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Quantifying Impacts of Fossil Fuel Subsidy Reform as Response Measure for Low Carbon Development

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Oxford Institute for Energy Studies

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Outline

- Introduction
- Fossil fuel subsidy reform: A response measure
- Quantifying fossil fuel subsidy reform
- Case study: The Gulf countries with illustrations from Kuwait

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  - Natural Gas
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  - Oxford Energy Policy Club
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Principal Investigator

Dr. Manal Shehabi

- OIES-KFAS Supernumerary Research Fellow
- Applied economist focusing on policy assessment and design to achieve economic and resource sustainability especially in resource-dependent economies
- Evaluate policies and strategies to position for reform and energy transitions and response measures through macroeconomic modeling
- Multiple studies on quantifying impacts of energy subsidy reform
- Constructing economy-wide model for Kuwait and capacity building
- Energy and ocean sustainability in a changing climate
- Academic, research, and professional corporate experience across the US, Australia, and Europe.

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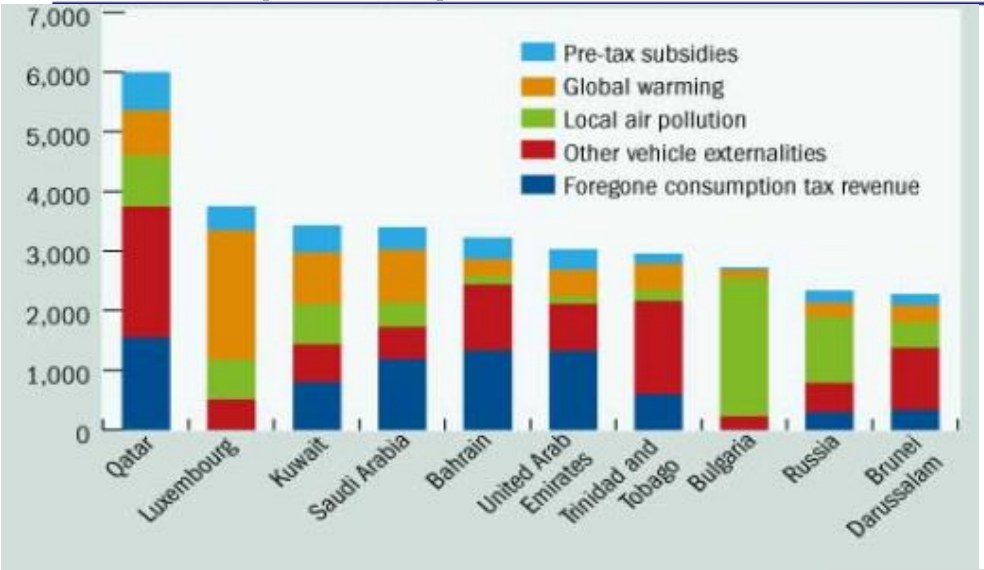
Energy Subsidies and Carbon Emissions

- Consumer or producer subsidies
- Inefficient
- Distortionary
  - Further impact on price volatility, demand, and world oil prices
- Lead to wasteful consumption
- Have a negative impact on the environment
  - Fossil fuels are the highest carbon emitters
- Coal subsidies in the EU and Japan release CO_2 emissions as many as 50- 100 million tons/year
- In Australia, cheap subsidy for coal-based electricity in smelting industries generate greenhouse gas emissions as higher as 2.5 times
- For different reasons, but favor mostly the rich
- Can help the poor, but have severe fiscal, environmental, and welfare impacts.

Energy Subsidies & CO_2 Emissions per Capita (2014)



