Energy Subsidies, Economic Growth, and CO_2 emissions

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Presentation based on 2 papers

1. *"Energy Subsidies, Public Investment and Endogenous Growth."* (2017). ***Energy Policy*** 110, 693 - 709: https://doi.org/10.1016/j.enpol.2017.08.049

2. *"How much can CO_2 emissions be reduced if fossil fuel subsidies are removed?" (*2017). ***Energy Economics*** 64, 91 – 104: http://dx.doi.org/10.1016/j.eneco.2017.03.014

Organization of this presentation

1. Some stylized facts of fossil fuel subsidies and economic conditions

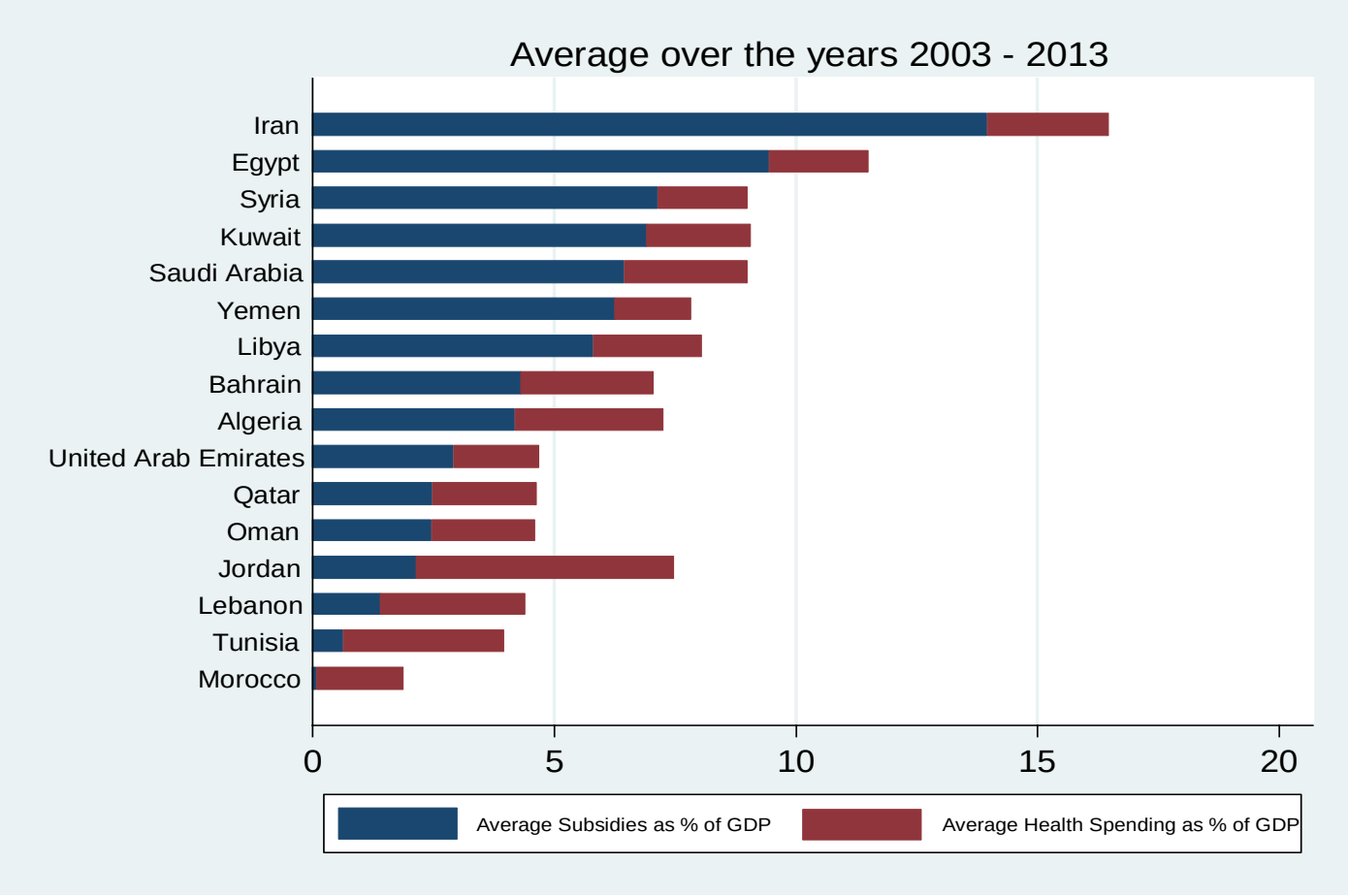
2. A conceptual background to the empirical analysis.

3. Empirical results on the relationship between economic growth and fuel subsidies.

4. Empirical results on the relationship between CO_2 emissions and fuel subsidies.

5. Conclusions

Fossil fuel subsidies expenditures versus health expenditures as percentage of GDP: MENA case



CO_2 emissions in developing countries

- The goal of the 2015 Paris Climate Conference (COP21) was to formalize a worldwide mandate that permits to keep global warming below 2°C.

- BUT any target to reduce CO_2 cannot be achieved without a commitment from the developing countries.

- The developing world not only ***emits half*** of the global CO_2 emissions, these emissions are also ***increasing faster*** than those in the developed world under “business as usual” (BAU) standards (Chakravarti et.al (2009), EIA (2014), and Parry, Veung and Heine (2015)).

What do we do here?

1. We demonstrate empirically (and theoretically) that elimination of subsidies could foster ***economic growth.***

2. We also analyze the channels by which such growth could take place.

What do we here?

