THE OXFORD INSTITUTE FOR ENERGY STUDIES

A RECOGNIZED INDEPENDENT CENTRE OF THE UNIVERSITY OF OXFORD

UNIVERSITY OF OXFORD

Quantifying Impacts of Energy Subsidy Removal as a Response Measure and Just Transition Policy Solutions for Low Carbon Development

Dr. Manal R. Shehabi

Oxford Institute for Energy Studies

29 August 2019

UNFCCC/ILO ASIA-PACIFIC REGION AWARENESS WORKSHOP TO MAXIMIZE THE POSITIVE AND MINIMIZE THE NEGATIVE IMPACTS OF IMPLEMENTATION OF CLIMATE CHANGE RESPONSE MEASURES, MALDIVES

Outline

- Fossil fuel subsidy reform: A response measure
- Quantifying reform: Case study of the Gulf countries with illustrations from Kuwait
  - Negative impacts
  - Just transition policy solutions
- Takeaways and conclusion

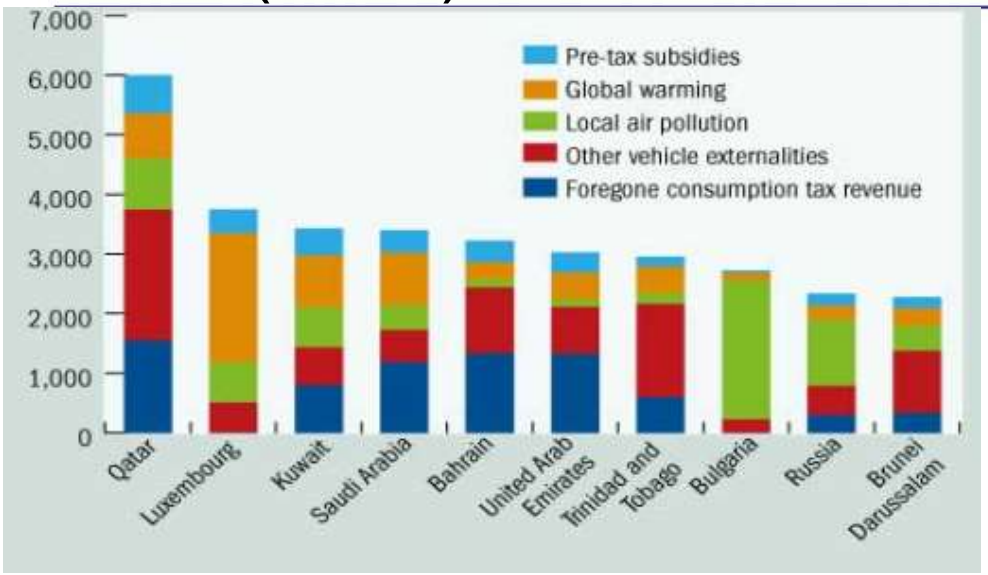
Outline

- **Fossil fuel subsidy reform: A response measure**
- Quantifying reform: Case study of the Gulf countries with illustrations from Kuwait
  - Negative impacts
  - Just transition policy solutions
- Takeaways and conclusion

Energy Subsidies and Carbon Emissions

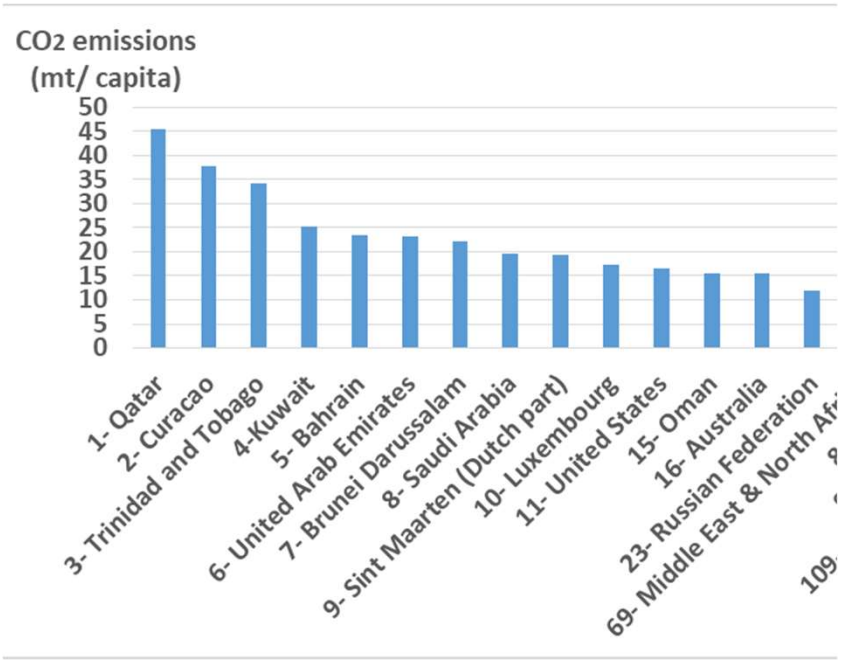
- Consumer or producer subsidies
- Inefficient
- Distortionary
  - Further impact on price volatility, demand, and world oil prices
- Lead to wasteful consumption
- Have a negative impact on the environment
  - Fossil fuels are the highest carbon emitters
- Coal subsidies in the EU and Japan release 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)