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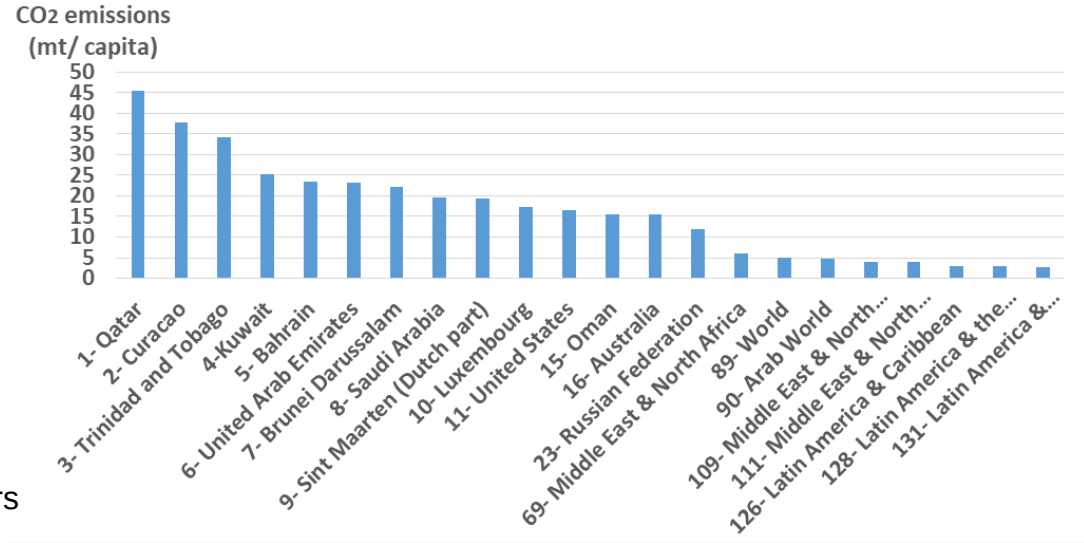
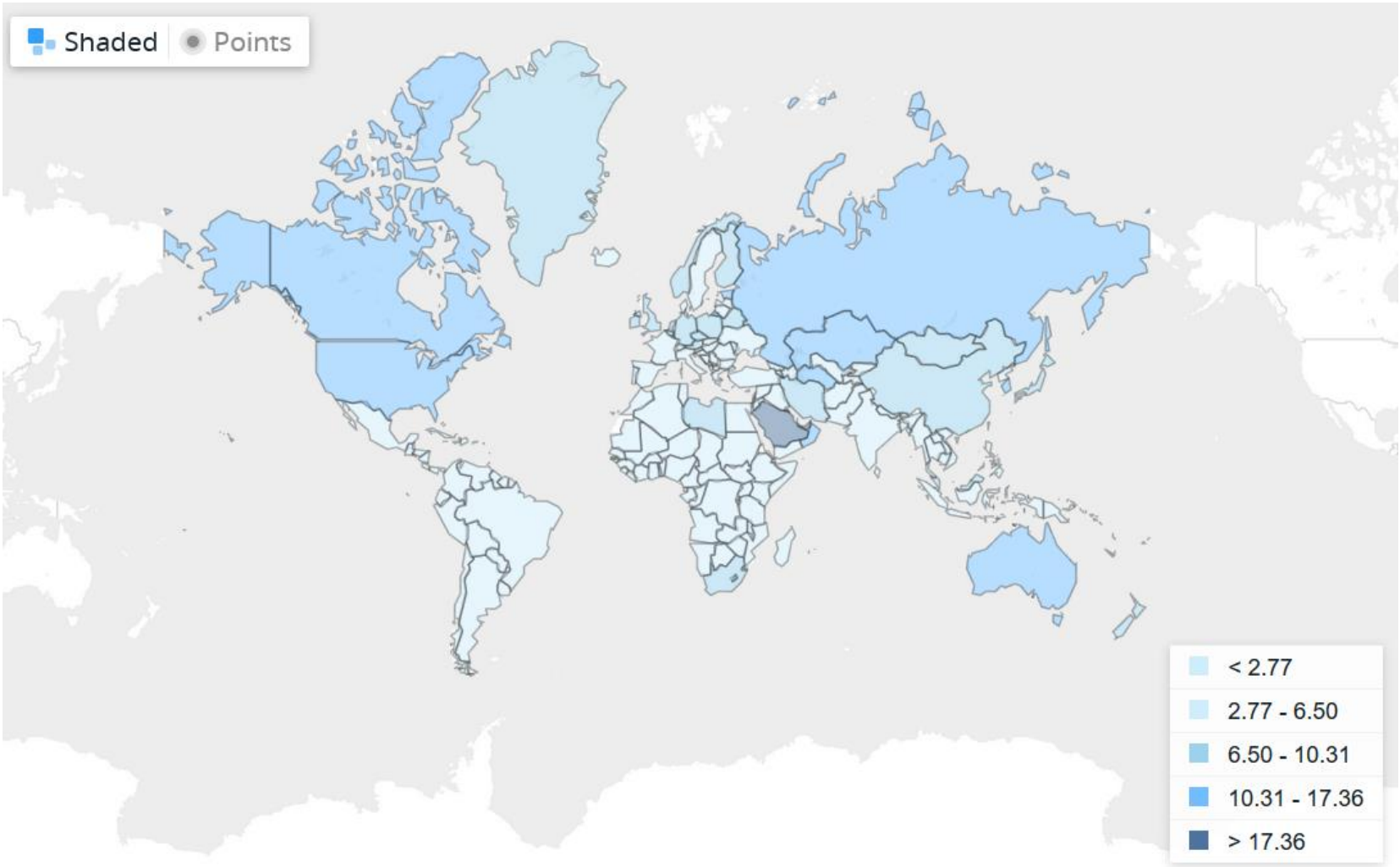
Source: IMF (2015) based on OECD labor force data.



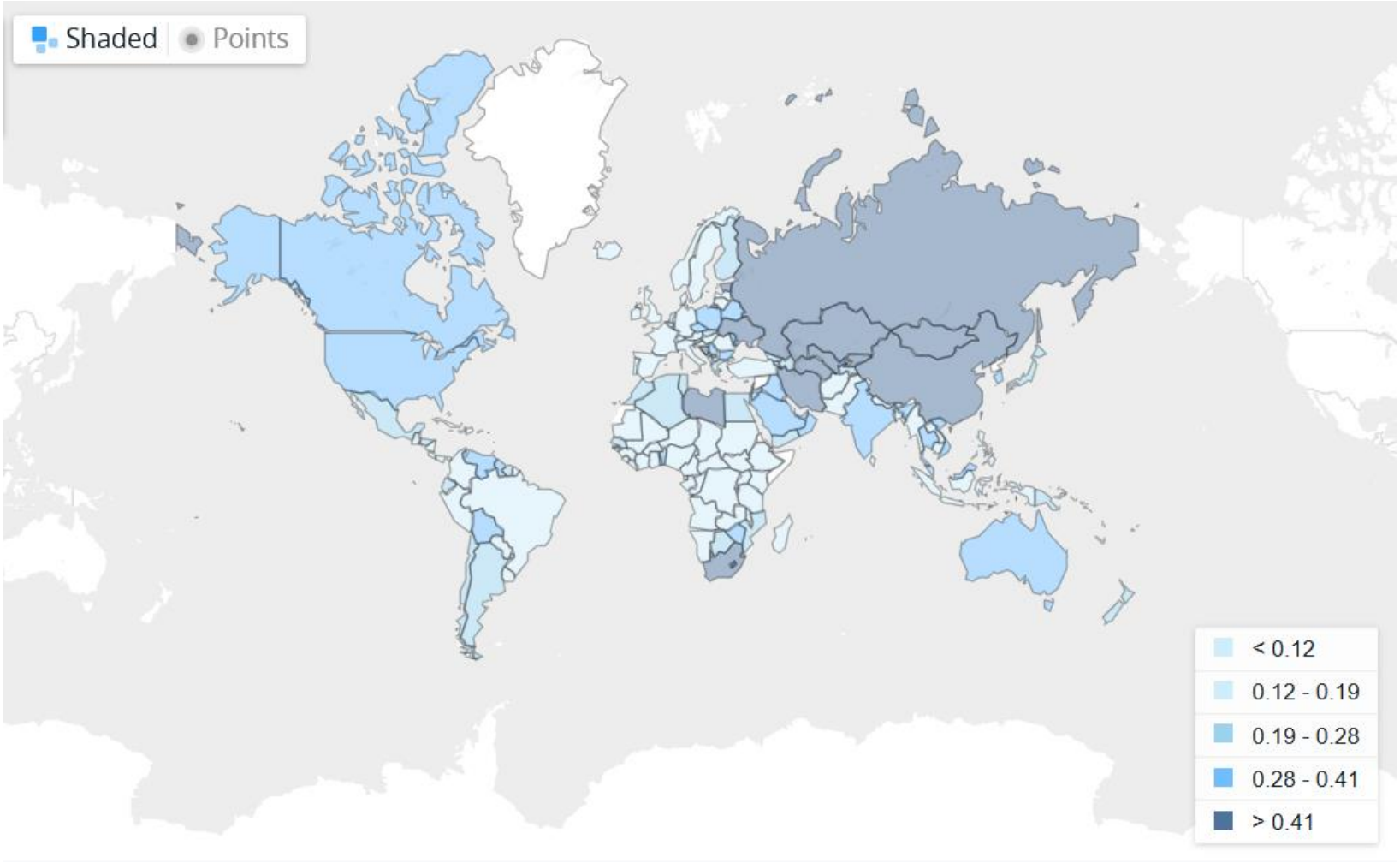
Source: World Bank (2014), World Development Indicators

CO_2 Emissions (Metric Tons) Per Capita



Source: World Bank (2014), World Development Indicators.

