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FOSSIL-FUEL SUBSIDY REFORM AND THE LINK BETWEEN POPULAR OPPOSITION AND INFORMATION

Amalia Bringéus (22879) Tove Forsbacka Karlsson (22880)

Abstract

Fossil-fuel subsidy reform stands high on the international agenda. Fossil fuels are generously subsidised despite the fact that unambiguous research shows that the subsidies cause crowding out of public social spending, fiscal pressure, higher emission of greenhouse gases and increased social inequality. Popular opposition constitutes one of the main barriers to subsidy reforms and a deeper understanding of it is of both national and global importance, as it could facilitate the phasing-out of fossil-fuel subsidies. In this paper we study the role information has on people's attitudes towards fossil-fuel subsidy reforms. By developing a theoretical framework we show why uninformed individuals are more likely to oppose reforms: as they are not aware of subsidies' aggregate impact they misjudge their utility. We test the framework's predictions by applying a probit model to data on Indian households. The empirical results substantiate the theoretical findings of a stronger opposition amongst uninformed individuals.

Keywords Political economy of reforms, fossil fuel subsidies, information
JEL D11, D83, Q48

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1. Introduction

World leaders collectively take a stand against fossil-fuel subsidies. At the G20 meeting in 2009, the union committed to phase out inefficient fossil-fuel subsidies that encourage wasteful consumption. Christine Lagarde, managing director of the International Monetary Fund, declared in 2013 that "[e]nergy subsidies are enormous in scale, and they help the people who need them least. Taking action on this issue alone would be good for the budget, good for the economy, and good for the planet." The launch of the United Nations Sustainable Development Goals and the Paris Agreement in 2015 make action against wasteful energy consumption more topical than ever. The negative impact caused by fossil-fuel subsidies does not only affect the countries deploying them, but the world as a whole, since they lead to increased greenhouse gas emissions, precipitating climate change, and accelerate the depletion of global fossil fuel reserves. How to successfully implement fossil-fuel subsidy reforms is a challenge of international importance and there is an urgent need of advancement of knowledge in this field.

Progress in fossil-fuel subsidy reforms has been slow and subsidies remain high. Energy plays a central role in the economy and reforms in the sector seldom come without complications. Several studies on the subject state that popular opposition is an important barrier that is holding governments back. Bad historical records, where large groups of society have been involved in dramatic political violence, protests and riots, have scared governments that would like to remove fossil-fuel subsidies. On the one hand, protests against retraction of welfare benefits are common. Egypt has throughout its recent history witnessed upheaval and riots caused by abolishment of food subsidies and the French farmers are notorious for blocking the roads every time financial aid to agriculture is at risk. Subsidies are often easy to impose but difficult to retract and in this sense fossil-fuel subsidies are by no means unique. On the other hand, it is well-documented that the benefits of fossil-fuel subsidy reforms outweigh their short-term costs. Why, then, would people oppose a reform that would increase their standard of living and social welfare?

The purpose of this study is to analyse whether lack of information about fossil-fuel subsidies can explain popular opposition, by studying whether individuals that are uninformed about the existence of fossil-fuel subsidies are more likely to oppose a reform. There is very little research on how lack of information affects people's attitudes towards fossil-fuel subsidy reforms. We aim

to bridge this gap of knowledge by developing a theoretical framework for how information affects people's attitudes. Thereafter, we test the predictions of the framework by conducting an econometric analysis of empirical data on Indian households.

India is of special interest for a study on fossil-fuel subsidy reforms and shares many similarities with other countries that consider phasing out fossil-fuel subsidies. In terms of absolute amounts spent on fossil-fuel subsidies India makes it to the world top-five. With its large capacity of renewable energy and adequate institutional capacity, India has the prerequisites that a transition away from fossil-fuel subsidies requires, both in terms of energy sources and in complementary policies to alleviate a short-term increase in poverty. Reforming fossil-fuel subsidies in India would benefit the Indian people, the Indian economy and the world as a whole.

This paper begins with a description of the extent of fossil-fuel subsidies, difficulties faced in fossil-fuel subsidy reforms and more detailed information about the geographical market our empirical test concerns (*Section2*). *Section 3* provides a review of the current state of knowledge. In *Section 4* we further specify our research question and develop our theoretical framework. We proceed with empirically testing the framework in *Section 5*. We compare the consistency amongst our theoretical predictions and empirical results in *Section 6*, discuss our findings and analyse their further implications. In *Section 7* we conclude our findings and identify areas for future research.

2. Background

2.1 Fossil-fuel subsidies: from economic stimulus to expenditure trap

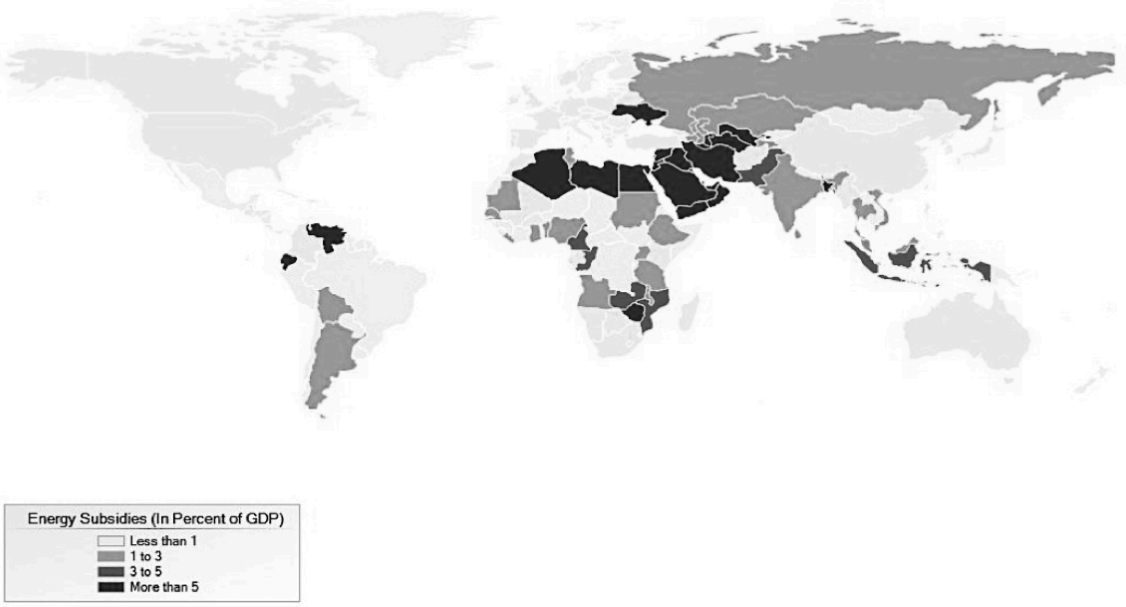


Figure 1: Energy subsidy intensity in the world 2011 (Ebeke & Ngouana 2015).

Governments devote a significant proportion of their activity to transferring resources between citizens. Subsidies are used worldwide, with the aim to steer markets in directions more consistent with considered public objectives. With regards to the national importance energy has, and its impact on the economy, governments have been particularly keen to regulate the energy market. By implementing subsidies governments can influence demand for, supply of and investments in different energy sources. The presence of externalities in the energy market can be described as market failures, as there are effects of energy production, both positive and negative, that are not captured by market prices. In the presence of externalities Adam Smith's invisible hand cannot be entrusted to create efficient resource allocations. In such cases, when markets fail, government interventions can be necessary to increase efficiency and incentives-changing policies can in those cases be justified (Fisher & Rothkopf 1989). However, government intervention does by no means guarantee increased efficiency. Fossil-fuel subsidies are one example of market regulations that have turned out to be inefficient, as they have not proven cost-effective for achieving the policy objectives set (Kojima 2016).

Since the early industrial era, fossil fuels have played a central role for economic development and growth. Aiming to increase economic performance, many governments introduced subsidies on fossil fuels in order to lower the price and encourage consumption. Fossil fuels have also been subsidised to shield domestic consumers from volatility in international energy prices and to support energy-intensive industries (GSI & TERI 2012). Later on, fossil-fuel subsidies have been motivated as a way to fight poverty, as it enables the poor to afford energy (Ellis 2010). The use of fossil-fuel subsidies is still widespread, amongst both democracies and autocracies, developing as well as developed countries (see *Figure 1*). There is no universal definition of a fossil-fuel subsidy but one commonly used for energy policies in academic publications is the one by the International Energy Agency (IEA) from 1999 "[a]n energy subsidy is any government action that concerns primarily the energy sector and that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers" (IEA 1999). Subsidies can take various forms, everything from direct financial transfers, or indirect support mechanisms such as preferential tax treatments, trade restrictions and price controls (Ellis 2010). Fossil-fuel subsidies are the most widely used, and the most expensive, amongst energy subsidies. According to IEA the total amount spent to subsidise fossil fuels in 2014 was 493 billion dollars, compared to the 112 billion dollars that were spent on subsidies to aid deployment of renewable energy[1] (IEA 2015).

Today fossil-fuel subsidies' negative impact is well-documented and besides international agreements, peer pressure and development goals, governments all over the world have expressed their intentions to reform fossil-fuel subsidies. The subsidies hamper economic growth and they impose large fiscal costs leading to increased public debt and increased tax burdens (Ellis 2010). Countries with high energy subsidies also have significantly less social expenditures, implying that subsidies crowd out public social spending on education and health (Ebeke & Ngouana 2015). Fossil-fuel subsidies have proven to have a regressive effect, mainly benefitting rich households. In 2010, for instance, only 8 per cent of the 409 billion dollars spent on fossil-fuel subsidies went to the poorest 20 per cent of the population, making fossil-fuel subsidies a reinforcement of inequality (IEA 2011). Further on, the subsidies are damaging for the environment as they lead to higher emissions of greenhouse gases (Ellis 2010). There are several alternatives to fossil fuels including renewable energy. With the launch of the United Nations Sustainable Development Goals clean energy is stated as an internationally prioritised objective.

[1] Fossil-fuel subsidies are difficult to measure due to transparency issues and lack of standardized measurements. IEA's estimation and IMF's pre-tax estimation yield similar results and both are calculated using the price-gap approach (GSI 2014).

By keeping the price of fossil fuels artificially low, both consumption and production of renewable energy is restrained and investment in alternative energy is discouraged, causing a slower adaptation to future energy demands (Bordoff & Losz 2015).