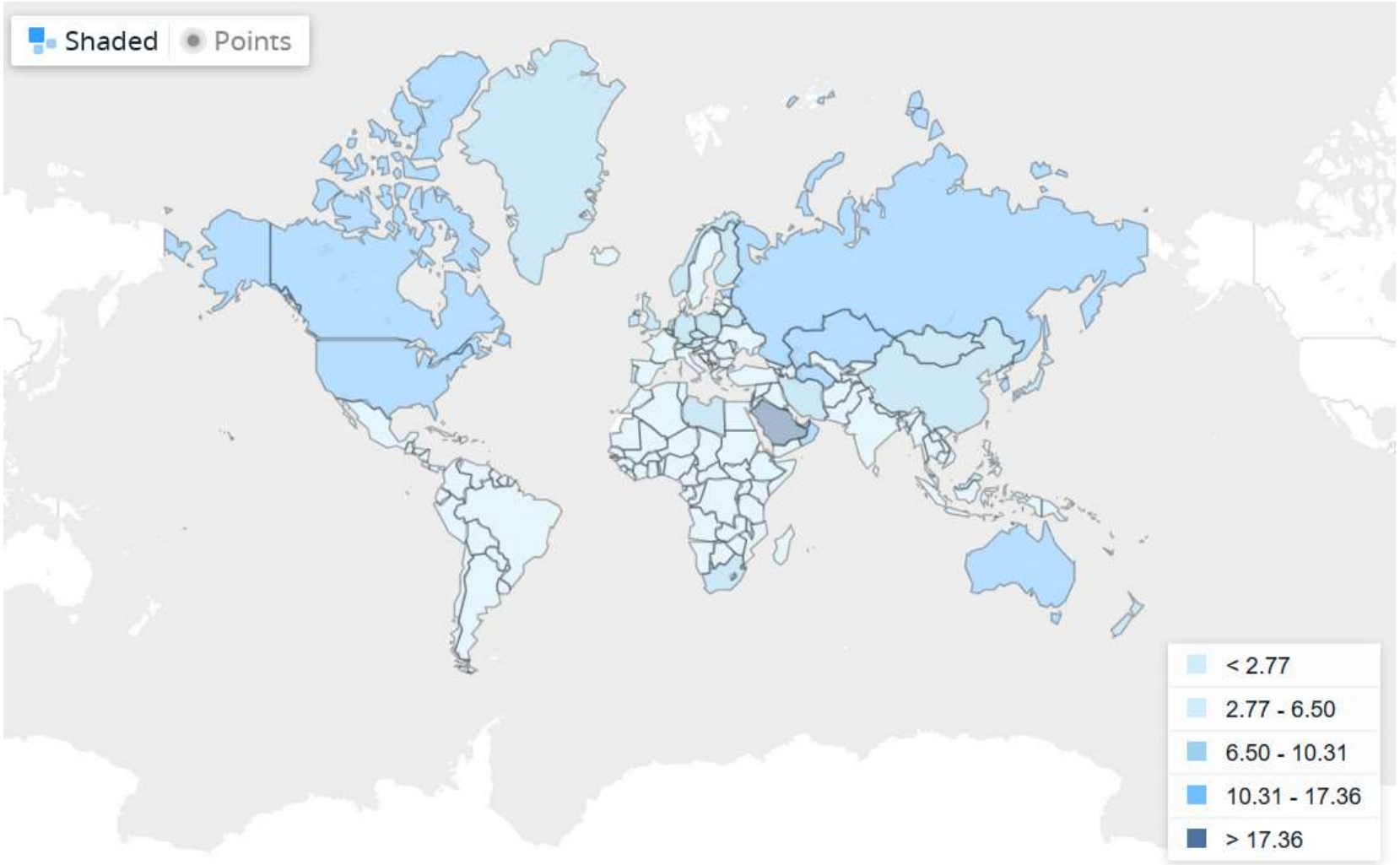
$

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 mitigation measure
  - As a response measure in economies suffering fiscal effects of mitigation measures (lower demand) and oil price declines As a
  - key response measure for energy importers to climate change to promote reduction in energy consumption and carbon emissions

Potential Impacts of Energy Subsidy Reform

- **Positive impacts**:
  - Fiscal savings
  - Reduced consumption
  - Reduced 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 CO_2 emissions by more than 20%, and cut pre-mature air pollution deaths by more than half.
  - Opportunities for investments and technologies in renewables and in more efficient fossil fuel consumptions
  - Opportunities for new employment opportunities

Potential Impacts of Energy Subsidy Reform

- **Negative impacts**:
  - Inflationary pressures that reduce households' welfare
  - Economic contraction (in terms of GDP and employment)
  - Hindrance of industrial competitiveness of the export-oriented sectors
  - Economic contraction in all domestic non-energy energy-user sectors
  - Negative labor market effects
  - Loss in employment in energy industry and supporting sectors
  - Loss in employment in non-tradable services
  - Decline in consumption
  - Possible exchange rate effects and terms of trade effects
  - Disproportionately hurt the poor
  - Negative socioeconomic effects especially relating to energy poverty

Solution and Challenge

- **Solution**:
  - Applying economic policies including just transition models that support maximization of positives and minimization of negative of impacts of response measures
  - To do so, it is necessary for government to:
    1) Measure the effects of response measures
    2) Based on the results of the measurements, determine impacted areas and, accordingly, evaluate and design policy response solutions (e.g.: policies that affect transition of work force, decent work and quality to
    3) Measure the effects of the policy solutions.