CO_2 Emissions (kg per PPP $ of GDP)



Source: World Bank (2014), World Development Indicators.

Pressure for Reforms

- Colossal task
- A global goal (e.g., G20 commitments), but fossil fuel consumption subsidies increased by 12% in 2017, reaching US$300 million (IEA, 2018)
  - More than half of that is accounted for by 11 of the major oil producing economies
- Distribution of rents for political equilibrium
- Local and global pressure to reduce energy subsidies
  - As a fiscal solution for economies suffering effects of oil price declines
  - As a key response measure to climate change to promote reduction in energy consumption and carbon emissions

Potential Impacts

- Positive impacts:
  - Fiscal savings
  - Reduced consumption and reduction in GHG
  - IMF estimates that eliminating post-tax subsidies in 2015 could raise government revenue by $2.9 trillion (3.6% of global GDP), cut global CO2 emissions by more than 20%, and cut pre-mature air pollution deaths by more than half.
- Some negative impacts of energy subsidies reform:
  - Inflationary pressures that reduce households' welfare
  - Hindrance of industrial competitiveness of the export-oriented sectors
  - Economic contraction
  - Labor market effects
  - Disproportionately hurt the poor
  - Negative socioeconomic effects especially relating to energy poverty and economic development
- Difficult to quantify secondary (indirect) micro and macroeconomic and environmental effects.

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Why an Economy-Wide CGE Model

- Applied general equilibrium (GE) method for research and public policy
- A class of economy-wide models that captures the major structural features of an economy, representing interactions between industries
- Offers industry disaggregation in a quantitative description of an economy through a set of mathematical equations
- Evaluating economy-wide impacts of policies and economic shocks in the presence of economic distortions requires capturing interactions between industries and second-best effects, which can be measured only by CGE models
- Used when analysis requires considering the empirical implications of simultaneous equilibrium in a number of markets
- For policy makers, very useful whenever policy changes affect a large share of economic activity or when it is important to consider changes in the sectoral structure of output, trade, demand, employment, prices
- **Has become the preferred method to affect public policy**
- A very powerful tool….

  ….. but depends on the modeler's and user's interpretation of results

What is it..

- IT IS:

✓ Simulation tool
  – What if scenario
✓ Micro and macroeconomic foundations
✓ Real; relative prices (*numeraire)*

- IT IS NOT:

X Prediction tool
  - What will scenario
X Statistical correlation
X Money (inflation)

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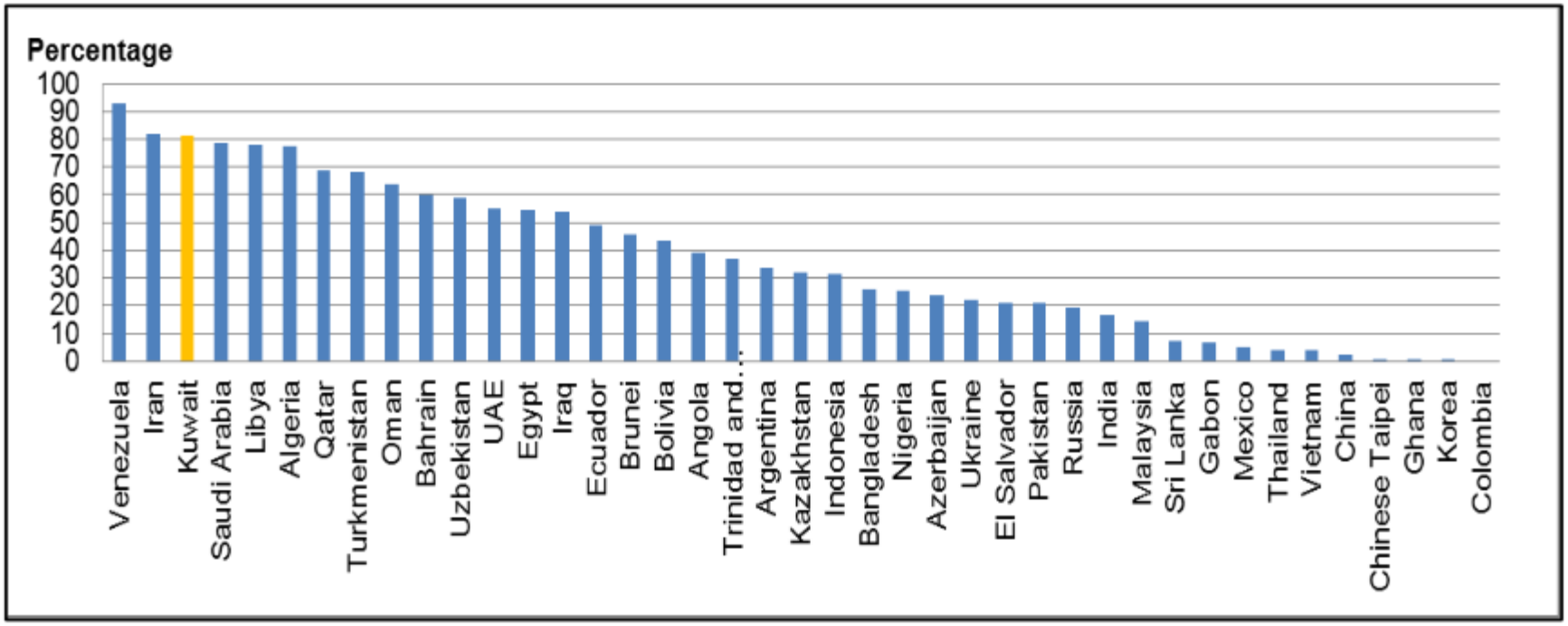
Average Subsidization Rates (2014)

