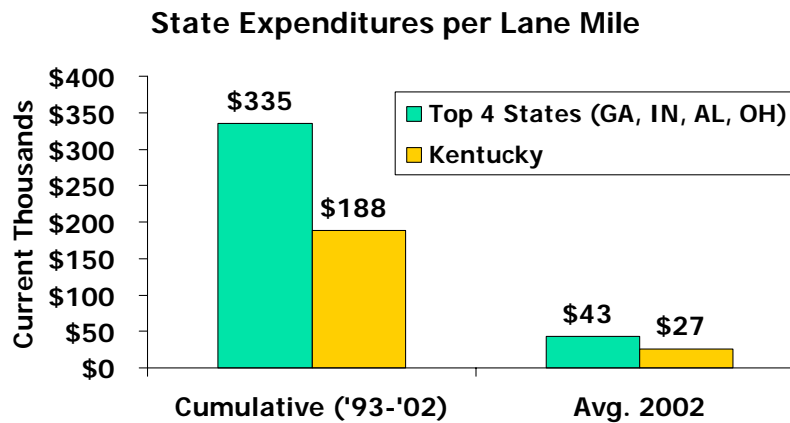
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Total State Expenditures (current thousands), Highways (Capital outlay included), U.S. Census Bureau (includes expenditures, regardless of source -- e.g., state and federal dollars are included here).

State-controlled lane mile data from "Highway Statistics," US Department of Transportation, Federal Highway Administration (various years), <<http://www.fhwa.dot.gov/policy/ohpi/hss/index.htm>>.

## How much is Kentucky spending relative to the top states?



*Note: FL was excluded as a spending outlier (OH was used instead).*

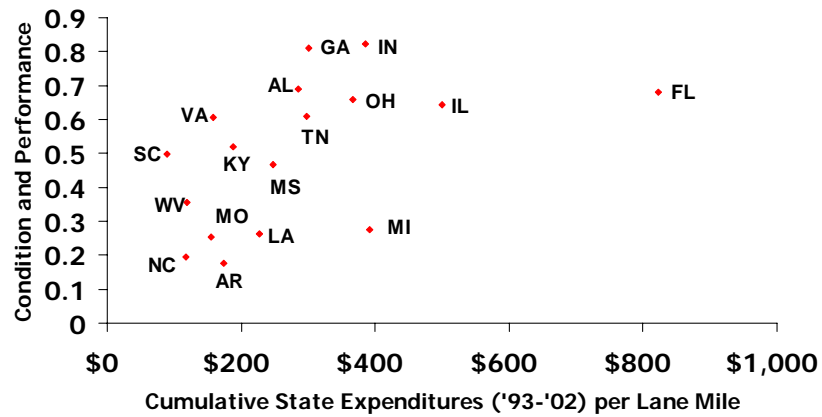
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The “top” states refers to the condition index score. Indiana, Georgia, Alabama, Florida, and Ohio are ranked first through fifth. However, Florida was excluded because it is a spending outlier.

## Funding is Related to Condition and Performance



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This chart illustrates how states that had the highest cumulative state expenditures from 1993 to 2002 on a (state-controlled) lane mile basis had the highest condition and performance scores over the 2002 and 2003 period.



# The State of Kentucky's Road System

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- Trend toward more use, congestion, and delay
- Extent and Condition
  - Kentucky has a comparable number of total lane miles given its demography, geography, and economy
    - There could be regional inadequacies within the state
    - National benchmark is low by some accounts
  - Condition is average
- Funding
  - Road Fund lagged behind the General Fund
    - Fuel efficient vehicles and inflation have eroded the gas tax
- Will KY's road system be adequate in the future?
  - Depends, in part, on whether the revenue system is modernized