The Social Cost of Thailand's Transportation Fuel Pricing Policy

present to

PUEY UNGPHAKORN INSTITUTE FOR ECONOMIC RESEARCH WORKSHOP

Wichsinee Wibulpolprasert; Bhawin Teveyanan

Thailand Development Research Institute

9 July 2016

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Outline of the Talk

- Background and Motivations
- Empirical Strategy
  - Estimating demand elasticity
  - Constructing efficient price structure
  - Measuring deadweight loss from pricing policies
- Data
- Results
  - Estimating demand elasticity
  - Constructing efficient price structure
  - Measuring deadweight loss from pricing policies
- Policy Recommendations

Background and Motivations

สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Background and Motivations

- Why does Thailand have to distort/subsidize fuel prices ?

- What do we get from fuel pricing policy ?

- Limitation in reforming the petroleum price structure

Research Questions

1. How much are the economic costs associated with these distortions?

2. What could be the alternative policies that achieve the same objectives with minimal negative impacts on economic efficiency and government's budget?

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Key takeaways

- Two objectives of the recent transportation fuel pricing policies:
  1. Support the low-income and curb inflation: Diesel price cap
  2. Enhance energy security: Biofuel subsidies
- Almost all the fuels have been priced below their social cost
  - Diesel is the most underpriced → imposes the highest efficiency cost
- Benzene consumers are more responsive to the change in fuel prices than before
  - Future policy that creates price distortions will also result in a larger deadweight loss
- Policy recommendations
  - Set fuel prices to better reflect social cost (i.e. collect higher taxes)
  - Recycle additional tax revenue through:
    - Targeted income transfer to the poor and the logistic sector [short-run]
    - Expanding infrastructure for mass transport, improving public transportation, encouraging mode shift [long-run]

Analysis Steps

Estimate price elasticity of demand

- Group petroleum products
- Estimate the own- and cross-price elasticities

Construct the efficient price structure

- The private cost
- The social costs

Predict the efficient consumption

- Under the efficient pricing scheme
- Using the estimated price elasticity

Calculate the deadweight loss

- Over- or under-consumption
- Use the efficient consumption

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

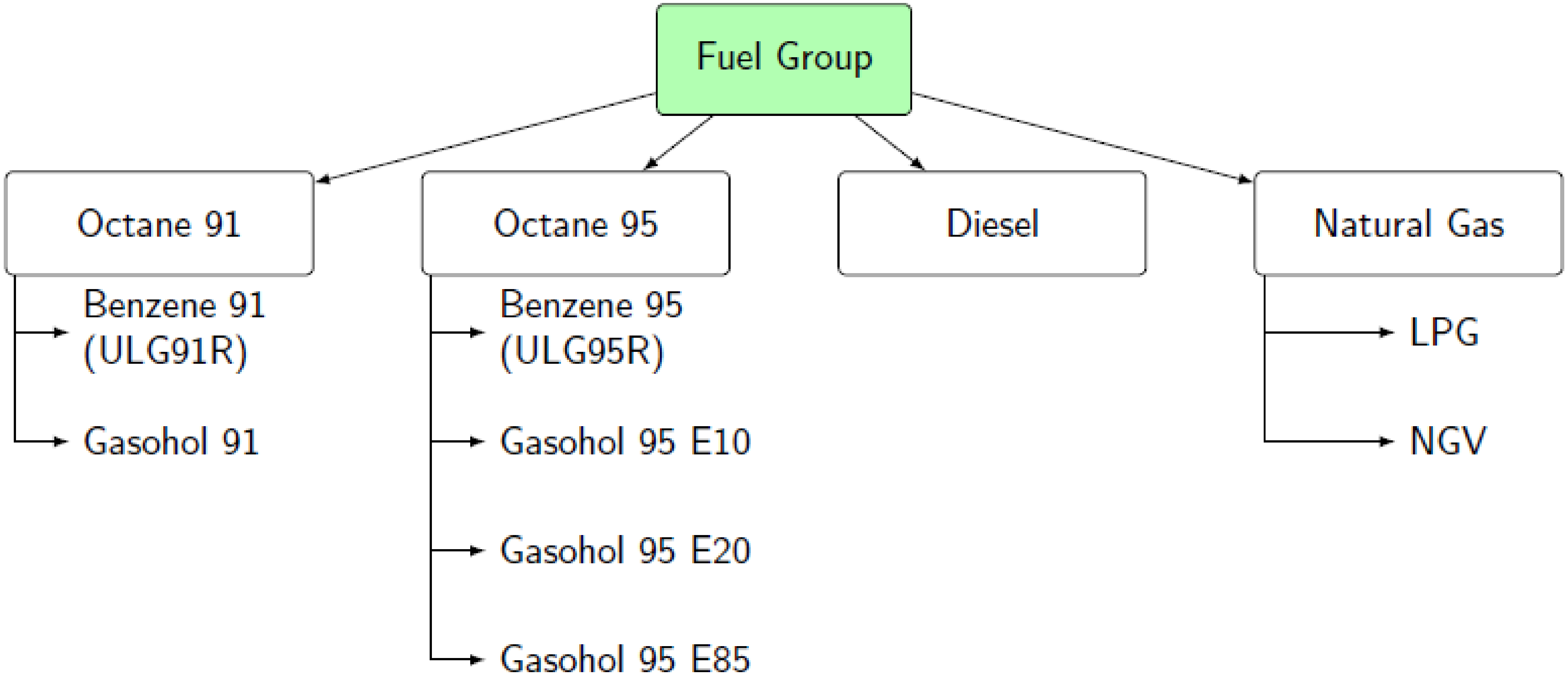
Literature Review

- Demand Elasticities
  - Koomsup et al. (2014)
  - Kansuntisukmongkol and Tangkitvanich (2007)
  - Vikitset (2006, 2008); Chenphuengpawn (2012, 2014)
- Efficient pricing
  - Kansuntisukmongkol and Tangkitvanich (2007)
  - Koomsup et al. (2014)
  - Parry et al. (2014)
- Deadweight loss calculation
  - Davis (2013)
  - Vikitset (2006, 2008); Chenphuengpawn (2012, 2014)

Empirical Strategy

สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Fuel Groups for Demand Estimation



TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Almost Ideal Demand System (AIDS)

For each bottom-level fuel within the Octane 95 segment, the budget share is specified as:

$$s_{it} = \alpha_i + \beta_i \ln(Y_{Gt}/\pi_{Gt}) + \sum_{k=1}^{J_G} \ln(p_{kt}) + \epsilon_{it},$$

Where :

- i denotes specify fuel in the bottom category
- G denotes the top-level fuel segment
- T denotes time (month-year)
- Y_{Gt} is the total expenditure
- π_{Gt} is the price index for the segment
- p_{kt} is the price of individual fuel in the bottom category

Segment-level price index takes the form of the Stone price index: $\ln(\pi_{Gt}) = \sum_{k=1}^{J_G} s_{kt} \ln(p_{kt})$

Budget share of each fuel within the top-level is defined similarly

Almost Ideal Demand System (AIDS)

- Calculate the *uncompensated* elasticity as :

$$\epsilon_{ij} = -\delta_{ij} + \{\gamma_{ij} - \beta_i \frac{d \ln \pi}{d \ln p_j}\}/s_i,$$

where $\delta_{ij} = 1$ for $i = j$ and $\delta_{ij} = 0$ otherwise.

- Calculate the *compensated* elasticity as :

$$\epsilon^*_{ij} = \epsilon_{ij} + s_j(1 + \frac{\beta_i}{s_i}).$$

TDRI สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

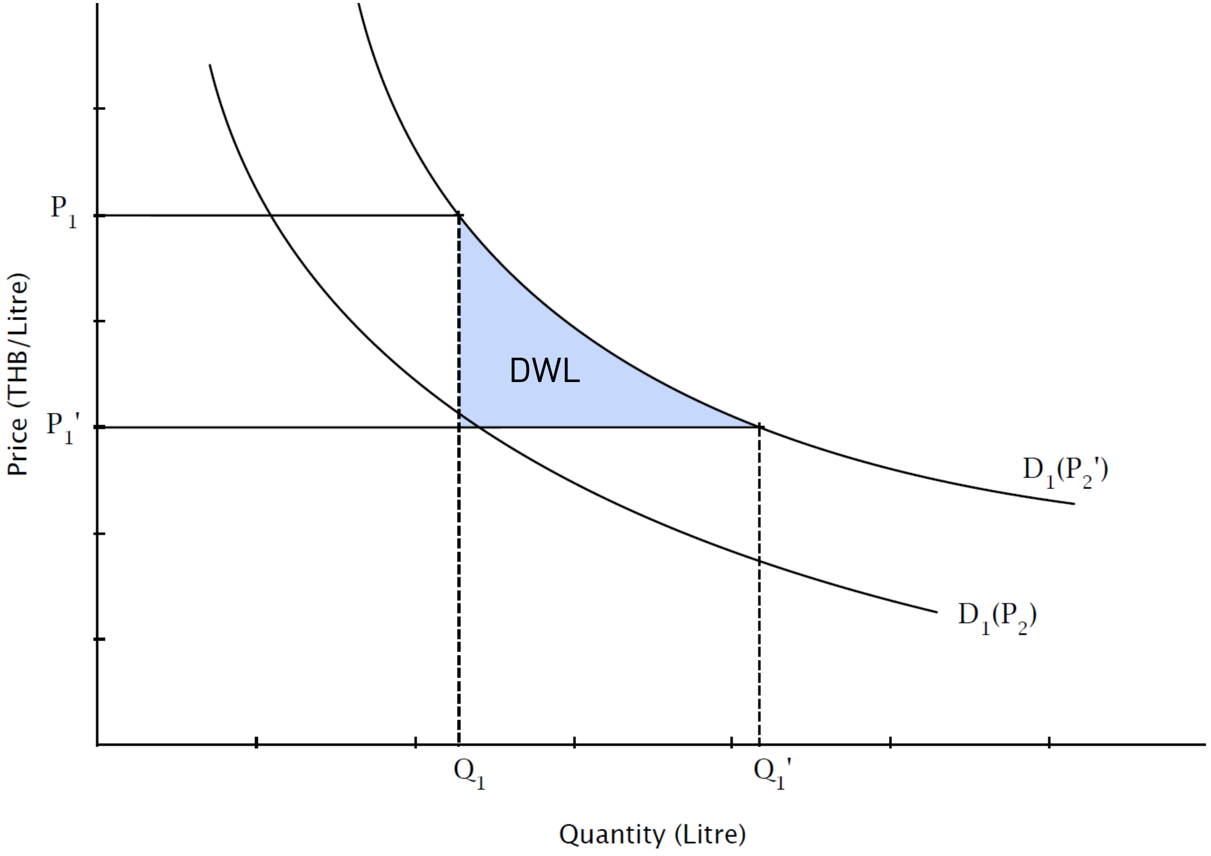
Efficient (Socially Optimal) Prices

Efficient retail prices = private cost + external costs of transportation fuel + vat

