

Long-Run Relation among Motor Fuel Use, Vehicle Technology, Income, & Gas Price for the US

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October 2007

Highlights

- Focus
 - Energy Use in Personal Transport
 - Systemic Relation among Gasoline Price, Income, Fuel Consumption, and Technology
- Methods
 - Johansen Cointegration Test
- Findings
 - Long-run, Cointegrating Relationship means Price, Technology, and Consumption cannot be Easily Disentangled in the Short-Run

Outline

- Energy-GDP Causality Literature
- Income $\leftarrow \rightarrow$ Transport Energy Demand IEA Countries
- Systemic Look at US Transport Sector
- Conclusions

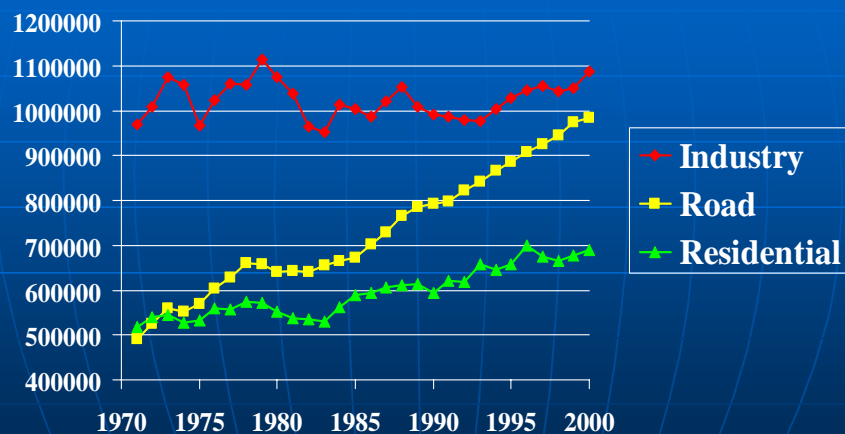
Energy-GDP Causality Literature

- Developed & developing countries
- Annual & monthly data
- Bivariate & multivariate
 - Price (CPI & energy), capital, employment
- Highly Aggregated
 - Exceptions:
 - Hondroyannis et al., 2002
 - Liddle, 2006

Literature Summary: No Coherent Story

- Multi-country studies found full spectrum of results
 - No causality, bi-causality, uni-directional causality
- Different studies of same countries produced contradictory results
 - Time period
 - Data sources
 - Methods

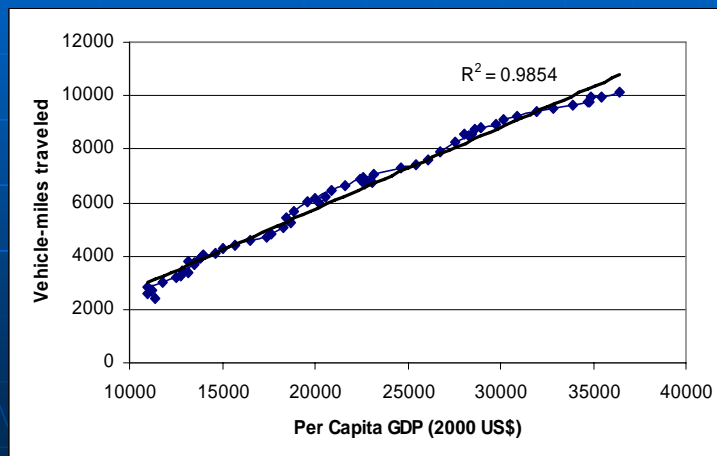
OECD Energy Consumption by End-Use



Previous Work: Data

- Annual IEA data 1960-2000, 18 OECD countries
- Natural log GDP per capita (95 US\$ using PPP)
- Natural log road and residential energy consumption per capita (toe/person)

Vehicle-miles traveled per capita & GDP per capita in US, 1946-2004.