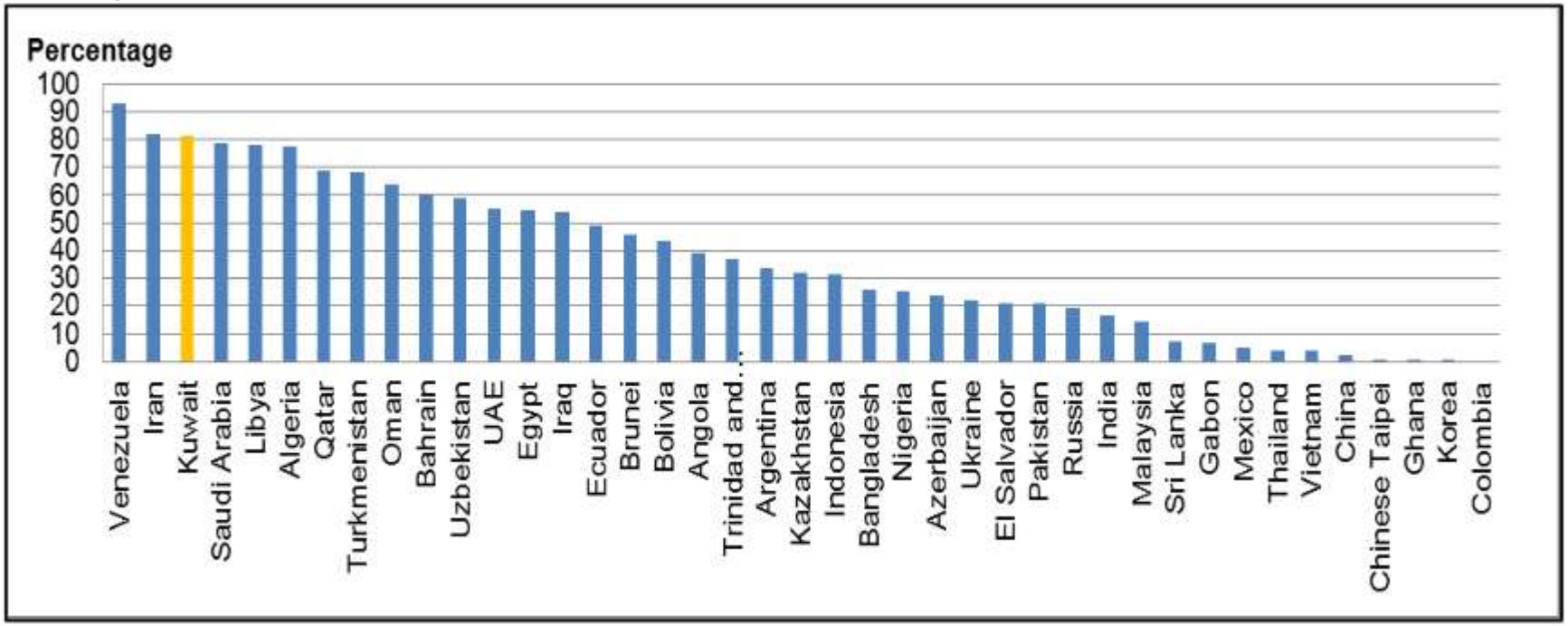
-- Difficult to quantify secondary (indirect) micro and macroeconomic and environmental effects

Outline

- Fossil fuel subsidy reform: A response measure
- **Quantifying reform: Case study of the Gulf countries with illustrations from Kuwait**
  - **Negative impacts**
  - **Just transition policy solutions**
- Takeaways and conclusion

Background: Average Subsidization Rates (2014)