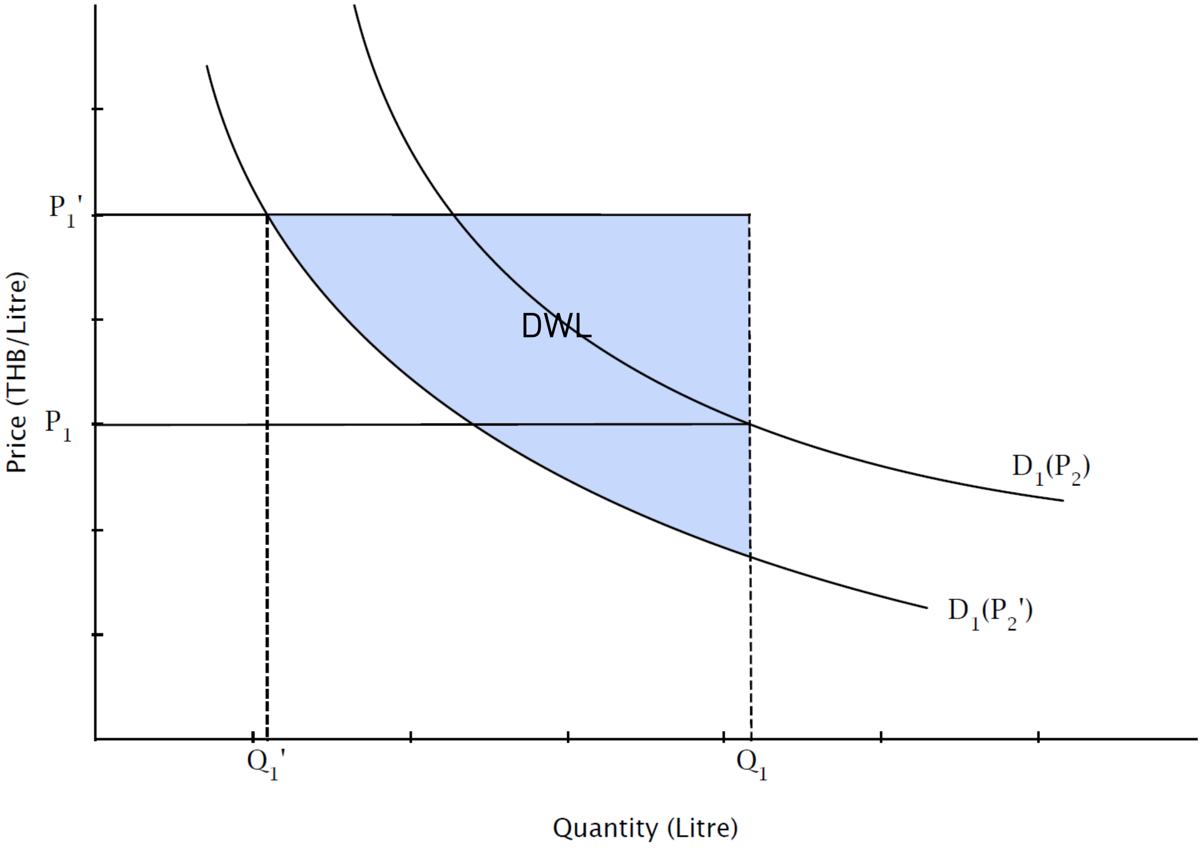
- External costs of transportation fuel contains 4 main social costs
  - social cost of CO_2
  - social cost of local air pollutions (SO_2, NO_x)
  - social cost of congestion
  - social cost of accidents

Calculating Deadweight Loss

$$DWL = \left| \int_{Q_i}^{Q'_i} D(q)\,dq - P'_i(Q'_i - Q_i) \right|$$. -------------- DWL Equation



Deadweight loss in the case of underconsumption



Deadweight loss in the case of overconsumption

Data

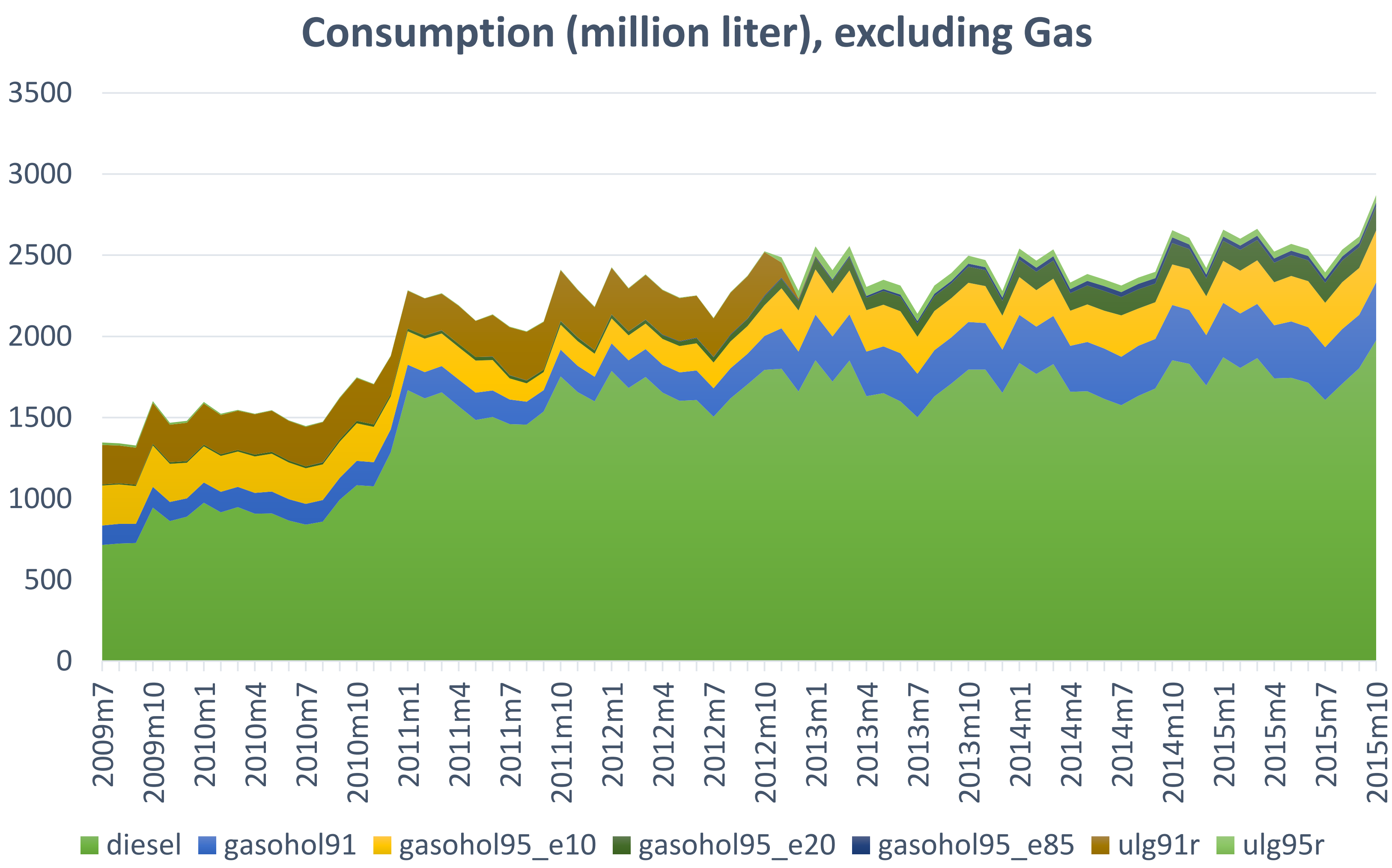
TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Data sources

- Monthly-level data on fuel prices and consumption
  - The Energy Policy and Planning Office (EPPO), Ministry of Energy
- Number of Gasohol 95 E20 and E85 stations
  - The Department of Energy Business (DOEB), Ministry of Energy
- External costs of transportation fuels – previous studies
  - Kansuntisukmongkol and Tangkitvanich (2007)
  - Koomsup et al. (2014)
  - Parry et al. (2014)

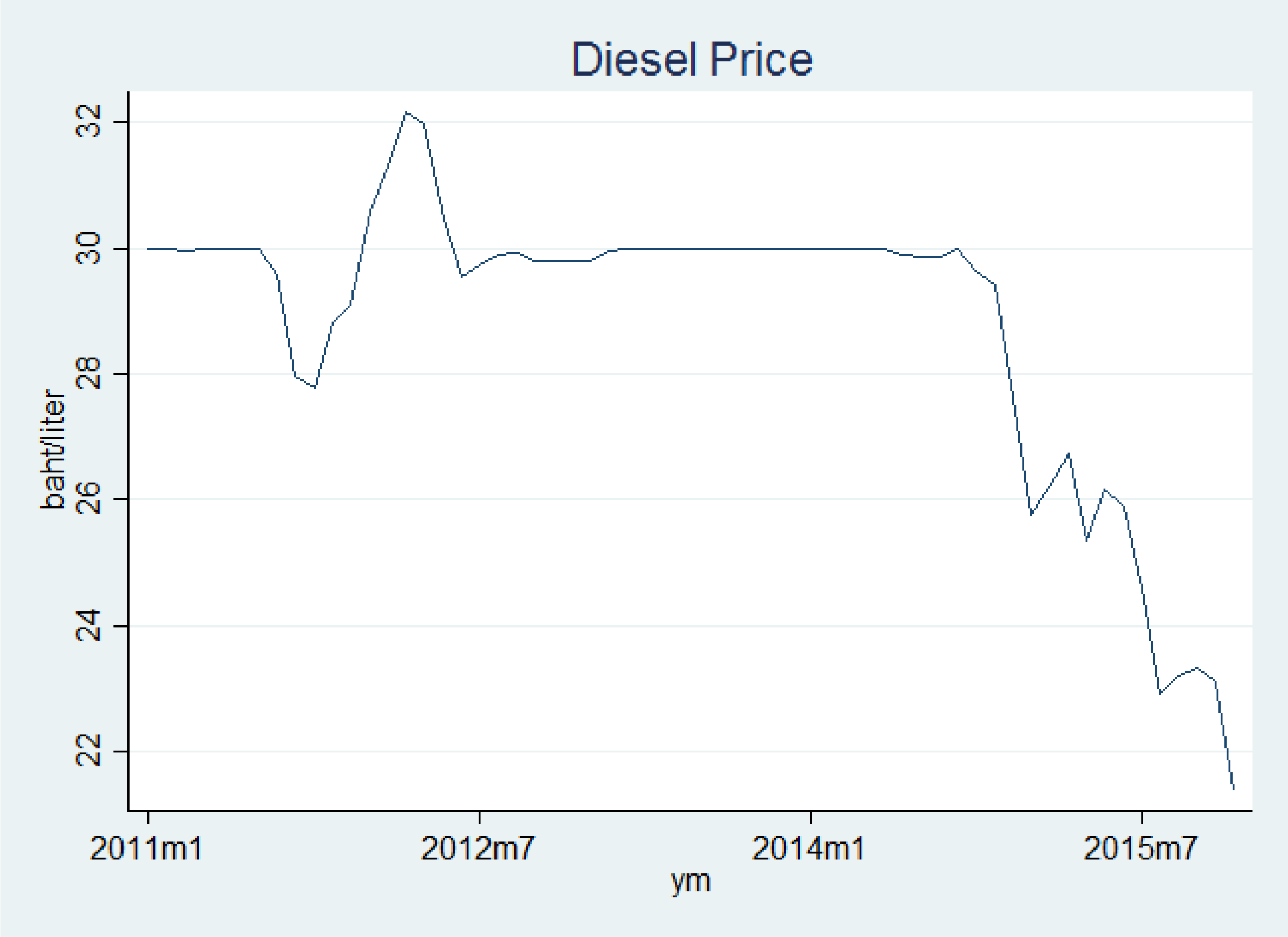
TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Consumption of Transportation Fuels, 2011 to 2015



