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The Value of a Barrel of Oil Saved in Saudi Arabia

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October 14, 2017

Takeaways

- ✓ Policies designed to curb oil consumption have positive impacts in terms of welfare, GDP, and carbon emissions, although the cost of the policy and the impact on productivity have a critical role.
- ✓ We find that the average welfare gains for all the policies studied is 25.4 dollar per barrel of oil saved. This number includes the potential decrease in the international the price due to the increase in Saudi exports.
- ✓ Among all the policies studied, we find that a car scrapping program, the deployment of renewable technology and programs that increase electricity productivity could be the most efficient in terms of welfare. These policies are relatively easy to escalate to a significant amount of oil saved (75,000 bpd), increase welfare between $530 and $1,213 Million annually and reduce CO2 emission by 10 Million tons annually.

Motivation and research question

- ✓ Saudi Arabia (KSA) has a high level of oil consumption due to the low price of domestic energy. The KSA is the largest oil exporting country in the world and, at the same time, has one of the highest levels of oil consumption per capita – 45 barrels per year compared to 22 in the US and 11 in Germany.
- ✓ The KSA has already taken measures to curb domestic oil consumption. The KSA raised the price of 91 and 95-octane gasoline by about 67% and 50% in January 2016. In addition, the KSA raised electricity and launched the National Renewable Energy Program to shift from fossil fuel to renewable technology in generation, with the aim of achieving to 9.5 GW of installed capacity by 2023.
- ✓ The difference between domestic price and international price represents an opportunity to allocate oil more efficiently.

Research question:

- ✓ What is the value of a barrel of oil saved domestically and instead exported – taking a long run perspective?

The textbook answer to the research question

✓ **What is the value of a barrel of oil saved domestically and instead exported?**

The marginal productivity of a barrel of oil across all activities and sectors would be identical and equal to its market price. For the KSA, this implies that, given the lower administered domestic prices of oil, its marginal productivity should be lower than the international price. The difference between domestic price and international price represents the potential benefit.

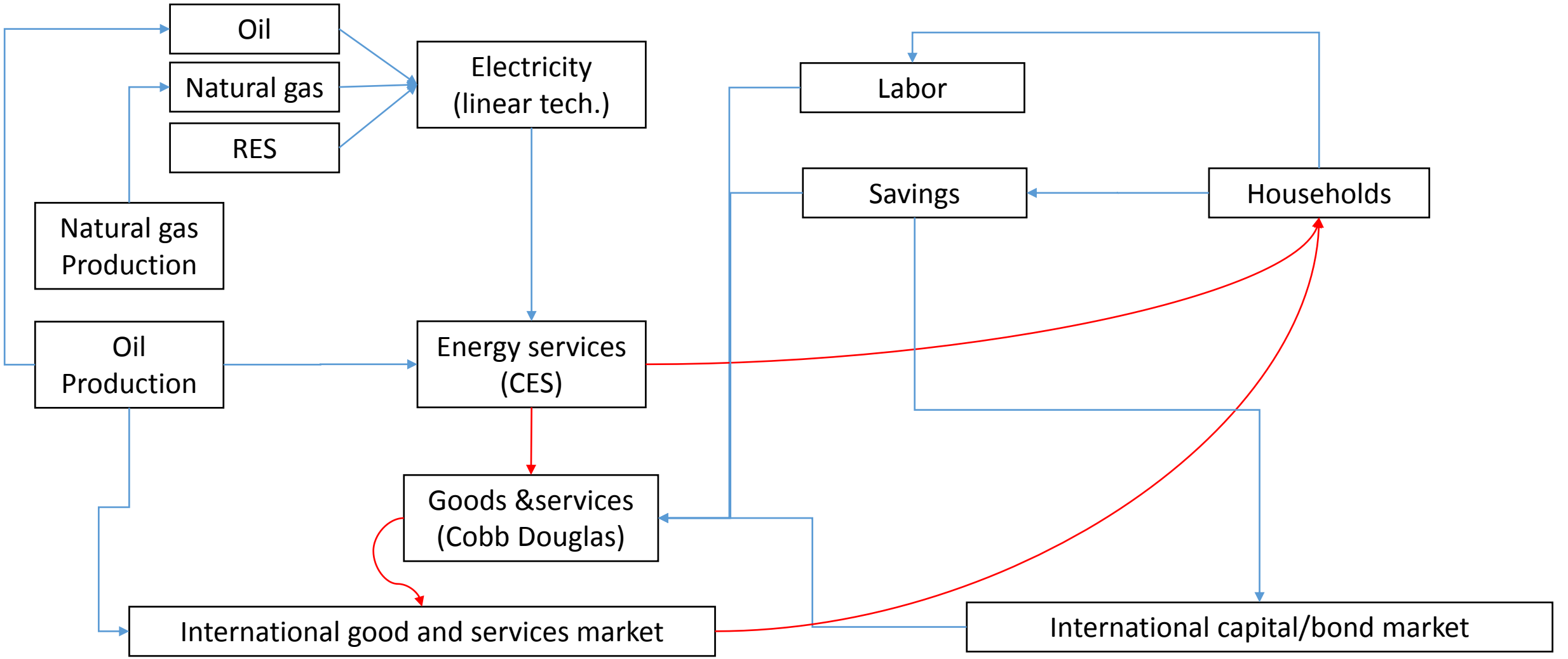
Nevertheless, **this answer is incorrect** for oil saved from domestic consumption in the KSA for three reasons.

