Oil Product Demand Where Have We Been and Where Are We Going?

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More than a century of use

What's driving oil consumption

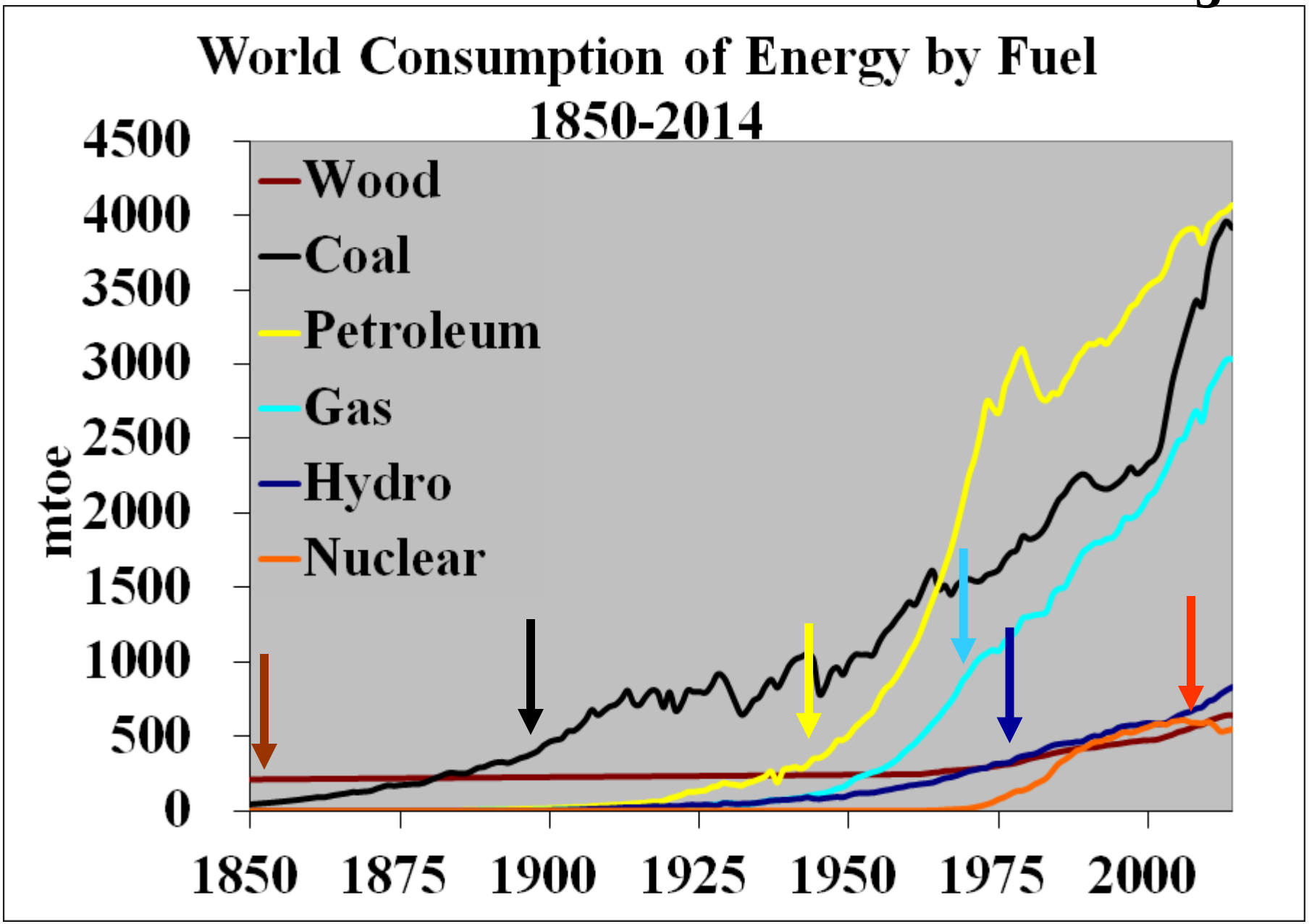
Elasticities

Refinery slates over the decades

Oil and product price elasticities

Lags in adjustment

Gasoline and diesel demand elasticities


World Consumption of Energy by Fuel
1850-2014
mtoe
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Wood
Coal
Petroleum
Gas
Hydro
Nuclear
1850
1875
1900
1925
1950
1975
2000

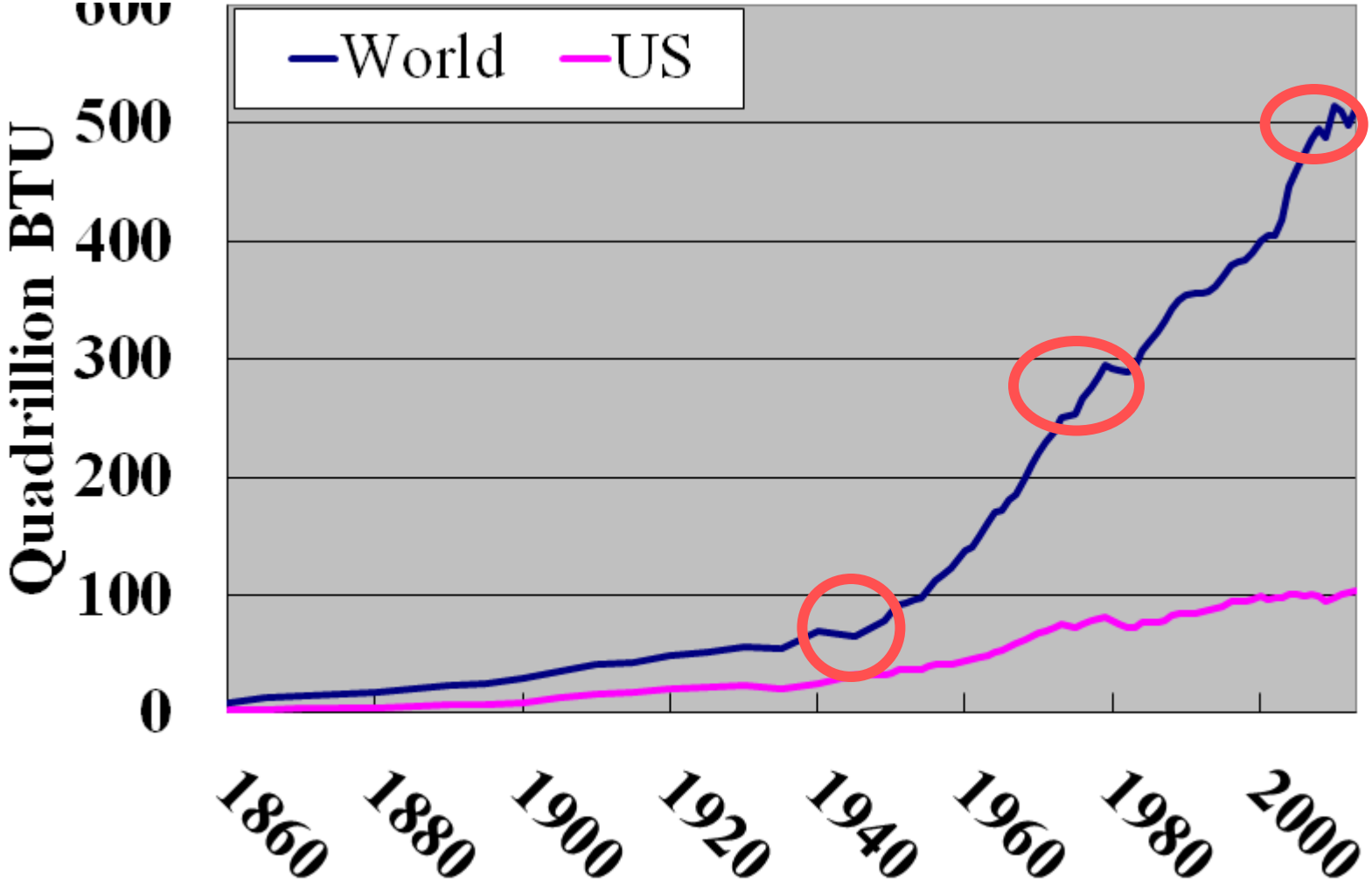
James Sweeney (1984)

The Response of Energy Demand to Higher Prices: What Have We Learned?

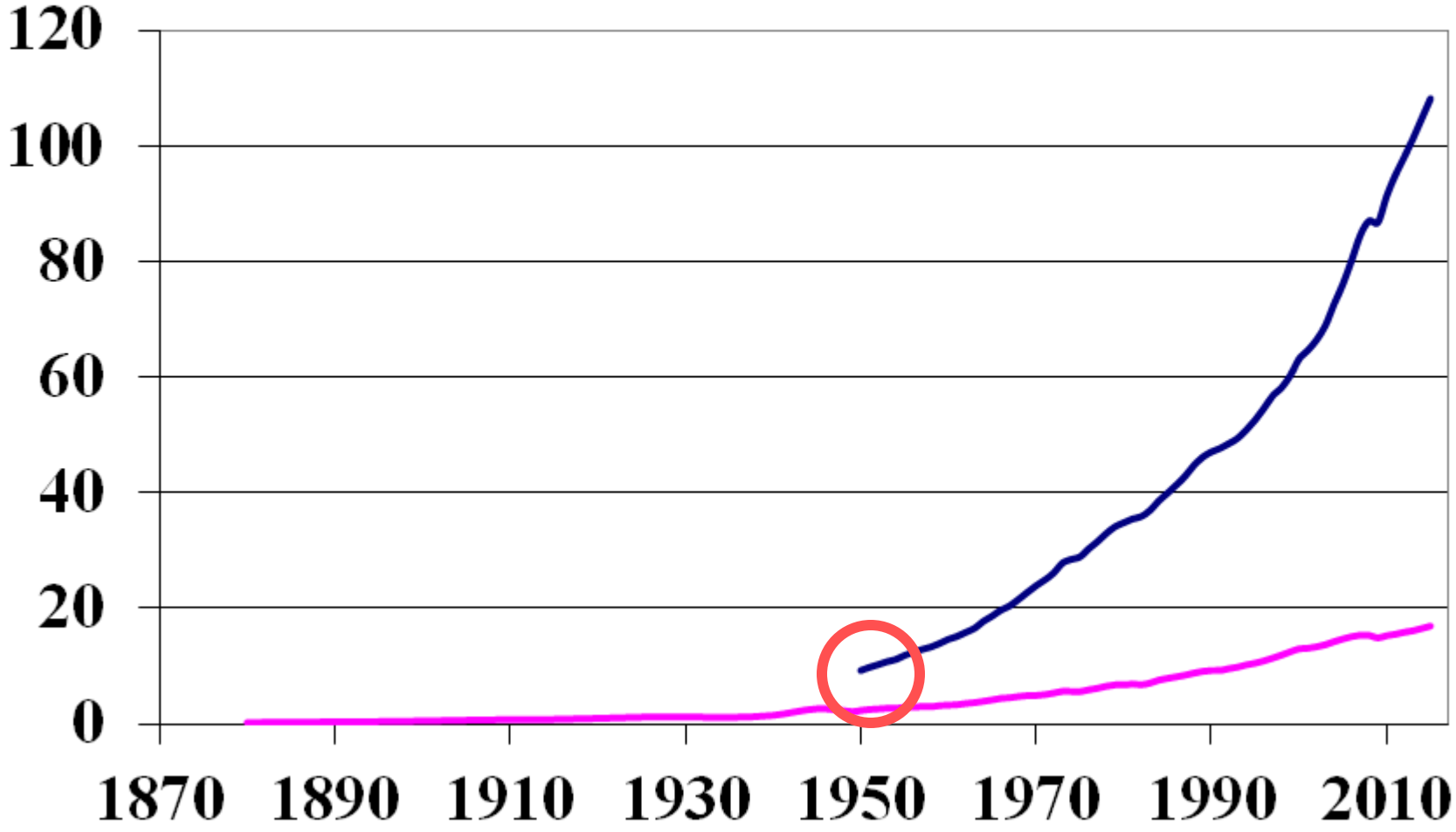
James L. Sweeney, *The American Economic Review*, Vol. 74, No. 2, Papers and Proceedings of the Ninety-Sixth, Annual Meeting of the American Economic Association. (May, 1984), pp. 31-37.