2.2 Fossil-fuel subsidy reform and popular opposition

One explanation for why fossil-fuel subsidies remain high is that reforms seldom come without complications. Academics describe subsidies as asymmetric as they tend to be easy to introduce and difficult to withdraw. This reasoning is applicable to any kind of government, democracies as well as autocracies (The Abdullah Bin Hamad Al-Attiyah Foundation 2015). There is no universal strategy for how to successfully implement fossil-fuel subsidy reforms (Beaton et al. 2013), but GSI (2012) provides a subsidy reform framework, recommending steps that should be taken into consideration in the reform process, (see *Figure 2*). Given the energy sector's size and influence there are several stakeholders and political forces that are closely linked to the energy market. Each country is facing different challenges in terms of conflicting vested interests (Bordoff & Losz 2015). When subsidies are removed an increase in energy prices is inevitable. The supply of energy is central to the world economy and variations in prices affect public welfare and productivity in practically all sectors. Two challenges following directly from this are inflation and declining living standards for the poor. Even though fossil-fuel subsidies are regressive, the direct effect of a price increase is likely to initially hit the poor the hardest (Ellis 2010). Basically all countries face these challenges when implementing reforms and countries vary in their institutional capacity for handling these obstacles. However, both the negative social impact and inflation have proven to be manageable and can even be confronted *ex ante* if good preparation is in place and complementary policies are introduced (The Abdullah Bin Hamad Al-Attiyah Foundation 2015). To minimise the negative impact of energy price increases, countries usually implement fossil-fuel subsidy reforms when international energy prices are low. Popular opposition has proven to be weaker when oil prices are low (Bordoff & Losz 2015).

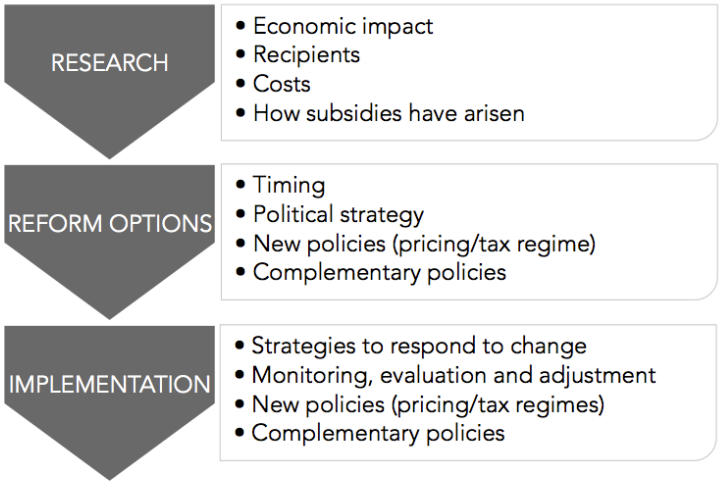


Figure 2: A framework for fossil-fuel subsidy reforms by GSI (2012).

Due to a general dissatisfaction with retraction of welfare benefits popular opposition constitutes a recurring barrier against reform (The Abdullah Bin Hamad Al-Attiyah Foundation 2015). Even though fossil-fuel subsidies are inefficient means of alleviating poverty, they provide a small but certain benefit to consumption. Cheap energy is a tangible and concrete benefit, distributed to a large proportion of the population, who gladly take to the streets if this benefit is at stake. This makes subsidy cuts a political minefield (Anderson 2014). Popular opposition can hinder reforms at two stages. Firstly, it can constitute a barrier to subsidy reform to be implemented. People can lobby, demonstrate and use their democratic rights to maintain status quo. Governments, feeling that their political position is threatened, are likely to refrain from subsidy reform. Secondly, people can pressure politicians to reintroduce the subsidy after reforms have been implemented. There is a long list of historical examples of subsidy reforms followed by popular opposition, an event steered by human behaviour where the degree of repercussions is rather hard to predict ex ante. In Bolivia, the fossil-fuel subsidy reform in 2007 resulted in a major public backlash with rapid reinstatement of the subsidy, when the energy prices were increased with 80 per cent. Nigeria had a similar experience in 2012 when reforms triggered riots and general strikes that made the government reintroduced the subsidy. The strength of this barrier should thus not be underestimated (GSI & TERI 2012). Popular opposition is commonly stated in previous research as the barrier holding governments back (Bordoff & Losz 2015, The Abdullah Bin Hamad Al-Attiyah Foundation 2015, Beaton et al. 2013).

2.3 Evidence from the Indian electricity market

In 2015, India contributed to the single largest share of growth in global energy demand. India has the largest increase in demand for coal use in power generation, and oil demand increased more than in any other country (IEA 2015). In 2013, India spent 47 billion US dollars to subsidise fossil fuels, which makes India the third largest subsidiser after Iran and Saudi Arabia. More than 6 billion US dollars were spent directly on electricity, leading to high financial distress on the state budget (Bárány & Grigonyte 2015). India is the third largest economy, home to one-sixth of the world's population, but accounts for only 6 per cent of the global energy use. One fifth of the population still lacks access to electricity. Based on forecasts of increased electricity demand, 2.8 trillion dollars will be required to secure energy supply in 2040. The Indian power sector faces severe challenges, including power shortages, financial losses and insufficient capacity (IEA 2015). The weakest link in the value chain is the state-owned distribution companies. Subsidies accounted for 16 per cent of the total revenue of electricity distribution companies in 2006–2010 (Papathanasiou 2016).

In India, electricity and petroleum products are subsidised. The electricity subsidies are disbursed by the state governments, in contrast to the petroleum products that are regulated at the national level. The subsidies are provided to the distribution companies so that they can lower consumer prices. Electric power is generated by conversion of energy from other sources, such as mechanical, thermal and chemical energy, through a generator. The Indian electricity generation is dominated by the use of fossil fuels. In 2010–2011 more than 80 per cent of electricity generated in India was fossil fuel produced (GSI & TERI 2012). Coal was the most commonly used energy source and constituted 66 per cent of the electricity generated in India. Further on, 12 per cent came from natural gas (*see Figure 3)*. Consequently, the current electricity subsidy is essentially a fossil-fuel subsidy and will be denoted that for the rest of this paper.

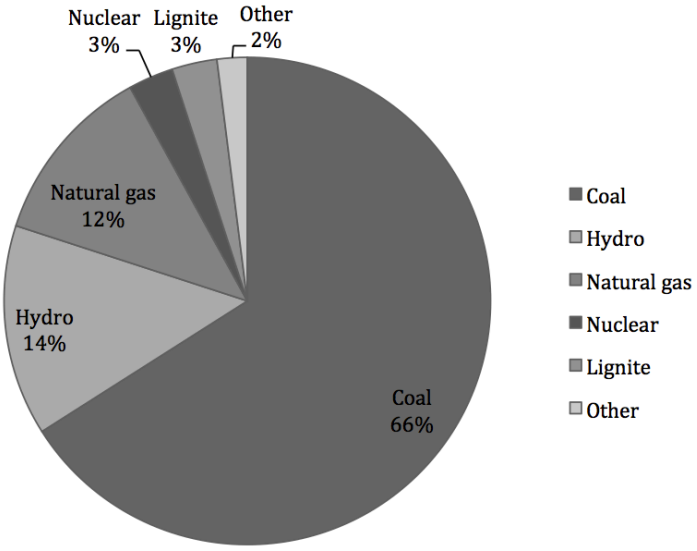


Figure 3: Percentage of energy sources in electricity generation, in 2010-2011. Data from the Central Electricity Authority (2011).

The fossil-fuel subsidies are inefficient, as they are not cost effective in meeting their policy objectives, but the situation on the market has become resilient, reflecting the strength of political opposition to a subsidy reform. A large proportion of India's population work within the agricultural sector or live below the poverty line, two segments that would be adversely affected from a subsidy reform. Previous attempts to reform fossil-fuel subsidies have been met with popular opposition. This has made elected officials and policymakers anxious to implement reforms (GSI & TERI 2012).

3. Previous research

3.1 The rationale behind popular opposition

Walton and Seddon (1994) have studied the post-Cold War transition of developing countries in Central and Eastern Europe. They examined the relationship between popular opposition and the process of economic and social transformation associated with liberalisation and promotion of free markets. Public response and action to downsizing in governmental spending that take the form of political demonstrations, general strikes and riots, is commonly called austerity protests. Austerity protests arise from specific dissatisfaction and tend to be particularly associated with retraction of social services. Huntington (1986) argued that unfulfilled public expectations and changes in social welfare are common reasons for popular unrest. Previous studies have used different theories to explain the driver behind popular unrest, the two most widespread are the rational response theory and moral economy arguments (Sach 2012). Walton and Seddon (1994) argued that people riot since they want to change existing political structures and force governments to increase their living standards. Gurr (1970), on the other hand, argued that the poor protest to express their grievance against social inequality. While a rational economic man would participate in protests only if he believed that would change the outcome and enhance his personal wellbeing, a morally driven individual would act according to his or her values and principles, protesting being a way to take a stand and express one's feelings.

3.2 Policy making and information

Taking into consideration all three pillars of sustainable development, research shows fossil-fuel subsidy reforms should be in the public's interest. Thus, neither the theory of Gurr nor Walton and Seddon can explain why people would oppose fossil-fuel subsidy reforms, as a reform would be to their benefit. The persistence of inefficient policies is, however, by no means a new phenomena. Rausser (1992) have studied financial aid to impoverished farmers that remained even when the farmers became wealthier than the taxpayers. Knieger (1993) have found that tariff programme in developing countries, aiming to substitute import-substituting industries, remained even after being internationally criticised. Several studies have shown that imperfect information can explain market inefficiencies. Coate and Morris (1995) have shown that inefficient policies can prevail if voters have imperfect information. They have studied implementations of policies where the citizens faced uncertainty whether they would benefit

from the policy or not. In line with the Virginia school of political economy they argued that inefficient policies are likely to prevail because citizens usually are poorly informed by the impact of different policies. Alcott and Taubinsky (2015) have investigated the role of lack of information and inattention to electricity costs on the light bulb market. Electricity bills are aggregate and periodic and hence it is difficult for consumers to estimate the effectiveness of electricity investments. Consequently, there are high demands on consumers to gather information and perform sophisticated calculations. Since electricity is costly even small inefficiencies aggregate to substantial losses.

