

# Distributional Impact of Carbon Taxation on Household Welfare, Income Inequality and Poverty in Thailand

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Carbon tax is a market-based and cost-effective mitigation policy to achieve environmental goals and raise revenues

**But, Negative distributional concerns**

- ❖ Regressive welfare effects
- ❖ Worsen income inequality and poverty reduction
- ❖ Raise public concerns and political resistance

Q: Is pricing policy effective in reducing residential energy consumption

Q: Does a carbon tax cause unequal impact on household welfare?

Q: Does a carbon tax policy worsen income inequality and poverty incidence?

Effectiveness

Equity

Social

Policy design

## Scope of the study

Partial equilibrium analysis based on household consumption

- Exclude potential effects from income side (i.e., changes in wages and employment), reallocation of input in production and;
- Exclude any welfare benefits from reduced carbon emissions.

## Conclusion

- **Residential energy demand is price inelastic.** The demand of transport fuels are more price elastic as compared to electricity. Higher income household are more responsive to price changes.
- **Unequal welfare losses** on households across income groups
- Carbon tax is found to **be most progressive** in Thailand and results in reduction of poverty rates by 0.3% **when revenues are recycled through elderly pension**

## Methodology and data

### Demand estimation

The Quadratic Almost Ideal Demand System (QUAIDS) model estimated using Iterated Linear Least Square estimator (ILLE) estimation techniques imposing theoretical restrictions:

$$w_i = \alpha_i(z) + \sum_{j=1}^k \gamma_{ij} \ln p_j + \beta_i \ln \left( \frac{m}{a(p, \theta)} \right) + \frac{\lambda_i}{b(p, \theta)} \left[ \ln \left( \frac{m}{a(p, \theta)} \right) \right]^2 + \rho_i \hat{v} + \epsilon_i$$

### Simulation

Assume a hypothetical tax rate of USD37 per tCO<sub>2</sub> (i.e., the social cost of carbon) on the consumption of fossil fuels at petroleum refineries and power generation. The effects on welfare are calculated by

$$\frac{CV}{con} = \sum_{i=1}^n w_i \frac{\Delta p_i}{p_i} + \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n w_i \epsilon_{ij} \left( \frac{\Delta p_i}{p_i} \right) \left( \frac{\Delta p_j}{p_j} \right)$$

where i=electricity, transport fuels, food and beverages and other non-durable goods

### Scenarios

Without compensation (S1); Revenues are recycled to compensate households through: Equally transfer (S2); Increase elderly pension (S3); Increase food support (S4); Reduce income tax (S5)

**Data:** Household Socio-Economic Survey for the year 2009,2011, 2013 (114,470 observation for demand estimation), monthly consumer price indices , input-output table (regrouped into 37 sectors)

## Results

### Residential demand responsiveness

Household groups	$\epsilon^m$	$\epsilon^u$	$\epsilon^c$
<b>A. Low-income</b>			
Electricity	0.656*** (0.0070)	-0.521*** (0.0130)	-0.498*** (0.0130)
Transport fuels	1.311*** (0.0120)	-0.514*** (0.0280)	-0.436*** (0.0280)
<b>B. Middle-income</b>			
Electricity	0.623*** (0.0080)	-0.522*** (0.0130)	-0.500*** (0.0130)
Transport fuels	0.936*** (0.0090)	-0.596*** (0.0210)	-0.523*** (0.0210)
<b>C. High-income</b>			
Electricity	0.603*** (0.0100)	-0.531*** (0.0130)	-0.509*** (0.0130)
Transport fuels	0.735*** (0.0100)	-0.647*** (0.0170)	-0.576*** (0.0170)

Standard errors in parentheses

### Effects on household welfare

Equivalent consumption	Mean monthly consumption per household (Baht)	Relative welfare losses*		
		Direct effect	Indirect effect	Total effect
Quintile 1	7,087	1.15%	1.42%	2.57%
Quintile 2	10,227	1.25%	1.41%	2.66%
Quintile 3	13,416	1.32%	1.40%	2.72%
Quintile 4	18,456	1.31%	1.38%	2.69%
Quintile 5	34,749	1.30%	1.29%	2.59%
<b>All households</b>	<b>16,787</b>	<b>1.27%</b>	<b>1.38%</b>	<b>2.65%</b>

\*Measured by CV as a percentage of consumption

All figures take into account the sampling weights and survey design

### Effects on income inequality and poverty incidence

Inequality measures	Status quo (Y2013)	Carbon tax scenarios				
		S1	S2	S3	S4	S5
Gini coefficient	0.3871	0.3873	0.3831	0.3819	0.3847	0.3873
Theil index	0.2685	0.2691	0.2636	0.2622	0.2652	0.2682
Poverty rate	11.1%	12.1%	11.2%	10.8%	11.1%	11.8%
Changes in poverty rates		1.0%	0.1%	-0.3%	0.0%	0.7%

All figures take into account the sampling weights and survey design