Energy directly or indirectly in almost all economic activity

World and U.S. Primary Energy Consumption 1860-2013
US about 20%



World and U.S. GDP 1880 - 2015
Billion (PPP) USD



Brown, Stephen (forthcoming) New estimates of the security costs of U. S. oil consumption. Energy Policy

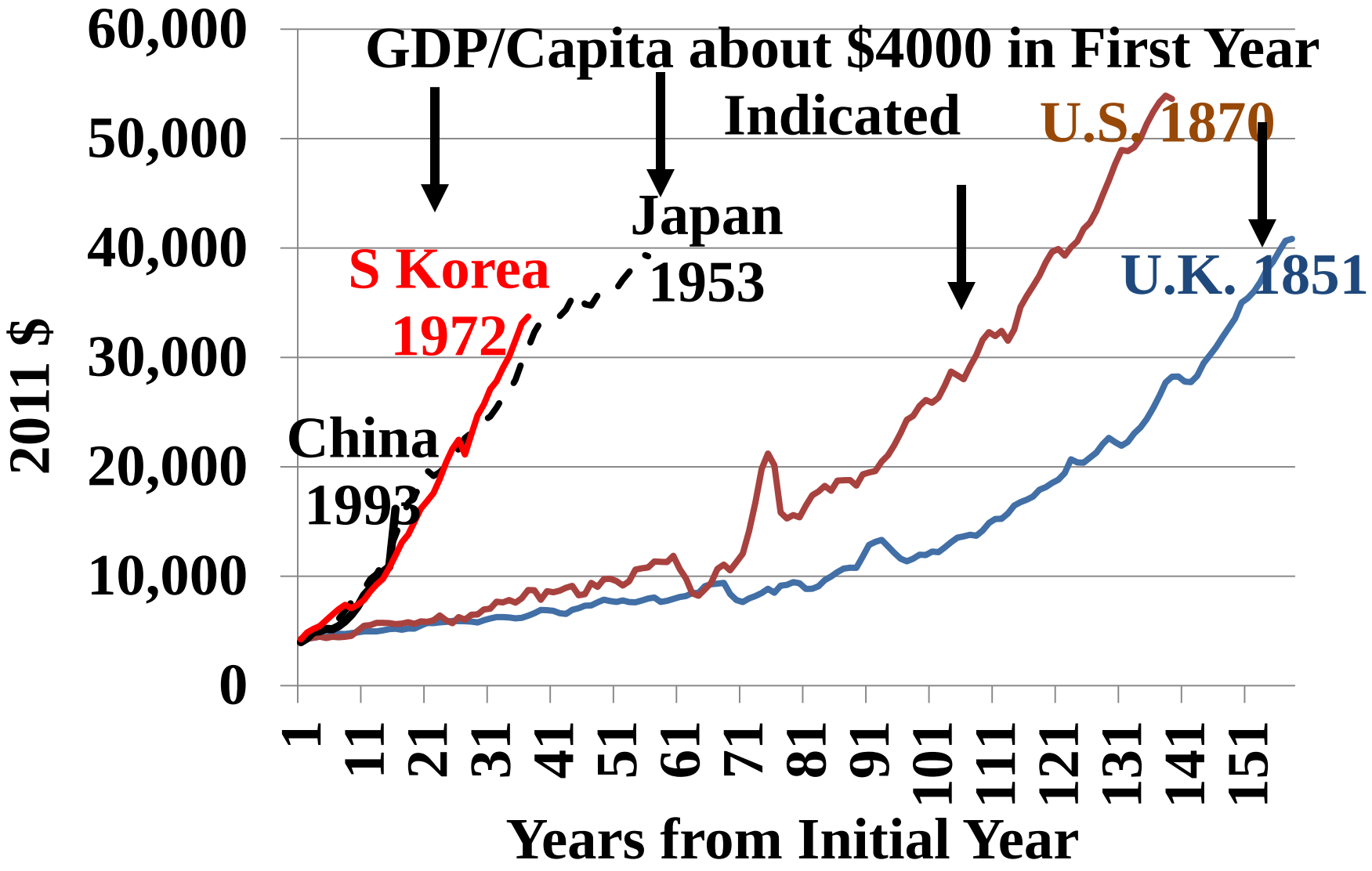
$$\varepsilon_Y = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta Y}{Y}}$$

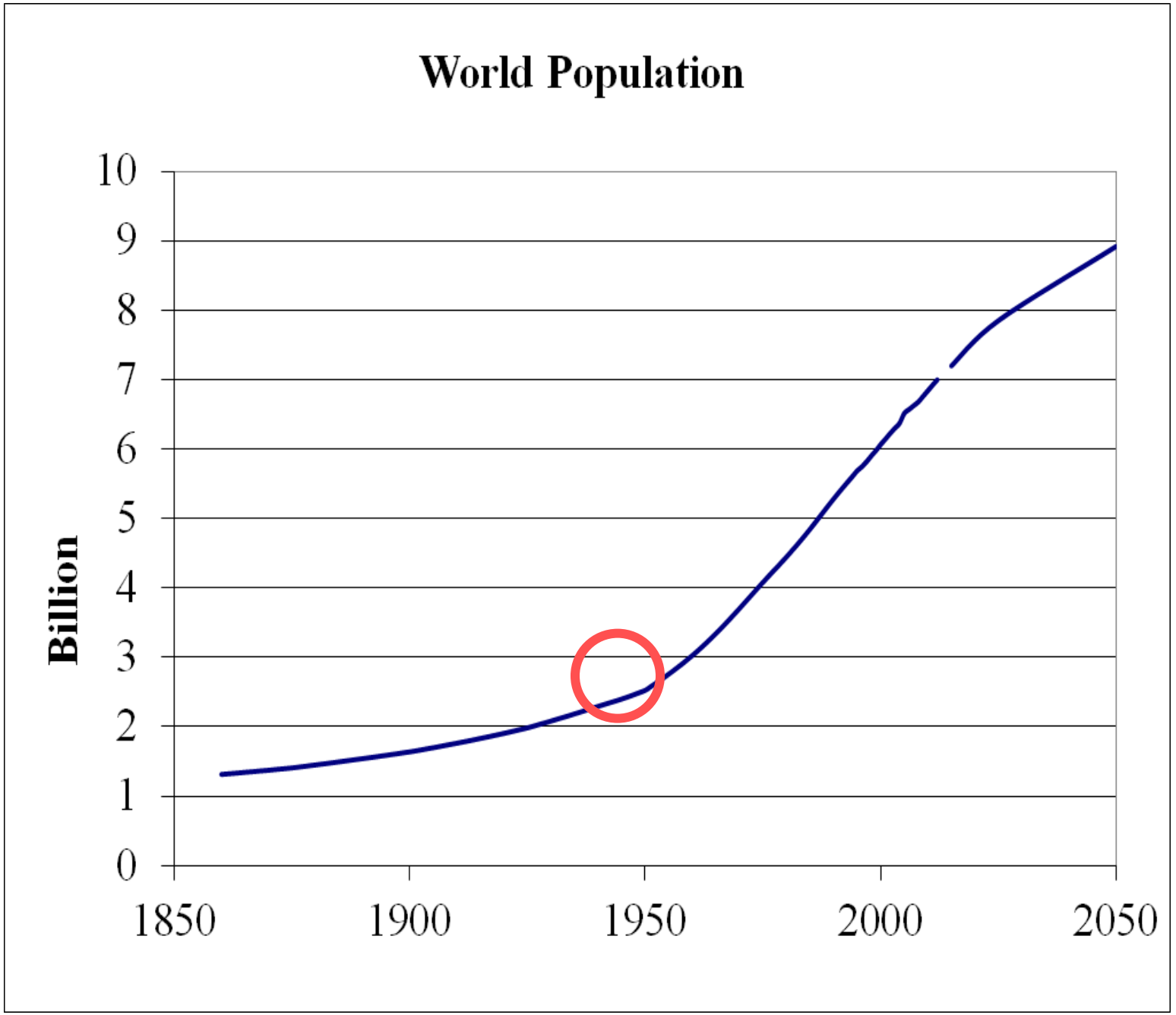
Oil demand income elasticity

0.70

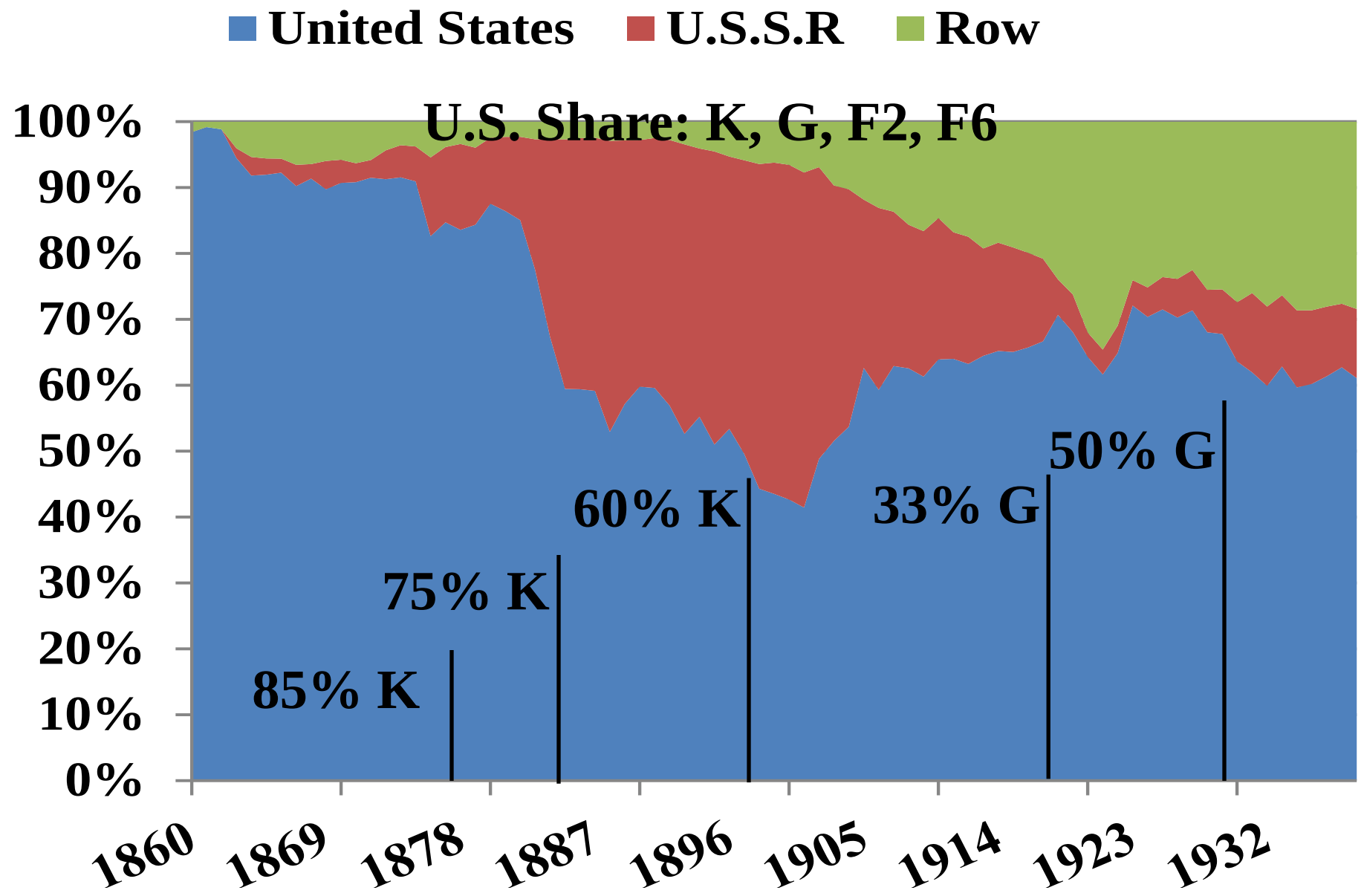
(0.55, 0.75)