- We analyze the major potential role that removing fossil fuels subsidies can have in reducing CO_2 emissions through a reduction in the consumption of fossil fuels.

- We then answer the following question:

How much can CO_2 emissions be reduced if subsidizing countries increase their price of gasoline and diesel by 20 USD cents per liter?

Hypotheses

Hypothesis 1: *elimination of energy subsidies can have positive impacts on economic growth in countries that implement enduring energy price reforms by reducing fuel subsidies.*

Hypothesis 2: *elimination of energy subsidies can reduce significantly CO_2 emissions.*

DEFINITION 1

- The price gap is the difference between the domestic price and the international price of fossil fuels. (We distinguish between importers and exporters of fossil fuels.)

- **The price gap is *negative* when the fuel is *subsidized*, or *positive* when the fuel is *taxed*.**

DEFINITION 1

We use the **Koplow's (2009) "price gap**":

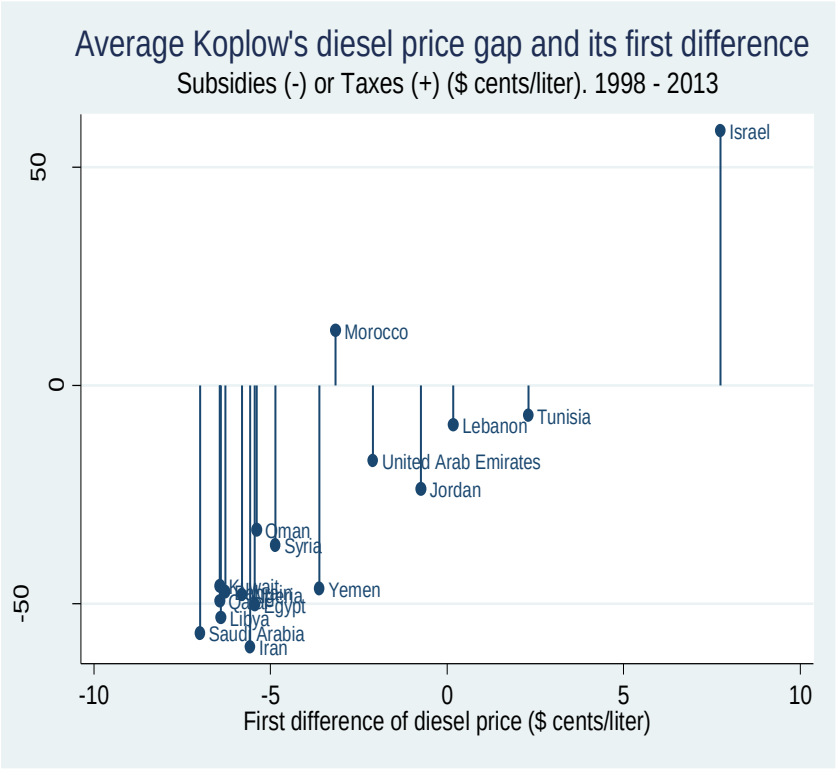
- For *countries that are fossil fuel importers*, the price gap is equal to:

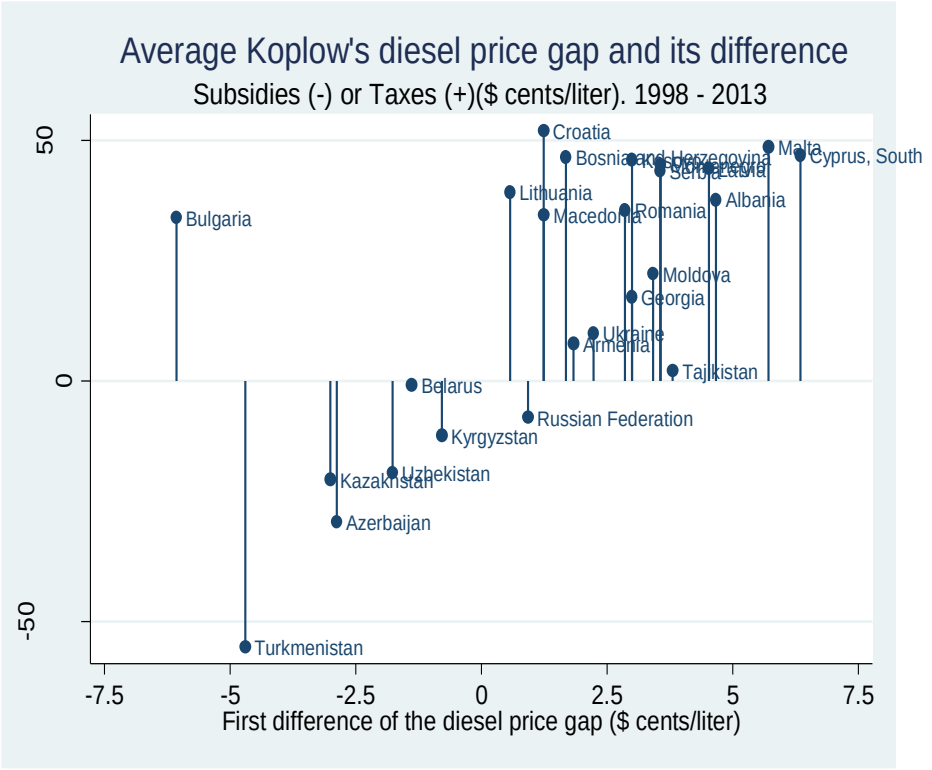
domestic fuel retail price – (average U.S. retail price - 10 US$ cents per liter)