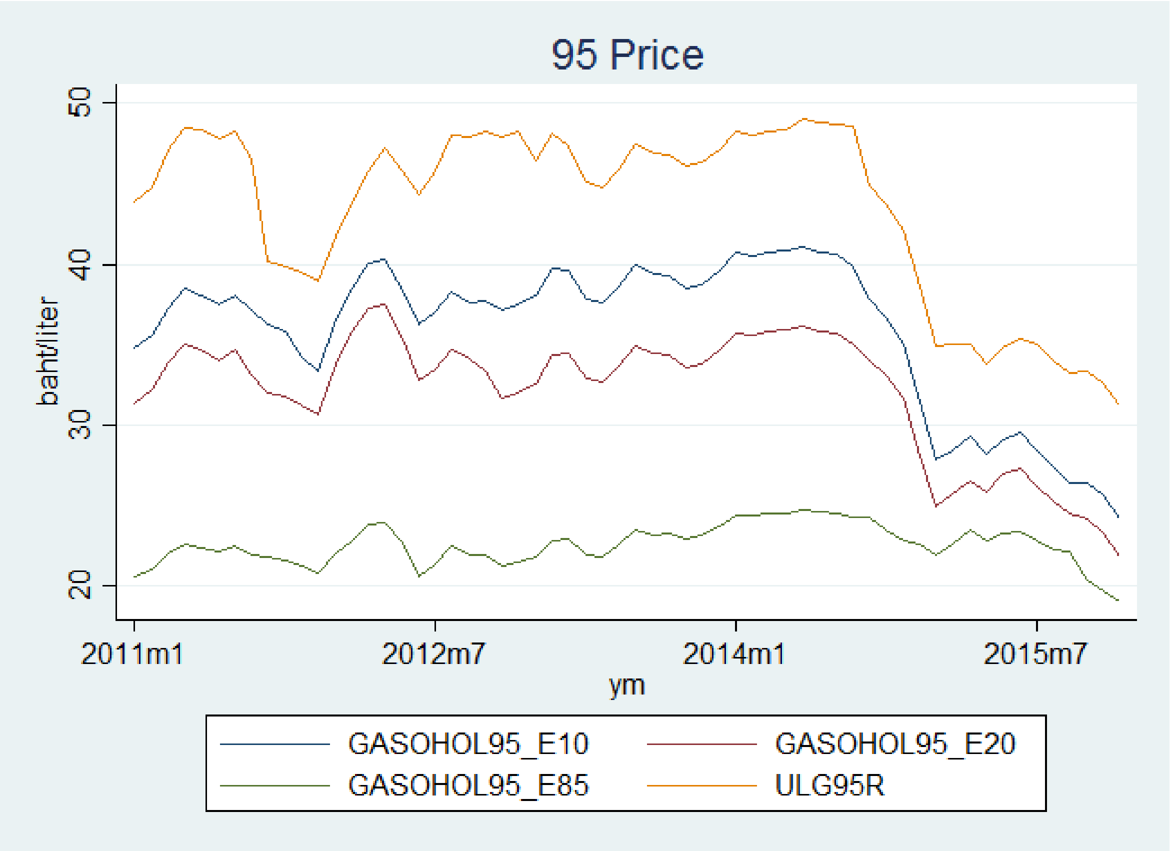
- Diesel accounts for the largest portion of transportation fuel consumption, followed by Octane 91 and Octane 95
- ULG91R was discontinued in 2013
- Consumers of ULG91R may have switched to Gasohol91, ULG95R, and Gasohol95 E10

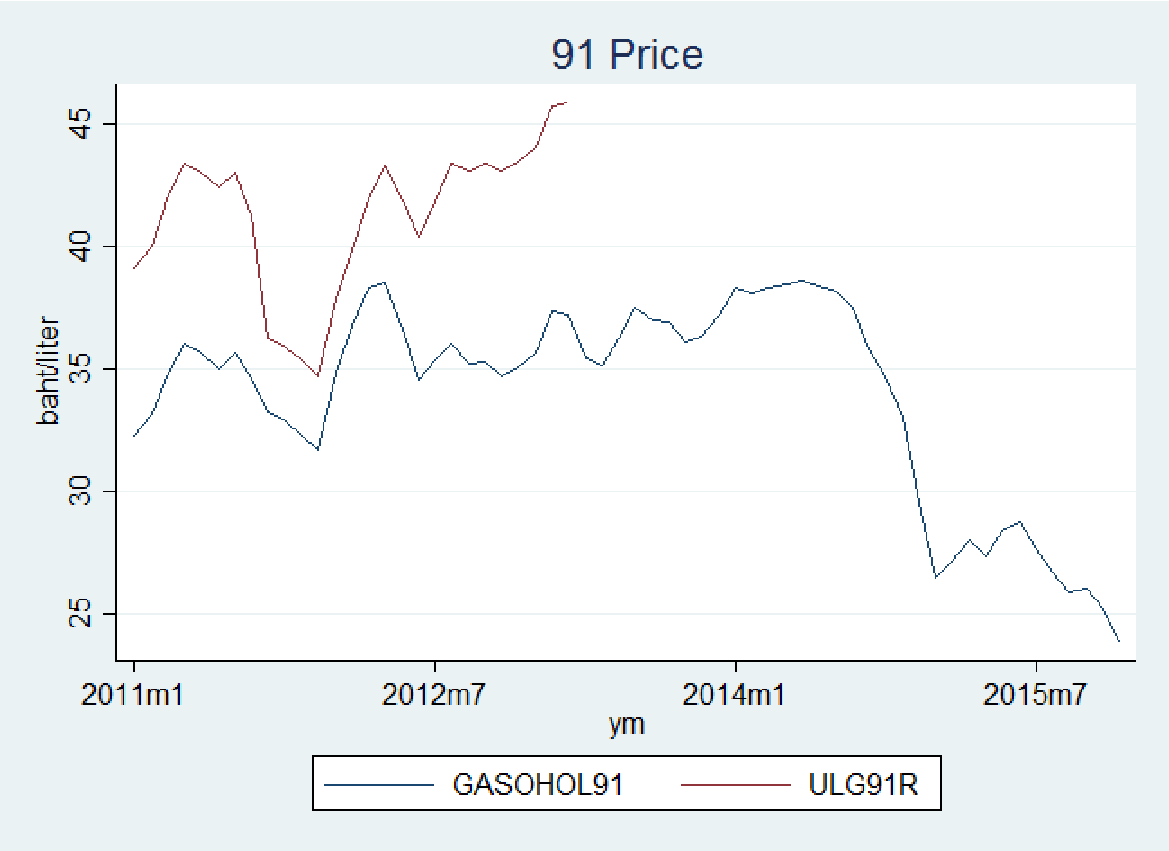
Average Price of Diesel



- Diesel price has been highly stable and almost never exceeded 30 THB/liter
  - Diesel accounts for the largest share of transportation fuel consumption
  - **Government's priority to protect consumers from the rising cost of crude oil**

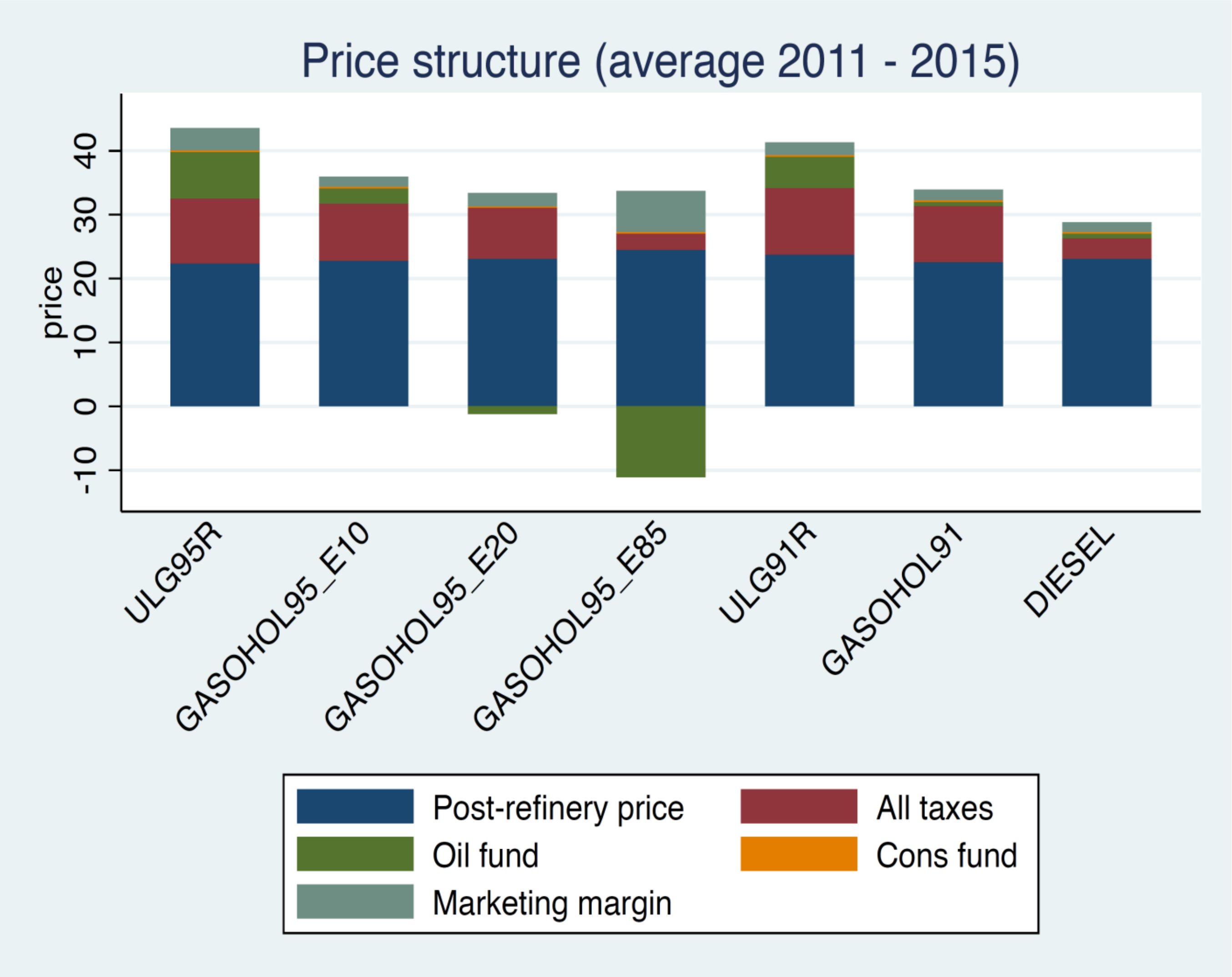
Average Price of Octane 95 and Octane 91





- Gasohol prices are consistently lower than the prices of their non-gasohol counterparts
- More ethanol contents -> the cheaper the retail price
- **Government's priority to encourage consumers to switch to gasohol**

Status Quo Price Structure (average 2011 – 2015)



- All fuels have similar post-refinery prices
- Price structure varies according to the level of tax and oil fund fee
  - ULG95R and ULG91R were subject to a lot of tax and oil fund fee
  - Ethanol with more gasoline contents were subject to minimal tax and fees
  - Diesel was also subject to minimal tax and fees
- Gasohol 95 E20 and E85 received subsidies from the oil fund to make them more attractive to consumers

Results

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Price Elasticities, Octane 95

Variable	P(Regular 95)	P(Gasohol95 E10)	P(Gasohol95 E20/E85)
Quantity Regular 95	-2.28***	2.88***	-0.60
	(0.44)	(0.80)	(0.57)
Quantity Gasohol95 E10	0.62***	-1.67***	1.05***
	(0.13)	(0.25)	(0.19)
Quantity Gasohol95 E20/E85	-0.30	2.43***	-2.13***
	(0.34)	(0.63)	(0.45)

- Regular 95 is a close substitute to Gasohol 95 E10, but not to the E20/E85
- Gasohol 95 E10 is a closer substitute to E20/E85 than to Regular 95
- E20/E85 is a close substitute to Gasohol 95 E10

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Price Elasticities, Top-level Gasoline

Variable	P(Octane 95)	P(Octane 91)	P(Diesel)
Quantity Octane 95	-1.08**	0.68	0.40**
	(0.54)	(0.50)	(0.20)
Quantity Octane 91	0.97*	-1.21**	0.25
	(0.53)	(0.51)	(0.22)
Quantity Diesel	0.12	0.05	-0.17**
	(0.17)	(0.16)	(0.08)

- Own- and cross-price elasticities of demand for the top level gasoline group are much smaller than the bottom level (Octane 95 group)
- Larger own- and cross-price elasticities for Octane 95 and 91 groups than those of diesel
- It is much harder to substitute across the top-level gasoline, especially between Benzene and Diesel