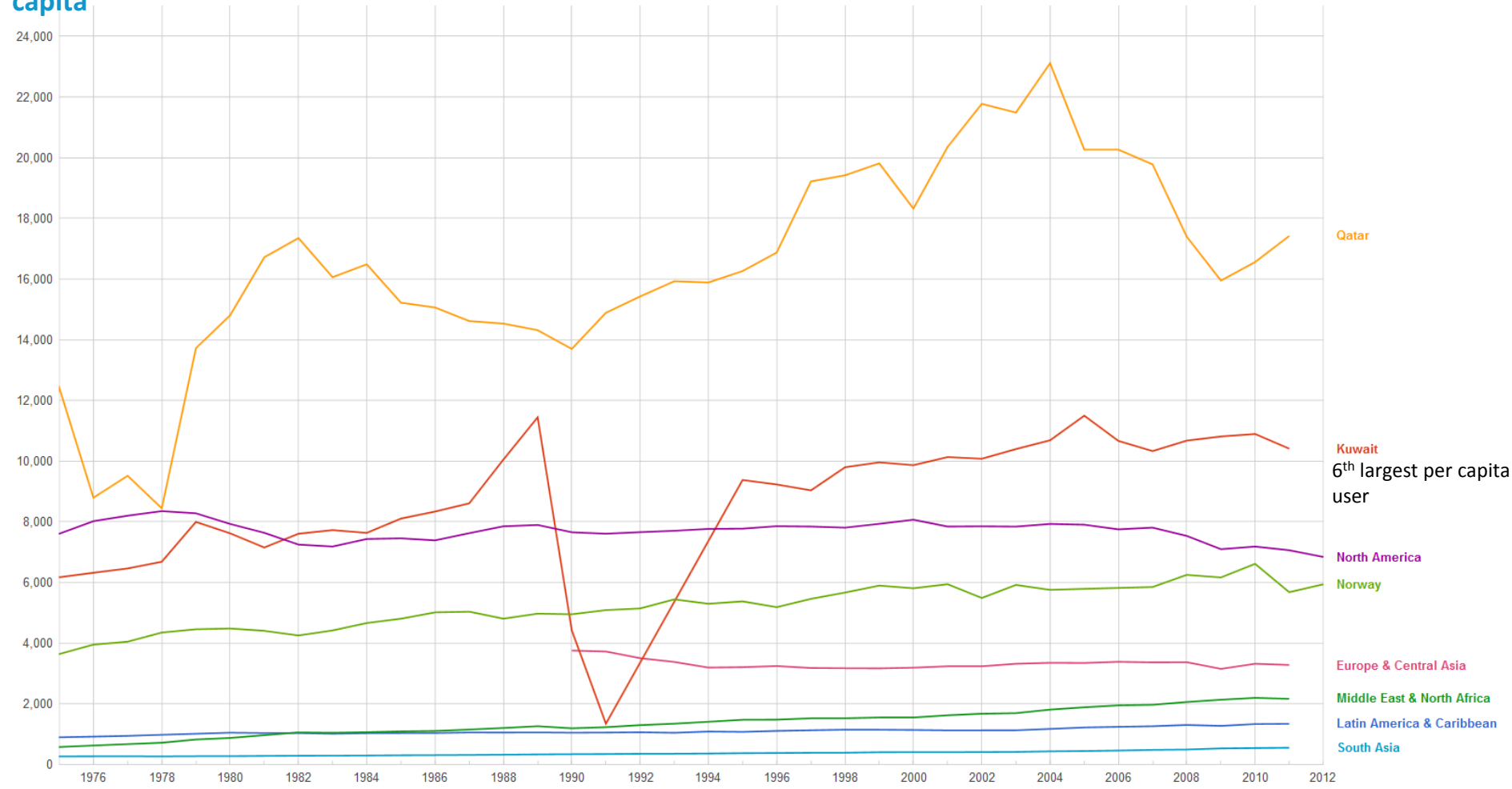
Average subsidization rates for 2014



Source: Author's analysis using U.S. Energy Information Administration data.

Energy Consumption (2014)

kg of oil equivalent/ capita



6^{th} largest per capita user

Source: **World Bank data.**

Regional Energy Pricing Reform

Electricity prices were less than one twentieth of generation costs and had in decades.
Water (desalinated using energy sources) offered at virtually no cost.
Gasoline and diesel at highly subsidized rates.
After oil price in 2014, energy subsidy reform was presented as solution for consumption and fiscal problems.

GCC average gasoline price:

2015	*2018*
$0.3/liter	*$0.54/liter*

Quantifying Energy Subsidy Reform

- Constructing an economy-wide computable general equilibrium (CGE) model for Kuwait
- Simulations from Shehabi (2017, 2019)
- Output combines analysis and rigor with understanding of on-the-ground policy challenges and energy dynamics
- Model includes conventional features
  - Almost small open economy assumption
  - Armington elasticities
  - Real changes
- Departs from conventional CGE modeling, by including oligopolistic behavioral structure in its supply side with profit maximization and collusion from Asano & Tyers (2015), in the spirit of Blanchard & Giavazzi (2003)