Long Term Income Growth: Where in the Development Cycle

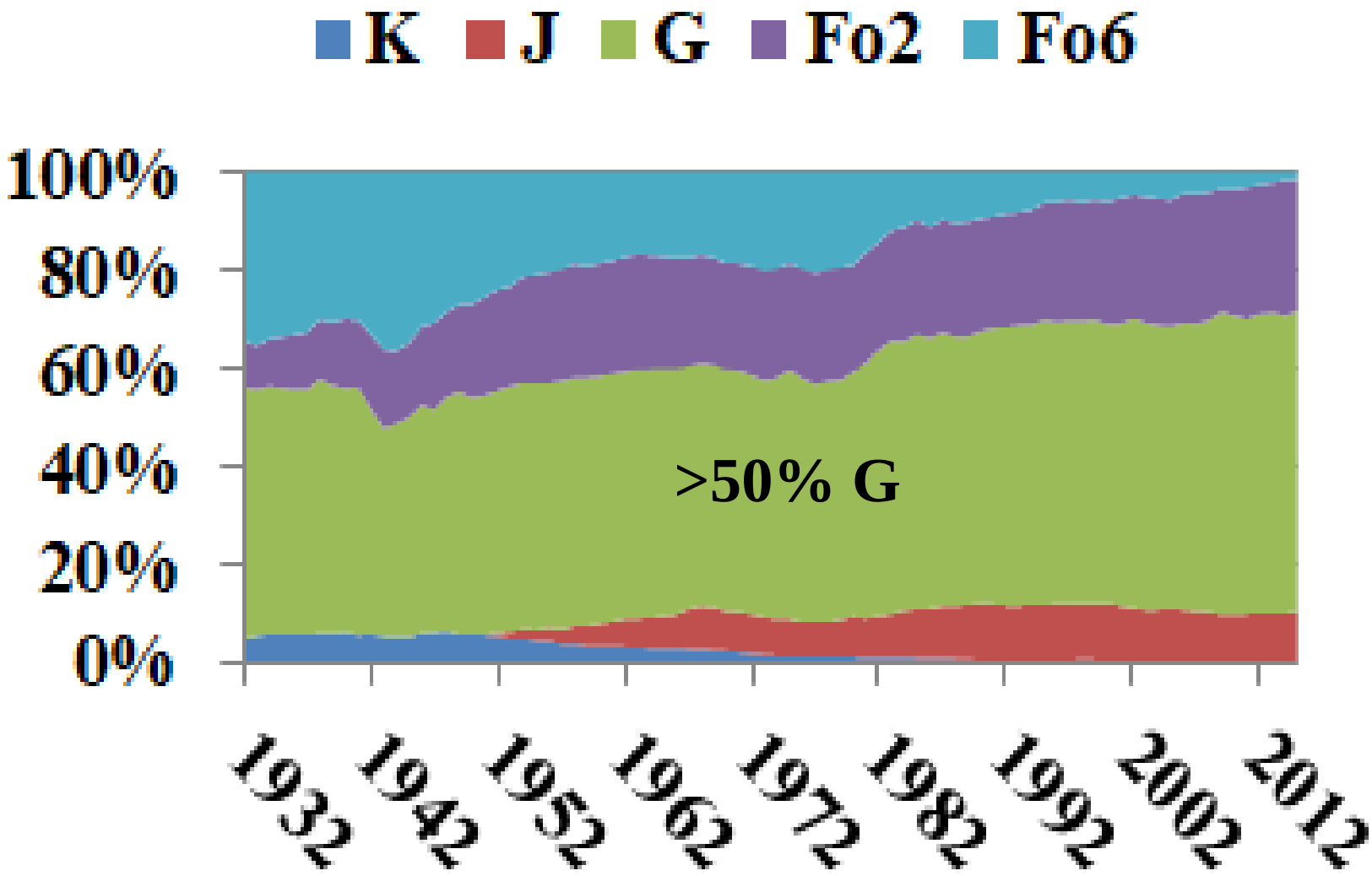



World Population
Billion
10
9
8
7
6
5
4
3
2
1
0
1850
1900
1950
2000
2050

Share of World's Oil (Primary Product)



U.S. Product Slate
Share of Five Products (Secondary)



James Sweeney (1984)

Buyers respond to higher prices

conservation and fuel switching

Brown, Stephen (forthcoming) New estimates of the security costs of U. S. oil consumption. Energy Policy

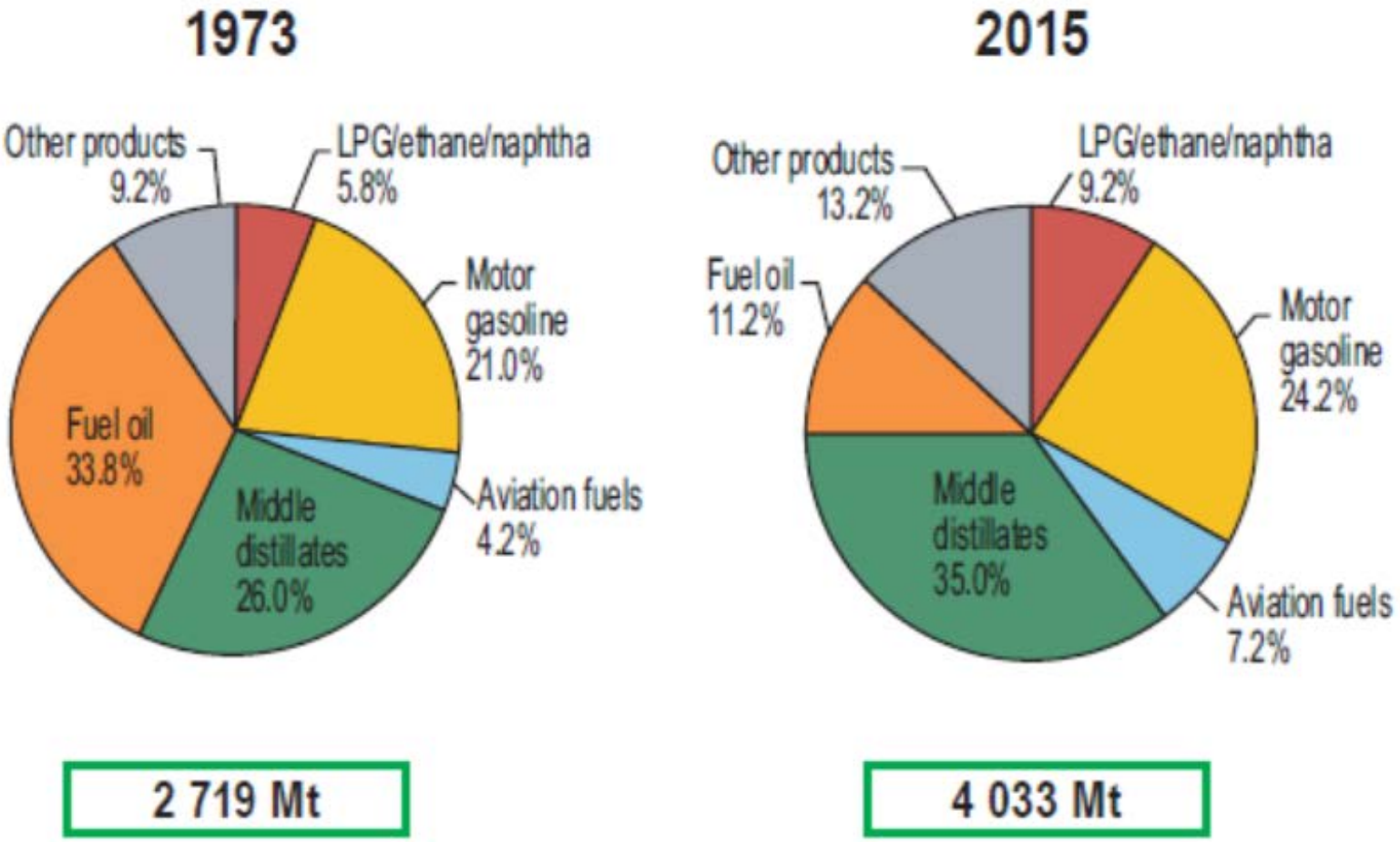
$$\varepsilon_P = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}}$$

Oil demand price elasticity

Short run **-0.055**

(-0.02, -0.09)

1973 and 2015 shares of refinery output by product



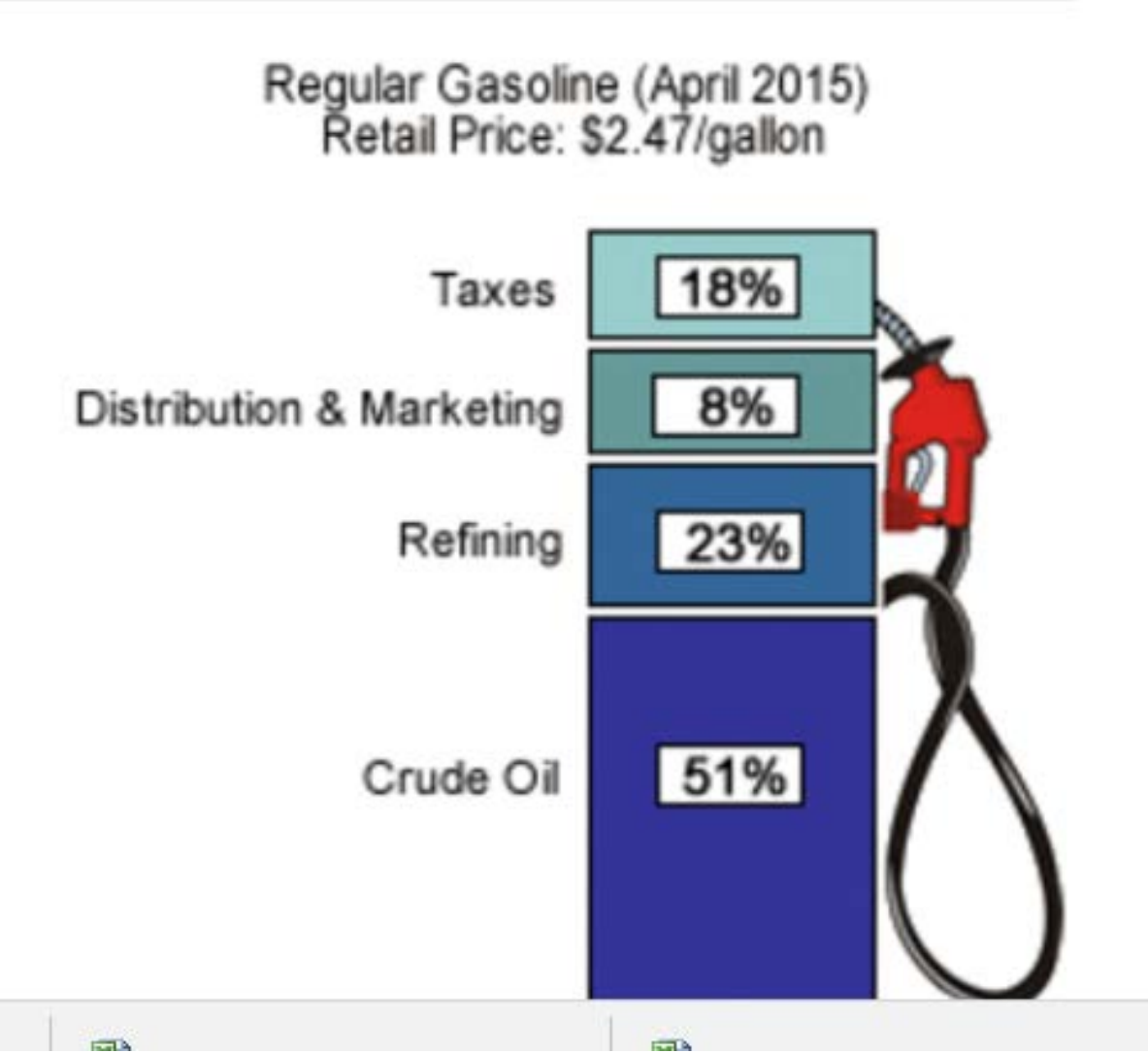
Price Elasticities of Oil (O) Products (X)