3.3 The role of information in fossil-fuel subsidy reforms

Even though billions are spent, annually, to subsidise fossil fuels (IEA 2015), studies have found that information about the existence of fossil-fuel subsidies amongst the population is scarce. Calvo-Gonzalez, Cunha and Trezzi published a study for the World Bank Group in 2015, where they investigated fossil-fuel subsidies of liquefied petroleum gas in El Salvador. They found that lack of information regarding the subsidy and the imminent reform was the rule rather than the exception. Only 15 per cent of the surveyed citizens knew the correct market price of liquefied petroleum gas. Further on, Calvo-Gonzalez, Cunha and Trezzi found that satisfaction with a reform was higher with ex ante awareness that a reform was about to take place but that only 18 per cent of the respondents considered themselves to be informed about the policy reform.

When provided information about fossil-fuel subsidies, research has shown that different groups in society react differently. Pradiptyo et al. (2015) have analysed perceptions of subsidy reform regarding the fuel Premium in a study on Indonesia. In their study they investigated reactions when citizens were provided information about, firstly, the mere existence of the subsidy, secondly, the amount of fiscal resources spent on the subsidy, and thirdly, the parts of society that benefit from the subsidy. They found that groups with different characteristics vary in their levels of responsiveness and they identified groups in society with a higher acceptance towards a price-increase policy reform, such as individuals that were richer, more highly educated and lived in urban areas. Furthermore, they argue that some characteristics, such as educational attainment and vehicle ownership, may change over time and, consequently, that opinions regarding subsidy reforms might not be permanent.

In his research on autocracies in the Gulf Region, Krane (2014) studied perceived entitlement to cheap electricity amongst the citizens and how they react to information. He found that entitlement-minded citizens are more opposed to a price increase in electricity than citizens who do not feel entitled to subsidised electricity. After providing respondents with different types of information, Krane examined how willingness to pay higher electricity prices differed amongst entitlement-minded and non-entitlement-minded citizens and varied with the type of information presented to them. The entitlement-minded citizens' willingness to pay increased slightly when they were provided with the information that electricity prices were subsidised and their willingness to pay increased substantially when they were provided additional information that oil and gas were valuable exportable resources that were wastefully consumed by the Gulf States' citizens due to artificially low prices.

Krane focused on entitlement-minded citizens in his study but they were, however, in a minority. A relatively large fraction of the people that did not feel entitled did not oppose higher prices when informed about the fact that electricity prices were subsidised. Krane theorised that there are stronger incentives for informed citizens to support fossil-fuel subsidy reforms, compared to uninformed citizens. He motivated this, referring to a phenomenon, which he called economic rationality: "[o]ne such explanation could be a citizen desire for more prudent stewardship of national resource patrimonies […]". However, this theory was neither supported by a model nor empirics and no further studies on attitudes of citizens not feeling entitled to cheap electricity were conducted.

4. Research design

4.1 Research question

Research on popular opposition has shown that decreased social welfare and increased societal inequality are underlying reasons for popular unrest. However, an extensive amount of research has shown that fossil-fuel subsidy reforms increase living standards and reduce income disparities. A plausible explanation to why people oppose fossil-fuel subsidy reforms might be found in previous studies that have shown that inefficient policies can prevail in situations with imperfect information. Few studies have looked into which effect information about fossil-fuel subsidies, or rather lack thereof, has on popular opposition. To our knowledge, there is no previous research that theoretically explains and empirically confirms the direct link between lack of information about fossil-fuel subsidies and popular opposition against subsidy reforms.

In his study on how individuals react to information, Krane (2014) provides explanations for why citizens with information about fossil-fuel subsidies might support a reform, including the "economic rationality" explanation mentioned above, which relates to the lavish spending of national resources and citizens' wish for a more efficient allocation of these. It is reasonable to believe that people who know that the government allocates resources to subsidise fossil fuels will understand that the money could be spent differently. However, this reasoning is only applicable to citizens with information about fossil-fuel subsidies. We believe there are few reasons for why citizens that do not have information about the fact that fossil-fuel subsidies exist would support a price increase policy. To find out whether lack of information can explain popular opposition, we develop a framework for how information affects people's attitudes. Thereafter we test if our predictions have statistical support, using empirical data. Thus, we have settled for the following hypothesis:

Individuals without information that fossil fuels are subsidised are more likely to oppose fossil-fuel subsidy reforms

We believe this study could offer valuable insights for policy makers in countries aiming to reform fossil-fuel subsidies. A better understanding of popular opposition could step up the pace of fossil-fuel subsidy reforms and increase their likelihood of success. Further on, we believe this study can offer valuable insights applicable to similar cases where inefficient policies prevail, due to lack of information amongst the general public.

4.2 Theoretical framework

In order to answer the question whether lack of information can explain popular opposition against fossil-fuel subsidy reforms, we develop a theoretical framework to explain how information, or the lack thereof, affects people's attitudes.

We consider a situation where the government currently spends large amounts to subsidise fossil fuels, Λ. The government is considering reforming the subsidy. For the sake of simplicity, in this model the subsidy will either remain in its full amount, an outcome labelled S, or be fully removed, labelled R. In the framework, citizens can react to the reform in two ways: they can either oppose the reform or support it. Further on, the model is constructed in such a way so that citizens' utility depends on the three components (i) consumption of fossil fuels, $c_{i,f}$ (ii) consumption of private goods other than fossil fuels, $c_{i,n}$ and (iii) consumption of public social goods, g. In reality, these goods might be complements or substitutes, but we separate them to facilitate the theoretical analysis.

Research shows that fossil-fuel subsidies precipitate climate change and increase social inequality. However, as their negative impact on people will vary with regards to geographical living area and socioeconomic factors it is harder to draw unequivocal conclusions about how individuals' utility is affected by these aspects. We believe subsidies' crowding out effect to have a more homogenous impact on people, as practically all individuals benefit from higher provision of public social goods. Therefore, we choose to focus on subsidies' crowding out effect.

Initially, three assumptions are made. The first assumption is that the common pool of resources will either be spent on fossil-fuel subsidies or on public social goods,[2] and that citizens trust that this pool of resources will be spent accordingly. Secondly, the extent to which citizens posses information that fossil-fuel subsidies exist and correctly estimate the crowding out effect of a subsidy will vary from citizen to citizen but for the sake of simplicity we assume citizens will either be fully informed about the subsidy and the crowding out effect, or not. Thirdly, we assume people to act rationally and that their attitudes will depend on whether the reform increases their utility or not.

[2] Ebeke and Ngouana (2015) have found a strong correlation between high spending on fossil-fuel subsidies and low spending on public social goods, implying that fossil-fuel subsidies have a strong crowding out effect.

In this framework we first estimate a function of the true citizen utility. Citizens that are informed that the government subsidises fossil fuels will consider this equation. Secondly, we estimate a perceived utility function applicable to citizens without information that the government subsidises fossil fuels. The utility function we develop is derived from a model by Ebeke and Ngouana (2015). To better correspond to our research question we develop our framework with regards to fossil fuels and use slightly different denotations.

The true citizen utility can be denoted in the following way, where utility depends on consumption of private, c_i, and public, g, goods:

$$u_i(c_i, g) = ln(c_i) + v_i(g), \qquad \frac{\partial v_i}{\partial g} > 0 \tag{4.1}$$

Consumption of private goods, c_i takes the form of a Cobb-Douglas utility function, aggregate of the fossil fuel and non-fossil fuel goods, where θ_i represents the share of income spent on fossil fuels. The utility function of private consumption takes a logarithmic form, due to consumption having diminishing marginal utility.

$$c_i = c_{i,f}^{\theta} + c_{i,n}^{1-\theta}, \qquad 0 < \theta_i < 1 \tag{4.2}$$

Income is denoted y_i and taxation, as a fixed rate, is denoted $\bar{\tau}$. For a given subsidy rate, λ, and provision of public social goods, g, each citizen will decide how much fossil fuel and non-fossil fuel goods to consume:

$$(1 - \lambda)p_w c_{i,f} = \theta_i y_i (1 - \bar{\tau}), \qquad 0 < \lambda < 1 \tag{4.2a}$$

$$c_{i,n} = (1 - \theta_i) y_i (1 - \bar{\tau}) \tag{4.2b}$$

When fossil fuels are subsidised, citizens pay the fraction $(1 - \lambda)$, of the international energy price, p_w. Prices are normalised so that the price of non-fossil fuel goods equal unity.

Ebeke and Ngouana continue to expand their model to show that an equilibrium with low public social spending and high spending on energy subsidies can prevail and verify their predictions with an empirical study on emerging markets and low-income countries. With their utility

function (*Equation 4.1-4.2b*) as a basis, we from here on further develop the utility function and create a framework to investigate the role information has on people's attitudes.

The total amount the government spends on subsidies, Λ, depends on the subsidy rate, λ, and the total amount of citizens' consumption of fossil fuels, $c_{i,f}$:

$$\Lambda = \sum \lambda c_{i,f} \tag{4.3}$$

The government's resources consist of the total amount the citizens pay in tax. A fraction of this amount, δ, is allocated to a common pool of resources that we assume will either be spent on fossil-fuel subsidies or on public social goods, $\boldsymbol{G}$. Public social goods include spending on healthcare and education. Average income is denoted $\overline{y}$ and $\overline{c_f}$ represents average consumption of fossil fuels. Citizens' consumption of public social goods is denoted g.

$$\boldsymbol{G} = \sum(\delta y_i \overline{\tau} - \lambda c_{i,f}) \tag{4.3a}$$

$$g = \delta \overline{y}\, \overline{\tau} - \lambda \overline{c_f} \tag{4.3b}$$

Equation 4.1 can now be expressed in the following way (see *Appendix 1* for more comprehensive derivations):

$$u_i(c_i, g) = ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right)\right] + v_i\left(\delta \overline{y}\, \overline{\tau} - \lambda \overline{c_f}\right) \tag{4.4}$$

Under the two possible scenarios, where the subsidy either remains in its full amount, or is removed, $\lambda = 0$, citizen utility can be denoted in the following ways, where *Equation 4.4S* represents citizen utility if the subsidy remains and *Equation 4.4R* the utility if a reform is implemented:

$$u_{i,S}(c_i, g) = ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right)\right] + v_i\left(\delta \overline{y}\, \overline{\tau} - \lambda \overline{c_f}\right) \tag{4.4S}$$

$$u_{i,R}(c_i, g) = ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{p_w} + (1-\theta_i)\right)\right] + v_i(\delta \overline{y}\, \overline{\tau}) \tag{4.4R}$$

Equations 4.4S shows that the subsidy affects citizen utility in two ways: a subsidy has an increasing effect on utility as it enables citizens to consume more private goods but,

simultaneously, the subsidy decreases utility as less public goods can be provided by the government, $\frac{\partial v_i}{\partial g} > 0$. A citizen's attitude towards a subsidy reform depends on the aggregate effect of the subsidy. If utility decreases with a reform, hence if $u_{i,R} < u_{i,S}$ holds, the citizen will oppose a reform and otherwise support it. This can be expressed in the following way (see *Appendix 1* for more comprehensive derivations):

$$ln\left[\frac{\theta_i}{p_w} + (1-\theta_i)\right] < ln\left[\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right] - v_i(\lambda\overline{c_f}) \tag{4.5}$$

Equation 4.5 shows that whether, or not, a perfectly rational and utility maximising citizen will support or oppose a reform will depend on four factors out of which only one is individual for each citizen and three are externally given. The individual factor is share of income spent on fossil fuels, θ, and the equation shows that the larger share spent on fossil fuels, the stronger will the citizen oppose a reform. It is interesting to note, however, that while disposable income exists in the original *Equations 4.4S* and *4.4R*, the factor disappears when *Equation 4.5* is derived.