Adaptation of Economic Features

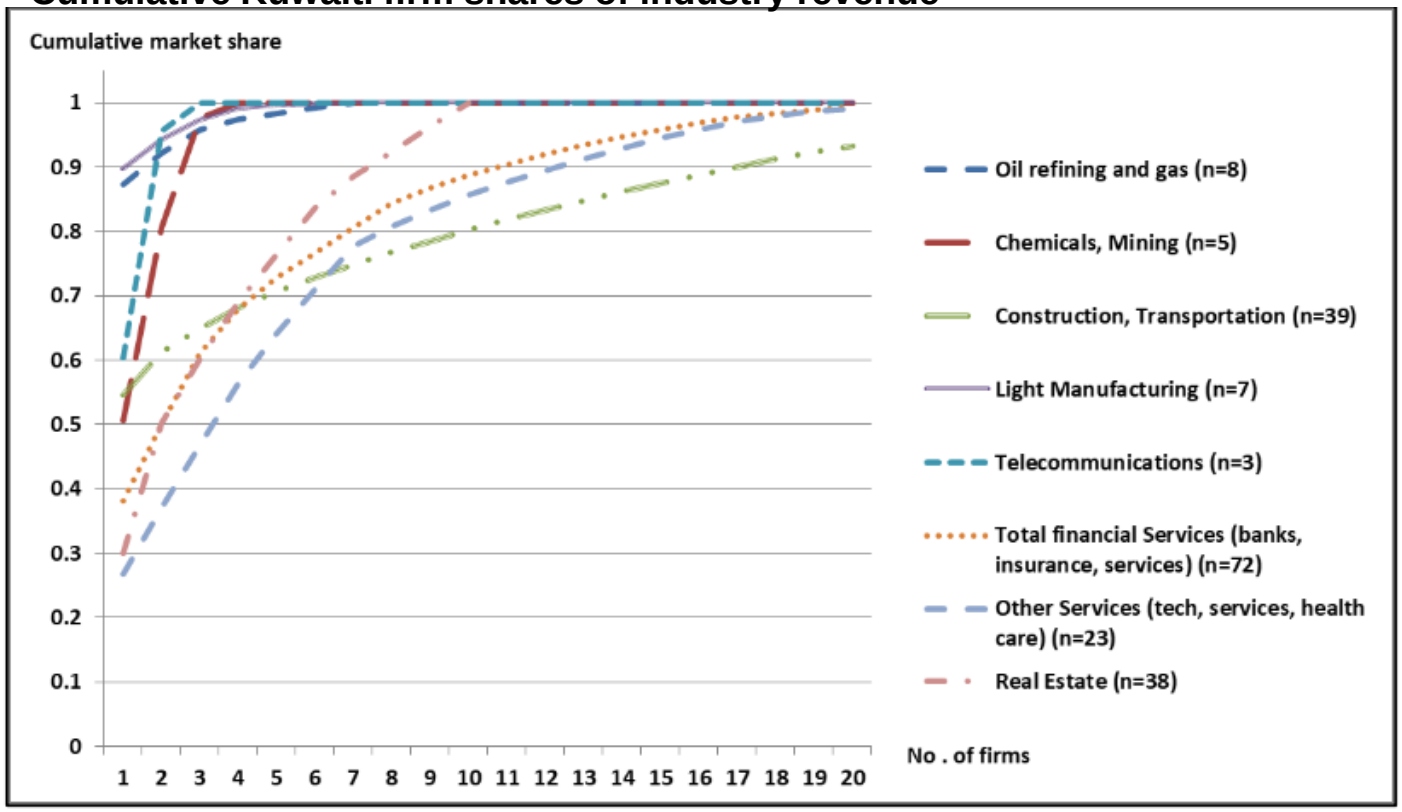
- Adapts idiosyncratic features, economic distortions, and constraints of the Kuwaiti economy
  - Specialization in petroleum
  - Public sector dominance
  - High subsidies
  - Flows into and out of the sovereign wealth funds
  - Separate labor markets and their structures

Sector	Kuwaitis		Non-Kuwaitis		Total	
	Numbers of employees	Percentage of total by sector	Numbers of employees	Percentage of the total labour force	Numbers of employees	Percentage of the total labour force
Public	326,271	70%	139,594	30%	465,865	100%
Private	93,195	5%	1,934,240	95%	2,027,435	100%
Unemployed	10,692	33%	21,255	67%	31,947	100%
Total	430,158	17%	2,095,089	83%	2,525,247	100%

Source: Author's analysis using Public Authority for Civil Information (PACI) - Population and labour force data, January 2015.

- Oligopolistic industrial structure

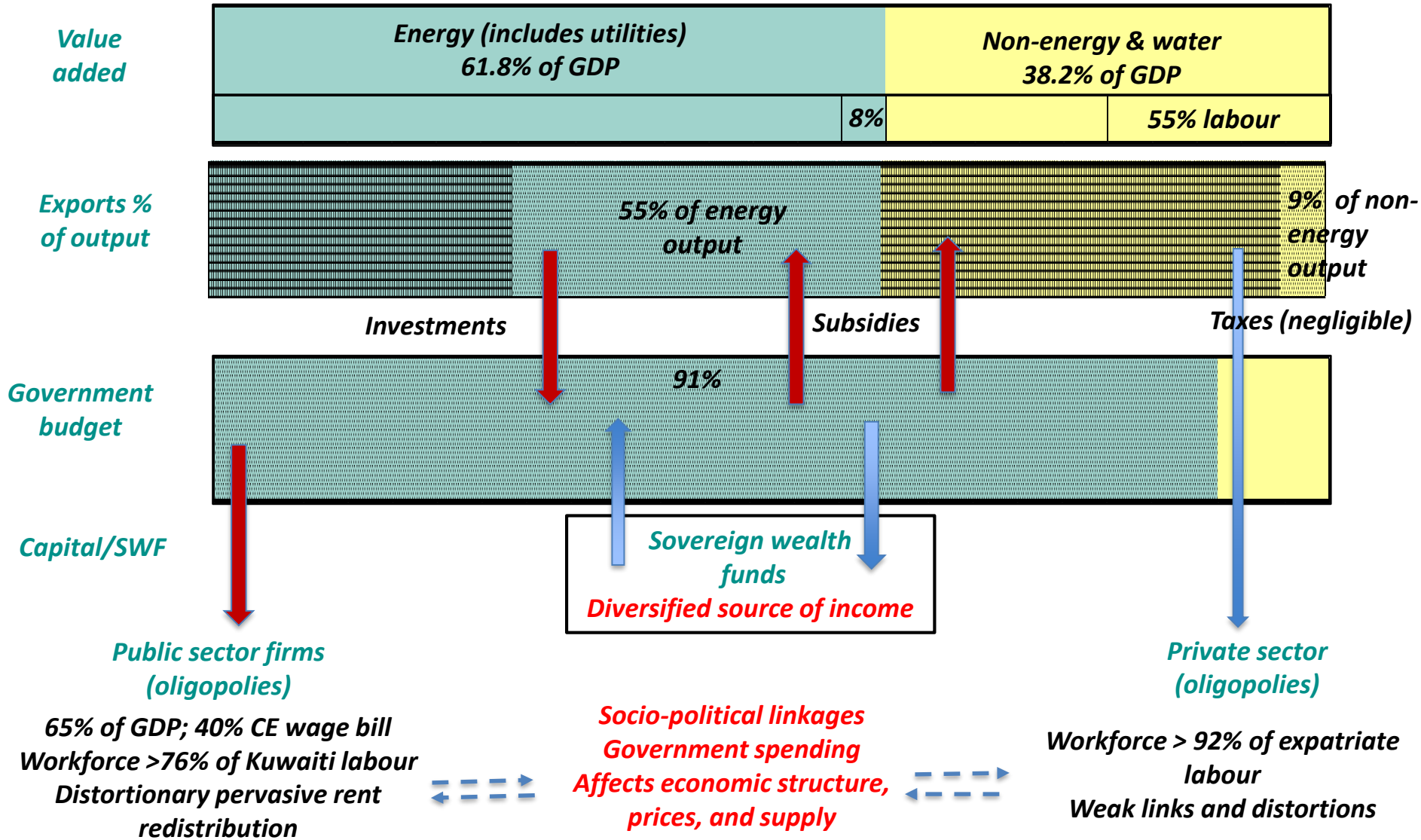
Cumulative Kuwaiti firm shares of industry revenue