- For *countries that are the fossil fuel exporters*, the price is equal to:

domestic fuel retail price – (average U.S. retail price - 20 US$ cents per liter)

Stylized facts: MENA and ECA countries





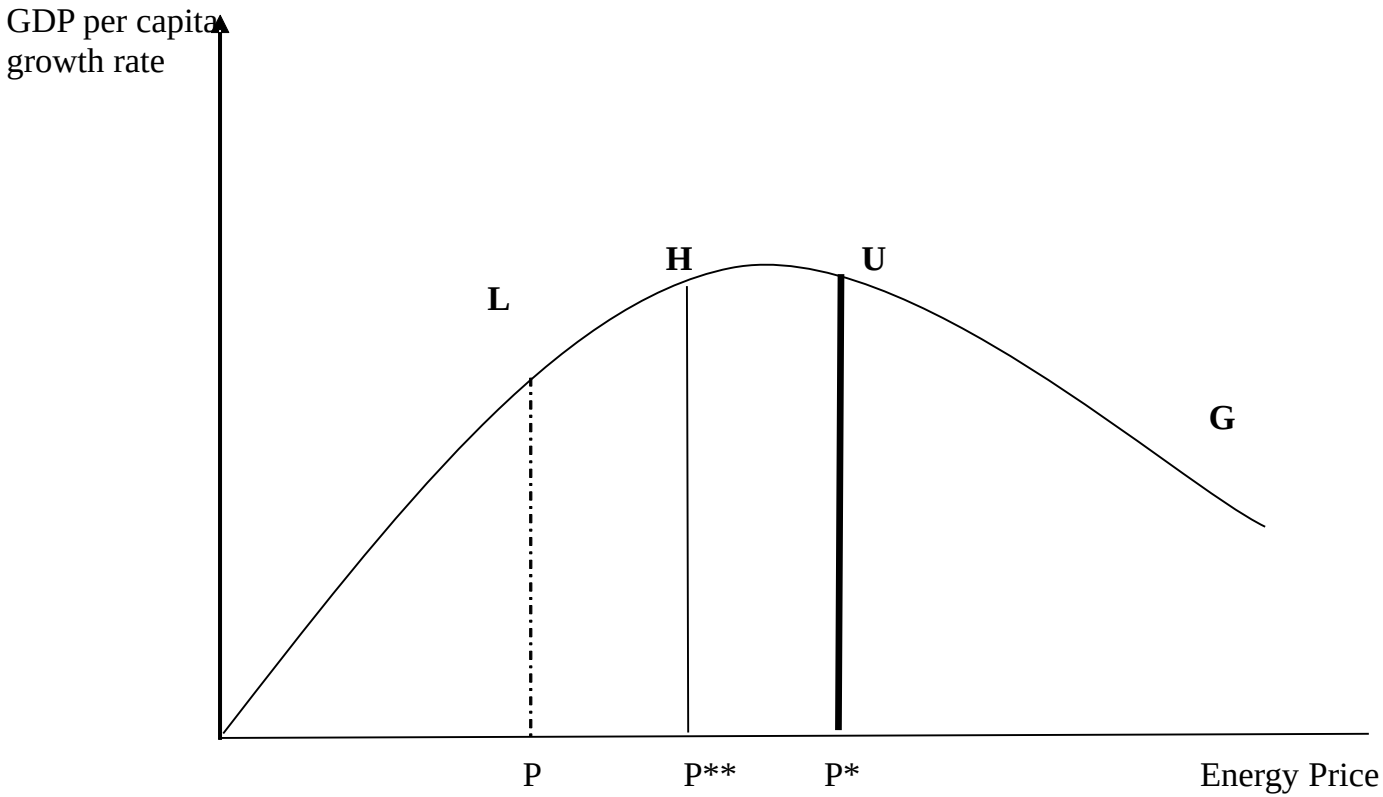
DEFINITION 2

1. Efficient pricing = Production cost + (transport and distribution costs) + Pigou tax **(P_g)**
2. The Pigou tax might include:

- Cost of supplying the product to the consumer (opportunity cost): P_1
- Consumption taxes: P_2
- Government's fiscal targets, P_F

Conceptual Background: *Relationship between energy prices and GDP per capita growth*

Figure 4



Conceptual Background:

Relationship between energy prices and GDP per capita growth

- A country that has originally a fossil fuel price equal to P but put into practice fuel subsidies, will experience higher economic GDP growth as energy price starts rising, i.e. subsidies start declining. We move from point **L** to point **H** along the curve for GDP growth rate (**G**).

  There could be *decreasing returns* to too high taxes (too high fuel cost) which could lead first to slower increases in GDP to finally starts decreasing as the fuel tax reaches its highest level of efficiency. We move from **H** to **U** along the curve **G**.

Our main results: *Relationship between energy prices and GDP per capita growth*

- A reduction in energy subsidies will increase rate of economic growth.

- This occurs through the elimination of negative externalities and the larger resources the government has available for public investments.

Empirical estimations: Cross-Sectional Analysis

1. A ***cross-section*** approach is used to analyze the *long-run effects*.

- The analysis considers relationships between GDP per capita growth on one hand, and the *price gap*.

- We study all the World Bank Regions in aggregate.

- Periods of study: (1998 – 2002); (2003 – 2007) and (2008 – 2013).

Cross Sectional Analysis. Excluding OECD countries: 2008 - 2012

For a given level of average subsidy, a 20 cents average increase in the diesel and gasoline price per liter has caused an average ***increase in GDP per capita growth*** rates by about 0.30 percent and 0.48 percent, respectively.