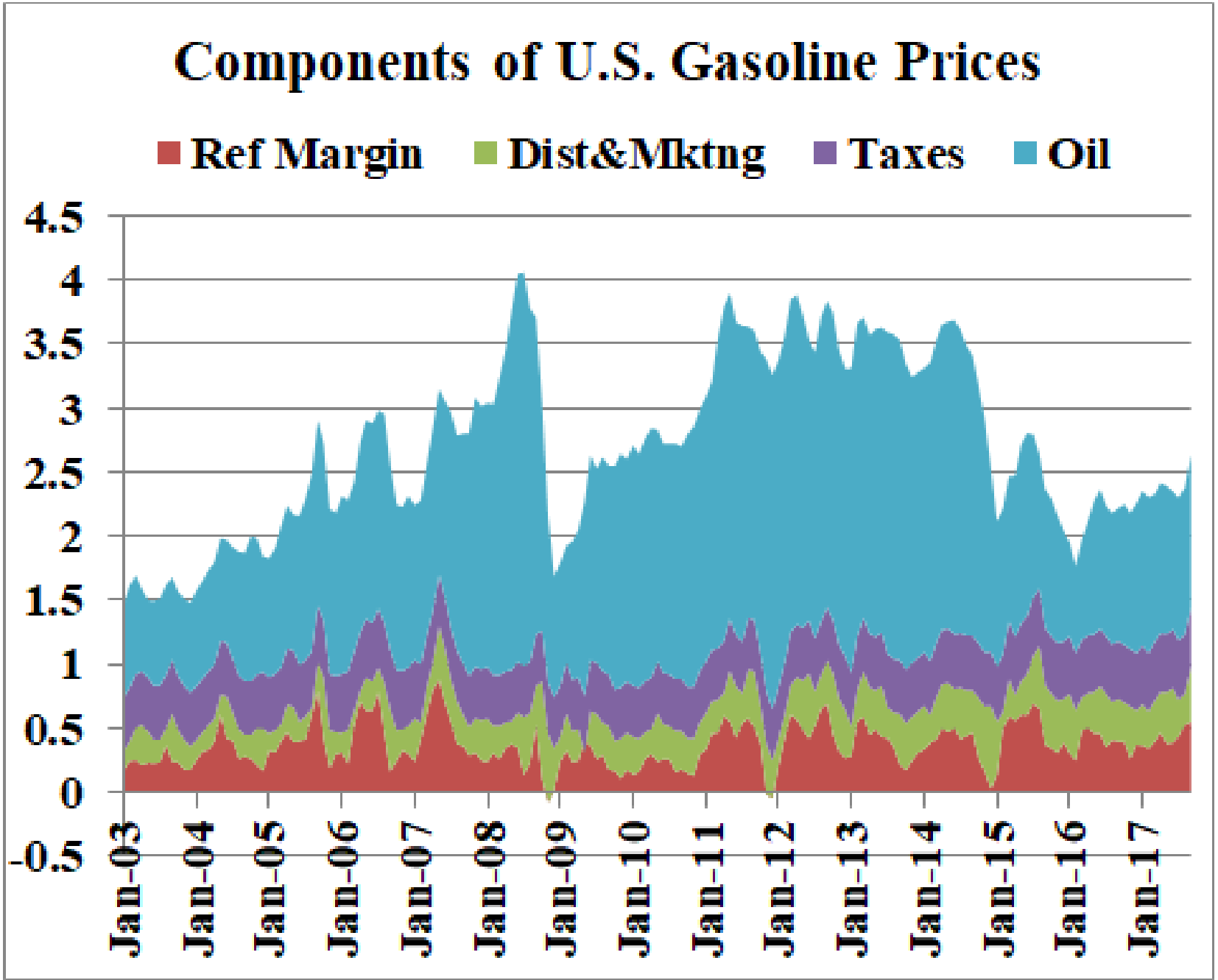
$$\varepsilon_O = \frac{\%\Delta O}{\%\Delta P}$$

$$\varepsilon_X = \frac{\%\Delta X}{\%\Delta P_X}$$

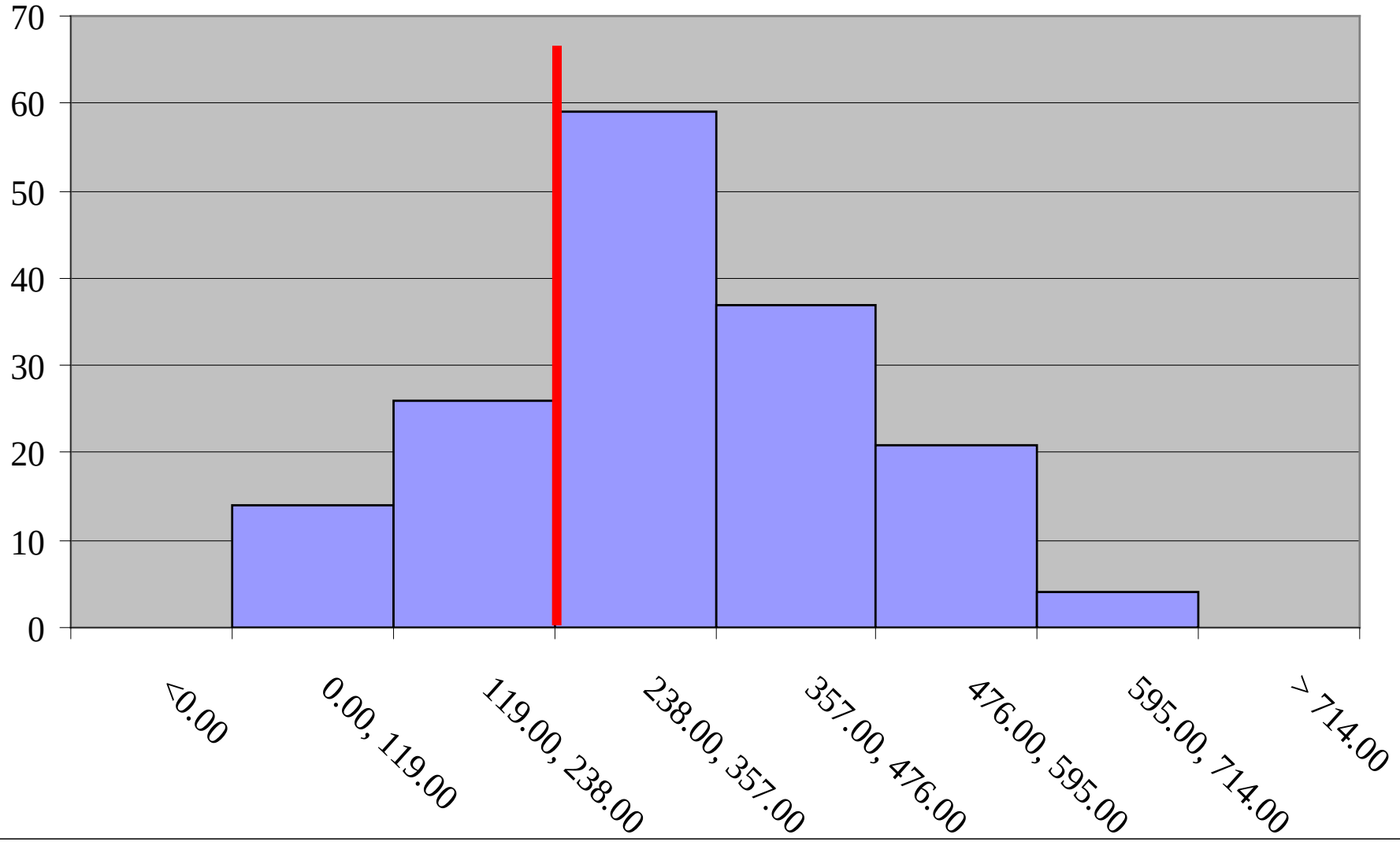
$$\varepsilon_O = \frac{\%\Delta O}{\%\Delta P} \quad \frac{\%\Delta P_X}{\%\Delta P_O}$$

Composition of a Gallon of Gasoline

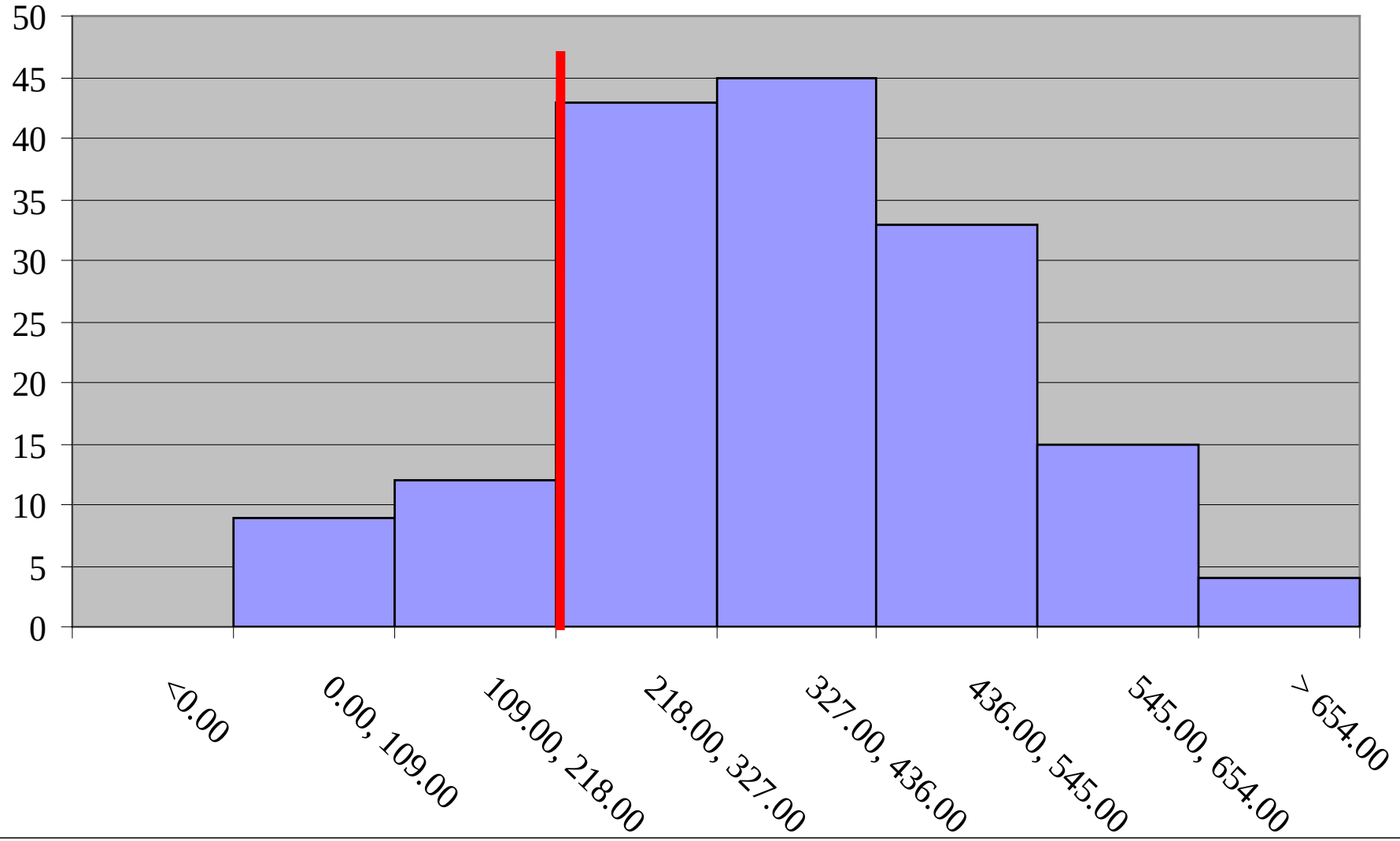



Components of U.S. Gasoline Prices
Ref Margin
Dist&Mktng
Taxes
Oil
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17

Diesel Prices by Country Frequency (US cents per gallon) 1 gallon is about 4 liters



Gasoline Prices by Country Frequency U.S. Cents per Gallon



Sweeney

Price elasticity for gasoline

Short Run: -0.2

Long Run: -0.6 to -1

Brown

price elasticity of oil

long run: -0.4

(-0.55, -0.75)