Source: Author's analysis using data from the Kuwaiti Stock Exchange.

Note: The vertical axis shows the cumulative share using revenue data except for financial services, which is calculated based on net profit (due to data limitations). The horizontal axis shows the number of total firms n.

Diversified, but…



Model Structure

- One representative household; the behavior of :
  - households that consume products, supply labor and skill, and own capital
  - firms that rent capital and hire workers
  - government that earns petroleum revenue, collects taxes, and transfers welfare payments/ subsidies.
- Factors of production: capital, arable land, natural resources, and 4 types of labor
  - Kuwait skilled; Kuwaiti unskilled
  - Expatriate skilled; Expatriate unskilled
- Flexibility of employment contracts
- Social Accounting Matrix using data for 2013
- 14 industries; 8 non-tradable; 6 energy intensive
- 3820 components and 247 equation blocks, 3606 separate equations (endogenous variables) using GEMPACK.

The Model

External financial flows	Domestic fiscal policy
Demand side: final, government, investment, intermediate, exports Each with its own elasticity **Consumption** is constant elasticity of substitution between differentiated home varieties and import varieties	**Supply side:** **Oligopoly industrial structures**: each firm supplies a differentiated product, carries recurrent fixed L & K costs, **sets prices to maximize profit**; **interacts on prices** (represented by the conjectural variations parameters). **Government regulation**
"Almost small" open economy	**Exogenous external economic conditions, e.g., oil prices**
<u>Comparative static</u> **Closures**- short and long run ➢ Fiscal closure ➢ labor mobility ➢ Physical capital; KIA	**Subclosures**: ➢ Oligopoly subclsoures: ➢ Free entry and exit ➢ Fixed *n* firms

Economic Structure

Economic structural elements 2013

Sector/ Percentage	Share of GDP^{FC*}	Share of total exports	Export share of output	Net exports over output
1 Agriculture	0.3	0.0	1.3	-63.3
2 Mining	1.4	0.0	0.0	0.0
3 Crude oil	48.9	42.1	50.5	50.3
4 Gas and petro-services	0.9	1.3	50.5	50.3
5 Oil refining	5.4	38.6	72.6	72.2
6 Chemical	1.1	3.4	37.4	-1.7
7 Light manufacturing	0.8	0.4	4.1	-56.0
8 Heavy manufacturing	0.8	1.9	8.1	-72.0
9 Electricity	0.6	0.0	0.0	0.0
10 Other network services	4.6	4.6	32.3	31.4
11 Construction	2.2	0.0	0.0	0.0
12 Transport	3.4	5.7	38.9	14.1
13 Financial services	7.8	0.7	4.1	-1.3
14 Other services	21.7	1.2	1.8	-15.6

* GDP^{FC} is GDP at factor cost, which is the sum of value added in each industry.

Source: Model database (social accounting matrix) constructed by author for 2013.

Subsidies' Size

Reported industry and consumption subsidies 2013

Demand sector or source	Subsidies (million USD)
1 Agriculture	255.6
2 Mining	8.14
3 Crude oil	138.3
4 Gas and petro-services	1.5
5 Oil refining	731.9
6 Chemical	890.4
7 Light manufacturing	194.4
8 Heavy manufacturing	125.2
9 Electricity	439.3
10 Other network services	789
11 Construction	184.7
12 Transport	198
13 Financial services	142.4
14 Other services	1232.4
Household consumption subsidies	3,277.4
Investment and inventory consumption subsidies	61.5
TOTAL reported consumption subsidies	8,670

Source: Author's CGE model database (SAM) constructed for 2013.

Simulations: Response Measure

Simulation	Scenario A
Oil price decline Simulating decline in global oil prices since 2014 (5%)	✓
Energy subsidy reform Simulating 50% increases in gasoline prices in 2016	✓

Simulating Energy Subsidy Reform as a Response Measure

Percentage change (departure from baseline)

Variable	Scenario A: Energy subsidy reform alone Oil price decline: -5% Pricing reform, households: 50% Pricing reform, firms: 5%
Macroeconomic indicators	
Real GDP	-10.10
Real GNP	-13.76
Real exchange rate	-2.62
Real rate of return on capital, gross of tax	-8.39
Capital stock	-3.58
Non-petroleum exports/GDP	0.53
Government	
Fiscal deficit/GDP	-9.66
Welfare payments	1.70
Current account/GDP	-14.34
Welfare and consumption	
Welfare (Real disposable income, CPI deflated)	-5.82
Household energy consumption	-11.22
Labor	
Unskilled expatriate labour employment	1.94
Skilled expatriate labour employment	1.49
Unskilled Kuwaiti labour employment	/
Industry/ oligopoly	
Pre-tax pure profits/GDP	0.27
Average markup	-0.29
Average markup, non-oil tradables	-0.19
Average markup, nontradable services	-0.77

Source: Simulation results.