Further on, three externally given factors affect citizen utility from a reform. Firstly, the subsidy rate, λ, affects attitudes. The removal of a large subsidy rate is likely to be met with stronger opposition, compared to a smaller subsidy rate. Secondly, the international energy price, p_w, affects people's attitudes towards reforms. Given that utility of private consumption takes a logarithmic form, citizens will value extra consumption of private goods differently, with regards to amount spent on private consumption. When international energy prices are low, private consumption is high and utility from extra consumption of private goods will be low, in comparison to that of public social goods. Consequently, the likelihood of support is higher when energy prices are low. On the other hand, when international prices are high, the reverse scenario holds and popular opposition is likely to be stronger. Finally, the average consumption of fossil fuels, $\overline{c_e}$, affects citizens' utility. The higher the average consumption of fossil fuels, the lower will opposition be.

Previous studies have shown that information about the existence of fossil-fuel subsidies can be scarce (Calvo-Gonzalez, Cunha & Trezzi 2015). Citizens without information about fossil-fuel subsidies will instead consider the perceived utility function below, *Equation 4.6*, as they are not aware that the subsidy exists (see *Appendix 1* for more comprehensive derivations). Due to lack of

information they are neither aware that the subsidy crowds out spending on public social goods, nor that the international energy price, p_w, is higher than the domestic price, p_f.

$$\hat{u}_{i,imperf}(c_i, g) = ln\left[y_i(1-\bar{\tau})\left(\frac{\theta_i}{p_f} + (1-\theta_i)\right)\right] \tag{4.6}$$

The uninformed citizens will only observe the increase in domestic energy prices and according to *Equation 4.6* an increase in energy prices will always lead to a decrease in perceived utility. Thus, there is no rational explanation to support a fossil-fuel price increase for utility maximising citizens without information that fossil fuels are subsidised.

To conclude, in this framework, we develop a function for true citizen utility to better understand how people are affected by fossil-fuel subsidy reforms. The results show that citizens with information that fossil fuels are subsidised will consider a handful of factors to estimate whether their utility would increase or decrease with a reform. Their attitude towards reform will ultimately depend on consumption preferences and exogenously given factors. We proceed by developing a utility function applicable to citizens that are uninformed about subsidies. These individuals will not understand a subsidy's aggregate impact, rather, only observe the diminishing effect a reform would have on private consumption. Consequently, they should always oppose a reform, as an increase in fossil fuel prices always will lead to a decrease in their perceived utility. By comparing informed and uninformed individuals, the framework predicts that individuals without information that fossil fuels are subsidised are more likely to oppose fossil-fuel subsidy reforms. However, the framework also demonstrates that lack of information is not the sole explanation to popular opposition.

5. Empirical test

5.1 Method

The framework developed in the previous section provides a theoretical explanation for why people without information about fossil-fuel subsidies are more likely to oppose subsidy reforms. In order to test this prediction, we turn to econometrics and conduct an analysis on empirical data, collected by the International Institute of Sustainable Development. In December 2015, they conducted an electricity consumer survey in India, for the purpose of assessing attitudes towards an electricity subsidy reform. The survey was conducted in the state Rajasthan and the respondents in the survey were all citizens with access to electricity. The sample households for the study were drawn following a stratified multi-stage sampling approach to ensure representativeness, in terms of income groups, of the Indian population. Furthermore, several other factors were taken into account, such as geographical spread, electrification rate, population density and economic status. However, only 80 per cent of the Indian population have access to electricity (IEA 2015) and consequently our results are only representative of them. In the survey 1000 respondents were asked, amongst other things, about their knowledge of electricity prices and subsidies and their attitudes towards electricity subsidy reforms.

5.1.1 Measuring lack of information and popular opposition

To assess whether people have information about the fact that electricity prices are subsidised the question below was asked to obtain our independent variable of interest. There are, however, limitations with measuring information in this way. Firstly, people's level of information is likely to vary between individuals and we would have preferred a measure capturing different levels of information, rather than to categorise people as having or not having information. Secondly, we would have liked to measure information in a way that takes into account people's understanding of subsidies' crowding out effect and level of financial literacy. Due to data limitations we were unable to do that, but we make the assumption that people that are aware that the government allocates money to subsidise fossil fuels also understand that the money could have been spent differently.

How does the electricity company cover its costs in supplying electricity?

The respondents were provided with four response categories. The polytomous dependent variable is transformed into a dichotomous variable with the response categories information and no information as indicated by *Table 1* below. None of the 1000 respondents chose the second option, "100% government support", yielding zero responses to that response category.

Table 1: Independent variable of interest

Response categories	**Transformed variables**	**Observations**
100% through customer revenues	No information	317
100% government support	No information	0
Combination of customer revenues and government support	Information	542
Don't know	No information	141

Table 1: Response categories, number of observations and transformation of the independent variable of interest into a dichotomous variable.

Popular opposition is measured by investigating attitudes towards a fossil-fuel subsidy reform, and a subsequent electricity price increase. It should be pointed out that the respondents' attitudes that we have at hand are ex ante attitudes regarding a subsidy reform. Attitudes are by no means constant and can change after the effects of a policy reform become evident. Pradiptyo et al. (2015) have also shown that personal characteristics can change, leading attitudes to change. Despite the fact that there is no definite certainty that attitudes will lead to certain behaviours, attitudes are commonly used as indicators for behaviour. To obtain our dependent variable respondents were asked the following question:

If the government announced that electricity prices had to rise so that the electricity company can better cover its costs do you think this would be reasonable?

The respondents were provided with the response categories listed below. The dependent variable, which just like the independent variable of interest takes the form of a polytomous variable, is recoded into a dichotomous variable, as indicated by *Table 2*.

Table 2: Dependent variable

Response categories	Transformed variables	Observations
Highly unreasonable	Oppose	502
Unreasonable	Oppose	299
Somewhat reasonable	Support	144
Reasonable	Support	54
Highly reasonable	Support	1

Table 2: Response categories, number of observations and transformation of the dependent variable into a dichotomous variable.

A drawback following the way the question is formulated is that individuals might have had different price increases in mind, when responding. It would have been more suitable to specify a fixed increase in prices.

5.1.2 Choice of econometric approach

As touched upon, both the dependent and independent variables of interest are polytomous but are transformed into dichotomous variables. For the independent variable this is a natural procedure, for the dependent variable a strategic one. The transformation allows us to employ a binary response model with the binary outcome of either supporting or opposing a subsidy reform. The probit model is applied, as it in contrast to the logit model assumes normally distributed standard errors, making it the more popular binary response model amongst economists (Wooldridge 2013). For comparability reasons, we also apply a logit model and a linear probability model (LPM) to the data.

The dependent variable takes the form of an ordinal dependent variable, where an ordinal regression is an alternative to the probit model. In addition to the probit model, an ordered probit regression is also conducted in order to verify consistency amongst the results. The ordered probit model is, however, by its nature difficult to interpret, hence only the probit model, will be used for interpretation purposes.

The probit model takes the following form, where $G(z)$ is the standard normal cumulative distribution function, which strictly takes on values between zero and one for all real numbers z; $0 < G(z) < 1$:

$$P(y = 1|\boldsymbol{x}) = G(\beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k) = G(\beta_0 + \boldsymbol{x\beta}) \quad (5.1)$$

The probit model is derived from an underlying latent variable model, where y^* is an unobserved, or latent, variable:

$$y^* = \beta_0 + \boldsymbol{x\beta} + \varepsilon \qquad y = 1[y^* > 0] \quad (5.2)$$

y equals 1 if $y^* > 0$ and y equals 0 if $y^* \leq 0$. Hence, the latent variable determines the value of y from *Equation 5.1*.

Furthermore, ε, is assumed to be independent of $\boldsymbol{x}$ and is assumed to have the standard normal distribution, $\varepsilon_i \sim N(0, \sigma^2)$.

The probit model is estimated using maximum likelihood estimation (MLE), which automatically accounts for heteroskedasticity in the variance of the dependent variable, conditional on the independent variables, $Var(y|\boldsymbol{x})$. MLE maximises the log-likelihood function, thus when estimating the $\boldsymbol{\beta}$ it maximises the product of the log-likelihoods for the observations. MLE is consistent, asymptotically normal, and asymptotically efficient under very general conditions, according to the general theory of MLE (Wooldridge 2013).

The coefficients in a probit model are interpreted as the change in the z-score of the probability given a one unit change in the corresponding independent variable, indicating a constant effect on the estimated probability (UCLA 2016). This does not, however, translate into a constant effect on the actual probability (O'Halloran 2010). Rather, the marginal effect, *Equestion 5.3 and 5.4*, of our independent variable of interest is estimated, holding all other variables at their means, to find the constant effect information has on the probability of supporting a fossil-fuel subsidy reform.

$$Y = P(y = 1|\boldsymbol{x}) = G\left(\beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k\right) \quad (5.3)$$

$$\frac{\partial Y}{\partial x_i} = \beta_i g\left(\beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k\right) \quad (5.4)$$

To examine whether multicollinearity is present in our regression we employ the Variance Inflation Factor and use the rule of thumb that multicollinearity will not be a concern if the test results display a value under 10 (Williams 2015).