Econometric Analysis: cross-sectional

- *We here determine what is the effect on economic growth per capita when the price gap is positive (i.e. there is a tax) or the price gap becomes less negative (i.e. the subsidy decreases).*

- We estimate:

$$GDP_{per\,capita}\ growth_i = \alpha_{1c} + \beta_{1c}(price\ gap)_i + \varphi_{1c}(price\ gap)^2{}_i + \theta_{1c} I_{i,1998} + \eta_{ic}$$

- To accept our ***Hypothesis 1:*** β_{1c} should be positive and statistically significant.

Cross Sectional Analysis. No OECD countries: 2008-2012

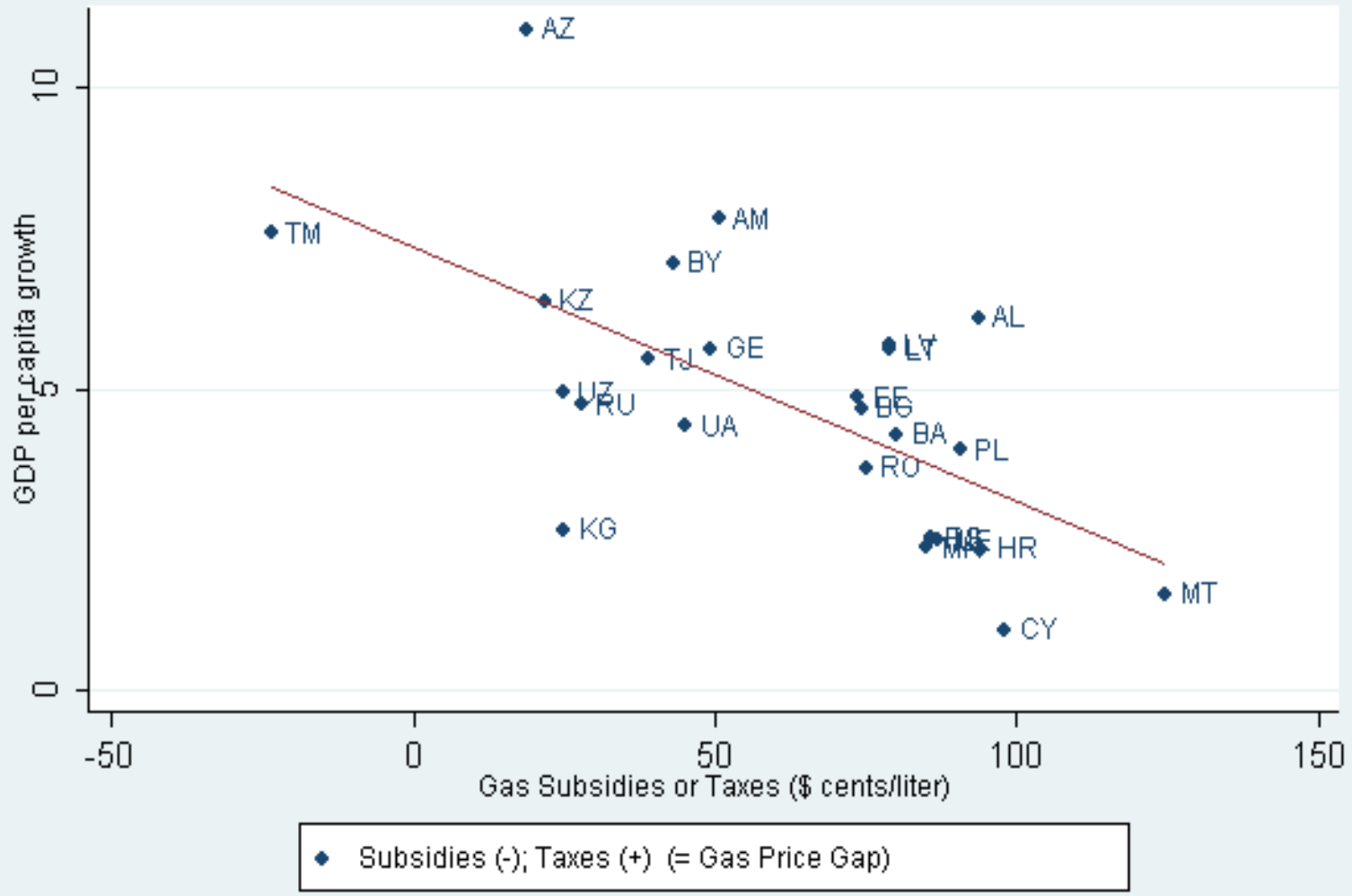
If the price gap is positive, there is a tax on this fuel; and a subsidy in the opposite case		
	Gasoline price increases (= price gap becomes positive or less negative)	Diesel price Increases (= price gap becomes positive or less negative)
Effect on GDP per capita growth (β_{1c})	**0.02396*** (0.00858)**	**0.01513** (0.00704)**

Figure 4. Correlation between GDP per capita growth and Estimated Gas Subsidies(-) or Taxes(+) ($ cents/liter)

MENA Countries. 1998 - 2012

Figure 5. Correlation between GDP per capita growth and Estimated Gas Subsidies(-) or Taxes(+) ($ cents/liter)

ECA Region Countries. 1998 - 2012



Cross-Sectional Analysis

- From observing the previous graphs, it becomes obvious that one needs to analyze these patterns by Region, and quantify the impact of fuel prices on the economic growth on the Regional basis.

- Such differentiation cannot be done by using the Cross-Sectional Approach.