Positives:

- *Adjustment mechanism*
- *Reduced consumption*

Negatives:

- *Insufficient fiscal solution*
- *Insufficient consumption reduction in long term*
- *Overall contractionary shock*
- *Limited expansion in non-oil trade owing to the depreciating RER*
- *Welfare deterioration*
- *Wage declines*
- *Expatriate labor employment*
- *Limited industrial expansion*
- *Minimal improvements in economic efficiency*

Simulations: Policy Reforms to Ameliorate Effects of Response Measure

Simulation	Scenario A	Scenario B
Oil price decline Simulating decline in global oil prices since 2014 (5%)	✓	✓
Energy subsidy reform Simulating 50% increases in gasoline prices in 2016	✓	✓
Tighter pricing surveillance that reduces collusive on prices in non-oil industries 20% reduction in businesses' tendency to collude, simulating policies of Kuwait Competition Protection Authority		✓
Improvements in private- and service-sector productivity Simulating potential policies to expand the private sector		✓
Mobility of unskilled Kuwaiti labor from public to the private sector with competitive wages Simulating "Kuwaitization" policy, labor training and mobility		✓

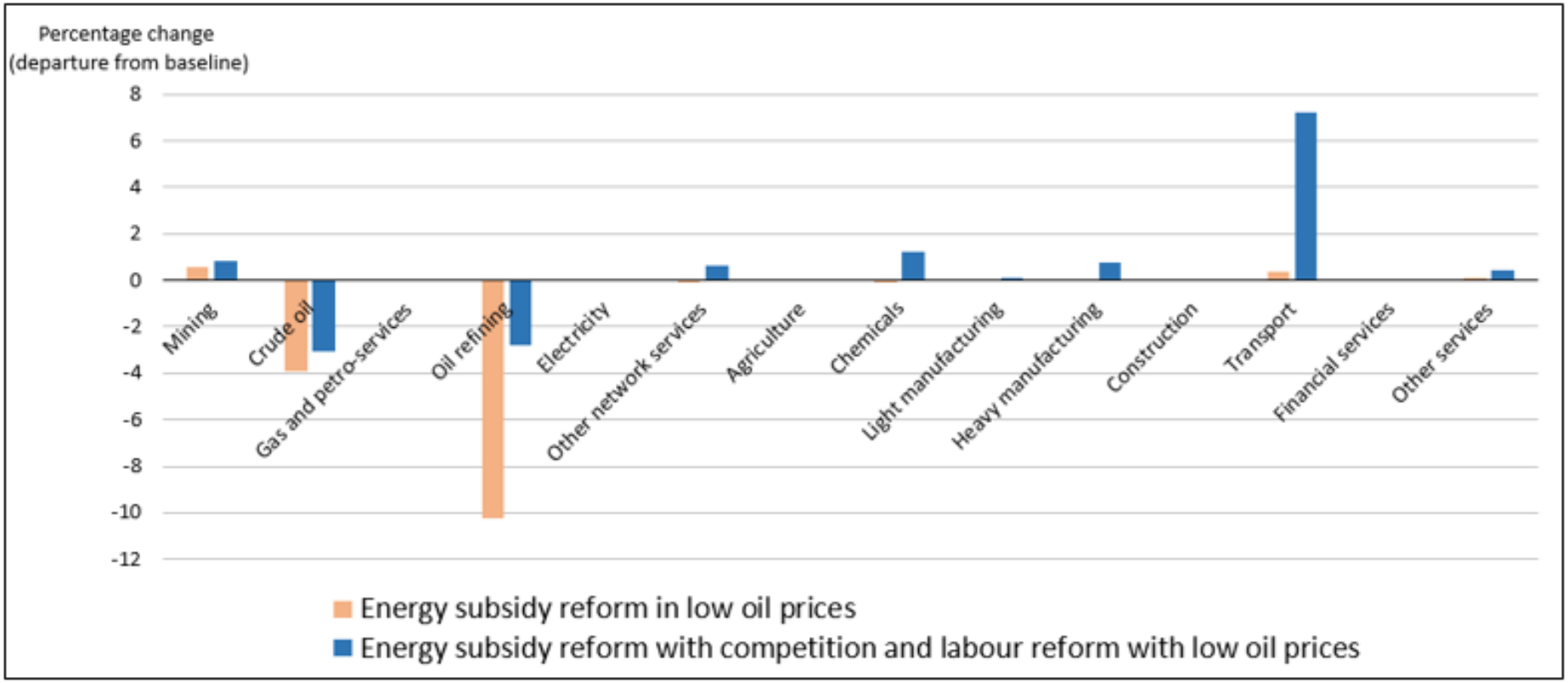
Combination of Energy Subsidy with Other Microeconomic Reforms

Variable	Percentage change (departure from baseline)	
	Scenario A: Energy subsidy reform alone	Scenario B: Energy subsidy combined with other reforms
	Oil price decline: -5% Pricing reform, households: 50% Pricing reform, firms: 5%	Oil price decline: -5% Pricing reform: 40% Competition reform: 20% Productivity boost: 6.5% Labour reform: mobility of unskilled Kuwaiti labour
Macroeconomic indicators		
Real GDP	-10.10	12.62
Real GNP	-13.76	9.83
Real exchange rate	-2.62	-4.54
Real rate of return on capital, gross of tax	-8.39	0.98
Capital stock	-3.58	7.17
Non-petroleum exports/GDP	0.53	9.53
Government		
Fiscal deficit/GDP	-9.66	0.65
Welfare payments	1.70	-3.76
Current account/GDP	-14.34	3.60
Welfare and consumption		
Welfare (Real disposable income, CPI deflated)	-5.82	6.98
Household energy consumption	-11.22	-4.63
Labor		
Unskilled expatriate labour employment	1.94	18.95
Skilled expatriate labour employment	1.49	16.01
Unskilled Kuwaiti labour employment	/	24.49
Industry/ oligopoly		
Pre-tax pure profits/GDP	0.27	-0.15
Average markup	-0.29	-2.62
Average markup, non-oil tradables	-0.19	-2.58
Average markup, nontradable services	-0.77	-3.58

Source: Simulation results.