As goodness-of-fit measure we apply McFadden's pseudo R-squared, as it provides information similar to the R-squared in OLS regression. McFadden's pseudo R-squared takes the following form:

$$1 - \frac{L_{ur}}{L_0} \tag{5.5}$$

$\boldsymbol{L_{ur}}$ represents the log-likelihood function for the estimated model and $\boldsymbol{L_0}$represents the log-likelihood function in the model with only an intercept. In the case that the covariates do not exhibit any explanatory power $\frac{L_{ur}}{L_0} = 1$ and the pseudo R-squared will take on a value of $\boldsymbol{0}$ (Wooldridge 2013). McFadden states that pseudo R-squared values between $\boldsymbol{0.2}$ and $\boldsymbol{0.4}$ represent a very good fit of the model (Louviere, Hensher & Swait 2000).

Furthermore a Wald test is conducted to examine the fit of our model. If the null hypothesis that our parameters are simultaneously equal to zero can be rejected, we can conclude that the inclusion of our independent variables other than our independent variable of interest leads to a statistically significant better fitting model (UCLA 2016).

5.2 Application of the model

When the probit model is applied to the dataset provided by the International Institute of Sustainable Development our baseline regression takes the following form:

$$\begin{aligned} P(attitude = oppose) = \beta_0 + \delta_1(no\ information) + \beta_1(electricity\ share) \\ + \beta_2(power\ cut\ frequency) + \beta_3(power\ cut\ duration) + \delta_2(rural) \\ + \delta_{3-7}(education) + \delta_{8-10}(income\ groups) + \delta_{11-21}(occupation) + \varepsilon \end{aligned} \tag{5.6}$$

Our dependent variable, attitude, is defined as the probability of opposing a fossil-fuel subsidy reform, with oppose taking on a value of 1 and support taking on a value of 0. The dichotomous

independent variable, no information, takes on a value of 1 for citizens having no information and a value of 0 for citizens possessing information.

With the intention of testing the prediction of the framework, *ceteris paribus*, that an individual without information that fossil fuels are subsidised is more likely to oppose a fossil-fuel subsidy reform, we control for various factors that can potentially influence attitudes. These include electricity consumption, residential area, education, income, occupation, and electricity availability.

5.2.1 Control variables

Electricity consumption

People that spend a large share of their income on electricity are likely to benefit from a subsidy to a larger extent than people consuming more non-subsidised goods and, thus, they are more likely to oppose subsidy reforms. In turn, since electricity constitutes large expenditures for these individuals, they are also likely to be more aware of electricity prices and subsidies. In addition, the theoretical framework predicts that share of income spent on fossil fuels is the only individually dependent factor that should affect individuals' utility from reform and hence their attitudes. Consequently, if share of income spent on electricity was not to be controlled for, this could lead to biased results.

Geographic factors

People that are informed of fossil-fuel subsidies are likely to have different attitudes towards fossil-fuel subsidy reforms, depending on whether they live in urban or rural areas. People living in cities are likely to have better access to public social goods provided by the state. They may thus be more aware of the benefits of public social goods. In contrast, in rural areas people are more self-sufficient and the access to public social goods is generally lower. Electricity subsidies might be one of few certain benefits provided by the state that individuals in rural areas directly benefit from in their everyday lives (Anderson 2014). They might thus to a greater extent doubt that a reform would be to their advantage. In the framework consumption of public social goods is assumed to be equal for all individuals. However, if consumption of public social goods differs this could affect peoples' utility and, consequently, their attitudes. In their study on Indonesia, Pradiptyo et al. (2015) showed that citizens living in urban areas were more likely to support fossil fuel-fuel subsidy reforms.

Demographic and socioeconomic factors

The aggregate impact of fossil-fuel subsidy reforms is complex. Even if individuals have information about fossil-fuel subsidy reforms the risk is high that they underestimate their crowding out effect. With a higher level of educational attainment, individuals are more likely to have better knowledge of society in general and an increased understanding of policy making and how fossil-fuel subsidies affect society. Consequently, highly educated individuals could be better at estimating subsidies' impact on their utility, which could lead to a greater support, compared to informed citizens with lower levels of education. Educated people are also more likely to have obtained information about the existence of subsidies. If not controlled for, this could lead to biased coefficients. One of the assumptions made in the theoretical framework was that citizens with information understand the crowding out effect. This assumption is less likely to hold for individuals with lower levels of education and, even if informed, individuals might miscalculate their utility and oppose a reform. Both Pradiptyo et al. (2015) and Calvo-Gonzalez, Cunha and Trezzi (2015) identified that citizens with a higher level of education are more likely to agree to a fossil-fuel subsidy reform.

Annual income could affect individuals' attitudes in two ways. Either, they could be more inclined to oppose reforms, as fossil-fuel subsidies are regressive (Ellis 2010). In line with this reasoning, low income groups might prefer public social goods, as these, if provided by the market, are costly (Ebeke & Ngouana 2015). Alternatively, high income earners could be more positive towards subsidy reforms, since they are more likely to be able to afford a welfare retraction. People with higher income, can afford electricity price increases to a greater extent, and are thus more likely to care less about electricity subsidies. Their ignorance could lead to lower information about fossil-fuel subsidies (Pradiptyo et al. 2015). Although the theoretical framework does not predict that utility, and hence attitudes, should be affected by income levels, different income groups might have different consumption preferences of private and public goods. Both the research by Pradiptyo et al. (2015) and Calvo-Gonzalez, Cunha and Trezzi (2015) have found that individuals with a higher income were more likely to agree with a fossil-fuel subsidy reform.

Occupation groups that run their own business might be more opposed to a subsidy reform as they directly observe the diminishing impact a price increase has on their revenues. In addition, they are likely to be better informed about prices and subsidies. Furthermore, people working

within electricity intensive sectors and that are more dependent on electricity in their work are more likely to both oppose reforms and be better informed. Research has, for example, shown that opposition tends to be especially strong within the agricultural sector (GSI & TERI 2012).

Electricity availability

Higher frequencies and durations of power outages are likely to make citizens more prone to oppose subsidy reforms, since if their electricity provision is of bad quality it is reasonable that they would be even less willing to pay higher prices for electricity. A more negative view of the distribution companies could increase information gathering as people might want to understand the reason behind the inadequate electricity provision. Alternatively, the negative attitude towards the companies could also lead to ignorance and lower levels of information.

5.2.2 Data limitations

When conducting empirical tests on self-reported attitudes, it is challenging to fully capture the influence of one factor. Measuring opposition and information in this manner inevitably comes with a drawback since we cannot fully exclude reverse causality, for example that citizens with an interest in energy politics or environmental protection, etc. have a more positive attitude towards subsidy reforms and therefore have chosen to become more informed about fossil-fuel subsidies. An experiment of how uninformed individuals react to information would have been necessary to overcome this potential problem. By controlling for the above listed variables, we try to single out the causal effect information has on attitudes.

We would have liked to further control for political involvement, as that can affect attitudes, since people supporting the ruling party are likely to support their policy reforms on a general basis and, hence, have a more positive attitude towards a subsidy reform. Similarly, lack of trust in that the benefit retraction will be compensated for with better access to public social goods, might lead to increased opposition amongst informed individuals. If data had allowed us to, we would have liked to control for these factors.

Furthermore the framework we develop identifies the international energy price as a factor influencing informed individuals' attitudes, a fact supported by previous research (Bordoff & Losz 2015). While the energy price is externally given and affects all informed individuals in the same direction, changes in energy prices might lead to varying strength of popular opposition

amongst these over time. The data used in our study was collected in 2015, when energy prices, and hence the price of electricity, were low and as a lower energy price increases the likelihood of support amongst informed individuals it should be taken into account that popular opposition is likely to be lower. It would have been of interest to compare attitudes with regards to different market prices of electricity but this requires the use of pooled cross sections or panel data. We leave it to future research to investigate the strength of this factors' impact.

Further on, it is of importance to note that the data is collected from a single country and that the sample is small in the context of fossil-fuel subsidies' global use. The sample is drawn with the intention to represent the Indian electricity consuming population, with regards to income levels, but it is difficult to generalise causal inference to other countries, as the situation might differ between nations. Such differences could be especially strong between democracies and autocracies, developed and developing countries, as well as fossil fuel importing and exporting economies.

5.3 Data description

Table 3 below depicts our data in a more detailed manner and additional information of the variables can be found in *Appendix 2*. The data mainly consists of categorical variables with the exception of three numerical ones. Looking at our dependent variable, attitude, we can identify a rather high mean value for oppose, with four fifths of the respondents opposing a fossil-fuel subsidy reform. Investigating our independent variable of interest, no information, the data shows that almost half of the respondents, 45.8 per cent, lack information about electricity subsidies.

No question was asked about relative amounts spent on electricity in the survey and, neither, were exact amounts of income provided. However, we calculate share of income spent on electricity consumption by dividing electricity consumption with mean values of the eight income groups given by the survey. This way of measuring share of income spent on electricity implies that the variables are not exact at an individual level and, further on, explains why the variable does not only take on values between 0 and 1. However, while a more exact variable would have been preferable, since our variable's mean value is well within 0 and 1 we believe the estimate to be adequate (see *Table 3*).

Data on electricity consumption for 12 respondents is missing in the dataset, which reduces our 1000 observations to 988. Respondents who did not report any electricity consumption comprised of illegal connections. All of the illegal connections in turn belonged to the groups poor and low income, making the data subject to selection bias due to it being missing not at random (MNAR). While only observations from the two lowest income groups were dropped, these two income groups are the largest in the sample comprising of 92.5 per cent of the respondents when taken together. When the observations are dropped, the two income groups still represent 92.4 per cent of the new sample. Since the representation of the sample is approximately the same compared to if no observations were dropped, and thus still representative of the Indian population, we believe the bias to be minimal. While this bias might be negligible, it would have been preferable to use the maximum number of observations possible in the regression. Taking the importance of the variable, share of income spent on electricity into account, the benefits of including the variable in the regression outweigh the costs of losing 12 observations.