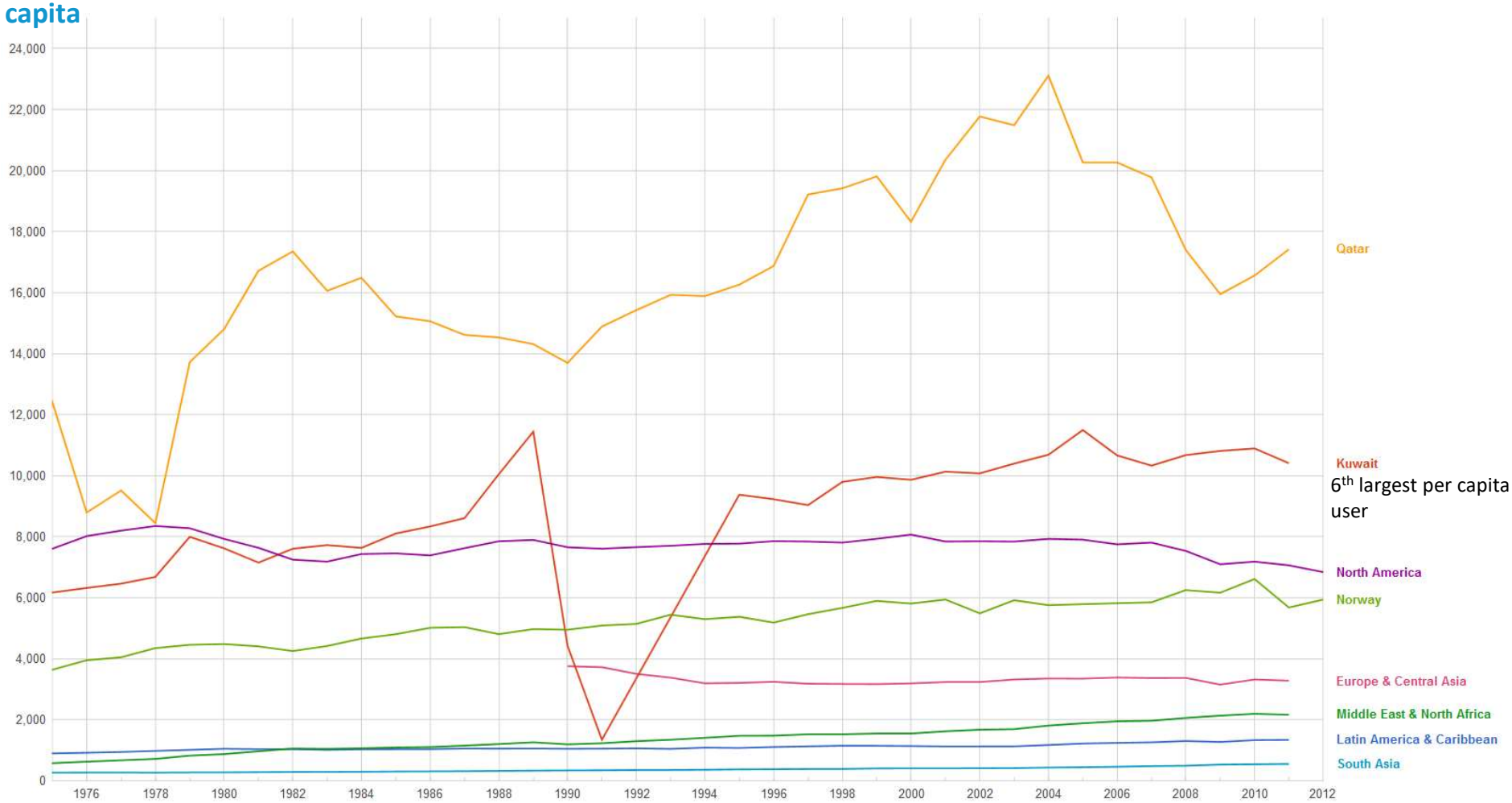
Average subsidization rates for 2014



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

Energy Consumption (2014)

kg of oil equivalent/ capita



6th 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.
- ~ 50% of local energy production goes to local consumption.
- 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*

Regional Energy Pricing Reform

Table 1: Energy prices in MENA oil-exporting economies, 2015–2018 ($/litre)

	Gasoline		Diesel	
Country	2015	2018	2015	2018
Algeria	–	0.35	–	0.19
Bahrain	0.27	0.53	0.27	0.42
Iran	–	0.29	–	0.07
Kuwait	0.24	0.34	0.39	0.38
Oman	0.31	0.58	0.38	0.65
Qatar	0.27	0.51	0.27	0.55
Saudi Arabia	0.14	0.54	0.06	0.13
United Arab Emirates	0.59	0.67	0.56	0.78

Sources: IMF (2015) for 2015 values; GlobalPetrolPrices.com (2018) for 2018 values.

Quantifying Energy Subsidy Reform

- Constructing an economy-wide computable general equilibrium (CGE) model for Kuwait
- Simulations from Shehabi (2017, 2019)
- Adapts idiosyncratic features, economic distortions, and economic constraints