Expansion in Sectoral Exports

Changes in exports/GDP under scenarios A and B



Sectoral Results

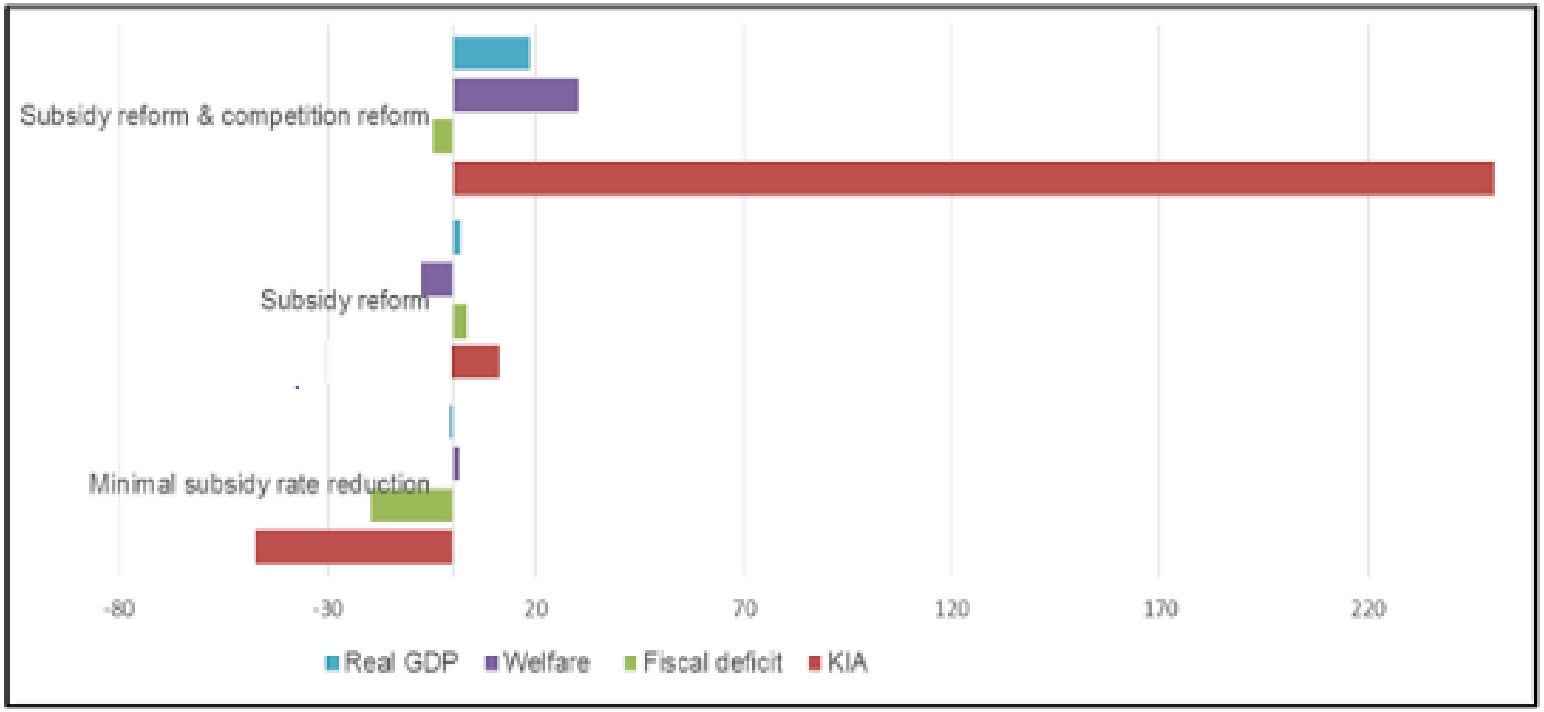
Simulated long-run sectoral effects of subsidy, labour, and competition reforms following oil price declines

Variable	Percentage change (departure from baseline)				
	Expatriate employment	Gross output	Markup ratios	Scale	**Exports/GDP**
Energy sectors					
Mining	21.10	33.80	−6.11	16.59	0.82
Crude oil	−9.97	−6.93	0.95	36.88	−3.08
Gas and petro-services	24.87	18.28	−0.13	−7.27	0.00
Oil refining	−24.45	−2.70	0.17	44.98	−2.81
Electricity	−12.79	19.51	−7.32	50.45	0.00
Other network services	18.13	22.13	−5.12	12.44	0.64
Non-energy sectors					
Agriculture	30.54	22.10	−8.30	4.11	0.01
Chemicals	45.12	49.26	−2.12	0.72	1.21
Light manufacturing	25.52	18.64	−0.21	−22.77	0.10
Heavy manufacturing	49.18	43.49	−1.00	−4.98	0.77
Construction	9.55	13.15	−0.14	10.67	0.00
Transport	104.58	120.43	−4.47	11.27	7.21
Financial services	27.98	21.73	−1.35	−43.63	0.06
Other services	14.19	18.09	−0.64	13.07	0.40

Source: Simulation results.

Maximizing Positives and Minimizing Negatives

Comparative tradeoffs and key short-run results of reform scenarios following oil price declines (Shehabi, 2017)



Source: Simulation results.

Note: Axis represents percentage change from baseline.

Takeaways

- Results show that energy subsidy reform minimally improves consumption reductions and does not offer fiscal solutions.
- It minimally improves non-oil export
  - depreciating exchange rate (trade effects)
  - elasticities of demand
  - efficiency improvements through oligopoly markup declines and moderated by the adjustment valves
- Limited expansion in non-energy sectors:
  - large share of oligopolies in the domestic market
  - low elasticity of substitution between imports and home goods
  - the share of imports in intermediate inputs of the non-energy tradables
- Reversal of negative impacts through large improvement & output gains from competition and labor reform
- In small (Gulf) economies, oligopoly pricing regulation has the potential role of moderating the negative economic impacts of energy subsidy reform.

Policy Implications

- A combination of fiscal, energy, and microeconomic policy is necessary to achieve meaningful positive economic effects (including diversification and socioeconomic development)
  - Sequencing of reform is important; political difficulty
- Redistributive measures to moderate socioeconomic implications
- With appropriate incentives, the reverse Dutch Disease (expansion of non-resource industries) could be considerably more effective, without becoming a panacea
- In developing economies with pervasive oligopolies, microeconomic reform can improve the efficiency and (positive) effects of subsidy reform
- Economic reforms are a main pillar in a set of reforms necessary for sustainability (economic, industrial, fiscal, social, environmental, institutional, economic culture).

Discussion

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