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

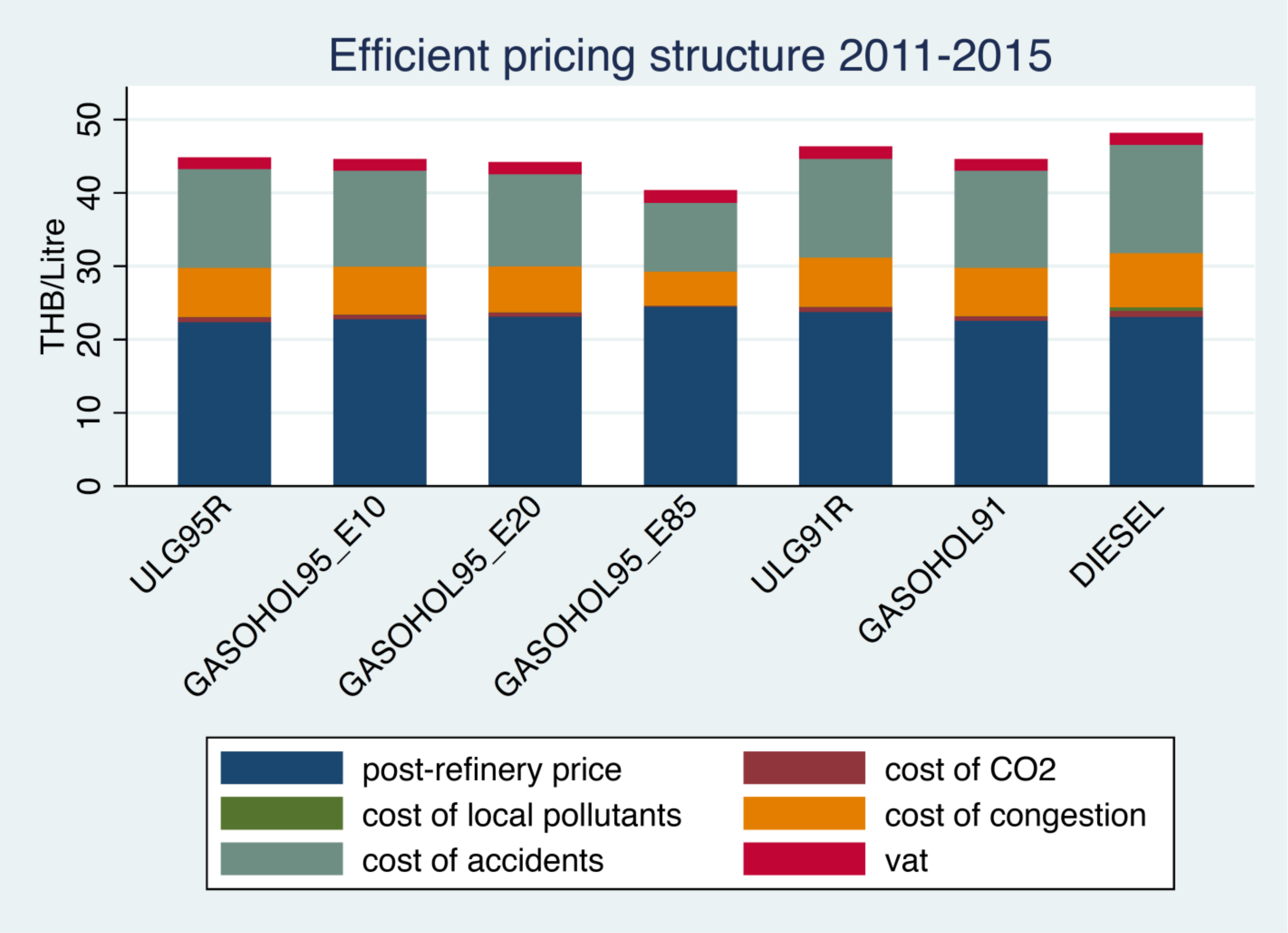
Our Estimates Suggest that Benzene Consumers are More Responsive to Price Changes

Study	Fuel Type	Own-price elasticity	Period
Koomsup et al. (2014)	Octane 91	-0.53	2002 - 2013
	Octane 95	-1.15	2002 - 2013
	Diesel	-0.68	2002 - 2013
Kansuntisukmonkol (2007)*	Benzene	-1.39	1993 - 2006
	Diesel	-1.07	1993 - 2006
Vikitset (2008)	Gasoline	-0.43	2002 - 2004
	Diesel	-0.35	2002 - 2004
Brons et al. (2008)	Gasoline	-0.34 (short-run)	various
	Gasoline	-0.84 (long-run)	various

* refers to Kansuntisukmongkol and Tangkitvanich (2007)

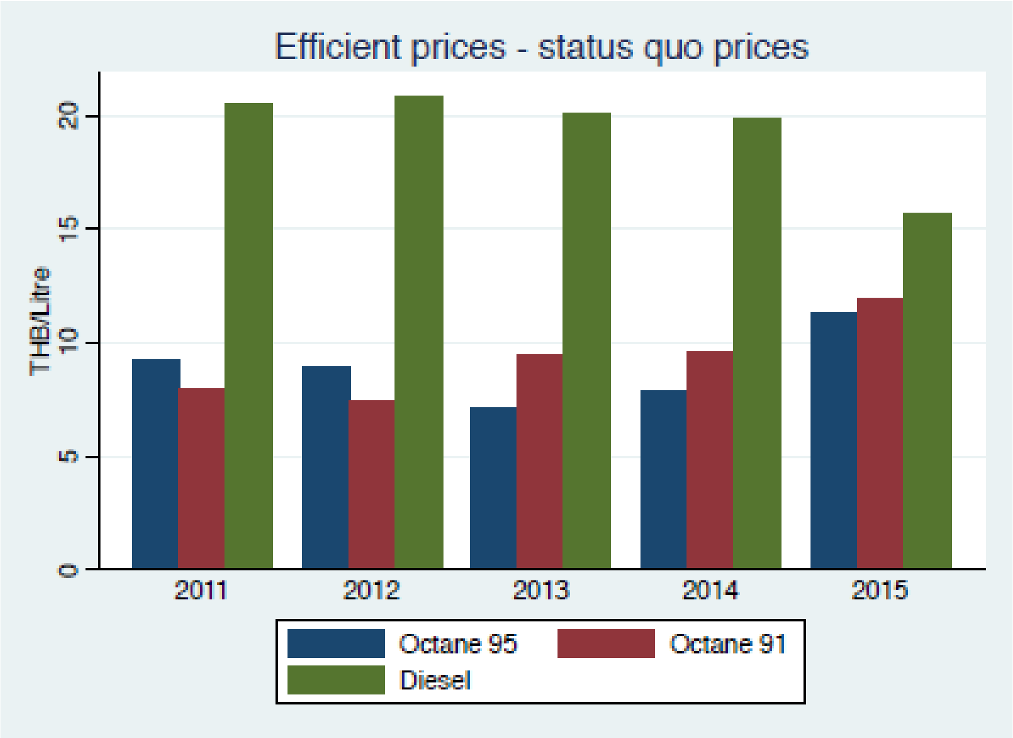
- Our results are most comparable to Koomsup et al (2014)
- Diesel has **lower** elasticity compared to previous estimates
- Octane 91 and 95 have **higher** elasticities compared to previous estimates
    - Distortions in the Benzene markets likely result in bigger inefficiencies than before

Accident and Congestion Costs Accounts for Almost Half of the Efficient Prices

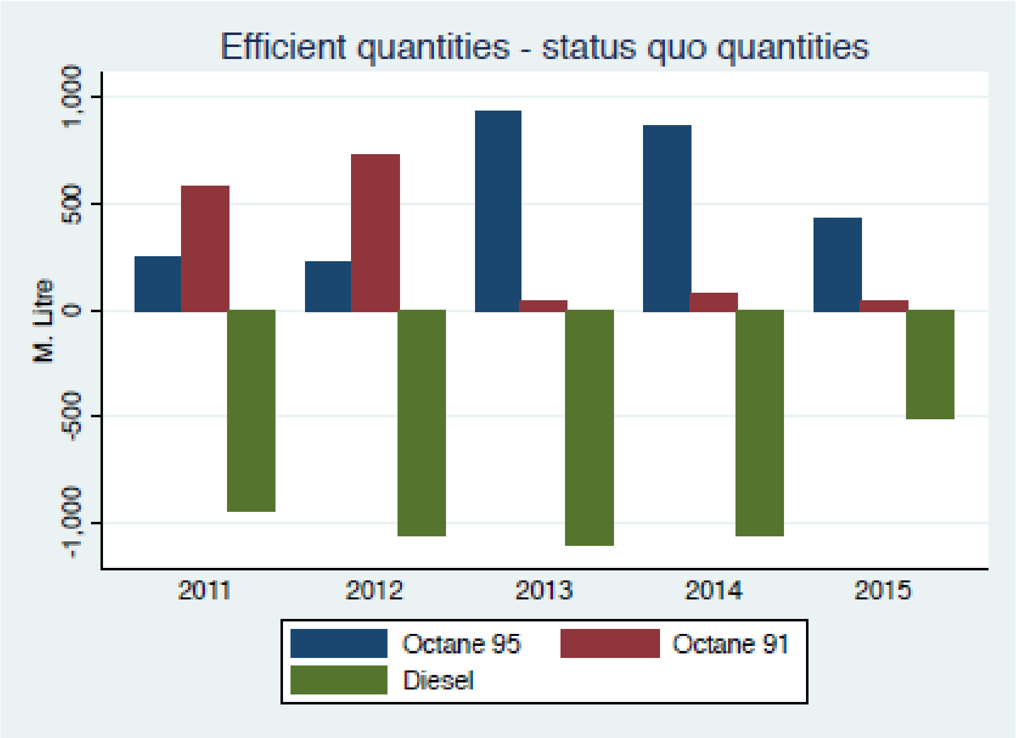


- Private cost accounts for 60% - 70% of the efficient prices
- Cost of accidents and congestion are the largest components of the social costs
- The efficient prices are more than 40 THB per liter for all gasoline types

Efficient Consumption, Top-level Gasoline Group



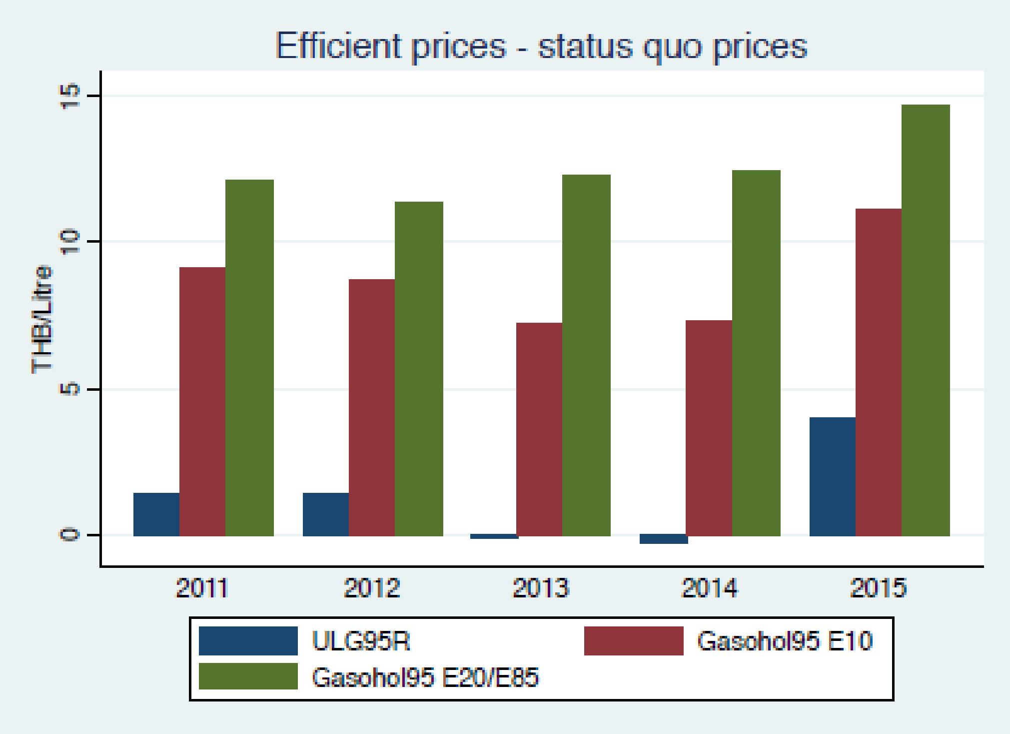
(A) Difference from the efficient prices



