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The long-run macroeconomic impacts of fuel subsidies

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ABSTRACT

Many developing and emerging market countries have subsidies on fuel products. Using a small open economy model with a non-traded sector, I show how these subsidies impact the steady state levels of macroeconomic aggregates such as consumption, labor supply, and aggregate welfare. These subsidies can lead to crowding out of non-oil consumption, inefficient inter-sectoral allocations of labor, and other distortions in macroeconomic variables. Across steady states, aggregate welfare is reduced by these subsidies. This result holds for a country with no oil production and for a net exporter of oil. The distortions in relative prices introduced by the subsidy create most of the welfare losses. How the subsidy is financed is of secondary importance. Aggregate welfare is significantly higher if the subsidies are replaced by lump-sum transfers of equal value.

1. Introduction

Subsidies on petroleum products are an important policy issue for many developing and emerging market economies. One reason is the sheer cost these subsidies impose on the governments that provide them. Data from the International Energy Agency (IEA) and the International Monetary Fund (IMF) provide many examples for net oil importing countries where the subsidies are on the order of 1 to 2% of GDP, sometimes higher. For net oil exporting countries, the subsidies are often much larger. Despite their costs, these subsidies are difficult to remove once in place and attempts to remove them, even partially, have often failed. This has been true even with the significant increase in oil prices seen over the last decade.[1]

Given their cost and persistence, it seems probable that these subsidies have important macroeconomic implications. This paper asks three interrelated questions in regards to this. First, how do these subsidies affect macroeconomic variables and aggregate welfare in the long-run? Second, what role does the method of financing the subsidy play in those results? Finally, does the distinction between being a net importer or exporter of oil matter?

To answer these questions, I construct a small open economy model with traded and non-traded sectors where households and firms use oil. The government subsidizes oil by selling it below its world price. The subsidy considered in this paper is a permanent (long-run) feature of the economy. As such, it distorts the steady state and imposes a permanent financing constraint on the government.[2]

Two variants of the model are considered. The first is an economy that has no domestic production of oil. This variant is referred to as the net oil importing model. In this model the government finances the subsidy through one of three tax instruments: a non-distorting lump-sum tax, a tax on labor income, or a tax on non-oil consumption. In the second variant, the net oil exporting model, the government has an endowment of oil that is greater than the domestic consumption of oil. In this case the government provides the subsidy by simply selling part of its oil endowment below the world price of oil.

For the net oil importer case, the results show that the subsidy reduces aggregate welfare across steady states.[3] For a subsidy that costs 1% of GDP the welfare losses are relatively minor, but the losses increase substantially for larger subsidies. Surprisingly, the method used to finance the subsidy has relatively little impact on this result. The distortion in relative prices introduced by the subsidy is responsible for the bulk of the welfare losses. This is confirmed by considering the losses that would occur if the government simply removed the subsidy and offset it with lump-sum transfers of equal cost. The aggregate welfare losses under the subsidy are anywhere between 15 to 25 times higher than the losses under the transfers.

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[1] For more evidence please see (Baig et al., 2007) and (Coady et al., 2010).

[2] Some governments do not distort domestic fuel prices in the long-run but do smooth them out in the short-run by temporarily limiting the pass-through of a change in world prices. Chile is one such example. Considering these policies requires looking at short-run dynamics and working with second-order approximations to the model. Given the different nature of such short-run subsidies, this is left for future research.

[3] Note these results do not provide any answers about how different groups within the economy are impacted, only how the economy as a whole is. It is quite possible that different groups may have higher or lower welfare depending upon how much of the subsidy they receive and how much of the tax burden they bear, among other things. This is also an interesting avenue for future research.

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In the net oil exporter case, the government does not need to rely on an explicit tax to finance the subsidy. Surprisingly, the different financing method available to net exporters does not significantly alter the aggregate welfare results compared to the net oil importer case. This is due to the fact that the distortion in relative prices is the main reason that aggregate welfare is lower. That feature of the subsidy is exactly the same whether the country is a net oil exporter or importer.

Underlying the welfare results are the actual changes in macroeconomic variables that occur because of the subsidy. Regardless of how the subsidy is financed, it leads households and firms to overconsume oil products, drives up wages in the economy, and increases production in the traded sector. The subsidy also distorts the relative price of non-tradables to tradable goods.

The change in other macroeconomic variables, such as non-oil consumption, production in the non-traded sector, and labor supply, depends upon the tax instrument used to finance the subsidy. Essentially, households pay for the higher taxes required to finance the subsidy through some combination of lower non-oil consumption and higher hours worked. The exact breakdown depends upon which tax instrument is used because they distort household behavior in different ways. Using labor or consumption taxes to finance the subsidy usually leads to a crowding out of non-oil consumption. This in turn lowers production in the non-traded sector and leads to an inefficient allocation of labor across sectors as labor flows out of the non-traded sector into the traded sector. All of these are important effects of a fuel subsidy typically not discussed by policy makers when considering the pros and cons of the subsidy.