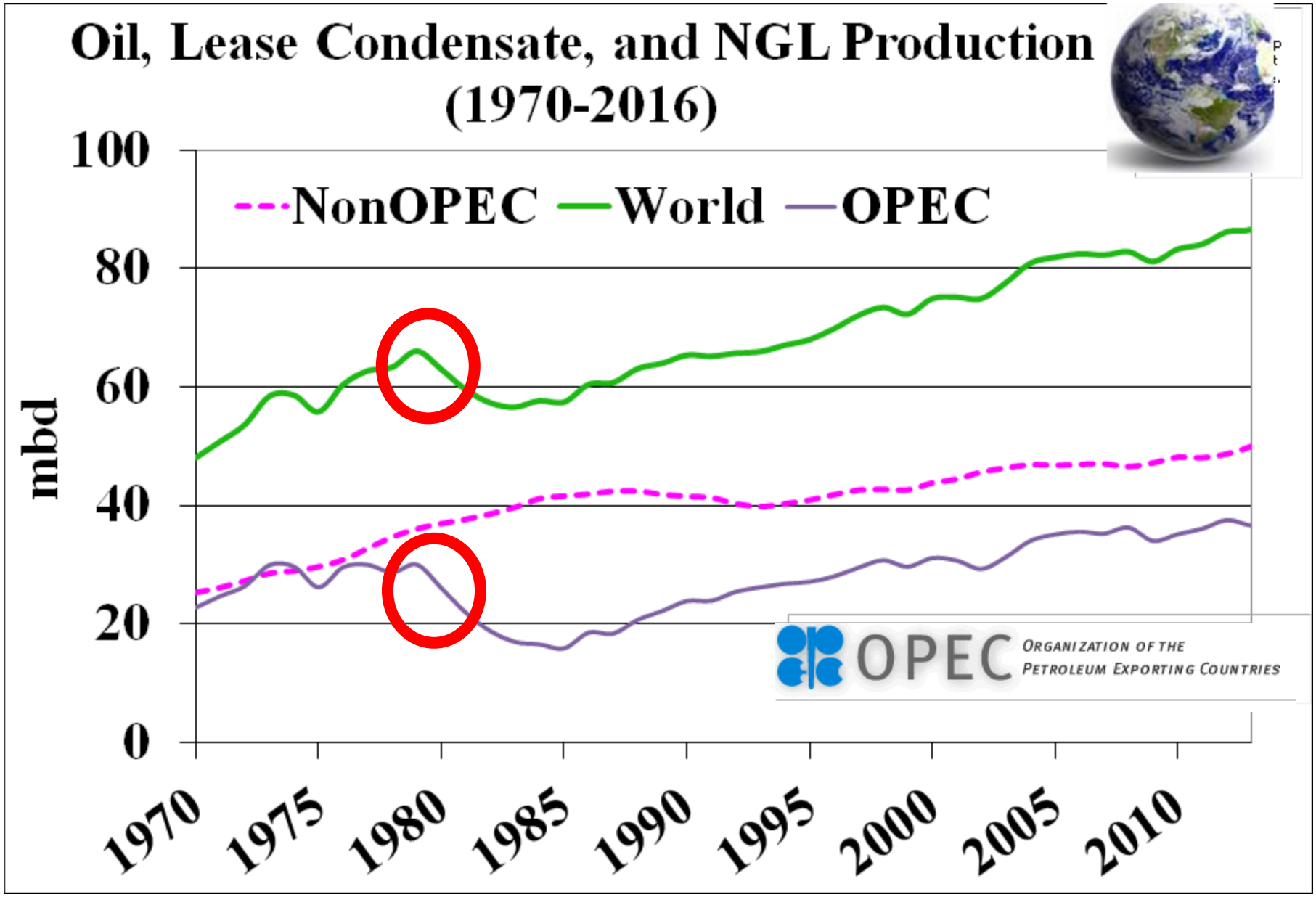
James Sweeney (1984)

Used with capital some very long lived

Fairly fixed ratio until replaced

Adjustment can continue for many years

Adjustment rates unknown


Oil, Lease Condensate, and NGL Production
(1970-2016)
NonOPEC
World
OPEC
mbd
100
80
60
40
20
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
OPEC
Organization of the
Petroleum Exporting Countries

James Sweeney (1984)

Energy is a derived demand

Gallons = Miles/(Miles/Gallon)

$$\varepsilon_G = \frac{\%\Delta G}{\%\Delta P} = \frac{\%\Delta M}{\%\Delta P} - \frac{\%\Delta MPG}{\%\Delta P}$$

Rebound effect (Cafe standards)

MPG ↑ Cost per mile↓ Miles ↑

cancelling some of efficiency gains

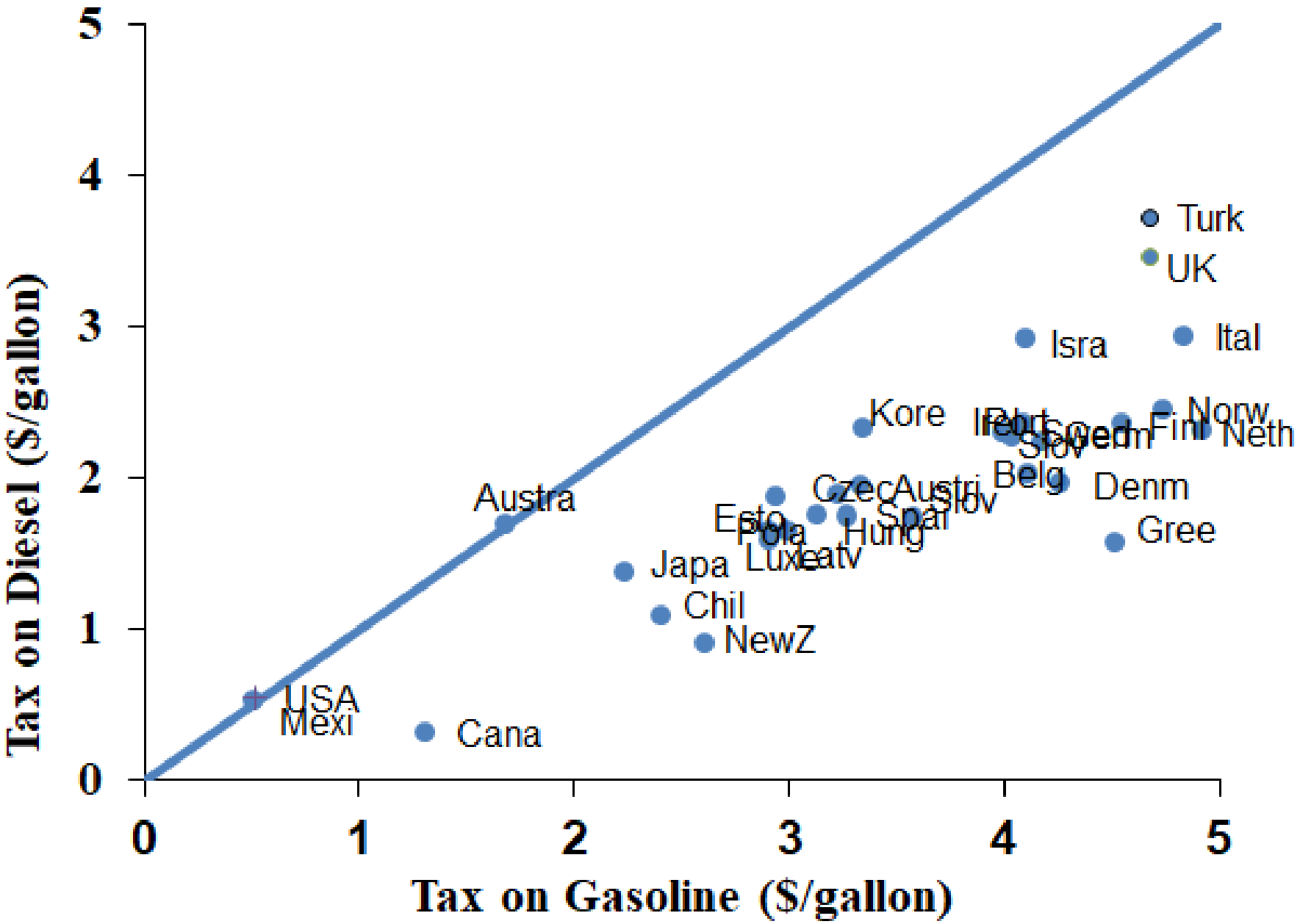
Greening, Greene, and Difiglio (2000)

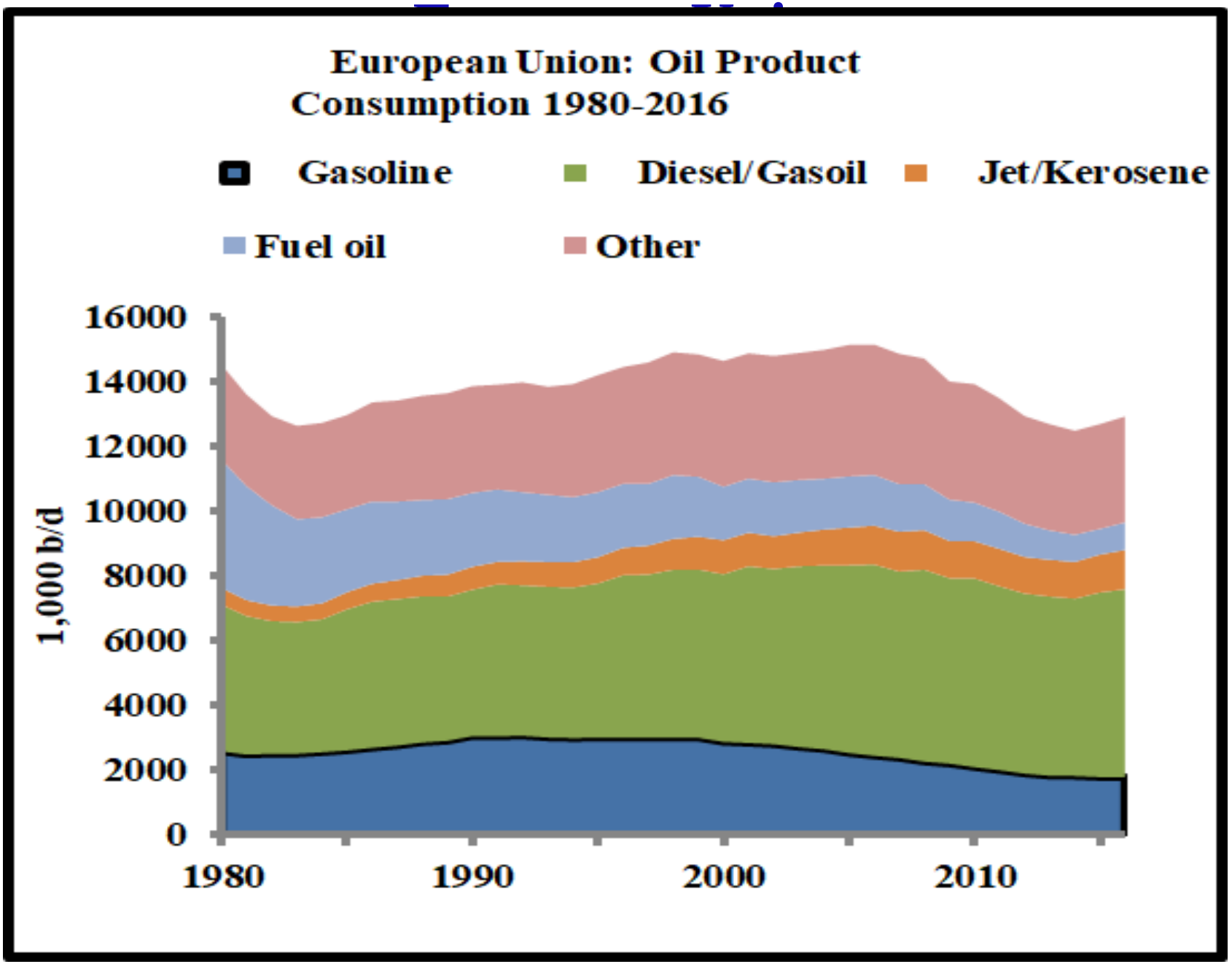
10% sr and up to 30% long run

Sweeney

Government policy can reduce

price & economic activity 80-90% of adjustment


Tax on Diesel ($/gallon)
Tax on Gasoline ($/gallon)
0
1
2
3
4
5
Turk
UK
Isra
Ital
Kore
Norw
Fini
Neth
Belg
Denm
Austra
Gree
Japa
Chil
NewZ
USA
Mexi
Cana


European Union: Oil Product Consumption 1980-2016
Gasoline
Diesel/Gasoil
Jet/Kerosene
Fuel oil
Other
1,000 b/d
16000
14000
12000
10000
8000
6000
4000
2000
0
1980
1990
2000
2010