Panel Data Analysis

2. A ***panel data analysis*** allows to study *short- and medium-run effects*.

- This analysis quantifies the contemporaneous and the two-year-lagged effect of the fuel price gap on economic growth. The analysis will be done by World Bank Region on the annual basis. We estimate:

$$GDP_{per\,capita}\ growth_{it} = \alpha_{1p} + \beta_{1p}(price\ gap)_{it} + \beta_{2p}(price\ gap)_{it-1} + \beta_{3p}(price\ gap)_{it-2}$$
$$\varphi_{1p}(price\ gap)^2_{it} + \varphi_{2p}(price\ gap)^2_{it-1} + \theta_{1p}I_{i,1998} + \tau_t + c_i + \eta_{it}$$

Panel Data Analysis

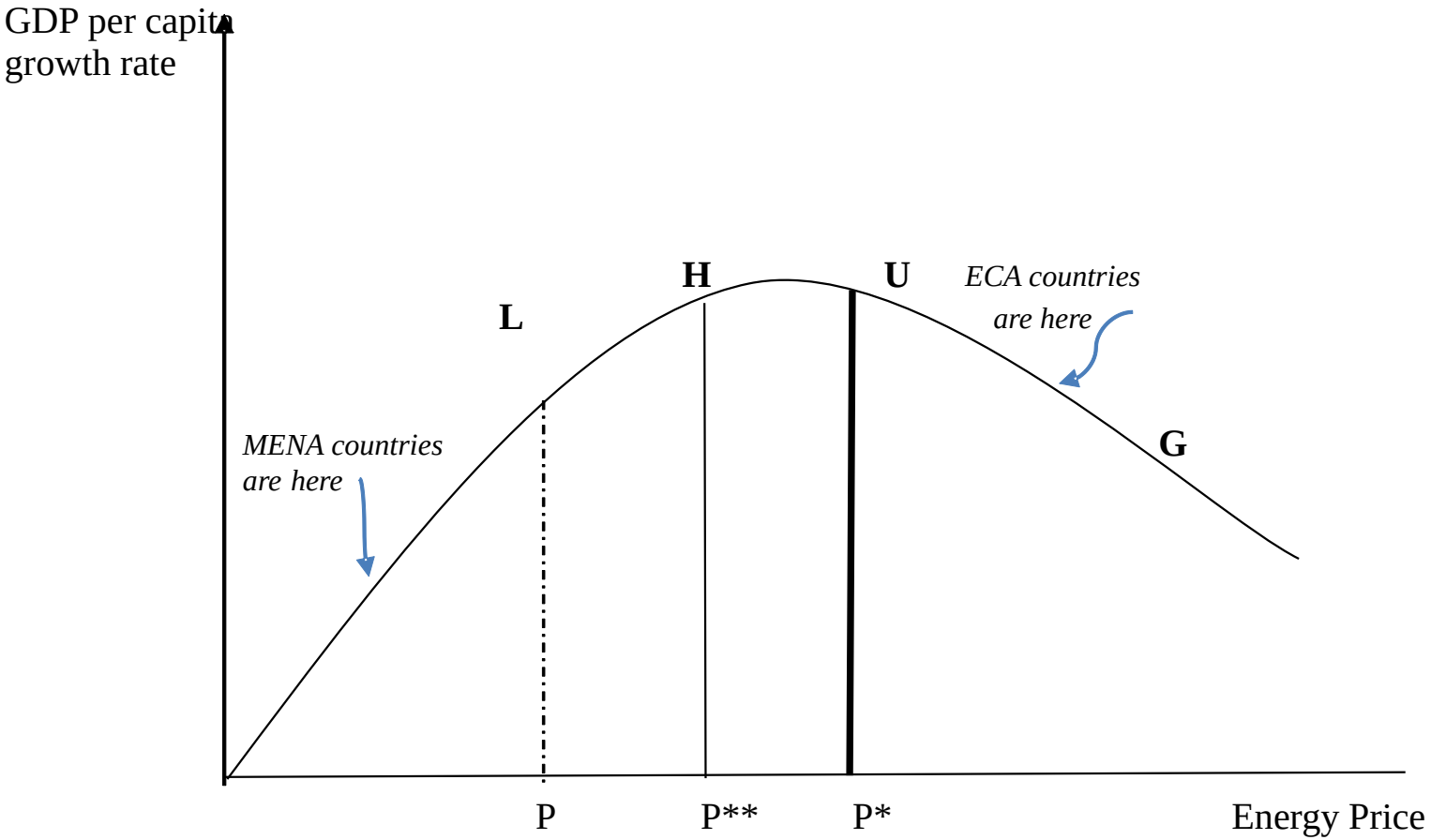
- The GDP per capita could start rising in the following periods via different “pathways” stimulated by the positive effects that the reforms have on government budget and social and infrastructure investment and reduction of negative externalities.

- In the meantime, enterprises gradually adjust their businesses to the more “correct” and new fuel price levels and their positive effects on externalities in the following periods.

Panel Analysis: effect on GDP per capita growth on past fuel price gaps (GMM)

RHS variable	MENA	ECA (minus OECD)
(Diesel price gap)$_{t-1}$	0.1311*** (0.0452)	-0.0465*** (0.0123)
(Gasoline price gap)$_{t-2}$	0.0853*** (0.0276)	-0.0343*** (0.00081)

Conceptual Background: *Relationship between energy prices and GDP per capita growth*



Channel Mechanisms: employment

- Contemporaneous effect of fuel price increases on employment (as for economic growth) is likely to be manifested mainly via increased fuel costs for businesses, which is likely to reduce employment in the short run (disregarding the effects of money transfers to the public).

