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Oil prices, socio-political destabilization risks, and future energy technologies

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ABSTRACT

Our review of some modern trends in the development of energy technologies suggests that the scenario of a significant reduction of the global oil demand can be regarded as quite probable. Such a scenario implies a rather significant decline of oil prices. The aim of this article is to estimate the sociopolitical destabilization risks that such a decline could produce with respect to oil exporting economies. Our analysis of the relationship between changes in oil prices and political crises in these economies shows a large destabilizing effect for price declines in the respective countries. The effect is highly non-linear, showing a power-law type relationship: oil price changes in the range higher than $60 per barrel only exert very slight influence on sociopolitical instability, but if prices fall below this level, each further decrease by $10 leads to a greater increase in the risks of crises. These risks grow particularly sharply at a prolonged oil price collapse below $40 per barrel, and become especially high at a prolonged oil price collapse below $35 per barrel. The analysis also reveals a fairly short-term lag structure: a strong steady drop in oil prices immediately leads to a marked increase in the risks of sociopolitical destabilization in oil-exporting countries, and this risk reaches critical highs within three years. Thus, the possible substantial decline of the global oil demand as a result of the development of the energy technologies reviewed in the first section of the present article could lead to a very substantial increase in the sociopolitical destabilization risks within the oil exporting economies. This suggests that the governments, civil societies, and business communities of the respective countries should amplify their effort aimed at the diversification of their economies and the reduction of their dependence on the oil exports.

1. Energy for societies, past and future

Performance and the very existence of industrial and postindustrial economies depend on energy resources, particularly fossil fuels. From the natural science point of view, everything that happens in macroworld is caused by, or equivalent to, energy transformations. Physical chemist and Nobel Laureate Frederick Soddy wrote in *Wealth, Virtual Wealth and Debt* (Soddy, 1926, p. 56):

> If we have available energy, we may maintain life and produce every material requisite necessary. That is why the flow of energy should be the primary concern of economics.

William Stanley Jevons, who was one of the founders of neoclassical economics, arguably the dominant school of economic thought in the 20th century, forecasted that the British Empire was going to decline, when its coal mines are exhausted, as he stated in *The Coal Question; An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal-Mines* (Jevons, 1906):

> Coal in truth stands not beside but entirely above all other commodities. It is the material energy of the country – the universal aid – the factor in everything we do. With coal almost any feat is possible or easy; without it we are thrown back into the laborious poverty of early times.

Indeed, after its "peak coal" and World War I, the UK had been surpassed by the US. However, Jevons did not see oil coming. Nevertheless, the empire on which the sun never sets, drastically reduced in size and international significance. Coal-based UK dominance was replaced with the dominance of the gasoline powered US. Internal combustion engines radically changed industries and economies. However, the demand in oil may also decline substantially in the forthcoming decades due to the development of some alternative energy technologies.

Global wind power may provide > 70 TW with existing

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technologies annually (Archer and Jacobson, 2005). Moreover, the amount of sun radiation received by the planet is about 23,000 TW per year, and that is only for continents (Perez and Perez, 2015). Modern renewable energy technologies depend on rare metals and other materials, which can become bottlenecks. Although, they are usually recyclable (Viebahn et al., 2015), reserves of neodymium and yttrium may become bottlenecks due to geopolitical considerations (Been, 2014). After the era of finite fossil fuels, rational decision would be to go with renewable energy, especially given amounts of potentially available resources.

While production of wind turbines requires rare materials, their use depends on available physical space, since costs of production naturally invite economy of scale for the turbine size, resulting in large turbines. Offshore wind farms are placed where they do not affect sea traffic routes. Onshore wind farms placement is more problematic, because electricity transmission is relatively expensive and electricity consumption occurs where people live, which means restrictions in the land availability for wind turbines (“not in my backyard” problem). However, it was estimated that providing 50% of the world's electricity consumption through wind power would take only 47 km^2 (Jacobson and Delucchi, 2011).

Photovoltaic systems are more flexible than wind farms in regard to land use. Moreover, placing them on rooftops converts wasted space into the site of energy production. Photovoltaic systems' energy return on energy investment (EROI) is about 10 to 25 for modern technology, and is expected to reach up to 60 in 2020 (Görig and Breyer, 2016). This, of course, depends on geography and seasonality. Placing photovoltaic panels in deserts where supply of sun radiation is better than in other places, meets certain limitations due to decrease in efficiency at high temperatures. Cooling them, which could partially solve this problem, is hardly an option for arid areas, such as the Sahara, Atacama, or even California (Skoplaki and Palyvos, 2009).

Energy production from biomass may also find its' market in certain geographic regions. However, agriculture is heavily subsidized in developed countries today. Replacing food crops with bioethanol sources would undermine farmers' incentives, since bioethanol EROI for most sources is below 3, which is well below conventional sources (Hall et al., 2014).