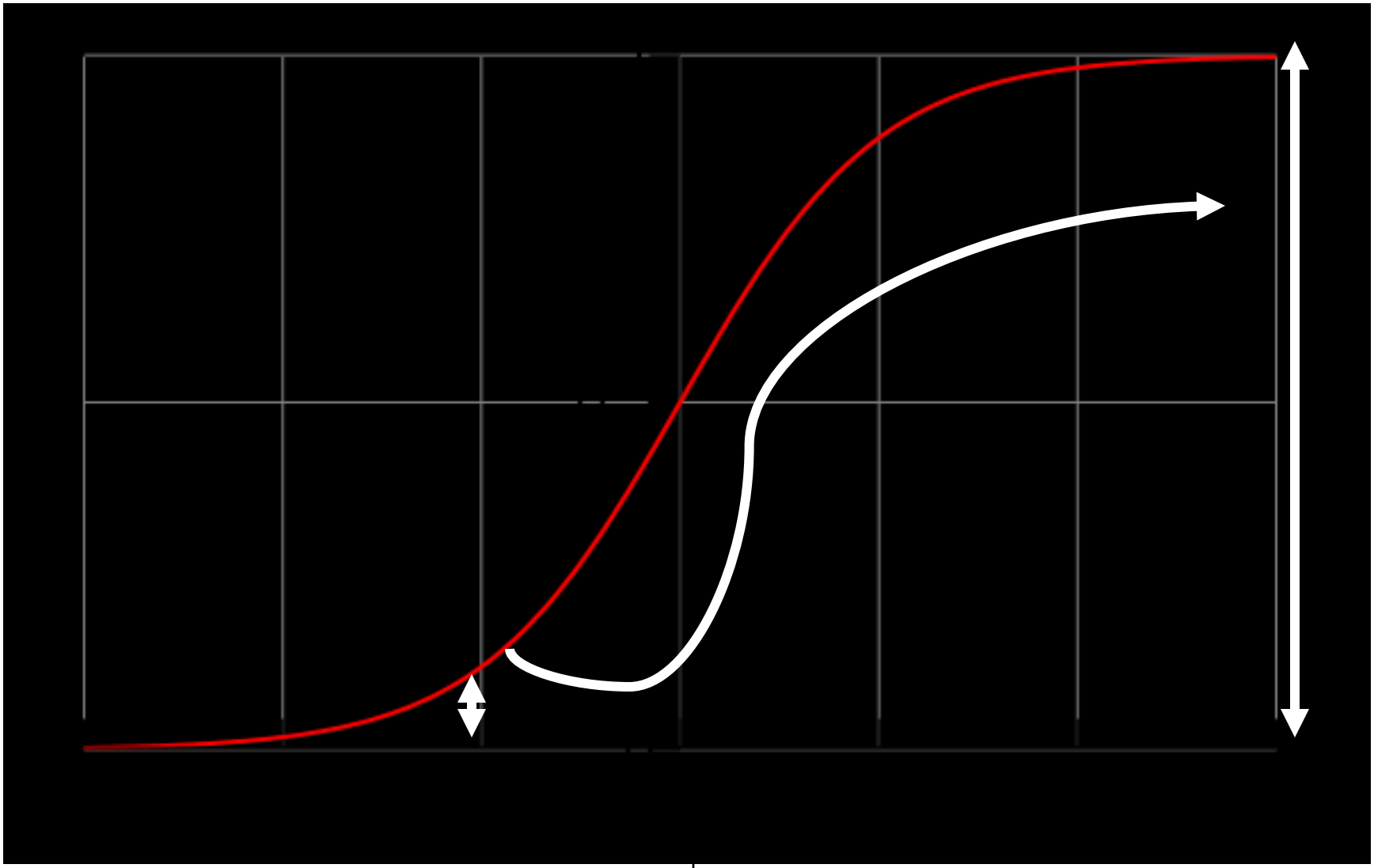
Gasoline Price Elasticities

		Price 2014 Dollars per Gallon		
		<$1.174	$1.174-$2.935	>$2.67
GDP	<$11740	-0.15	-0.22	-0.26
per	$11740-$23480	-0.11	-0.24	-0.32
Capita	>$23480	-0.22	-0.22	-0.33
Notes: 1 gallon = 3.785 liters				
Source: Dahl (2012). Price and GDP per capita converted from 2006 to 2014 $ using the U.S. CPI of 1.174 from World Development Indicators. GDP per capita measured in purchasing power parities.				

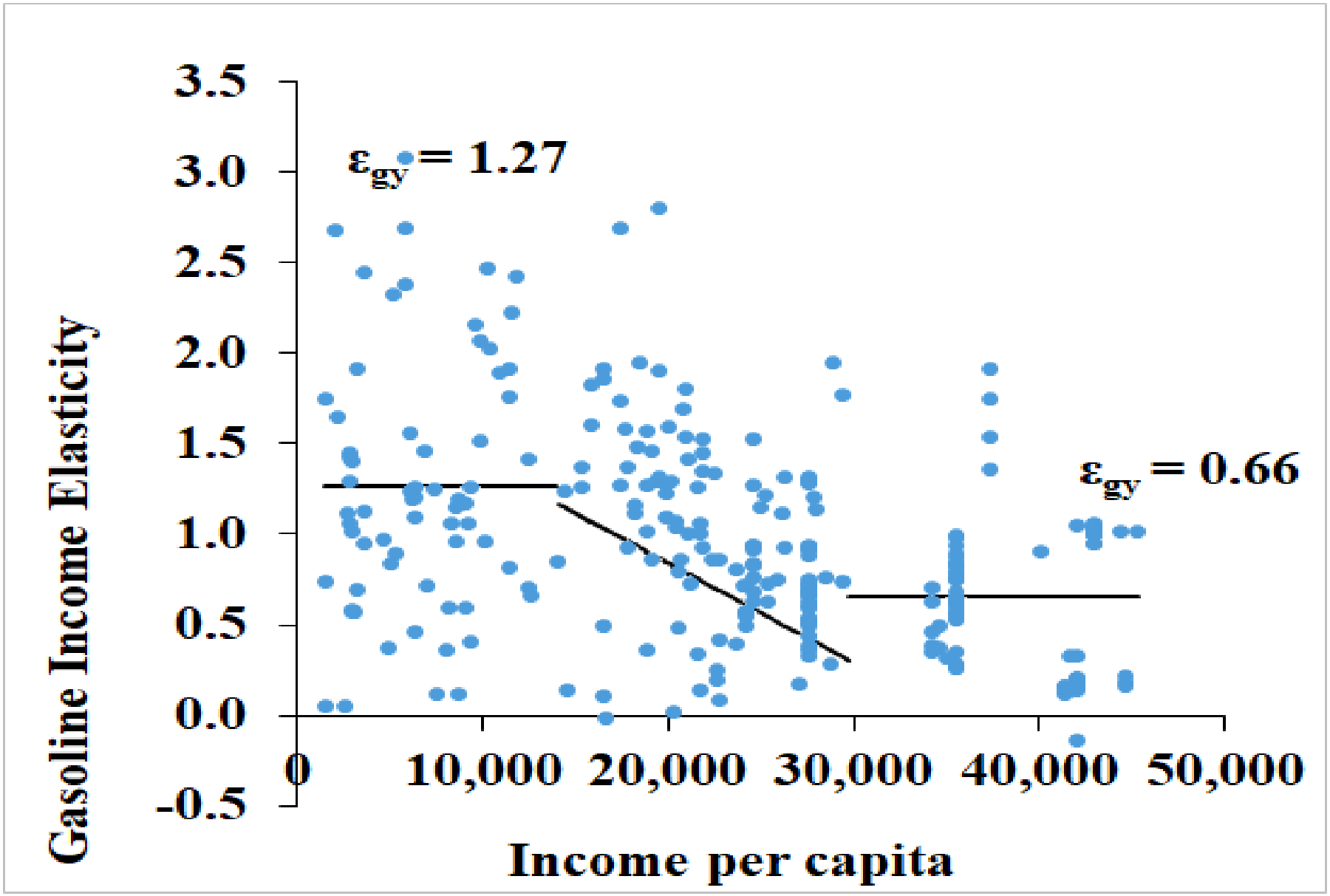
Diesel Price Elasticities

Diesel Price Elasticities Stratified by GDP per Capita and Price			
		Price 2014 Dollars per Gallon	
		<$2.935	>$2.935
GDP per Capita	<$17610	-0.22	-0.38
	>$17610	-0.13	-0.27
Notes: 1 gallon = 3.785 liters			
Source: Dahl (2012). Price and GDP per capita converted from 2006 to 2014 $ using the U.S. CPI of 1.174 from World Development Indicators. GDP per capita measured in purchasing power parities.			

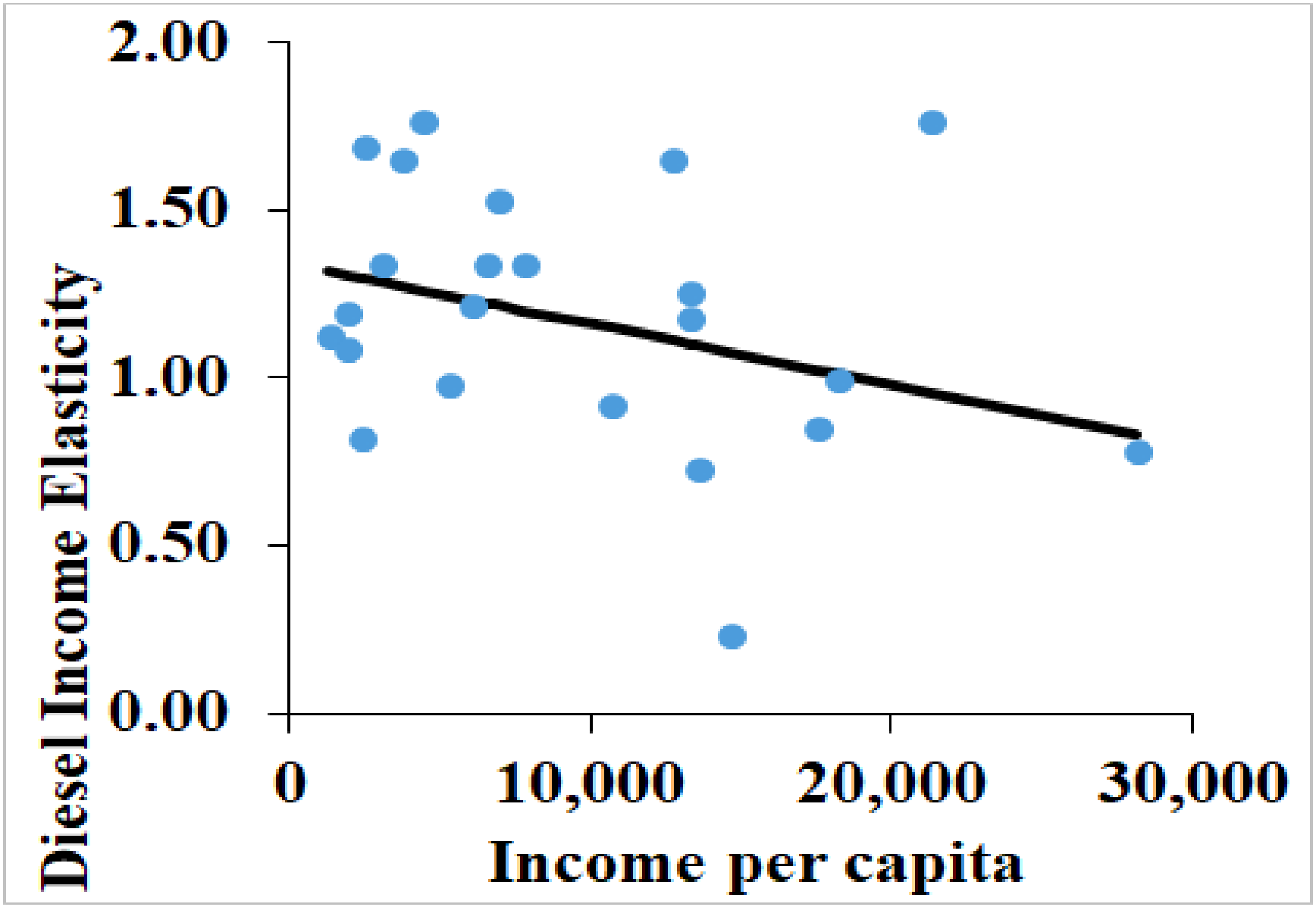
Short and Long Run Price and Income Elasticities Time Path