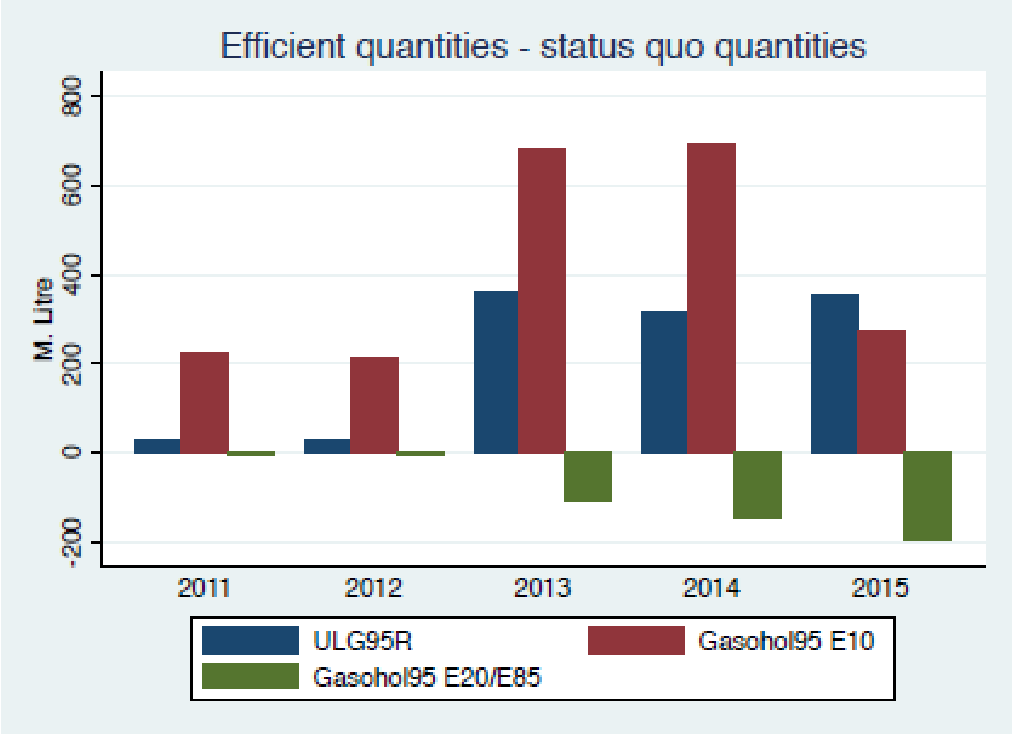
(B) Difference from the efficient quantities

- All three types of fuels were priced below the efficient level with Diesel being the most underpriced
- A switch to the efficient pricing scheme leads to an increased consumption of Octane 95 and Octane 91 and a significant reduction in Diesel consumption

Efficient Consumption, Octane 95 Group



(A) Difference from the efficient prices



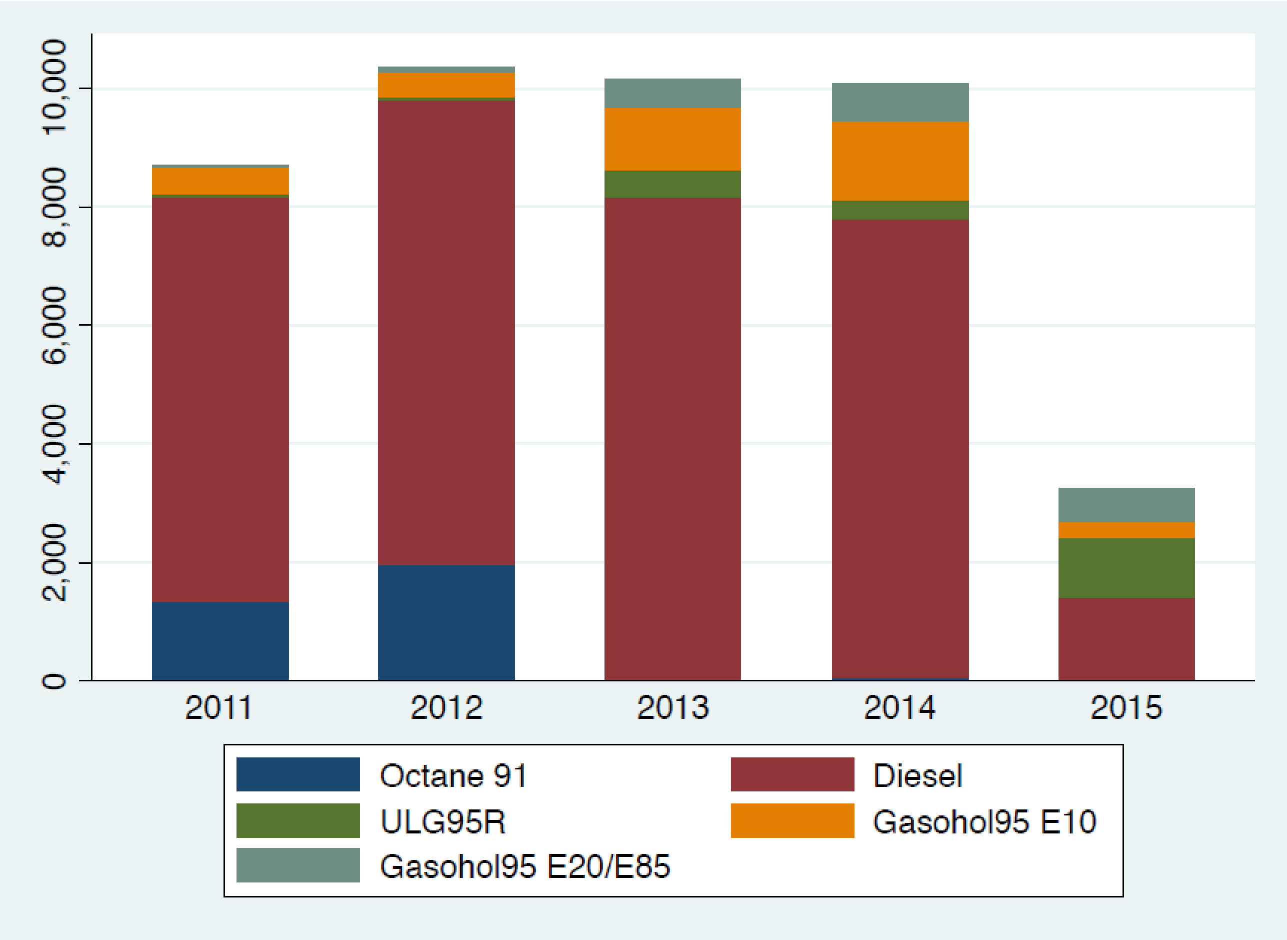
(B) Difference from the efficient quantities

- ULG95R was overpriced under the status quo in some periods (2013-2014)
- Gasohol 95 E10 and Gasohol 95 E20/E85 were underpriced under the status quo
- A switch to the efficient pricing leads to an increased consumption of ULG95R and Gasohol95 E10, and a decreased consumption of Gasohol 95 E20/E85

TDRI สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Diesel Creates the Largest Deadweight Loss

Annual deadweight loss



- Highest DWL in the Diesel market
- In 2015, the deadweight loss was reduced by more than half compared to 2014
- Total DWL during 2011 to 2015 amounts to:
  - ~ 1.2% of Thailand's GDP in 2016
  - ~ 2% percent of total expenditure on final energy consumption in 2014
- DWL of Ethanol-blended gasoline might be overstated due to their external benefit of relieving fuel scarcity (unaccounted for)
- DWL here has not taken into account additional distortions in the natural gas (LPG/NGV) market

Policy Recommendations

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

What does the Status Quo Price Structure Tell Us?

The status quo price structure between 2011 and 2015

Encourage consumers to substitute towards biofuels

Subsidizing the price of biofuels is already appropriate

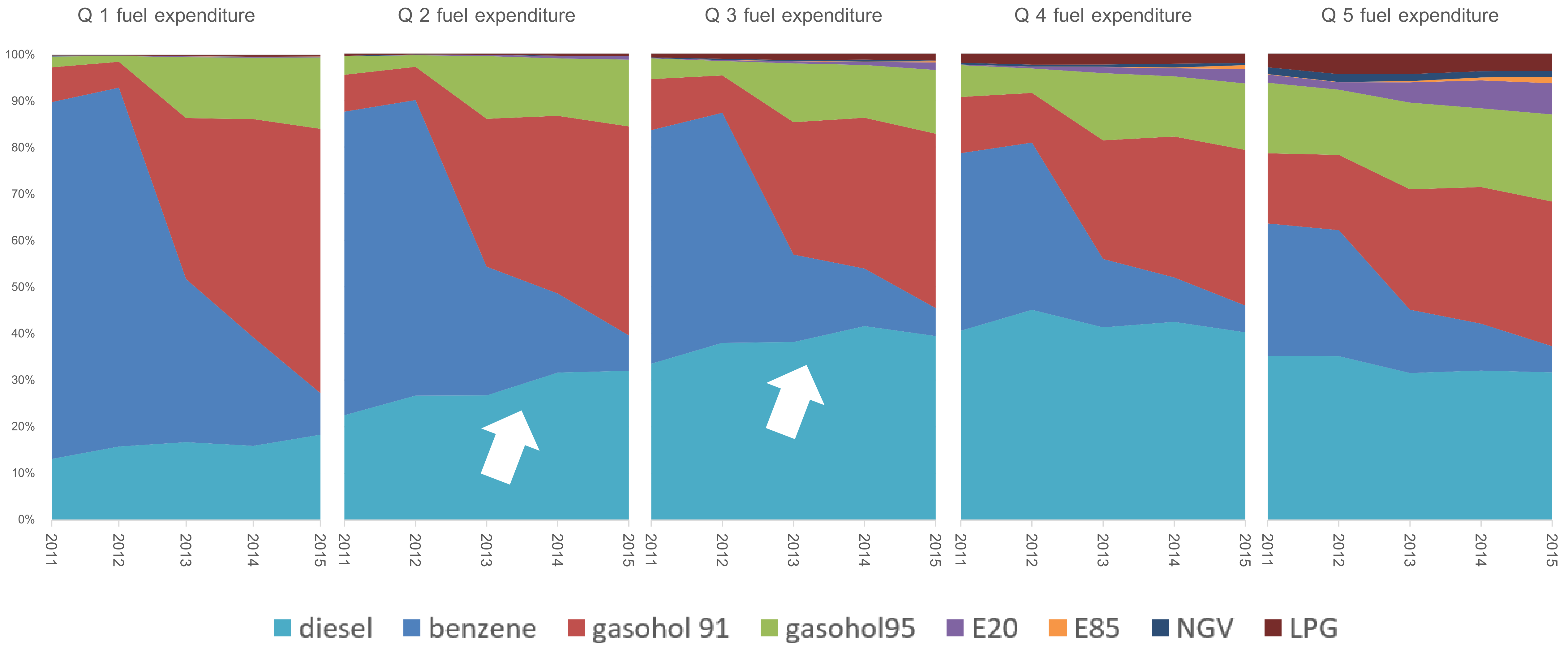
+

Alleviate consumers' burden on rising transportation costs by making Diesel cheap

Alternative policies to help the poor and curb inflation

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

The Middle Income Might Benefit Most from Cheap Diesel



TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Subsidizing Fuels is a Costly Way to Help the Poor

Fuel (Diesel) Subsidies

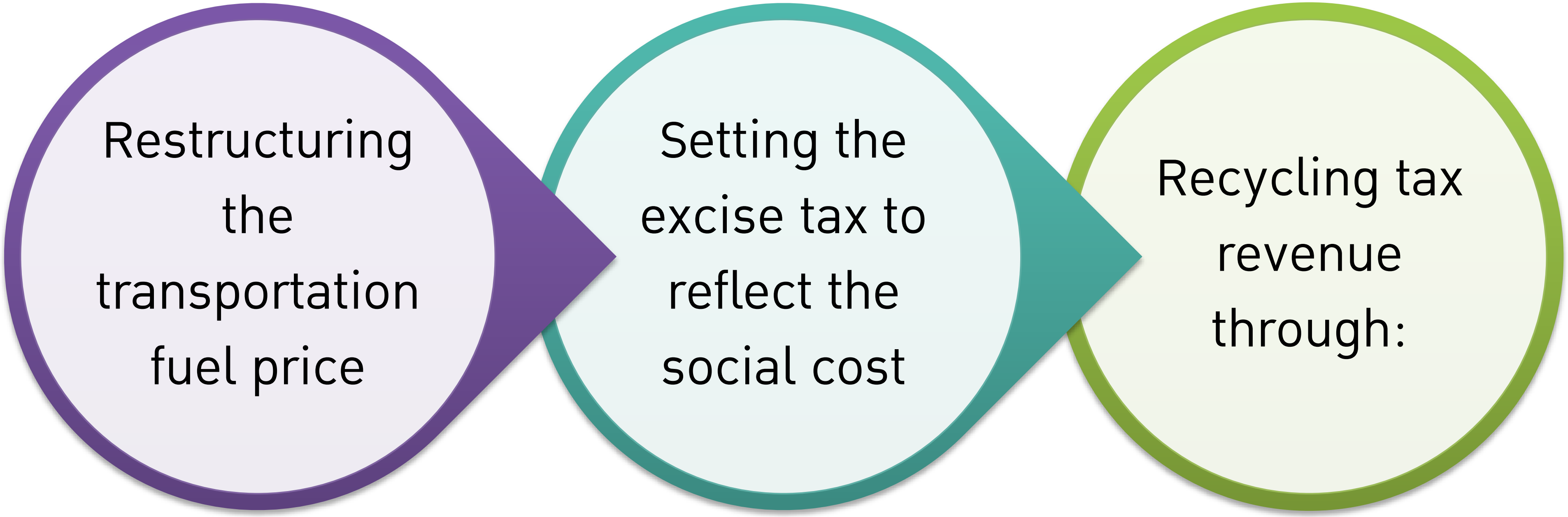
- Distort the fuel markets
- Large government's spending
- Limited benefit to the poor
- Benefit leakage to the non-poor