- Nonetheless, any fuel price reform made today will be beneficial for employment in the subsequent periods.

Channel Mechanisms: employment

Effect on Labor Force Participation ages 15 to 24/Population, age 15+ (%)		
MENA		
Diesel Price Gap$_t$	Diesel Price Gap$_{t-1}$	Diesel Price Gap$_{t-2}$
-0.0196**	0.0345***	0.0087***
(0.0091)	(0.0056)	(0.0020)

Channel Mechanisms: health

Effect on Health Expenditures/GDP (%)		
MENA		
Diesel Price Gap$_{t}$	**Diesel Price Gap$_{t-1}$**	**Diesel Price Gap$_{t-2}$**
0.00946* (0.00167)**	**0.00254* (0.00147)**	-0.00189 (0.00196)
Gasoline Price Gap$_{t}$	**Gasoline Price Gap$_{t-1}$**	**Gasoline Price Gap$_{t-2}$**
0.00092 (0.00232)	**0.00968*** (0.00099)**	**0.00245** (0.00114)**

Channel Mechanisms: Education

Effect on Education Expenditures/GDP (%)		
MENA		
Diesel Price Gap2$_{t}$	**Diesel Price Gap2$_{t-1}$**	**Diesel Price Gap2$_{t-2}$**
0.00957* (0.00244)**	-0.00279 (0.00242)	-0.00629*** (0.00282)

Conclusions

- We first demonstrate that higher economic growth is possible by eliminating energy subsidies.

- Taxing energy has several positive effects. One of them is that it provides governments with more resources to make public investments necessary to increase GDP growth.

Conclusions

- We found that raising diesel taxes might reduce labor participation in the very short run (as subsidies are removed), including the youth population aged 15 to 24 in the MENA countries.

- **But** as the economy reallocates resources in response to the new energy prices, and with the help of better infrastructure and better supply of public services, labor market participation and employment increase substantially in subsequent years.

Fossil fuel subsidies and CO2

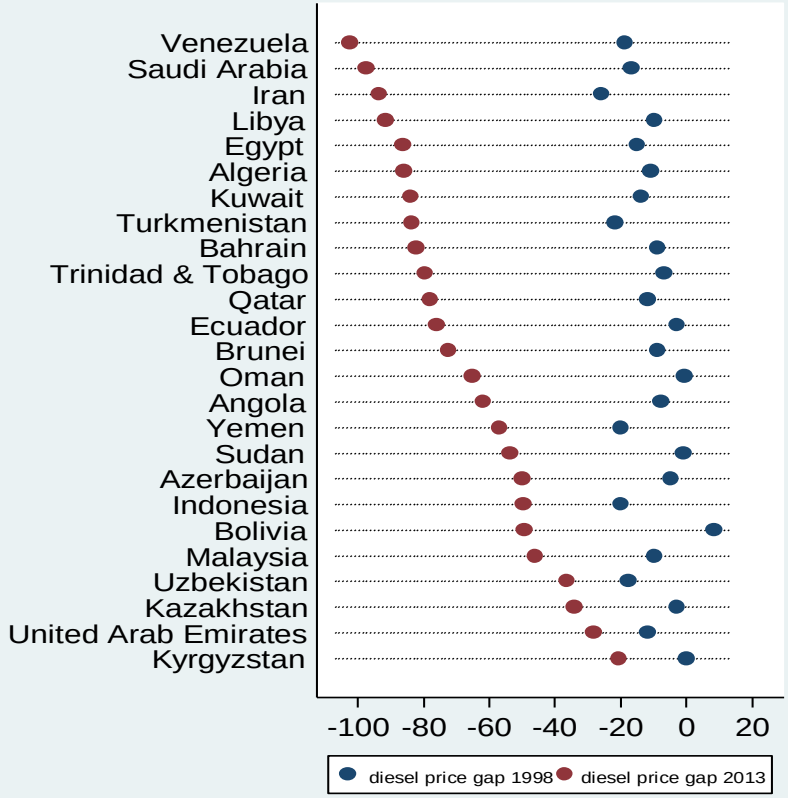
- We here need to estimate the short- and long-run demand for fossil fuels.

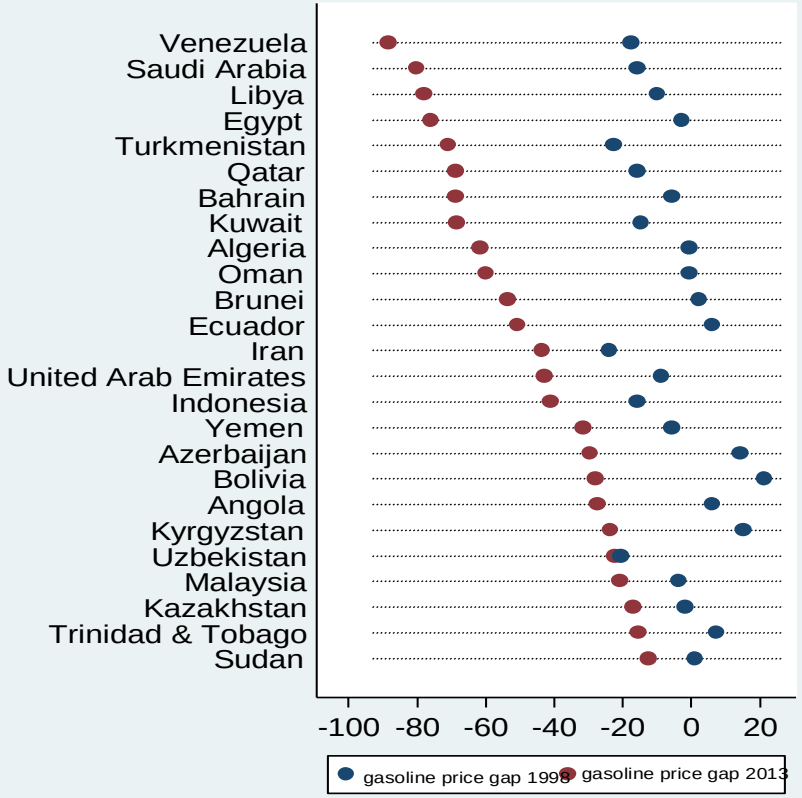
- We then estimate how much CO_2 emissions can be reduced if subsidizing countries increase their price of gasoline and diesel by 20 USD cents per liter.