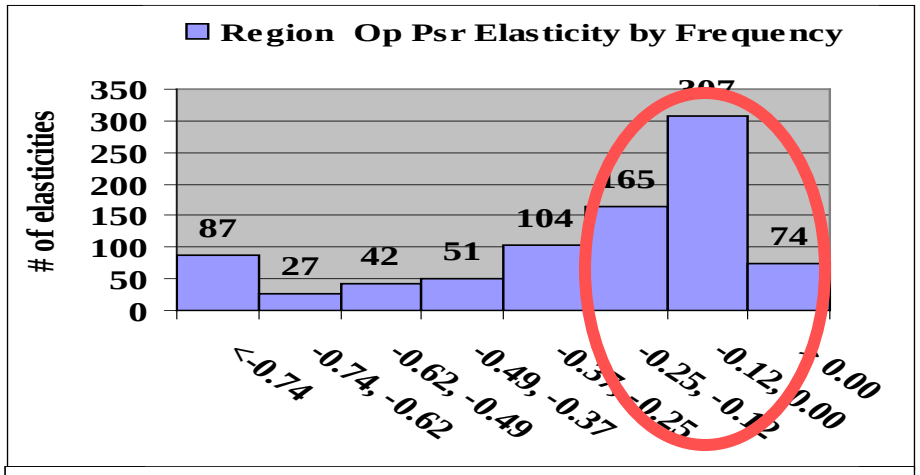


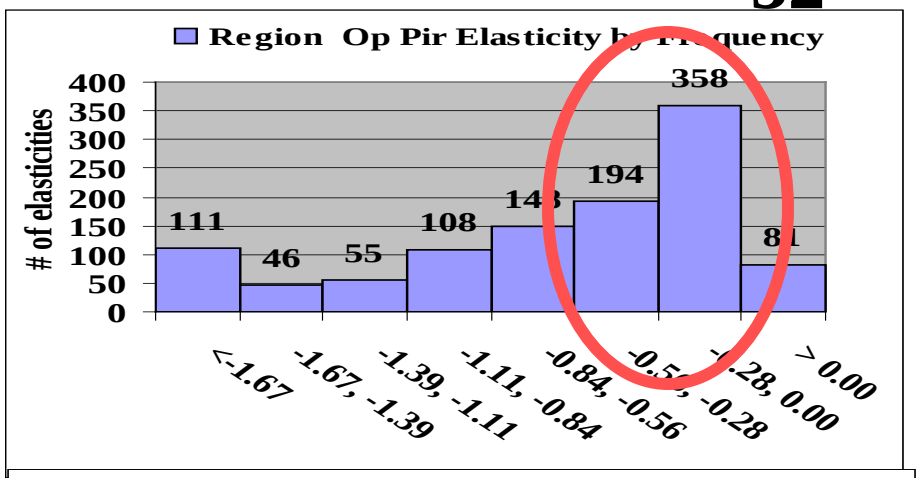
Gasoline Income Elasticity

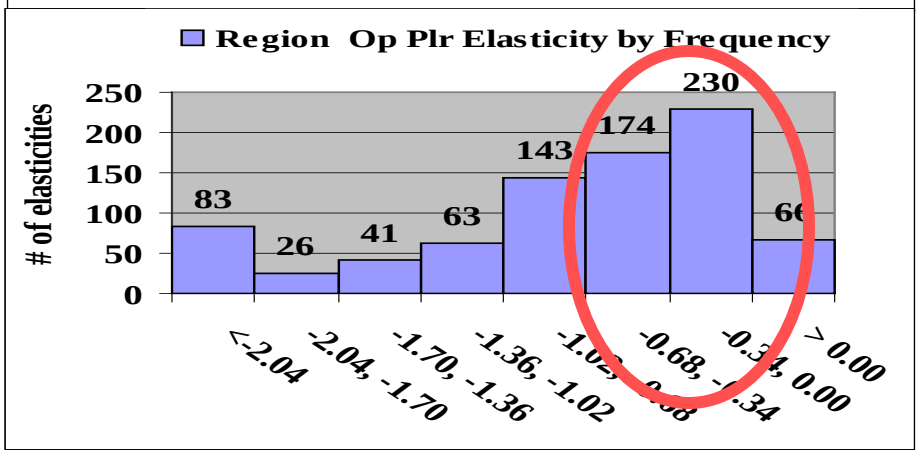


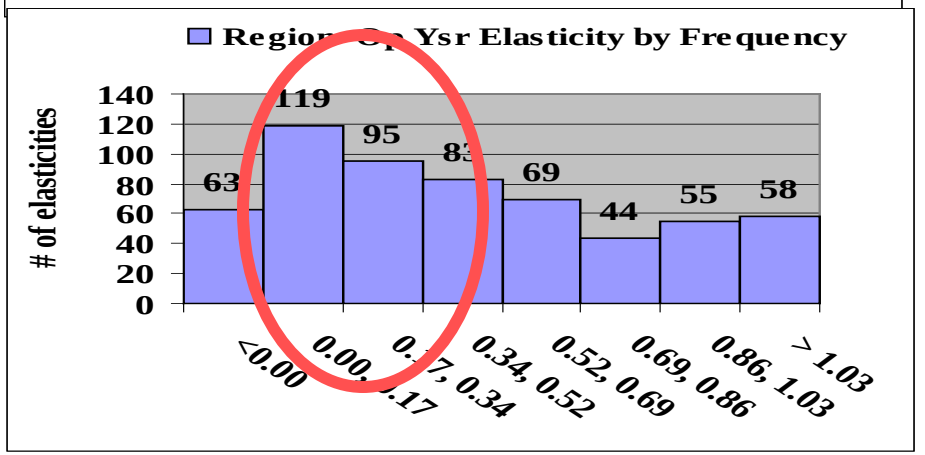
Diesel Income Elasticities

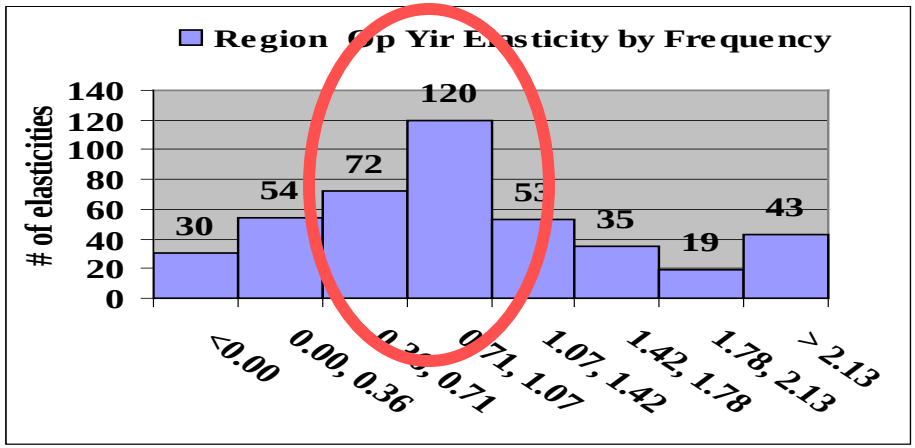


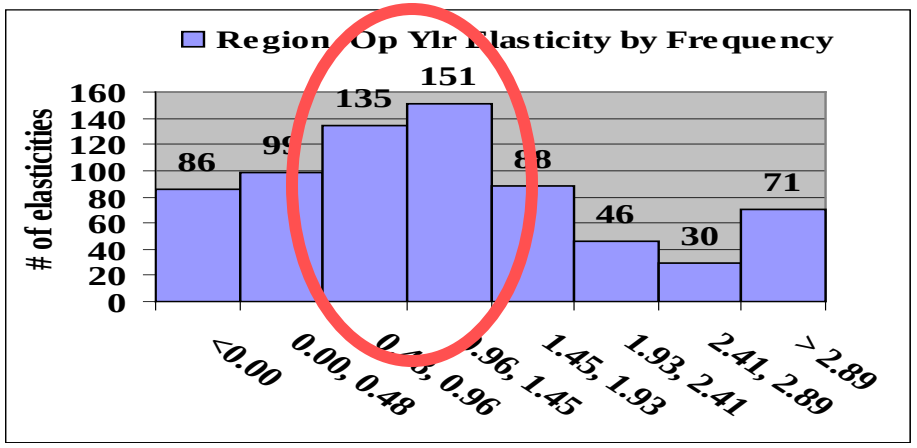

Region Op Psr Elasticity by Frequency
# of elasticities
350
300
250
200
150
100
50
0
87
27
42
51
104
165
74
<-0.74
-0.74, -0.62
-0.62, -0.49
-0.49, -0.37
-0.25, -0.12
> 0.00


Region Op Pir Elasticity by Frequency
# of elasticities
400
350
300
250
200
150
100
50
0
111
46
55
108
194
358
<-1.67
-1.67, -1.39
-1.39, -1.11
-1.11, -0.84
-0.84, -0.56
-0.28, 0.00
> 0.00


Region Op Plr Elasticity by Frequency
# of elasticities
250
200
150
100
50
0
83
26
41
63
143
174
230
<-2.04
-2.04, -1.70
-1.70, -1.36
-0.68, -0.34
-0.34, 0.00
> 0.00


Ysr Elasticity by Frequency
# of elasticities
140
120
100
80
60
40
20
0
63
119
95
69
44
55
58
<0.00
0.34, 0.52
0.52, 0.69
0.69, 0.86
0.86, 1.03
> 1.03


Region Op Yir Elasticity by Frequency
# of elasticities
140
120
100
80
60
40
20
0
30
54
72
120
53
35
19
43
<0.00
0.00, 0.36
0.71, 1.07
1.07, 1.42
1.42, 1.78
1.78, 2.13
> 2.13

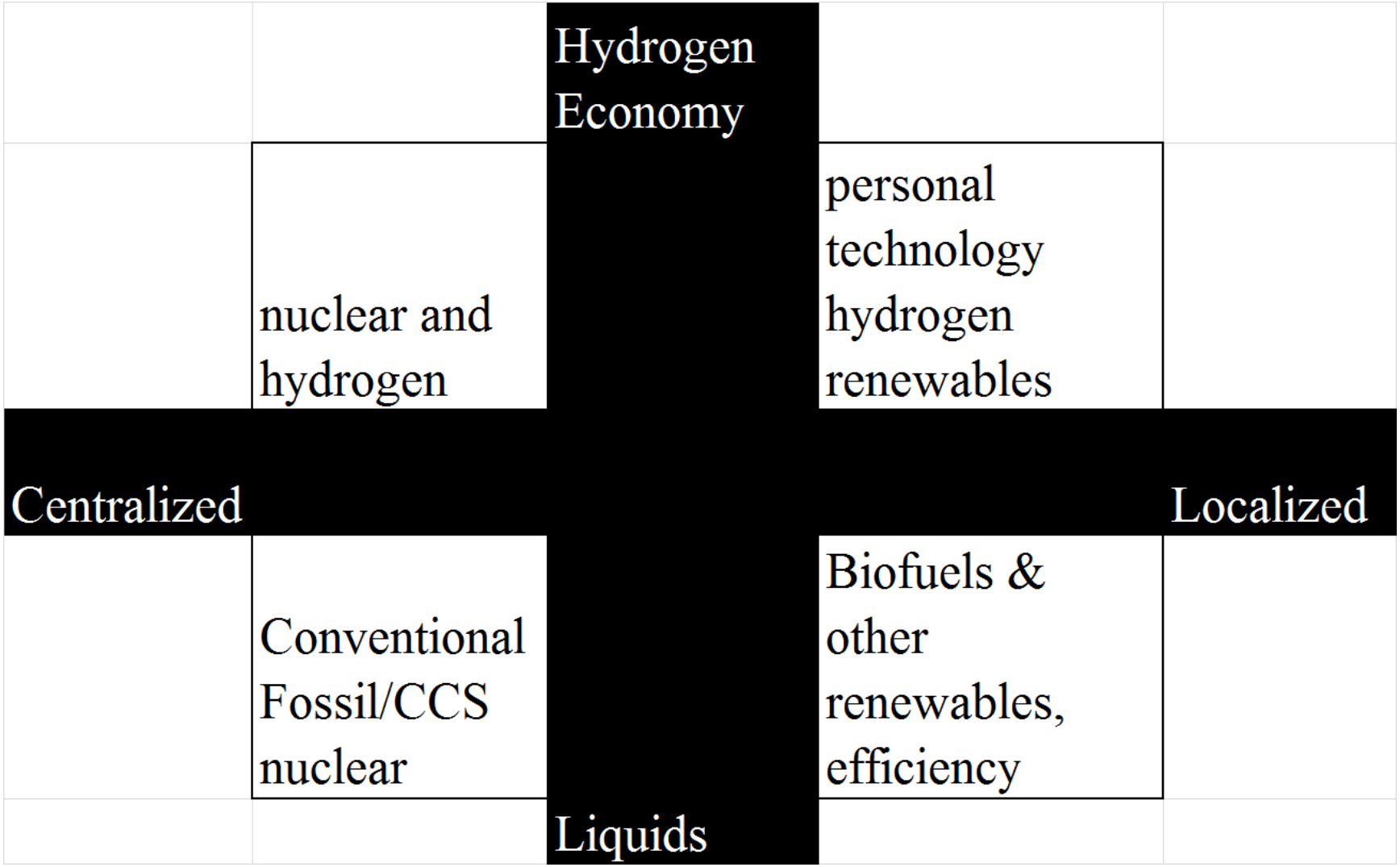

Region Op Ylr Elasticity by Frequency
# of elasticities
160
140
120
100
80
60
40
20
0
86
135
151
46
30
71
<0.00
0.00, 0.48
1.45, 1.93
1.93, 2.41
2.41, 2.89
> 2.89