1. Specialization in petroleum

Economic Structure

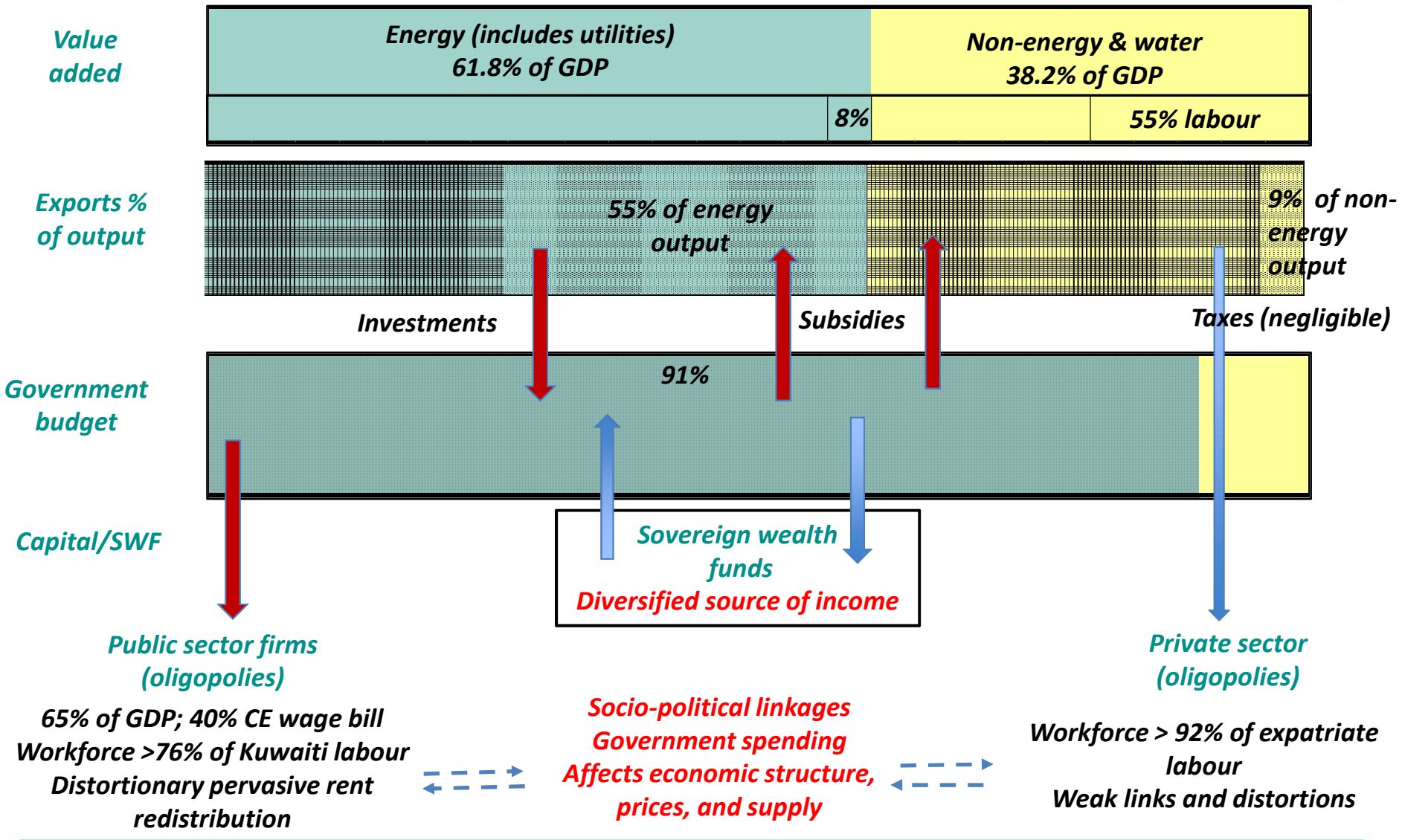
Economic structural elements 2013

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.

Diversified, but…



Quantifying Energy Subsidy Reform

- Constructing an economy-wide computable general equilibrium (CGE) model for Kuwait
- Simulations from Shehabi (2017, 2019)
- Adapts idiosyncratic features, economic distortions, and economic constraints

1. Specialization in petroleum
2. Public sector dominance
3. Flows into and out of the sovereign wealth funds

Subsidies' Size

4. High subsidies

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.

Incorporating the Labor Markets Structure

5. 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.

4 types of labor:

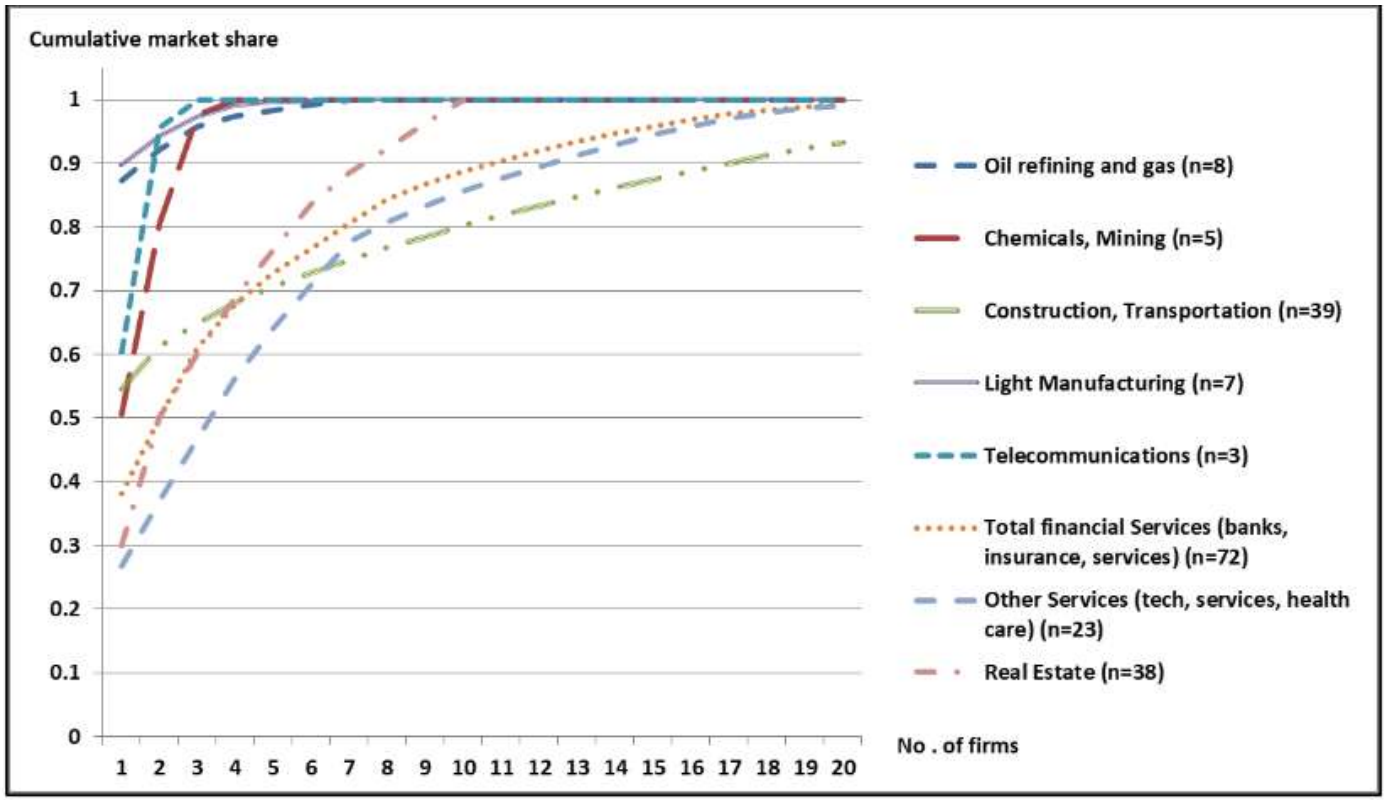
- Kuwait skilled; Kuwaiti unskilled
- Expatriate skilled; Expatriate unskilled