Propose

Income Transfer

- E.g. Conditional cash transfer (CCT)
- Use revenue from higher fuel tax
- None or minimal distortion in the fuel markets
- A well-design CCT program can:
  - Cover the targeted population
  - Minimize benefit leakage

Recommendations



- Income transfer program to the poor
- Improve public/mass transportation

Conclusion

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Conclusions

- Two objectives of the recent transportation fuel pricing policies:
  1. Support the low-income and curb inflation: Diesel price cap
  2. Enhance energy security: Biofuel subsidies
- Almost all the fuels have been priced below their social cost
  - Diesel is the most underpriced → imposes the highest efficiency cost
- Benzene consumers are more responsive to the change in fuel prices than before
  - Future policy that creates price distortions will also result in a larger deadweight loss
- Policy recommendations
  - Set fuel prices to better reflect social cost (i.e. collect higher taxes)
  - Recycle additional tax revenue through:
    - Targeted income transfer to the poor and the logistic sector [short-run]
    - Expanding infrastructure for mass transport, improving public transportation, encouraging mode shift [long-run]

Next steps

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

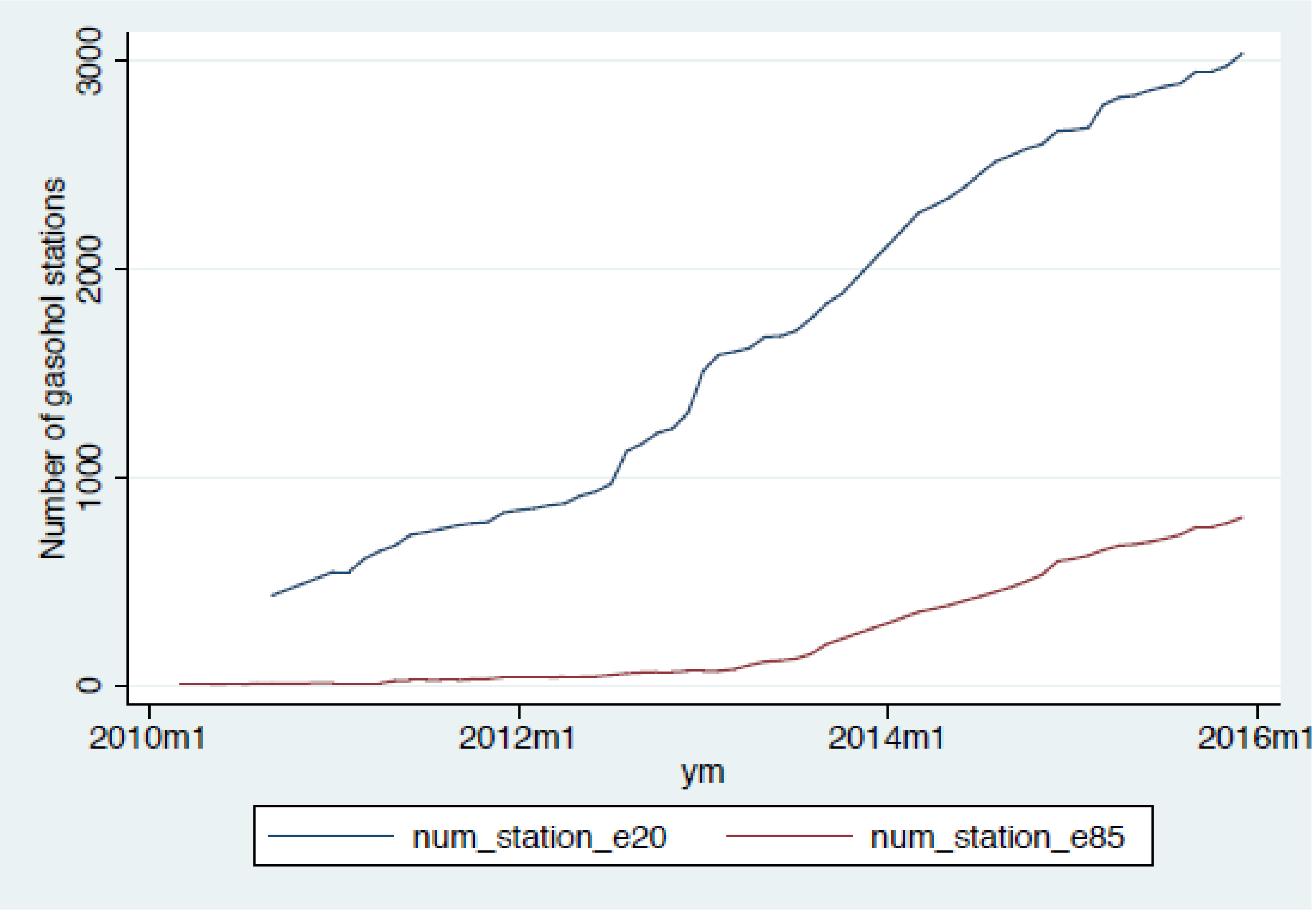
Future works

- Include LPG/NGV to the analysis
- Quantify the impact of implementing the efficient gasoline pricing and revenue recycling scheme on:
  - Logistic cost
  - Inflation
  - Tax revenue
  - Distributional impact
- Study on the cost of fuels shortage
- Examine how gasoline price volatility impacts consumers' price elasticity of demand for gasoline

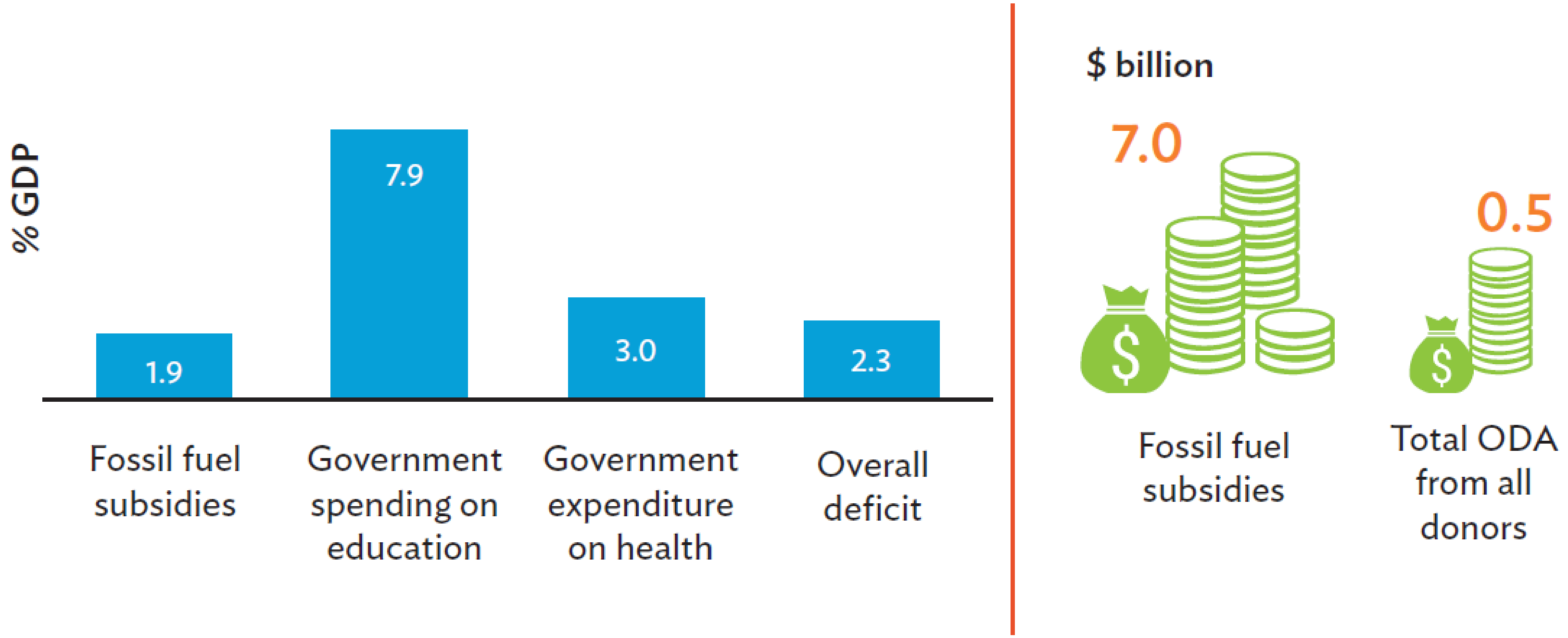
Back-up slides

TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Number of gasohol E20 and E85 stations, 2010 to 2015



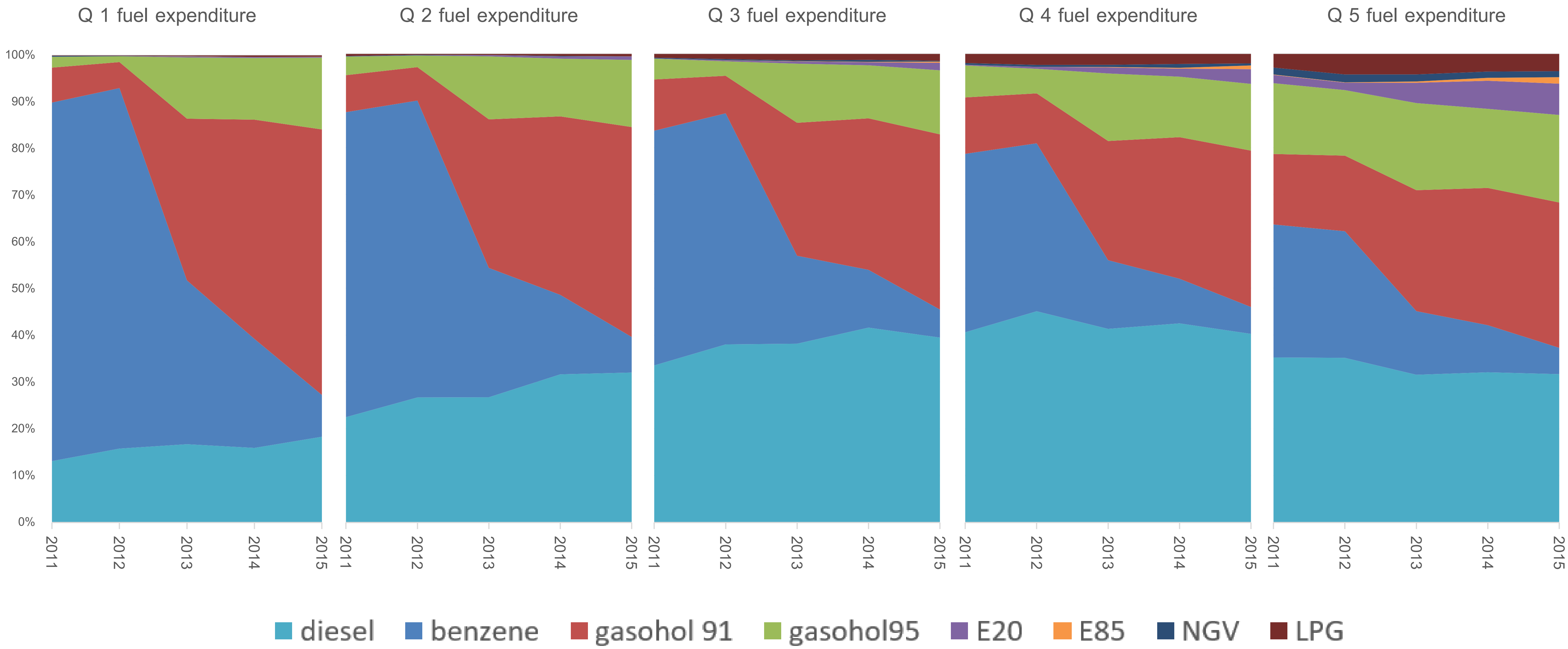
Fossil Fuel Subsidies Compared to Other Expenditure