Sweeney

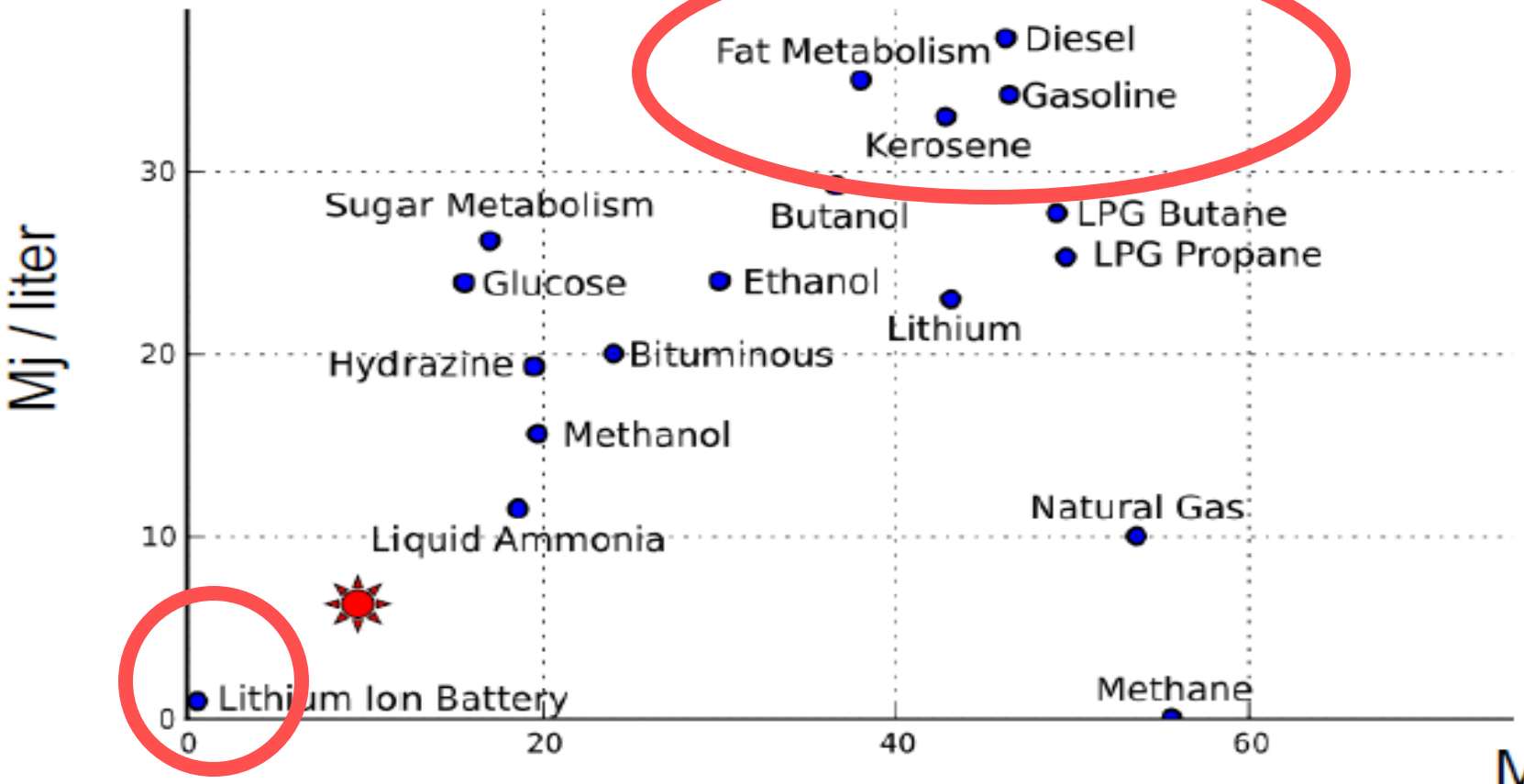
Demand oil, natural gas, and coal price elasticities in industrial uncertain

No fuel substitution non-rail transportation

Future Choices

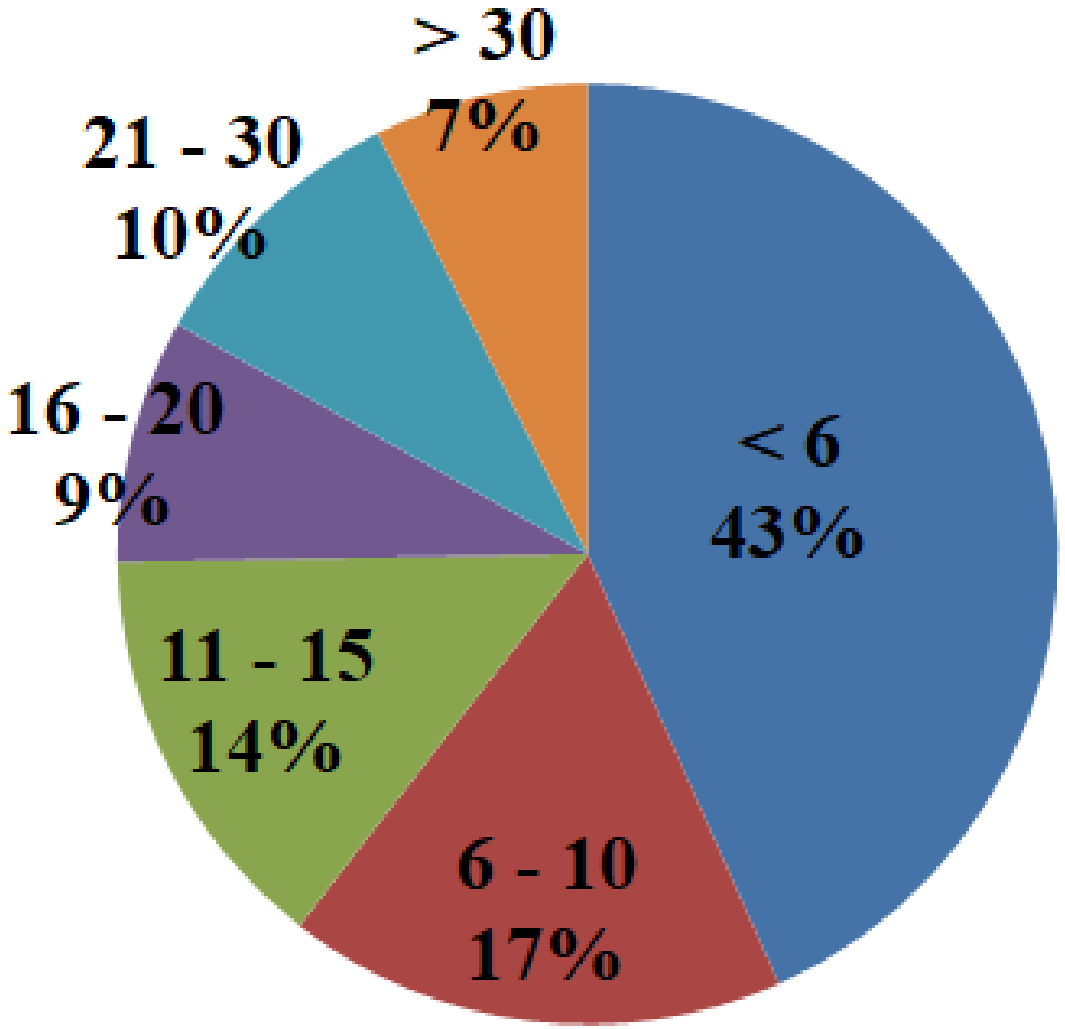


Energy densities of chemical fuels and the best commercial battery



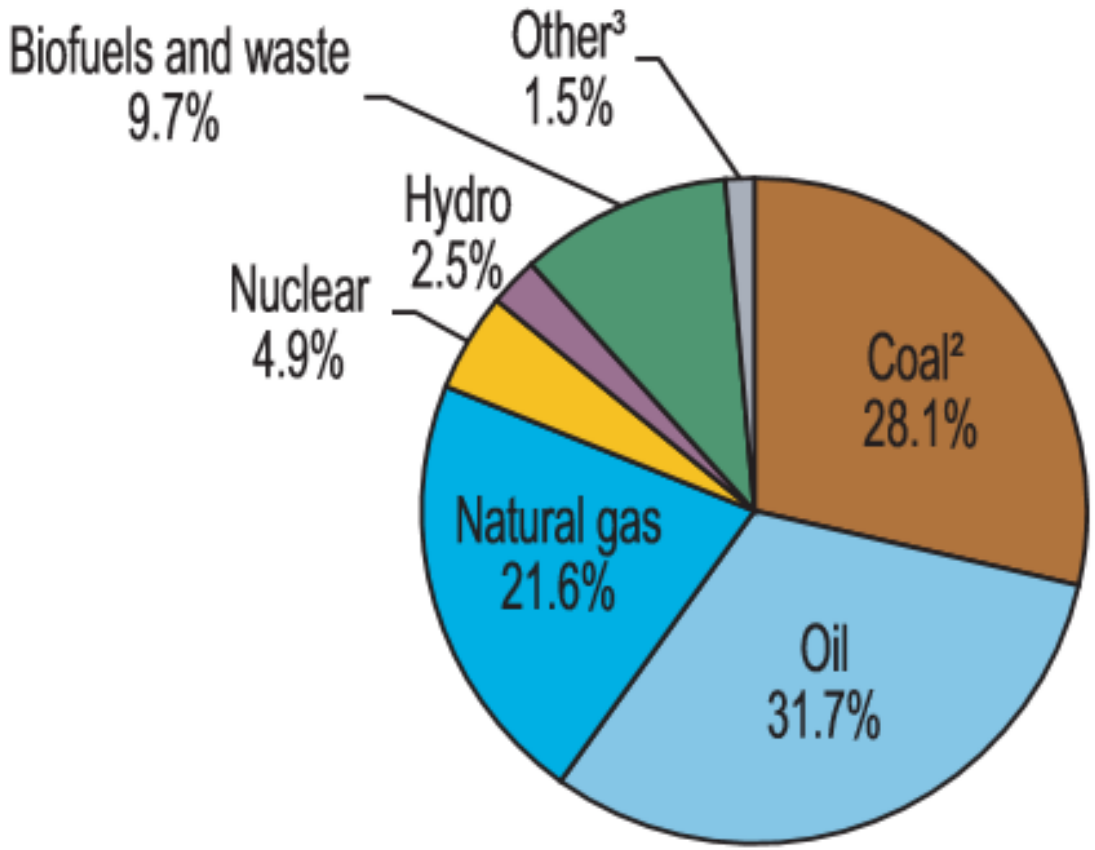
Body Fat	38 Mj/kg	35 Mj/liter
Kerosene, jet fuel	43 Mj/kg	32 Mj/liter
Lithium ion battery	0.54 Mj/kg	0.9 Mj/liter

U. S. Vehicle Trips By Distance (Miles)



Global Energy Supply By Source

2015



13 647 Mtoe

Elasticity Data Base

Dahl Energy Demand Data Base

DEDD

http://dahl.mines.edu/courses/dahl/dedd