Table 3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
oppose	1000	0. 801	0.399	0	1
no_info	1000	0. 458	0.498	0	1
Electricity availability and consumption					
elec_share (INR)	988	0.167	1. 213	0.0003	1.868
powercfreq per day	1000	2.945	2.762	0	30
powercdur per day, in hours	1000	2.517	2.845	0	18
Geographic factors					
rural	1000	0. 668	0.471	0	1
Demographic and socioeconomic factors					
Education					
noeduc	1000	0.250	0.433	0	1
prim	1000	0.251	0.434	0	1
mid	1000	0.249	0.433	0	1
second	1000	0.098	0.297	0	1
grad	1000	0.025	0.156	0	1
pgrad	1000	0.127	0.333	0	1
Income groups					
poor	1000	0.200	0.400	0	1
lowinc	1000	0.725	0.447	0	1
mediuminc	1000	0.054	0.226	0	1
highinc	1000	0.021	0.143	0	1
Occupation					
employgov	1000	0.050	0.218	0	1
agricultural	1000	0.065	0.247	0	1
artisan	1000	0.003	0.055	0	1
employpriv	1000	0.102	0.303	0	1
livestock	1000	0.009	0.094	0	1
priest	1000	0.003	0.055	0	1
renterinc	1000	0.005	0.071	0	1
selfemploy	1000	0.208	0.406	0	1
skilled labour	1000	0.083	0.276	0	1
unskilled labour	1000	0.288	0.453	0	1
ownfarm	1000	0.143	0.350	0	1
retired	1000	0.041	0.198	0	1

Table 3: Descriptive statistics of the data used in the empirical test.

5.4 Empirical results

The results from the empirical test of the framework are depicted in *Table 4,* including coefficients and significance levels. The results show a positive and significant relationship between our independent variable of interest, no information, and our dependent variable, attitude, at a significance level of 1 per cent, ceteris paribus. No information has a positive effect on the probability of opposing a subsidy reform. This supports our hypothesis that individuals without information that fossil fuels are subsidised, are more likely to oppose a subsidy reform.

For a more clear-cut interpretation of our results, the marginal effect of no information on the dependent variable is displayed in *Table 6* below. The results show that no information increases the probability of opposing a reform by 0.1481. Consequently, an individual lacking information is 14.81 percentage points more likely to oppose a fossil-fuel subsidy reform, compared to informed individuals. For information about the marginal effects of all independent variables in the regression, see *Appendix 3*. The linear probability, logit and ordered probit models all show results consistent to that of the probit model (see *Appendix 5-7*).

Table 4: Probit regression

VARIABLES	oppose
no_info	0.603***
	(0.108)
elec_share	0.541**
	(0.270)
powercfreq	0.0190
	(0.0254)
powercdur	-0.0313
	(0.0254)
rural	0.140
	(0.120)
prim	-0.385**
	(0.154)
mid	-0.555***
	(0.155)
second	-0.736***
	(0.200)
grad	-0.528*
	(0.312)
pgrad	0.155
	(0.213)
lowinc	0.324**
	(0.154)

mediuminc	0.331
	(0.257)
highinc	0.531
	(0.350)
agricultural	0.983***
	(0.323)
artisan	0.0935
	(0.869)
employpriv	0.190
	(0.245)
livestock	0.152
	(0.491)
o.priest	-
renterinc	0.184
	(0.699)
selfemploy	0.512**
	(0.226)
skilledlabour	0.339
	(0.271)
unskilledlabour	0.838***
	(0.243)
ownfarm	0.854***
	(0.254)
retiredemploy	0.402
	(0.285)
Constant	-0.0143
	(0.306)
Observations	985

Table 4: Probit regression, probability to oppose a fossil-fuel subsidy reform. Standard errors in parentheses, significance levels denoted *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Additional regression statistics

Number of observations	985
LR chi2(23)	140.34
Prob > chi2	0.000
Pseudo R2	0.1428

Table 5: Additional regression statistics for the probit regression.

Table 6: Marginal effects

Variable	dy/dx	z-value
no information	0.1481	(5.69)***
elec_share	0.1328	(2.00)**
number of observations	985	

Table 6: Marginal effects of no information and share of electricity for the probit regression. Significance levels denoted *** p<0.01, ** p<0.05, * p<0.1.

Furthermore, the regression results show significance, at varying levels, for share spent on electricity and for some of the categories of the variables education, income and occupation (see *Table 4*). The results show that an increase in share of income spent on electricity consumption, from spending 0 per cent to 100 per cent, increases the probability of opposing a reform by 0.1328, or 13.28 percentage points, at a 5 per cent significance level (see *Table 6*). The marginal effect for each education group is interpreted as the probability of opposing a reform, compared to not having education. In the same way, income groups are compared to poor and occupation groups to being employed by the government. The results show that the higher the level of education, the lower the likelihood to oppose a reform, with exception for the not significant categories graduate and post graduate. The likelihood of opposing a reform when working in the agricultural sector, at one's own farm, being self-employed and being an unskilled labourer is higher when compared to an individual employed by the government. For all independent variables' marginal effects, see *Appendix 3*.

It should be noted that the variable priest is dropped from the regression due to the fact that it predicts success perfectly and thus takes on the value of infinity (see *Table 4*). However, since only three of the respondents were priests no valuable conclusions can be drawn from this. The values of the Variance Inflation Factor for each of the independent variables (which can be found in *Appendix 4*) are all beneath 10 indicating that multicollinearity is not a concern in our analysis. McFadden's pseudo R-squared, displaying a value of 14.28 per cent, indicates a good fit of the model. Furthermore the Wald statistic (see *Appendix 4*) is statistically significant, implying that we can reject the null hypothesis that the coefficients of our independent variables are simultaneously equal to 0.

6. Discussion

In this paper we develop a framework to theoretically explain how individuals' utility is affected by fossil-fuel subsidy reforms. Individuals that are informed about the existence of fossil-fuel subsidies will estimate their utility taking a handful of factors into consideration, including consumption preferences and externally given factors. Uninformed individuals, on the other hand, are not aware that resources allocated to subsidise fossil fuels could be spent on public social goods. They will estimate their utility, using a different utility function, according to which there is no rational explanation to support a subsidy reform, since that would cause their perceived utility to decline. Hence, the prediction of the theoretical framework is that uninformed individuals are more likely to oppose fossil-fuel subsidy reforms but that lack of information is not the only reason behind popular opposition.

We proceed by empirically testing whether this prediction holds, using data on Indian households. The results conclusively show that lack of information increases the probability of opposing a reform by 14.81 percentage points, a both economically and statistically significant result. Both the theoretical framework and the empirical results support our hypothesis that uninformed individuals are more likely to oppose fossil-fuel subsidy reforms. Further on, in line with the framework's predictions the empirical test shows that there are additional factors other than lack of information influencing popular opposition. However, it is important to remember that due to the small sample in our study one must be careful with generalising causal inference. Fossil-fuel subsidies are used globally and since there might be important differences between countries additional research is necessary to confirm the relationship between lack of information and popular opposition in other situations. Furthermore, as discussed when we describe our method, *Section 5.1,* our variables measuring information and popular opposition have some limitations and other studies could investigate more sophisticated ways to capture the link between the two.

The framework offers additional insights on how factors other than information affect citizen utility when reforming fossil-fuel subsidies. Firstly, the framework shows that informed individuals' attitudes will differ with regards to share of income spent on electricity. The higher an individual's share, the stronger her opposition will be. The empirical results are consistent with this finding, as they show that an increase in share of income spent on electricity consumption, from spending 0 to 100 per cent, increases the probability of opposing a reform by 13.28

percentage points. Secondly, the framework predicts that individuals' utility depends on three externally given factors and that informed individuals will consider these when estimating their utility from a reform. While these factors affect informed individuals in the same way and, thus, cannot explain why they would react differently, the factors will vary over time and point towards the important role timing and implementation have on popular opposition. The framework predicts that a removal of a large subsidy rate is likely to be met with stronger opposition, compared to a smaller subsidy rate, a finding that has strong empirical support (Beaton et al. 2013). Moreover the framework predicts that the international energy price affects people's attitudes towards reforms, in the sense that reforms implemented when energy prices are high, are likely to be met with stronger opposition. This is also consistent with empirical studies (Bordoff & Losz 2015). A further prediction is that total consumption of fossil fuels affects citizens' utility. The higher consumption of fossil fuels, the lower is popular opposition likely to be. A possible explanation is that high fossil fuel consumption is likely to lead to an increased crowding out effect. Given these three factors' influence, identified by our theoretical framework, an empirical study conducted in a similar way like ours but under different circumstances might yield different results.

The framework predicts that rational uninformed individuals should oppose a fossil-fuel subsidy reform. A majority of the respondents in the data do so, yet a small share of the uninformed individuals show support, an outcome contradicting our theoretical findings. This might be explained by the fact that the assumption made in the framework, that individuals are utility maximising, might not always hold. The uninformed individuals might support the reform, despite of diminishing perceived utility.

Further assumptions underpin the framework. Firstly, fossil-fuel subsidy reforms require that people make a sacrifice today, in the form of a benefit retraction, and in return are compensated by the government with better access to public social goods in the future. If citizens lack trust in the government fulfilling their part, and instead allocate the money on ways unbeneficial for the citizens, this could explain the opposition. Secondly, we assume that people will understand the crowding out effect fossil-fuel subsidies have on public social goods. Moreover we indirectly assume people with information to have a profound understanding of the impact a reform would have on their utility. Subsidy reforms affect people in several ways making their aggregate impact on utility difficult to estimate, even for informed individuals, as it requires information gathering, sophisticated calculations and a general understanding of policy making. Thirdly, fossil-fuel

subsidy reforms are complex phenomena, difficult to grasp, as the costs occur directly, and are easy to observe, while the benefits from a reform come in diffuse forms, some far in the future. This puts high demand on the people in terms of rationality, another assumption made. According to the framework popular opposition should be explained by lack of information, share of income spent on electricity, the international energy price, the subsidy rate and the total energy consumption. However, since the assumptions underpinning the model are not likely to hold with full certainty, the framework is likely to predict a stronger support for fossil-fuel subsidy reforms amongst the informed individuals, compared to empiricism.

Abolishment of fossil-fuel subsidies leads to higher fossil fuel prices and the theoretical framework we develop shows that one consequence of this is that individuals' utility decreases as they can consume less private goods. The framework does not, however, consider the fact that renewable energy constitutes a substitute to fossil fuels. In some situations renewable energy might be a good enough substitute, minimising the decrease in utility following a reform. Individuals that do not feel dependent on fossil fuels are likely to have stronger support for a reform than the model predicts. However, development of renewable energy has often been discouraged by fossil-fuel subsidies. If these were removed the price increase of fossil fuels could make renewable energy more competitive, hence encouraging consumption and investments in this alternative energy source. This development could imply an increased support for the reform *ex post*.