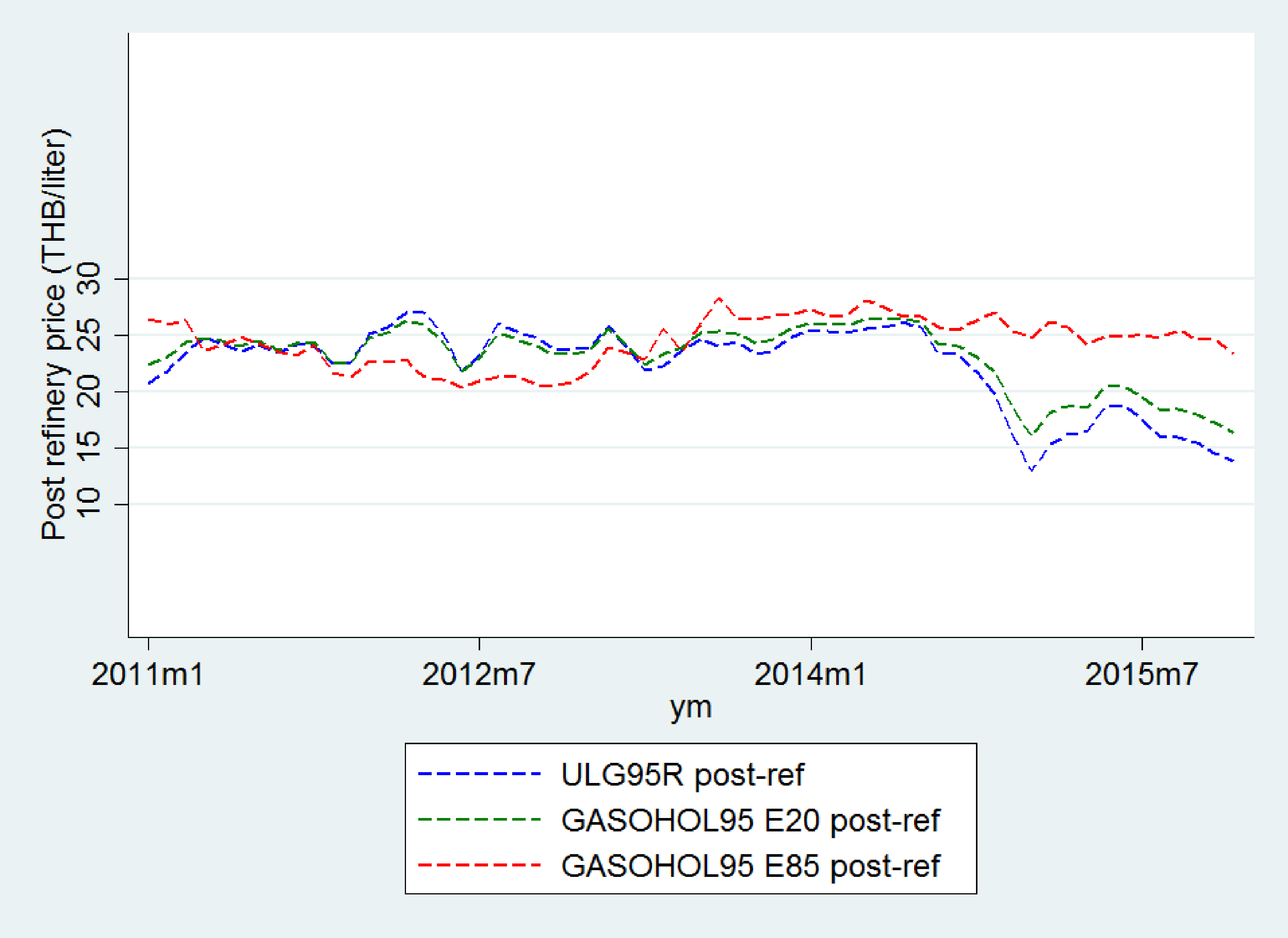
Note: ODA = official development assistance.

Sources: ADB, Statistical Database System; OECD, International Development Statistics; World Bank, Data.