Hydroelectric power can provide 3–4 TW annually (Perez and Perez, 2015). However, an important feature of hydro-power is that it can be turned on almost immediately, unlike coal and natural gas power plants, for which lag is at the scale of hours. This provides perfect opportunities for energy storage, so called pumped storage (Glasnovic and Margeta, 2015). Pumped storage does not require rivers, and can operate everywhere, at above zero temperatures. In the case of sub-zero temperature, pumped storage can work with non-water liquids, ironically, including gasoline.

Although nuclear power meets concerns regarding environmental issues and possible terrorist threat, nevertheless, slow progress on true renewables creates niche for nuclear power reactors (Darmani et al., 2014; Elliott, 2017; Khatib and Difiglio, 2016; Pahle et al., 2016). Moreover, Fast Breeders offer extension for the nuclear power resource base for > 1500 years, since they are able to utilize isotope ^{238}U, comprising 99.28% of the Earth's uranium, and not usable with presently dominating technology. Not less important, Fast Breeders will also be able to use thorium, which exceeds amounts of uranium in the Earth by a factor of two (Mahoney et al., 2015; Marchenko and Solomin, 2013; Nash, 2015; Sarangi, 2017).

Perspectives of nuclear fusion is hard to discuss here. Whether or not it will move from the realm of physics research to economic opportunities in more or less the near future, is not clear. However, progress in this field should be monitored, since it potentially offers unlimited supply of energy and all the corresponding consequences for humankind.

Oil accounts for 40% of energy consumption, with 65% of it used in transportation, whereas electricity accounts for about 18% of total energy consumption (IEA, 2016). Given that most of renewable energy end consumption should occur via electric power outlets, transition to renewables also depends on electricity transmission systems. Thus, electric vehicles become a critical point in transition to renewables, and their development could lead to a very significant decline of oil consumption (Dallinger et al., 2017; Hedegaard et al., 2012). Another option would be hydrogen cells, which are usable for individual vehicles (and other small scale applications), as well as for large electric networks (Cho et al., 2016; Schiebahn et al., 2015).

Unlike other energy technologies, natural gas besides electricity production, can be consumed regardless of electric grids, for central and residential heating, as well as for transportation. Thus, a decrease in oil supply will be (and already is) compensated with natural gas (Hedegaard et al., 2012), until economical electricity storage and smart grids change the field. The present oil consumption infrastructure is well compatible with the one for natural gas, and requires only minor modifications, including transportation. Importantly, a switch to natural gas from oil and coal significantly reduces CO_2 emissions.

Thus, our review of some modern trends in the development of energy technologies suggests that the scenario of a significant reduction of the global oil demand can be regarded as quite probable. Such a scenario implies a rather significant decline of oil prices. The aim of this article is to estimate the sociopolitical destabilization risks that such a decline could produce with respect to the oil exporting economies.

2. Oil prices and sociopolitical destabilization in oil exporting economies

The role of oil in the political stability of oil-exporting countries has long attracted the attention of researchers. The question is, of course, multifaceted. Thus, a significant number of papers show that oil-exporting states have a significantly greater risk of involvement in various types of armed conflict than other states (for a detailed review of such works see Nillesen and Bulte, 2014, also Colgan, 2010).

Regarding internal instability, two main hypotheses have been developed. One hypothesis points out that oil (and other valuable resources) provide funding for the insurgents, as well as the motivation for attempts to seize power – the so-called “greed model” (Collier and Hoeffler, 2004). Another common hypothesis states that dependence on export of natural resources leads to a weakening of the state — the so-called “Dutch disease” (Fearon, 2005; Fearon and Laitin, 2003).

A number of studies have shown an increased likelihood of violent internal conflicts in the oil-exporting countries as compared to other countries (Collier and Hoeffler, 2004; Ross, 2004a, 2004b, 2012; Fearon, 2005; Humphreys, 2005). Lujala (2010) finds that oil substantially prolongs conflict when located inside the conflict zone. Bell and Wolford (2015) show that in poor countries the discovery of new oil fields alone (even before the start of actual mining) significantly increases the likelihood of internal conflict. Moreover, the probability of civil wars in the countries producing oil, gas and diamonds is found to have increased in the period from the beginning of the 1970s until the end of the 1990s (Ross, 2006).

One should note, however, that there is still no fully unanimous agreement in this field — some works (e.g., Cotet and Tsui, 2013) point at the absence of a significant link between the discovery of new oil fields and the onset of internal conflicts, coup attempts, and civil wars; others (Soysa and Neumayer, 2007) find no relation between a country's oil resources and the onset of civil wars; finally, it is stated that in oil-rich countries corruption can lead not to increasing destabilization, but, on the contrary, to the strengthening of the regime through providing the means to bribe opposition groups (Fjelde, 2009).

Most of the works cited above use either the volume of a country's proven oil reserves or its oil exports as percent of GDP as their independent variables. However, Smith (2004) has argued that such an approach, omitting changes in the current pricing of oil, can lead to contradictory results. For example, if prices are rising, large oil reserves