Incorporating Oligopolistic Industrial Structure

6. Oligopolies

Distortionary, limit competition, economic efficiency

Cumulative Kuwaiti firm shares of industry revenue



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

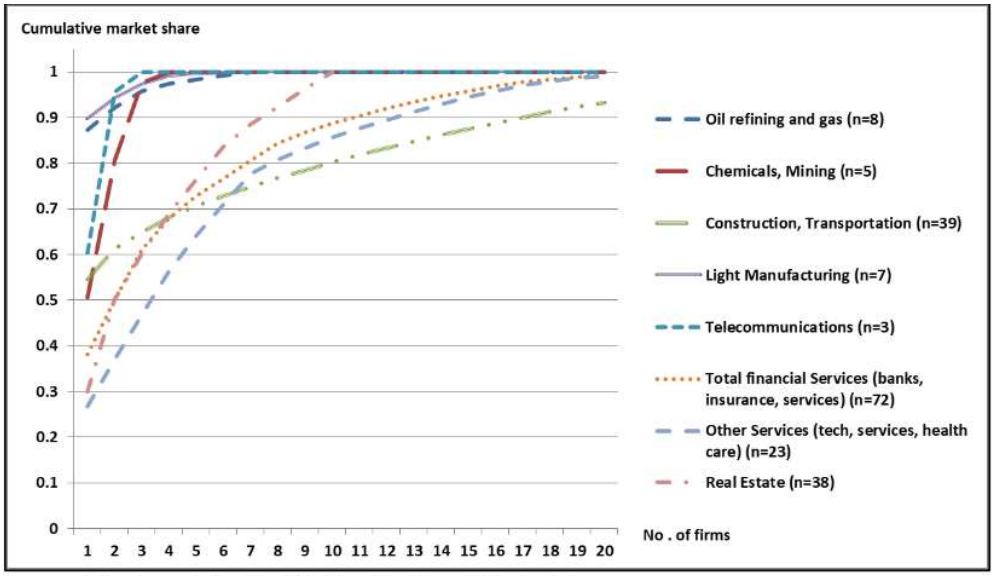
Note: The vertical axis shows the cumulative share using revenue data except for financial services, which is calculated based on net profit (due to data limitations). The horizontal axis shows the number of total firms n.

Incorporating Oligopolistic Industrial Structure

6. Oligopolies

Distortionary, limit competition, economic efficiency

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.

→ Model 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).

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 (Armington elasticities)	**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

Simulations 1: 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

Variable	Percentage change (departure from baseline) 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:

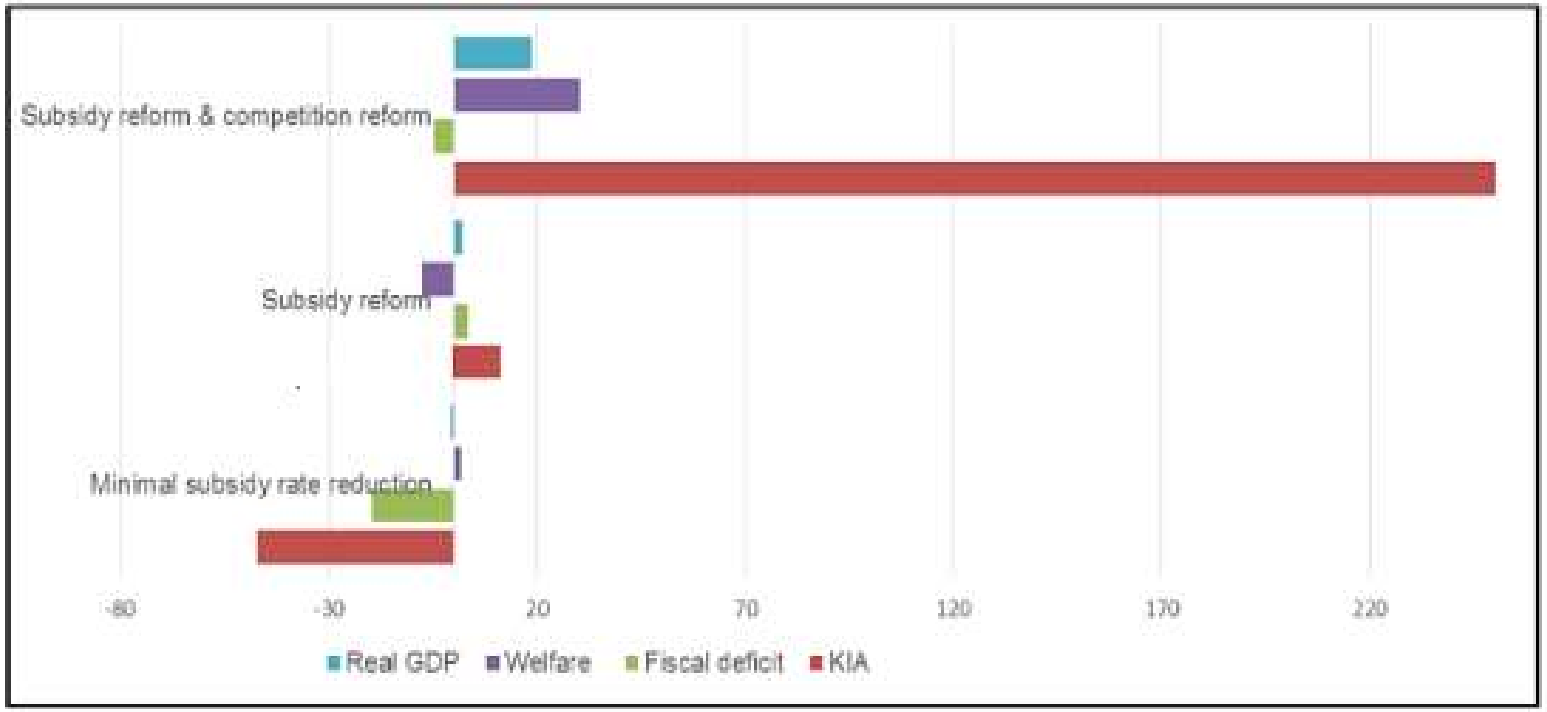
- *Insufficient fiscal solution*
- *Insufficient consumption reduction in long term*
- *Overall contractionary shock*
- *Limited expansion in non-oil trade owing to the depreciating RER*
- *Welfare deterioration*
- *Wage declines*
- *Expatriate labor employment*
- *Limited industrial expansion*
- *Minimal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