- ✓ There are different ways or policies to reduce the domestic consumption of oil, having different costs.
- ✓ The global demand for Saudi oil is not perfectly elastic, which impacts the incremental revenues from exporting the oil saved.
- ✓ Different policies can have different on the rest of the economy

Description of the model

- A **general equilibrium model for a small open economy** calibrated for the KSA economy.
- There is **representative household** that works, consumes final goods and energy services and saves in the local market and in the international bond market.
- The **domestic price of oil is administered** and it is lower than the international price of oil.
- The **government** collects revenues from oil and gas exported (from international and domestic demand), finance public policies, transfers net revenues to households and runs a balanced budget.
- There is a **representative and competitive energy services company** that uses oil and electricity to produce energy services.
- A **representative firm uses labor, capital and energy services to produce final good and services** that are sold to the household and, potentially, in international markets.
- There is a **international price of oil response function**, linking Saudi exports and the price of oil.
- There are an **international market for bond and another for final goods and services** that allow the KSA economy to run a current deficit or surplus.

Description of the model



Structural parameters of the model

Caloric efficiency of oil to produce electricity	$\alpha = 0.32$
Caloric efficiency of natural gas to produce electricity	$\beta = 0.42$
Parameter associated with the production of energy services	$\lambda = -0.26$
Labor elasticity in the production of final goods and services	$\theta = 0.58$
Parameter associated with capital and energy services in the production of final goods and services	$\upsilon = -1.38$
Parameter associated with the risk aversion in the utility function of households	$\sigma = 0.5$
Parameter associated with private consumption and energy services in the utility of households	$\sigma_c = -0.33$
Parameter associated with relative preference between private consumption and energy services of the households	$d = 2.8 * 10^{-3}$

Selected Macroeconomic variables

	Actual data 1995–2014	Model
Oil exports / Oil produced	0.81	0.78
Electricity generation from oil / Electricity[a]	0.68	0.66
Total consumption / GDP	0.58	0.63
Private consumption / GDP	0.35	0.38
Public consumption (public transfers in the model) / GDP	0.23	0.25
Investment / GDP	0.21	0.21

Blazquez, Jorge, Lester C. Hunt, and Baltasar Manzano. "Oil Subsidies and Renewable Energy in Saudi Arabia: A General Equilibrium Approach." *The Energy Journal* 38 (2017): 1-17.