There is a large literature that focuses on oil and the macroeconomy. To my knowledge, this is the first paper in that literature that looks at the long-run macroeconomic impacts of fuel subsidies and the fiscal policy issues associated with them.[4] Several IMF working papers, such as (Coady et al., 2006) and (Kpodar, 2006), have considered the distributional impacts of removing fuel subsidies on household expenditure by using social accounting matrix and input–output models. However, those models generally abstract from the fiscal policy aspect of the subsidy. As a consequence, removing a subsidy is unambiguously "bad" in those models because it means higher prices for all households. My model, which incorporates fiscal policy and general equilibrium effects, suggests things may be more complicated. While removing the subsidy forces households to pay higher fuel prices, it also implies lower taxes and reduced deadweight losses in the economy.

A related literature focuses on monetary policy responses to changes in the price of food, another good often subsidized in developing countries. For example, (Catao and Chang, 2010) explore the role food prices play in determining what price index a central bank should stabilize in a small open economy. (Anand and Prasad, 2010) consider a similar question in a two sector New Keynesian model where there is a flexible price "food" sector and a "non-food" sector which has sticky prices. Agents who work in the food sector are unable to smooth consumption over time due to a credit constraint. Both of these show that under certain conditions a central bank may want to stabilize headline inflation as opposed to the usual result of stabilizing sticky-price inflation. Neither paper incorporates subsidies.

The rest of the paper proceeds as follows. In the second section I motivate the paper by presenting some data on fuel subsidies. The third section introduces the model economy for the net oil importer case. The results for this case are presented in the fourth section. The fifth section presents results for the net oil exporter case. Section six shows results for sensitivity analysis. Section seven concludes.

[4] (Aissa and Rebei, 2012) considered optimal monetary policy in a two sector, closed economy New Keynesian model where the government stabilizes the price of one of the goods in the short-run. However, the subsidy in (Aissa and Rebei, 2012) is a short-run phenomenon only and their analysis focuses on monetary policy, not fiscal policy.

2. Empirical motivation

This section presents some evidence on the prevalence and size of fuel subsidies, and energy subsidies more generally, from 2000 to 2012.[5] The main source of data on these subsidies comes from the IEA, the IMF, and several other international agencies. For this reason, I first discuss how these agencies define and measure energy subsidies. I then document some features of the data available from them and conclude by giving more detail on the specifics of energy subsidies in three countries.

2.1. Defining subsidies

The IEA focuses on subsidies that lower the price consumers pay for oil products, natural gas, coal, or electricity generated with one of those fuels.[6] These subsidies tend to be the easiest to quantify and, in terms of their size, appear to be the most important for the time frame being considered. The working definitions of other institutions, such as the IMF, appear to be quite similar in practice so they are not discussed explicitly.

To identify and quantify the size of these subsidies, the IEA follows (Larsen and Shah, 1992) and uses the price-gap approach. In this approach, subsidies are measured by calculating the gap between a domestic retail price and a reference price which attempts to measure the true economic cost of the product being subsidized.

Estimates of subsidies calculated using the price-gap approach can reflect both opportunity costs and explicit costs. For a country with no oil production, the subsidy is an explicit cost, one typically paid for by the government. For a net oil exporter, the subsidy is typically an opportunity cost because in many cases the government simply sells domestically produced oil below its world price. The estimate then simply reflects the foregone revenue from not selling the oil at its economic cost. For a net oil importer with some domestic production, the estimate is both an explicit cost and an opportunity cost.

2.2. IEA data on fuel subsidies

Currently, the most comprehensive publicly available data set on energy subsidies is from the IEA. These are annual estimates, in billions of dollars, on the size of consumer subsidies on oil products, natural gas, coal, and electricity generated using fossil fuels in a total of 37 countries. The data begin in 2007 and end in 2011. Here I touch upon some of the more relevant features of the data for this paper. Those interested in more detail should refer to (IEA, 2010) or (IEA, 2011).

For the 5 years considered, the total value of all energy subsidies across all 37 countries was $342 B, $555 B, $311 B, $412 B and $523 B, respectively. Changes in any given year were to a large extent driven by changes in the price of oil. Subsidies on oil products made up the largest share of the total, on average a little under 50%. Out of the 37 countries identified as having a subsidy, 34 had subsidies on oil products, of which 21 were net oil exporters and 13 were net oil importers.[7]

One way to rank which country has large subsidies is by considering the dollar value of the subsidies in place. If one ranks countries by this metric, then the biggest subsidizers are generally either net oil importers that have large populations, such as China or India, or important net oil exporters, such as Iran or Saudi Arabia. For illustrative purposes the top panel in Table 1 uses the 2011 data to rank the top five net oil importing and exporting countries in that year.

For the issues considered in this paper, a better measure to consider is the size of the subsidies in relation to an economy's GDP. This provides some information on how much of a cost the subsidies impose on the

[5] Data on fuel subsidies in the 1980s and 1990s was sparser. For that reason, this section focuses on the time frame mentioned.

[6] For the exact definition please refer to (IEA, 2010) or (IEA, 2011).

[7] Countries are defined by the author as net oil exporters or net oil importers using data on annual oil supply and consumption from the Energy Information Administration (EIA) International Energy Statistics.