Countries that have kept their fossil fuel prices fixed between 1998 and 2013

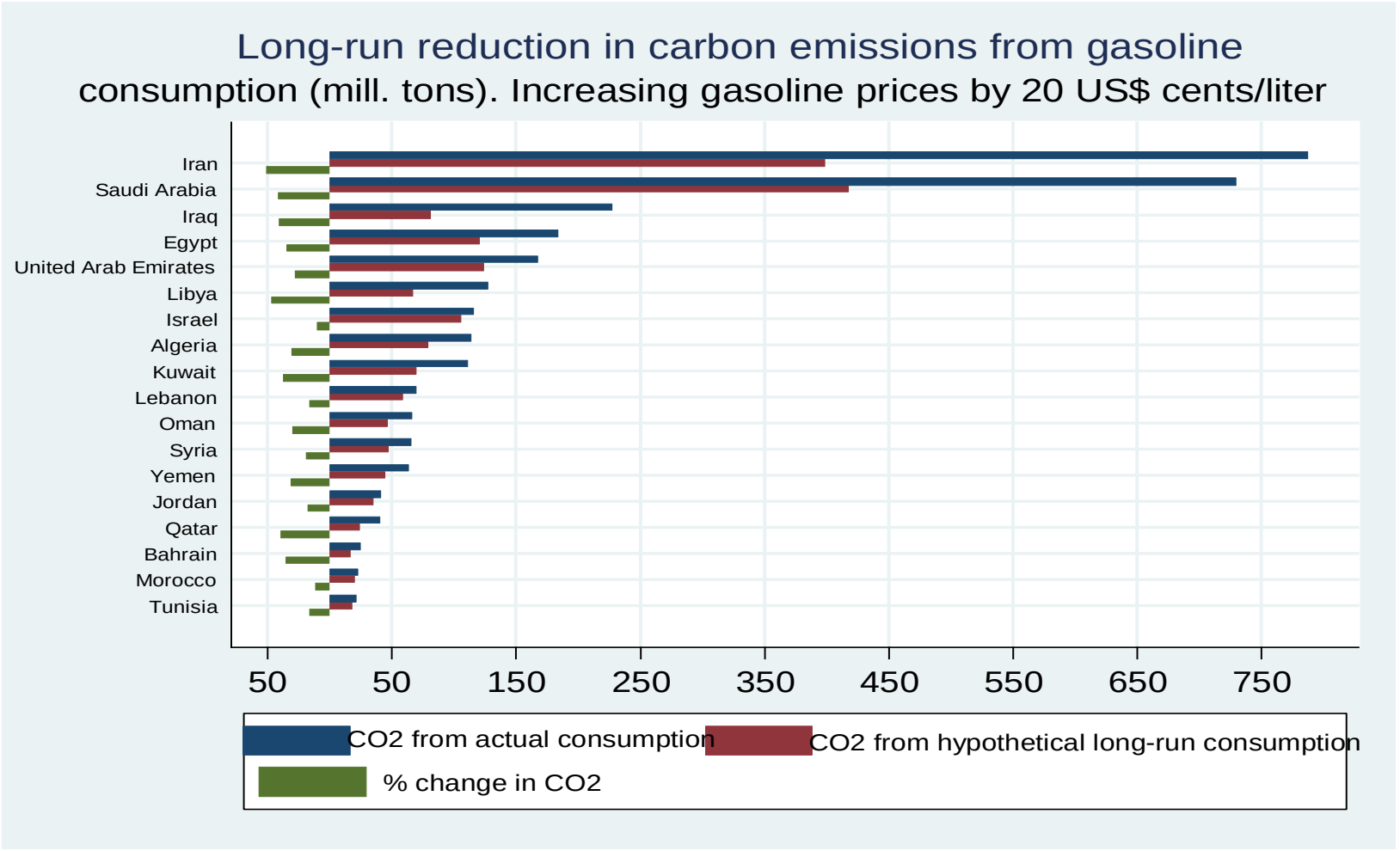
NON-REFORMERS: keeping fixed fossil fuel prices and rising subsidies

Koplow's fossil fuel gap prices ($ cents/liter). Subsidies (-). Taxes(+). 1998 - 2013