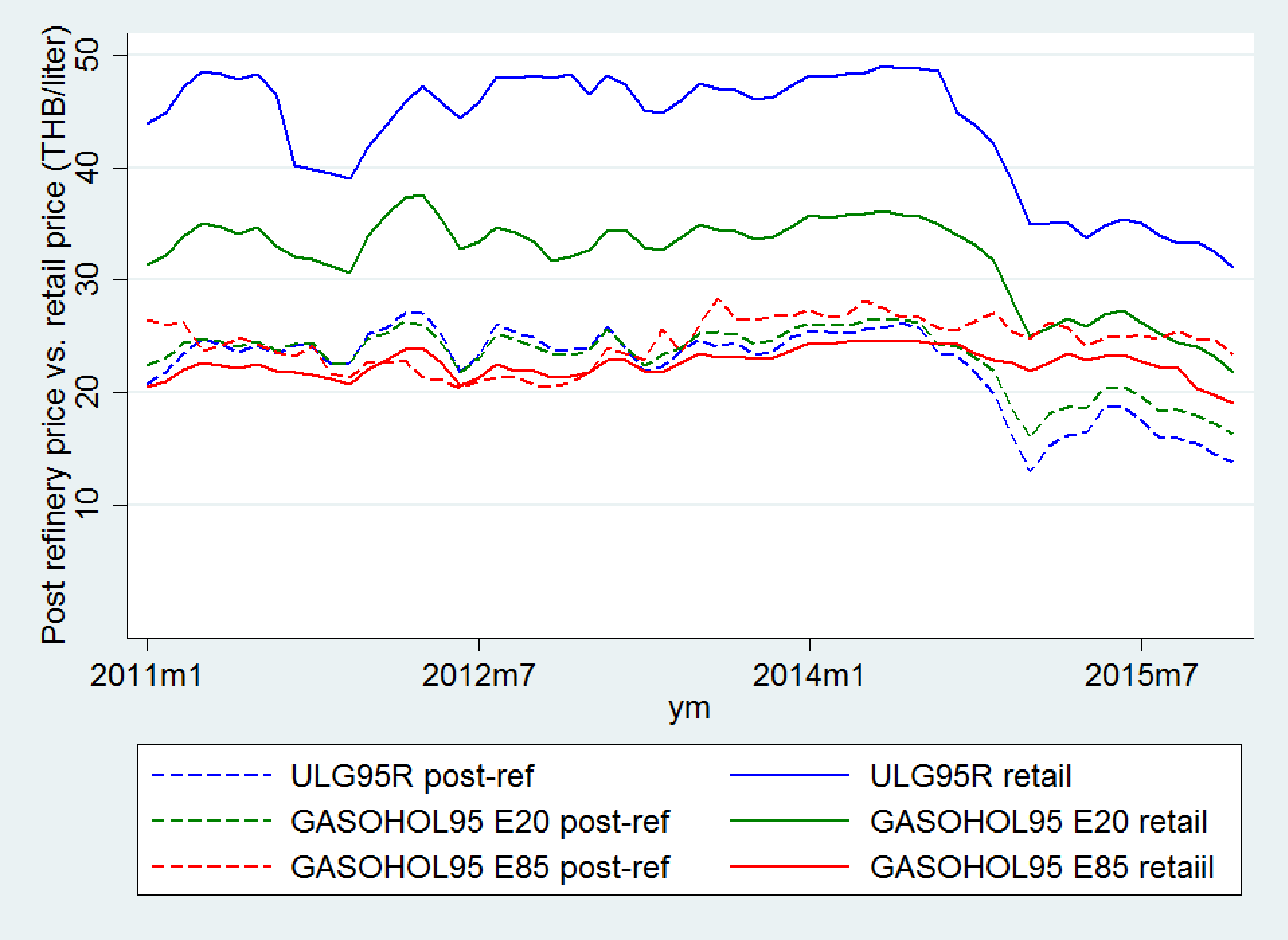
Fuel Expenditure by Income Quartile



Prices of Major Transportation Fuels are Heavily Distorted

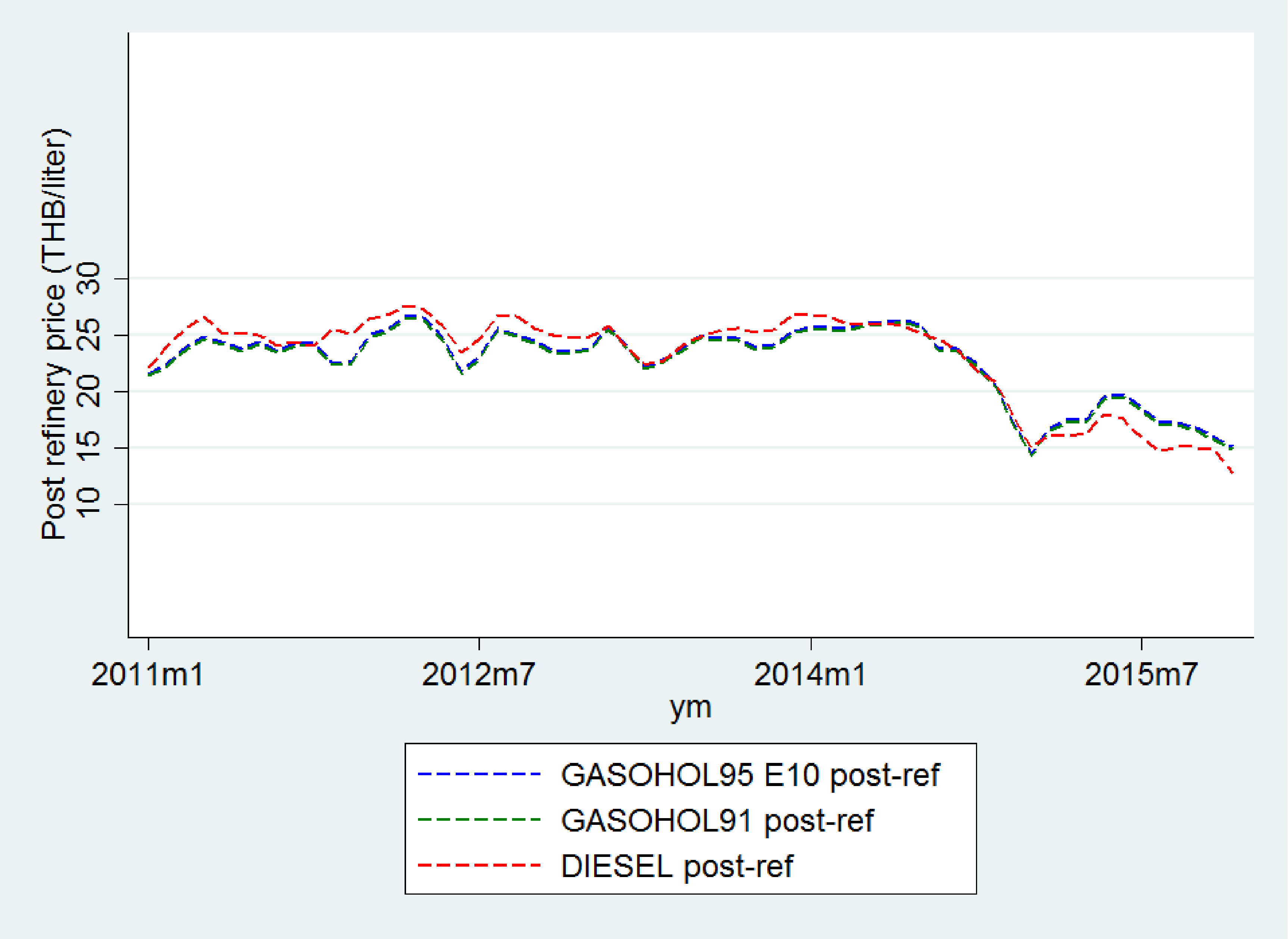


Prices of Major Transportation Fuels are Heavily Distorted

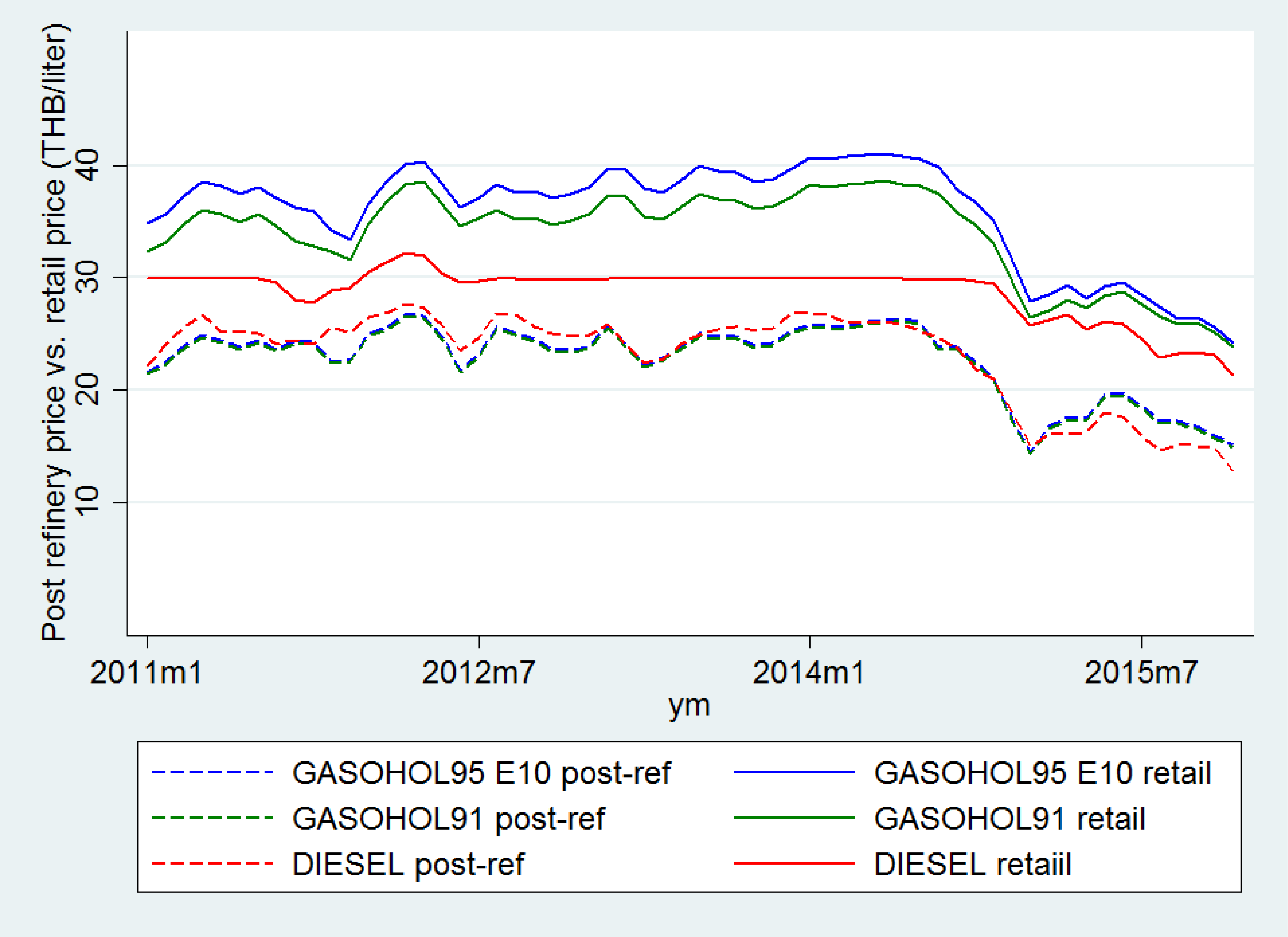


TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Prices of Major Transportation Fuels are Heavily Distorted

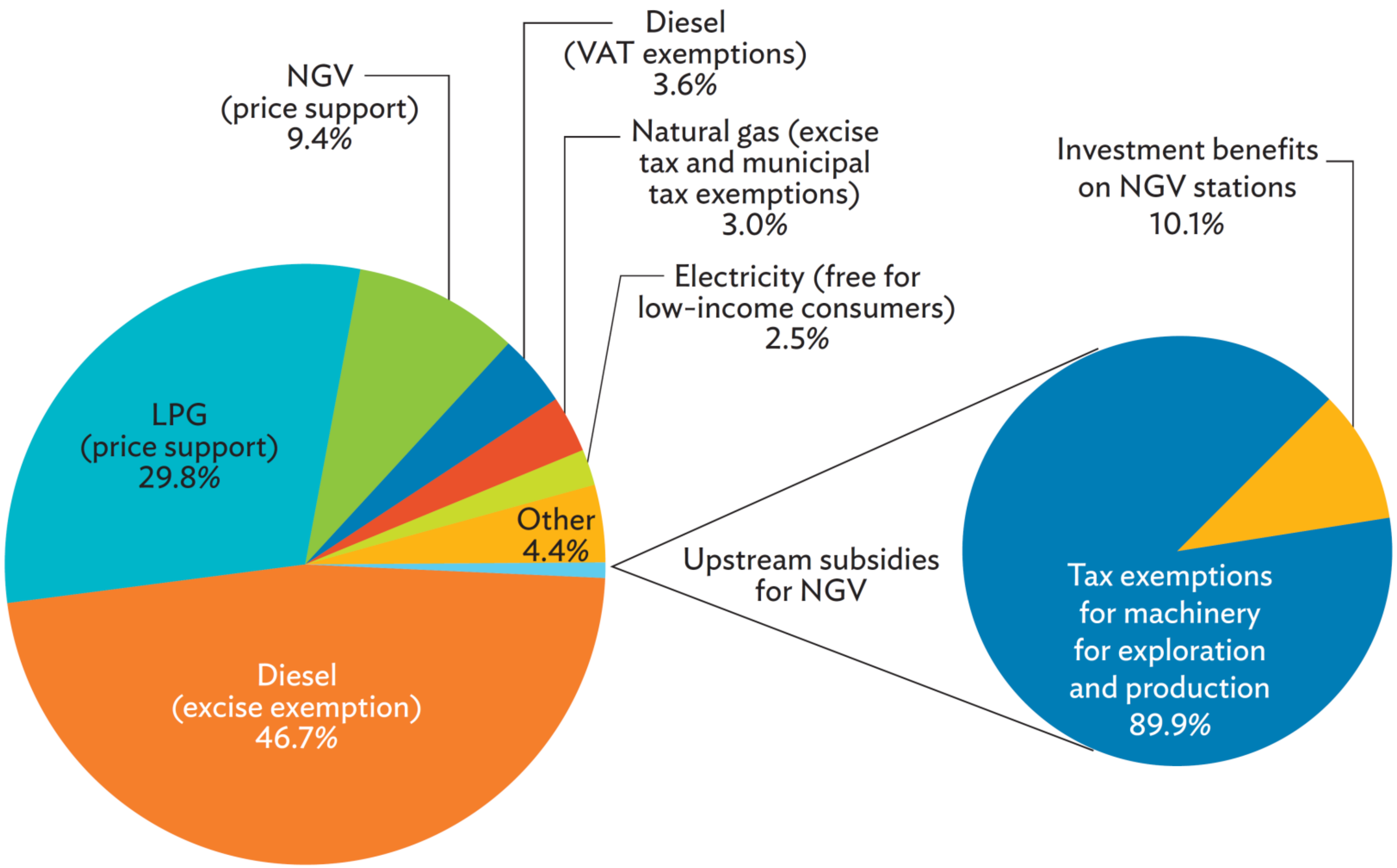


Prices of Major Transportation Fuels are Heavily Distorted



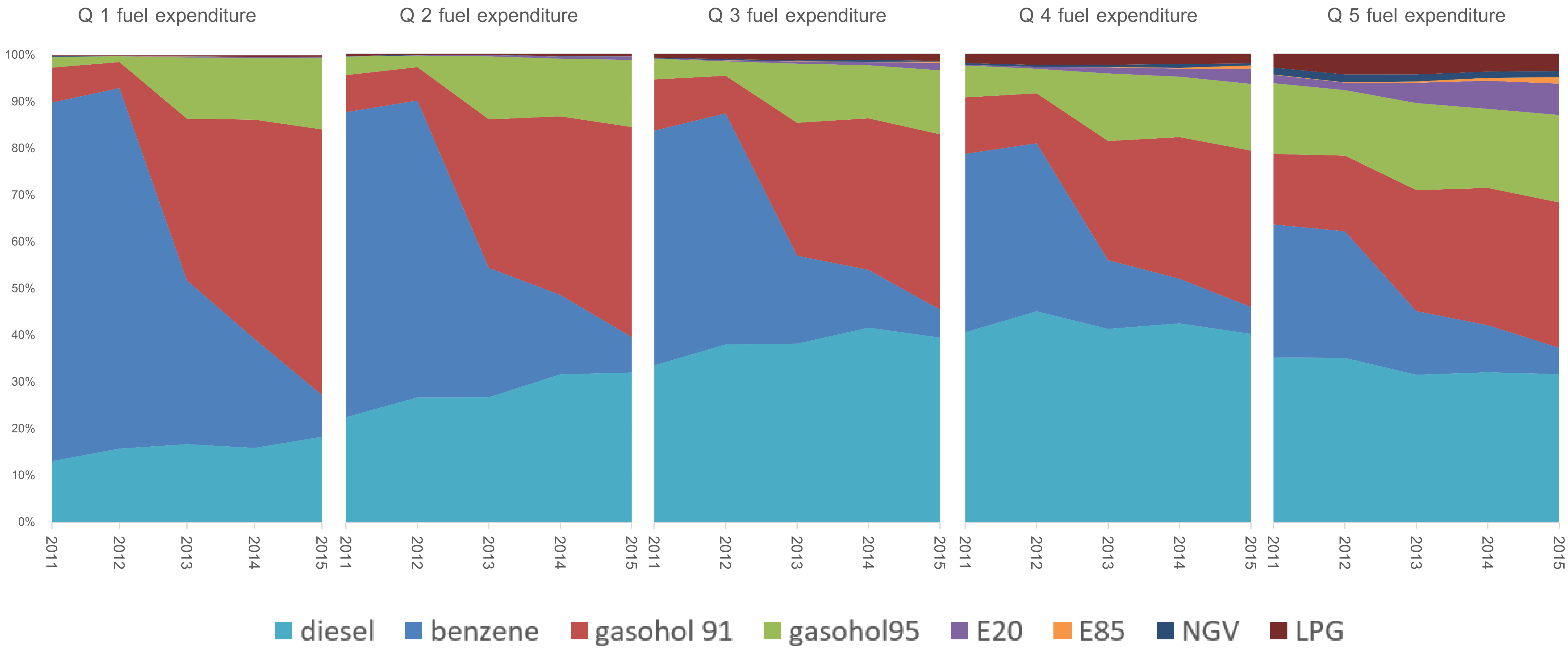
Diesel, LPG, NGV Received Non-trivial Implicit/Explicit Subsidies

Data from 2012



Sources: ADB, Statistical Database System; OECD, International Development Statistics; World Bank, Data.

The Lower-income Spend More on Diesel, LPG, NGV



TDRI
สถาบันวิจัยเพื่อการพัฒนาประเทศไทย

Are our Transportation Fuels too Cheap?

Source: Energy Policy and Planning Office, Ministry of Energy, Data from April 29, 2016.