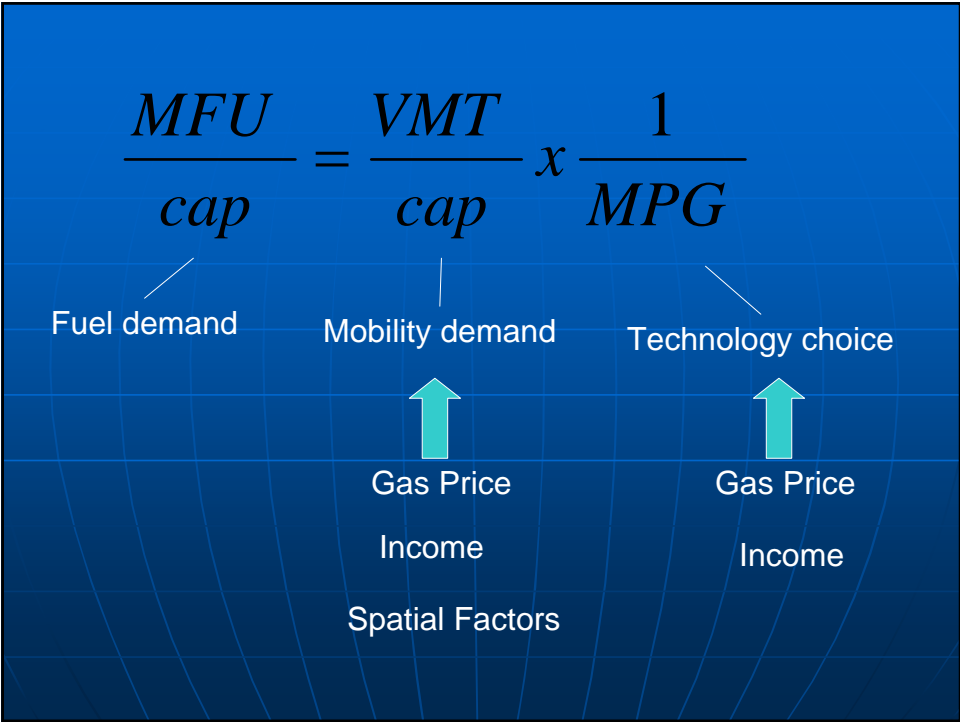


Previous Work: Methods

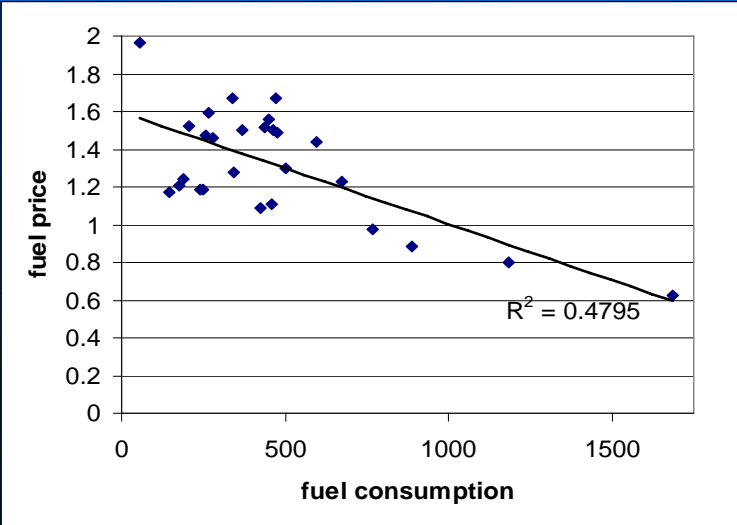
- Unit Root
 - Elliot, Rothenberg, Stock Dickey-Fuller test with GLS detrending
- Cointegration
 - Engle-Granger (bi-variate)
- Error correction model of Granger Causality

Previous Work: Results for Road & Residential Energy Per Capita & GDP Per Capita GCT

- Non-causality
 - AUS, CAN, FIN, FRA, ITL, KOR, MEX, PRT, TUR
- Bi-causality
 - BEL, JAP
- Income causes Energy consumption
 - NED
- Cointegration (long-run) Relationship
 - GRC: Income causes Energy consumption
 - DEN: Energy consumption causes Income
 - ESP: Income causes Energy consumption (long-run); Energy consumption causes Income (short-run)



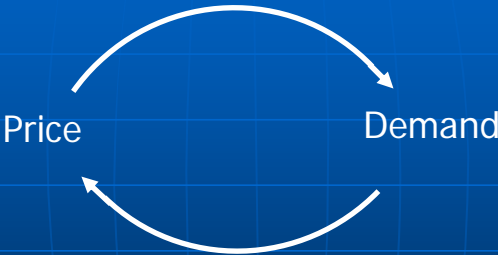
Gasoline Consumption & Gasoline Price for IEA Countries



Gas Price & Taxes

	Avg.	St. Dev	Range
w/ taxes	0.93	0.32	[0.42, 1.23]
w/o taxes	0.34	0.04	[0.29, 0.42]

Systemic Relationship



Data & Methods

Variable	Observations	Source
Natural log real GDP per capita	Annual, 1919-2004	Johnston and Williamson (2005)
Natural log real retail gasoline price	Annual, 1919-2004	Energy Information Agency
Natural log motor fuel use per capita	Annual, 1919-2004	Federal Highway Administration
Natural log vehicle-miles traveled per capita	Annual, 1936-2004	Federal Highway Administration
Natural log of miles per gallon	Annual, 1936-2004	vehicle-miles traveled/ motor fuel use

Data & Methods

- Unit Root
 - Elliot, Rothenberg, Stock Dickey-Fuller test with GLS detrending
 - Ng-Perron test with GLS detrending
- Cointegration
 - Johansen and Juselius test for multivariate cointegration
 - Two tests:
 - MFU, Income, Gas Price
 - MPG, Income, Gas Price

Results

- All series are stationary in first differences but not in levels (i.e., order I (1))
- One cointegrating equation at the 1% significance level
 - MFU, Income, Gas Price
- One cointegrating equation at the 5% significance level
 - MPG, Income, Gas Price

Results

	Ln_mpg	Ln_price	Ln_gdp	Const
<i>Cointegrating Eq</i>	1	0.343	-0.337	-1.04
<i>X²-test for exclusion</i>	16.34*	2.79***	8.82*	
<i>X²-test for weak exogeneity</i>	4.80**	3.87**	14.8*	

Results

	Ln_mfu	Ln_price	Ln_gdp	Const
<i>Cointegrating Eq</i>	1	-0.256	-0.805	3.38
<i>X²-test for exclusion</i>	19.63*	0.255	8.14*	
<i>X²-test for weak exogeneity</i>	19.96*	1.39	0.16	

Future Directions

- Structural breaks
 - Price series
- Price may be important in x-sectional (multi-country) analysis
- Additional variables
 - Spatial

Summary

- Transport is major consumer of energy & important source of CO² everywhere
- Demand for mobility increases strongly with income
- Although gas price and consumption are correlated across countries, higher gas taxes may not result in lower consumption
- Mobility/fuel demand has a long-run systemic relationship with gas price and income, as does technology choice with gas price and income

Policy Implications

- In developed countries, like the US, need a combination of policies addressing mobility options & technology as well as price to reduce fuel demand
- Countries like China and India would be wise to develop a system of prices, technology, and mobility options that help them avoid the challenge the US faces