Description of the polices aimed to reduce oil consumption

✓ **Target of the policies**

Reducing the use of oil in the KSA and lead to an increase in oil exports. For all policies, oil is exported at the international price; the cost of the each policy is financed directly by the government; the extra revenues from oil exports are transferred to households as a lump-sum transfer, and the policy is sustained over time

✓ **Brief description of the policies**

- **Policy 1:** *Increasing the production of oil. (for the sake of completeness) (cost: 9.3 $/bbl)*

- **Policy 2:** *Increasing the production of natural gas to generate electricity (cost: 7.1 $/bbl)*
- **Policy 3:** *Increasing the efficiency of natural gas power plants. (cost: 4.4 $/bbl)*
- **Policy 4:** *Deploying renewable technology (cost: 16.4 $/bbl)*

Electricity generation

- **Policy 5:** *Increasing the administered price of domestic oil. (cost: no cost)*

Disincentivizing the use of energy

- **Policy 6:** *Increasing the efficiency (in the use) of electricity in the 'production' of energy services. (cost: 34.3 $/bbl)*
- **Policy 7:** *Increasing the efficiency (in the use) of oil and oil products in the 'production' of energy services. (cost: 15.2 $/bbl or 53.6 $/bbl)*

More efficient use of energy

Simulation results

Impacts of the policies per additional barrel exported in dollars of 2016 and kilograms					
	Without price reaction		With price reaction		
Policy	Gross welfare gain	Net welfare gain	Net Welfare gain	Rank	CO_2
1 Production of oil	45.4	36.1	26.7	4	+11
2 Production of natural gas	45.4	38.3	28.9	3	-144
3 Efficiency of gas power plants	45.4	41.0	31.6	2	-368
4 Renewable technology	45.4	28.9	19.7	6	-368
5 Price of domestic oil	27.1	27.1	17.8	7	-368
6 Productivity of electricity	71.0	35.5	26.2	5	-368
7a Efficiency of oil (scrapping program)	71.0	55.2	45.7	1	-368
7b Efficiency of oil (hybrid program)	71.0	15.6	6.4	8	-368

- The results suggest that on average the 'marginal value' of a barrel of oil saved in the KSA (Policies 3, 4, 6, 7a and 7b) **is $25.4 for an international oil price of 55.4 $/bbl.**

- We highlight that **the negative impact due the oil price response**, the gap between the net welfare gain with price reaction and net welfare gain without price reaction, **is around $9.3 on average.**

Scalability of the programs

The KSA policymakers are likely to want to consider the impact of saving and exporting significantly more than one bpd. It is important to consider the technical possibilities of escalating the amount of oil saved and exported.

We explore the possibilities for increasing exports significantly above one additional barrel of oil a day; in particular increases of oil additional exports of 75,000 bpd and 375,000 bpd are considered.

Policy	Target 75,000 bpd	Target 375,000 bpd
1 Production of oil	Feasible	Feasible
2 Production of natural gas	Feasible	Feasible
3 Efficiency of gas power plants	Technically feasible	No feasible
4 Renewable technology	Feasible	Technically feasible
5 Price of domestic oil	Feasible	Feasible
6 Productivity of electricity	Feasible	Technically feasible
7a Productivity of oil (scrapping)	Technically feasible	No feasible
7b Productivity of oil (hybrids)	Feasible	No feasible

The main lesson from this initial analysis is that to increase oil exports substantially (above 75,000 bpd), the KSA government would need to increase the production of oil and/or natural gas, or increase the administered domestic price of oil.

Welfare gains of policies aimed to save 75,000 bpd

Annual impacts of the policies to increase oil exports by 75,000 bpd				
	$ Million			Millions of tons
Policy	Welfare	GDP	Net public revenues	CO_2
1 Production of oil	730	1,157	915	+0.2
2 Production of natural gas	790	1,157	975	-4,0
3 Efficiency of gas power plants	850	1,157	1,035	-10,1
4 Renewable technology	520	1,157	705	-10,1
5 Price of domestic oil	472	254	1,510	-10,1
6 Productivity of electricity	605	2,335	-328	-10,1
7a Productivity of oil (scrapping)	1,213	2,355	261	-10,1
7b Productivity of oil (hybrids)	51	2,316	-864	-10,1

- The main insight from Table 5 is that 75,000 bpd saved in the KSA increases welfare and reduce carbon emissions
- Policy 7a, Policy 4 and Policy 6 are the best policies from a policymaker standpoint, since they are easy to escalate, increase societal welfare and reduce CO2 emission by 10 Million tons annually.
- The potential disadvantage of *Policy 6* and *Policy 7a* is that the high cost harms public revenues.

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Thank you for your attention