Unambiguous research shows that fossil-fuel subsidy reforms' benefits should outweigh their costs, implying that a subsidy reform should be to individuals' overall benefit (Ellis 2010). It might therefore be perceived contradictory that the framework shows that, even if informed, individuals' utility can decrease with a reform. However, the theoretical framework only incorporates the crowding out effect fossil-fuel subsidies have on public social spending, while fossil-fuel subsidies have proven damaging with regards to all three pillars of sustainable development. Since information on increased greenhouse gas emissions and increased social inequality is neither considered in the framework nor the empirical study, this could explain the discrepancy between the citizens' attitudes and those of the more informed politicians and researchers.

7. Concluding remarks

In this paper we both theoretically explain why and empirically show that lack of information increases popular opposition against fossil-fuel subsidy reforms. By developing a framework we show that uninformed individuals misjudge their utility, as they are not aware of subsidies' aggregate impact. Our empirical results are consistent with the framework's predictions and show that lack of information increases the probability of opposing a reform with 14.81 percentage points. Another contribution we make in this paper is the additional insights offered in why informed individuals vary in their support for subsidy reforms. We show why attitudes amongst informed citizens can vary between individuals, countries and over time as their utility from subsidy reforms depends on consumption preferences and a number of exogenous factors. The empirical results confirm the finding that attitudes differ between individuals with regards to the share of income spent on electricity.

Previous research has found that information about fossil-fuel subsidies is scarce amongst the public and that attitudes amongst groups with different characteristics vary when provided with information on fossil-fuel subsidies (Krane 2014, Pradiptyo et al. 2015, Calvo-Gonzalez, Cunha & Trezzi 2015). With 45.8 per cent of the respondents lacking information about the fact that electricity is subsidised, our empirical study on India confirms the widespread lack of information and, consequently, the important role it has on popular opposition, one of the main barriers to fossil-fuel subsidy reforms. Our findings contribute to the current state of knowledge as they provide a deeper understanding of why uninformed individuals to a greater extent oppose fossil-fuel subsidy reforms. National policy makers and politicians that consider reforming fossil-fuel subsidies, but are held back, can draw important conclusions from our more profound explanation of popular opposition. As the use of fossil-fuel subsidies in one country affects the world as a whole, advancement of knowledge on how to overcome popular opposition is thus of interest for nations and organisations advocating the global phasing-out of fossil-fuel subsidies. Furthermore we believe that our findings offer valuable insights applicable to similar cases where inefficient policies prevail, due to lack of information amongst the general public.

The aim of this thesis is to analyse whether lack of information can explain popular opposition against fossil-fuel subsidy reforms. The framework developed shows that it is an important factor but not the sole reason behind opposition. Therefore, it would be of interest for future research to further investigate the opposition amongst informed individuals and empirically test the other

potential explanations we provide: an insufficient understanding of subsidies' crowding out effect, bounded rationality and lack of trust in that reforms' costs, in the form of welfare retractions, will be compensated for. It could also be of further interest to, in an extended version of the framework, incorporate the impact of information about fossil-fuel subsidies on citizen utility, including all three dimensions of sustainable development in the framework.

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Appendix 1: Theoretical framework, additional derivations

c_i = consumption of private goods

$c_{i,f}$ = consumption of fossil fuels

$\overline{c_f}$ = average consumption of fossil fuels

$c_{i,n}$ = consumption of private goods other than fossil fuels

δ = fraction of governmental resources allocated to the common pool of resources, (including public social goods and the subsidy)

θ_i = share of income spent on fossil fuels

g = consumption of public social goods

λ = subsidy rate

p_e = domestic energy price

p_w = international energy price

$\overline{\tau}$ = taxation, fixed rate

y_i = income

$\overline{y}$ = average income

Derivation of equation (4.4):

$$u_i(c_i, g) = ln(c_i) + v_i(g) \tag{4.1}$$

$$c_i = c_{i,f}^{\theta} + c_{i,n}^{1-\theta} \tag{4.2}$$

$$(1-\lambda)p_w c_{i,f} = \theta y_i(1-\overline{\tau}) \tag{4.2a}$$

$$c_{i,n} = (1-\theta_i)y_i(1-\overline{\tau}) \tag{4.2b}$$

$$g = \delta\overline{y}\overline{\tau} - \lambda c_e \tag{4.3b}$$

$$u_i(c_i, g) = ln\left(c_{i,f}^{\theta} + c_{i,n}^{1-\theta}\right) + v_i\left(\delta\overline{y}\overline{\tau} - \lambda\overline{c_f}\right)$$

$$u_i(c_i, g) = ln\left[\frac{\theta_i y_i(1-\overline{\tau})}{(1-\lambda)p_w} + (1-\theta_i)y_i(1-\overline{\tau})\right] + v_i\left(\delta\overline{y}\overline{\tau} - \lambda\overline{c_f}\right)$$

$$u_i(c_i, g) = ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right)\right] + v_i\left(\delta\overline{y}\overline{\tau} - \lambda\overline{c_f}\right) \tag{4.4}$$

Derivation of equation (4.5):

$$u_{i,S}(c_i, g) = ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right)\right] + v_i\left(\delta\overline{y\tau} - \lambda\overline{c_f}\right) \quad (4.4S)$$

$$u_{i,R}(c_i, g) = ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{p_w} + (1-\theta_i)\right)\right] + v_i(\delta\overline{y\tau}) \quad (4.4R)$$

$$u_{i,R}(c_i, g) < u_{i,S}(c_i, g)$$

$$ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{p_w} + (1-\theta_i)\right)\right] + v_i(\delta\overline{y\tau}) < ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right)\right] + v_i\left(\delta\overline{y\tau} - \lambda\overline{c_f}\right)$$

$$ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{p_w} + (1-\theta_i)\right)\right] + v_i(\delta\overline{y\tau}) < ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right)\right] + v_i(\delta\overline{y\tau}) - v_i(\lambda\overline{c_f})$$

$$ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{p_w} + (1-\theta_i)\right)\right] < ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right)\right] - v_i(\lambda\overline{c_f})$$

$$ln\left[y_i(1-\overline{\tau})\right] + ln\left[\frac{\theta_i}{p_w} + (1-\theta_i)\right] < ln\left[y_i(1-\overline{\tau})\right] + ln\left[\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right] - v_i(\lambda\overline{c_f})$$

$$ln\left[\frac{\theta_i}{p_w} + (1-\theta_i)\right] < ln\left[\frac{\theta_i}{(1-\lambda)p_w} + (1-\theta_i)\right] - v_i(\lambda\overline{c_f}) \quad (4.5)$$

Derivation of equation (4.6)

$$\hat{u}_{i,imperf}(c_i, g) = ln\left[\frac{\theta_i y_i(1-\overline{\tau})}{p_f} + (1-\theta_i)y_i(1-\overline{\tau})\right]$$

$$\hat{u}_{i,imperf}(c_i, g) = ln\left[y_i(1-\overline{\tau})\left(\frac{\theta_i}{p_f} + (1-\theta_i)\right)\right] \quad (4.6)$$

Appendix 2: Variable description

Table 7: Description of variables

Variable	Description
oppose	attitude towards subsidy reform, oppose=1, support=0
no_info	lack of information that electricity is subsidised, no_info=1, info=0
Electricity consumption	
powercfreq	average number of power frequency cuts per day
powercdur	total average duration of power cuts per day, in hours
elec_share	share of income spent on electricity, in INR
Geographic factors	
rural	living area, rural=1, urban=0
Education	
noeduc	no educational attainment=1, other =0
prim	primary education=1, other =0
mid	middle school=1, other =0
second	secondary school=1, other =0
grad	graduate studies=1, other =0
pgrad	post graduate studies=1, other =0
Income group	
poor	income below 50,000 INR=1, other=0
lowinc	income between 50,000 and 200,000 INR=1, other=0
mediuminc	income between 200,000 and 400,000 INR=1, other=0
highinc	income above 400,000 INR=1, other=0
Occupation	
employgov	employed by the government=1, other=0
agricultural	agricultural labourer=1, other=0
artisan	working as an artisan=1, other=0
employpriv	employed by a private company=1, other=0
livestock	livestock rearing=1, other=0
priest	priest=1, other =0
renterinc	rental income=1, other=0
selfemploy	self-employed/own business=1, other =0
skilled labour	skilled labour=1, other =0
unskilled labour	unskilled labour=1, other =0
ownfarm	own farm=1, other =0
retired	retired pensioner=1, other =0

Table 7: Description of the variables used in the empirical test.

Appendix 3: Probit model, marginal effects

Marginal effects after probit
y = Pr(oppose) (predict)
= 0.83768356

Table 8: Probit regression, marginal effects

variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]	X
no_info	0.1481	0.0260	5.69	0.000	0.0971	0.1991	0.4518
elec_share	0.1328	0.0663	2.00	0.045	0.0030	0.2627	0.1658
powercfreq	0.0047	0.0062	0.75	0.455	-0.0076	0.0169	2.9320
powercdur	-0.0077	0.0062	-1.24	0.216	-0.0199	0.0045	2.5198
rural	0.03444	0.0293	1.17	0.240	-0.0231	0.0919	0.6701
prim	-0.0947	0.0374	-2.53	0.011	-0.1680	-0.0213	0.2518
mid	-0.1364	0.0377	-3.62	0.000	-0.2102	-0.0625	0.2518
second	-0.1808	0.0487	-3.71	0.000	-0.2763	-0.0852	0.0964
grad	-0.1296	0.0763	-1.70	0.090	-0.2792	0.0200	0.0244
pgrad	0.0381	0.0522	0.73	0.466	-0.0642	0.1404	0.1259
lowinc	0.0796	0.0376	2.12	0.034	0.0059	0.1532	0.7289
mediuminc	0.0813	0.0631	1.29	0.198	-0.0424	0.2049	0.0548
highinc	0.1304	0.0859	1.52	0.129	-0.0379	0.2986	0.0213
agricultural	0.2414	0.0793	3.04	0.002	0.0860	0.3968	0.0629
artisan	0.0230	0.2135	0.11	0.914	-0.3955	0.4414	0.0030
employpriv	0.0468	0.0603	0.78	0.438	-0.0714	0.1650	0.1025
livestock	0.0373	0.1205	0.31	0.757	-0.1990	0.2735	0.0091
renterinc	0.0452	0.1719	0.26	0.793	-0.2916	0.3820	0.0051
selfemploy	0.1258	0.0559	2.25	0.024	0.0163	0.2353	0.2091
skilledlabour	0.0833	0.0668	1.25	0.213	-0.0476	0.2142	0.0822
unskilledlabour	0.2057	0.0600	3.43	0.001	0.0882	0.3232	0.2904
ownfarm	0.2097	0.0626	3.35	0.001	0.0870	0.3324	0.1442
retired	0.0988	0.0702	1.41	0.159	-0.0387	0.2364	0.0416

Table 8: Marginal effects of all independent variables for the probit regression (holding all other variables at their means).