Simulations 1: Policy Reforms to Ameliorate Effects of Response Measure

Simulation	Scenario A	Scenario B-1
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		✓

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.

Simulations 3: 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		✓

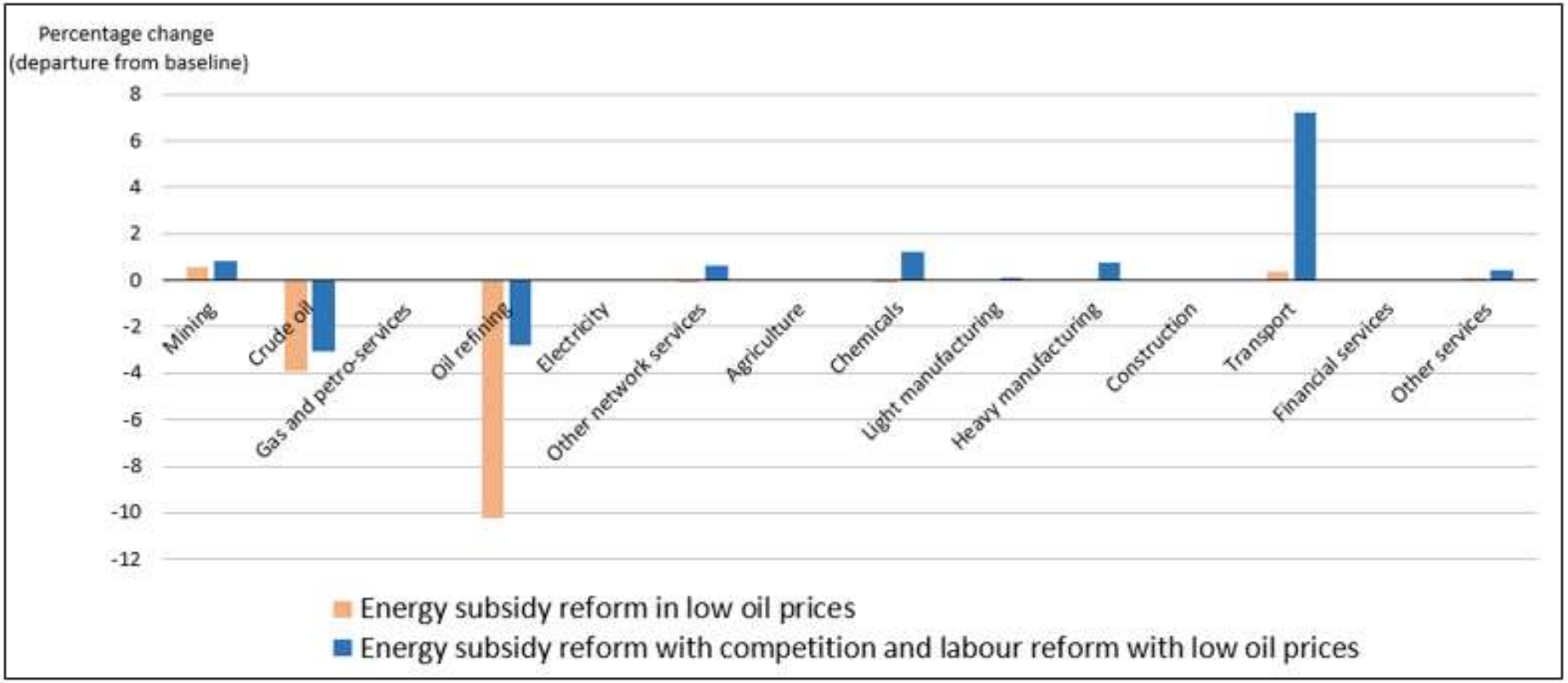
Combination of Energy Subsidy with Other Microeconomic Reforms

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



Source: Model simulations.

Sectoral Results: Maximizing Positives

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

	Percentage change (departure from baseline)				
Variable	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.