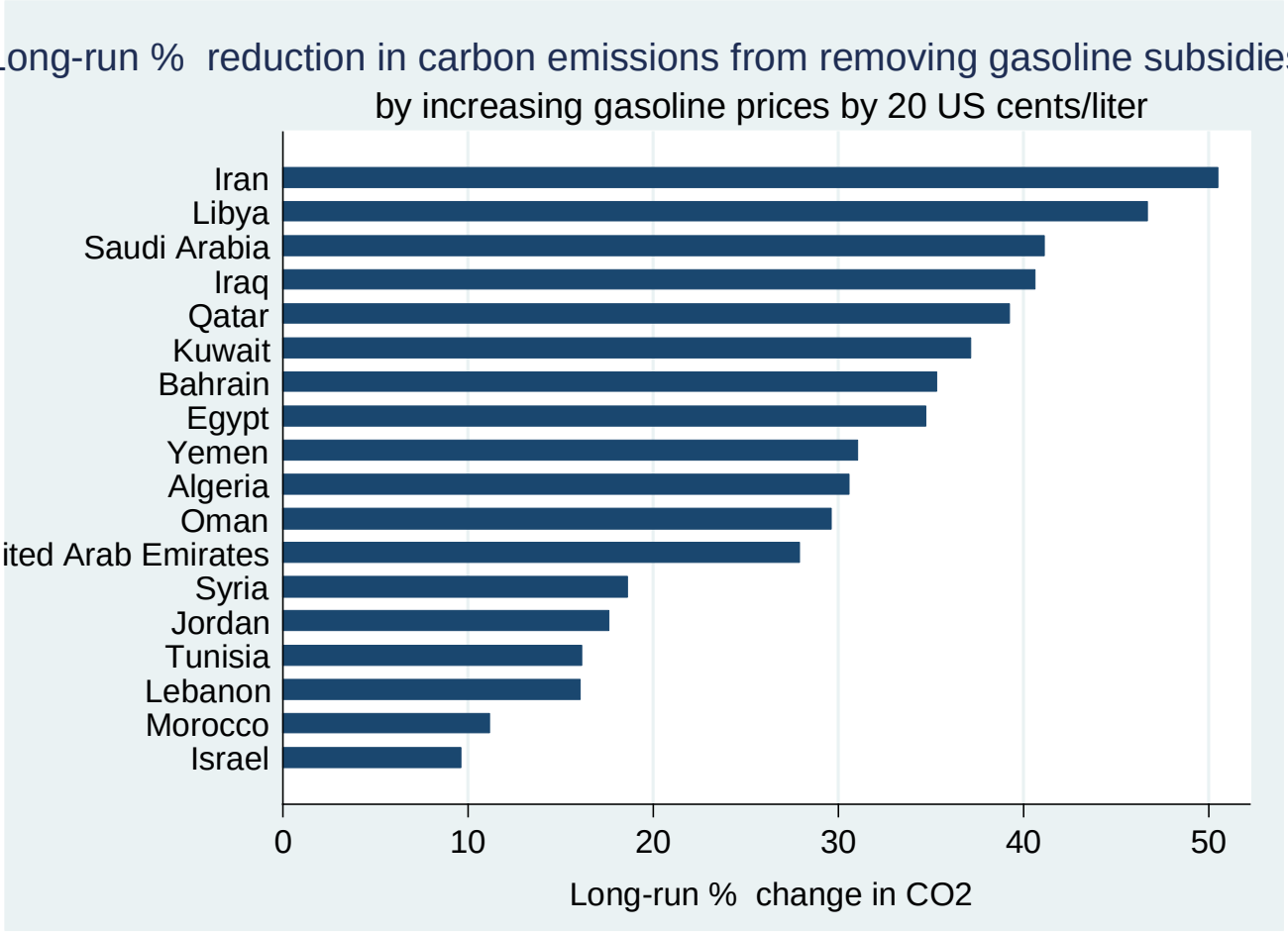




Total and Reduction of CO_2 emissions: MENA Region



Long-run Reduction of CO_2 emissions: MENA Region



Reductions in CO_2 emissions from increasing diesel and gasoline prices by 20 US$ cents per liter: OECD excluding Mexico

Country	CO_2 reduction diesel (%)	CO_2 reduction gasoline (%)	Country	CO_2 reduction diesel (%)	CO_2 reduction gasoline (%)	Country	CO_2 reduction diesel (%)	CO_2 reduction gasoline (%)
Australia	7.60	31.11	Greece	6.43	24.19	Norway	4.39	17.74
Austria	5.74	22.35	Hungary	5.65	23.10	Poland	6.50	24.68
Belgium	5.52	19.60	Iceland	6.90	20.23	Portugal	6.17	20.87
Canada	8.87	32.74	Ireland	5.33	22.07	Slovakia	13.72	37.70
Chile	9.39	29.17	Israel	6.78	21.70	Slovenia	6.16	25.36
Czech Republic	5.99	3.78	Italy	5.06	19.42	Spain	6.17	23.93
Denmark	5.12	19.43	Japan	6.5	22.74	Sweden	5.07	20.12
Estonia	7.27	28.65	Korea, South	6.89	21.44	Switzerland	5.08	22.98
Finland	5.49	19.11	Luxembourg	6.47	23.83	Turkey	5.75	19.34
France	5.53	20.03	Netherlands	5.44	18.54	United Kingdom	4.21	19.05
Germany	5.42	20.06	New Zealand	10.28	29.27	United States	10.25	39.71

CONCLUSIONS

- Assuming a scenario with an increase in the price of diesel and gasoline by 20 USD cents per liter, the reductions in the consumption and CO_2 emissions can be up to 50 percent in the MENA region.

- Our main message is that removing energy subsidies should pertain all (developed or developing) countries, and be part of any international agreement on reduction of CO_2 emissions. This will also have a positive effect in the economies of the subsidizing countries.