Outline

- Fossil fuel subsidy reform: A response measure
- Quantifying reform: Case study of the Gulf countries with illustrations from Kuwait
  - Energy subsidy reform impacts
  - Just transition policy solutions
- **Takeaways and conclusion**

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

References

- Asano, A., and Tyers, R. (2015). 'Third arrow reforms and Japan's economic performance', UWA Discussion Paper 15.17, University of Western Australia, Perth, www.business.uwa.edu.au/__data/assets/pdf_file/0012/2765847/15.17-Asano,-A.-and-Tyers,-R.-Third-Arrow-Reforms-and-Japans-Economic-Performance.pdf.
- Awan, G.A. (2013), Relationship between environment and sustainable economic development: A theoretical approach to environmental problem. *International Journal of Asian Social Science*: 3(3), 741- 761.
- Blanchard, O., and Giavazzi, F. (2003). 'Macroeconomic effects of regulation and deregulation in goods and labor markets', *Quarterly Journal of Economics*, 118(3), 879–907, https://doi.org/10.1162/00335530360698450.
- Coady, D., Parry, I., Sears, P., & Shang B. (2015). How Large are Global Subsidies. *IMF Working Paper, WP/15/105.* IMF: Washington, D.C. https://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf
- IEA (International Energy Agency). (2018). *Outlook for Producer Economies 2018: What Do Changing Energy Dynamics Mean for Major Oil and Gas Exporters?* Paris: IEA.
- IMF (International Monetary Fund). (2015). *IMF Survey: Counting the Cost of Energy Subsidies.* Energy and the Environment. July, 25. https://www.imf.org/en/News/Articles/2015/09/28/04/53/sonew070215a

References

- Mukherjee S. & Chakraborty, D. (2014). Relationship between Fiscal Subsidies and CO2 Emissions: Evidence from Cross-Country Empirical Estimates. *Economics Research International*: 2014, 346139, https://doi.org/10.1155/2014/346139.
- Sasana H. et al. (2017). The Effect of Energy Subsidy on the Environmental Quality in Indonesia. *International Journal of Energy Economics and Policy:* 7(5), 245-249.
- Shehabi, M. (2017). Assessing Kuwaiti energy pricing reforms. *OIES Paper MEP 17,* Oxford Institute for Energy Studies, Oxford, https://doi.org/10.26889/9781784670931, www.oxfordenergy.org/wpcms/wp-content/uploads/2017/11/Assessing-Kuwaiti-Energy-Pricing-Reforms-MEP-17.pdf.
- Shehabi, M. (2019). Is energy subsidy reform in an oil-exporting small economy beneficial to trade? illustrations from Kuwait. *OIES Paper No. MEP 21,* Oxford Institute for Energy Studies, Oxford, www.oxfordenergy.org/wpcms/wp-content/uploads/2019/01/Is-energy-subsidy-reform-in-an-oil-exporting-small-economy-beneficial-to-trade-MEP-21.pdf.
- Sovacool, B.K. (2017), Reviewing, reforming, and rethinking global energy subsidy: Towards a political economy research agenda. *Ecological Economics*: 135, 150-163.
- Tyers, R. (2015). Service oligopolies and Australia's economy-wide performance. *Australian Economic Review*, 48(4): 333–56.
- World Bank (2014). *World Development Indicators.*

Break-Out Group Work

Break-out Group Work on Key Sectors for Asia-Pacific and Potential Impact from Response Measures and Follow up Actions

Following Kuwait's Example, Assess the Impact of a Response Measure and Just Transition Policies

Identify the following using model terms (Variables) following the example of Kuwait
Country of your choice in Asia-Pacific
Key attributes (location, economic driver, resources)
What promoted the adoption of a response measure?
What is the **response measure, quantified** if possible?
What is the **quantified target** that the response measure is intended to achieve? **Choose one** *E.g. decrease local energy consumption by 20%* *Decrease carbon intensity by 30% through the reduction of local energy consumption by 20%)*
What are the social, economic, and employment effects of the response measures and/or its impacts?
What are example of Just Transition policies that can maximize the positive and minimize the negative? **Quantifiable policies if possible** *What about other microeconomic reform (e.g. supply/ demand side policies, competition?*
Which sectors or target group will this policy address? (employers, workers in a specific industry, women, youth, etc.)?

Identify	Example from the case of Kuwait
Country of your choice in Asia-Pacific	Kuwait
Key attributes (location, economic driver, resources)	Arabian peninsula, oil exporter, limited other resources, access to water and ports, available labor
What promoted the adoption of a response measure?	Climate change mitigation measures caused reduction of oil revenue and fiscal challenges
What is the **response measure, quantified if possible?**	Reduction of energy subsidy by 50%
What is the **quantified** target that the response measure is intended to achieve? **Choose one**	- Decrease local energy consumption by 20% *Other options could include:* *- Decrease carbon intensity by 30% through the reduction of local energy consumption by 20%)*
What are the social, economic, and employment effects of the response measures and/or its impacts?	✓ Economic contraction ✓ Loss of jobs ✓ Inflation, reduced welfare ✓ Reduced consumption and GHG emissions ✓ Increased oligopolistic markups
What are example of Just Transition policies that can maximize the	20% reduction in businesses' tendency to

The OIES

- *We are a world leading independent and autonomous energy research institute*
- *Recognized center of the University of Oxford*
- Our research is structured across three main programmes:
  - Oil
  - Natural Gas
  - Electricity
- Our publications are read worldwide and serve a diverse audience
- Sister institutions and events
  - Oxford Energy Policy Club
  - Oxford Energy Seminar
  - Events

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.

Quantifying Energy Subsidy Reform

- Constructing an economy-wide computable general equilibrium (CGE) model for Kuwait
- Simulations from Shehabi (2017, 2019)
- 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)