Appendix 4: Test results

A4.1 Variance Inflation Factor, test for multicollinearity

Table 9: Variance Inflation Factor

Variable	VIF	1/VIF
unskilledlabour	6.43	0.1554
selfemploy	4.85	0.2063
ownfarm	4.13	0.2420
employpriv	3.19	0.3133
skilledlabour	2.98	0.3357
agricultural	2.57	0.3898
powercdur	2.19	0.4569
powercfreq	2.04	0.4893
retiredemploy	1.82	0.5497
lowinc	1.73	0.5779
mid	1.72	0.5826
mediuminc	1.68	0.5965
prim	1.62	0.6155
second	1.60	0.6250
pgrad	1.38	0.7268
rural	1.35	0.7394
highinc	1.30	0.7715
elec_share	1.25	0.8010
livestock	1.24	0.8038
grad	1.24	0.8079
renterinc	1.16	0.8602
no_info	1.13	0.8829
priest	1.10	0.9067
artisan	1.09	0.9208

Table 9: Variance Inflation Factor, test for multicollinearity, mean VIF=2.12.

A4.2 Wald Chi-Square test for parameters

Table 10: Wald Chi-Square test

Wald test
chi2(22) = 84.89
Prob > chi2 = 0.000

Table 10: Wald Chi-Square test statistic and corresponding significance level.

Appendix 5: Logit model

A5.1 Logit regression

Table 11: Logit regression

VARIABLES	oppose
no_info	1.105***
	(0.198)
elec_share	1.083**
	(0.529)
powercfreq	0.0280
	(0.0460)
powercdur	-0.0454
	(0.0452)
rural	0.248
	(0.208)
prim	-0.701**
	(0.291)
mid	-1.044***
	(0.286)
second	-1.330***
	(0.356)
grad	-0.972*
	(0.532)
pgrad	0.305
	(0.425)
lowinc	0.601**
	(0.276)
mediuminc	0.645
	(0.445)
highinc	0.971
	(0.595)
agricultural	1.592***
	(0.571)
artisan	0.0125
	(1.403)
employpriv	0.298
	(0.403)
livestock	0.158
	(0.808)
o.priest	-
renterinc	0.230
	(1.255)
selfemploy	0.823**
	(0.373)
skilledlabour	0.483
	(0.453)
unskilledlabour	1.448***

	(0.413)
ownfarm	1.423***
	(0.435)
retiredemploy	0.659
	(0.466)
Constant	-0.0459
	(0.526)
Observations	985

Table 11: Logit regression, probability to oppose a fossil-fuel subsidy reform. Standard errors in parentheses, significance levels denoted *** p<0.01, ** p<0.05, * p<0.1.

Table 12: Addition regression statistics

Number of obs	985
LR chi2(23)	142.37
Prob > chi2	0.0000
Pseudo R2	0.1448

Table 12: Additional regression statistics for the logit regression.

A5.2: Logit model marginal effect

Marginal effects after logit
y = Pr(oppose) (predict)
= 0.84640155

Table 13: Logit regression, marginal effects

variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]	X
no_info	0.1437	0.0248	5.79	0.000	0.0951	0.1923	0.4518
elec_share	0.1408	0.0682	2.06	0.039	0.0071	0.2745	0.1658
powercfreq	0.0036	0.0060	0.61	0.543	-0.0081	0.0154	2.9320
powercdur	-0.0059	0.0059	-1.00	0.315	-0.0174	0.0056	2.5198
rural	0.0323	0.0269	1.20	0.231	-0.0205	0.0851	0.6701
prim	-0.0911	0.0372	-2.45	0.014	-0.1640	-0.0182	0.2518
mid	-0.1358	0.0364	-3.74	0.000	-0.2070	-0.0645	0.2518
second	-0.1729	0.0455	-3.80	0.000	-0.2620	-0.0837	0.0964
grad	-0.1263	0.0688	-1.84	0.066	-0.2611	0.0084	0.0244
pgrad	0.0396	0.0551	0.72	0.472	-0.0684	0.1476	0.1259
lowinc	0.0781	0.0356	2.20	0.028	0.0084	0.1479	0.7289
mediuminc	0.0838	0.0576	1.46	0.146	-0.0291	0.1968	0.0548
highinc	0.1262	0.0772	1.64	0.102	-0.0250	0.2774	0.0213
agricultural	0.2070	0.0743	2.79	0.005	0.0614	0.3525	0.0629
artisan	0.0016	0.1825	0.01	0.993	-0.3560	0.3592	0.0030
employpriv	0.0388	0.0525	0.74	0.460	-0.0641	0.1417	0.1025
livestock	0.0206	0.1051	0.20	0.845	-0.1855	0.2266	0.0091
renterinc	0.0298	0.1632	0.18	0.855	-0.2900	0.3497	0.0051
selfemploy	0.1070	0.0491	2.18	0.029	0.0109	0.2032	0.2091
skilledlabour	0.0627	0.0592	1.06	0.289	0-.0532	0.1787	0.0822
unskilledlabour	0.1883	0.0539	3.50	0.000	0.0827	0.2939	0.2903
ownfarm	0.1850	0.0570	3.25	0.001	0.0733	0.2967	0.1442
retired	0.0857	0.0608	1.41	0.159	-0.0335	0.2059	0.0416

Table 13: Marginal effects of all independent variables for the logit regression (holding all other variables at their means).

Appendix 6: Limited probability model

Table 14: Limited probability model regression

VARIABLES	oppose
no_info	0.145***
	(0.0255)
elec_share	0.119*
	(0.0627)
powercfreq	0.00367
	(0.00617)
powercdur	-0.00571
	(0.00622)
rural	0.0350
	(0.0295)
prim	-0.0670*
	(0.0350)
mid	-0.128***
	(0.0360)
second	-0.186***
	(0.0509)
grad	-0.120
	(0.0845)
pgrad	0.0346
	(0.0422)
lowinc	0.0702**
	(0.0352)
mediuminc	0.0680
	(0.0679)
highinc	0.123
	(0.0942)
agricultural	0.283***
	(0.0788)
artisan	0.0696
	(0.226)
employpriv	0.102
	(0.0703)
livestock	0.0970
	(0.140)
priest	0.453**
	(0.228)
renterinc	0.138
	(0.181)
selfemploy	0.206***
	(0.0646)
skilledlabour	0.155**
	(0.0750)
unskilledlabour	0.270***
	(0.0667)
ownfarm	0.277***

	(0.0691)
retiredemploy	0.167**
	(0.0807)
Constant	0.493***
	(0.0796)
Observations	988
F(24, 963)	6.45
Prob > F	0.0000
R-squared	0.1384
Adj R-squared	0.1169
Root MSE	0.37493

Table 14: LPM regression, probability to oppose a fossil-fuel subsidy reform. Standard errors in parentheses, significance levels denoted *** p<0.01, ** p<0.05, * p<0.1.

Appendix 7: Ordered probit model

Table 15: Ordered probit regression

VARIABLES	oppose
no_info	0.517***
	(0.0790)
elec_share	0.348*
	(0.193)
powercfreq	0.0545***
	(0.0207)
powercdur	-0.0255
	(0.0195)
rural	0.124
	(0.0901)
prim	-0.358***
	(0.110)
mid	-0.533***
	(0.112)
second	-0.634***
	(0.154)
grad	-0.501**
	(0.247)
pgrad	0.00806
	(0.137)
lowinc	0.188*
	(0.112)
mediuminc	0.292
	(0.204)
highinc	0.203
	(0.279)
agricultural	0.510**
	(0.238)
artisan	0.0435
	(0.660)
employpriv	0.0262
	(0.203)
livestock	0.0818
	(0.409)
priest	0.423
	(0.673)
renterinc	-0.418
	(0.514)
selfemploy	0.319*
	(0.187)
skilledlabour	0.216
	(0.221)
unskilledlabour	0.562***
	(0.196)
ownfarm	0.503**

	(0.204)
retiredemploy	0.214
	(0.234)
Constant cut1	-2.626***
	(0.374)
Constant cut2	-1.097***
	(0.244)
Constant cut3	-0.265
	(0.240)
Constant cut4	0.681***
	(0.241)
Observations	988

Table 15: Ordered probit regression, probability to oppose a fossil-fuel subsidy reform. Standard errors in parentheses, significance levels denoted *** p<0.01, ** p<0.05, * p<0.1.

Table 16: Additional regression statistics

Number of obs	988
LR chi2(24)	169.69
Prob > chi2	0.0000
Pseudo R2	0.0748

Table 16: Additional regression statistics for the ordered probit regression.

Table 17: Ordered probit regression, marginal effects, outcome 0 = highly reasonable

_at	Margin	Std. Err	z	P>|z|	[95% Conf.	Interval]
1	0.0010178	0.0010148	1.00	0.316	-0.0009711	0.0030068
2	0.0001579	0.0001831	0.86	0.388	-0.0002009	0.0005168

Table 17: Marginal effects for information and no information, ordered probit regression (holding all other variables at their means). A higher marginal effect indicates an increased likelihood of belonging to a certain outcome.
1. _at: No information = 0, 2. _at: No information = 1.

Table 18: Ordered probit regression, marginal effects, outcome 1 = reasonable

_at	Margin	Std. Err	z	P>|z|	[95% Conf.	Interval]
1	0.0588109	0.008859	6.64	0.000	0.0414476	0.0761742
2	0.0189216	0.0040182	4.71	0.000	0.011046	0.0267972

Table 18: Marginal effects for information and no information, ordered probit regression (holding all other variables at their means). A higher marginal effect indicates an increased likelihood of belonging to a certain outcome.
1. _at: No information = 0, 2. _at: No information = 1.

Table 19: Ordered probit regression, marginal effects, outcome 2 = somewhat reasonable

_at	Margin	Std. Err	z	P>|z|	[95% Conf.	Interval]
1	0.1746472	0.0145857	11.97	0.000	0.1460598	0.2032346
2	0.0882023	0.0103982	8.48	0.000	0.0678223	0.1085823

Table 19: Marginal effects for information and no information, ordered probit regression (holding all other variables at their means). A higher marginal effect indicates an increased likelihood of belonging to a certain outcome.
1. _at: No information = 0, 2. _at: No information = 1.

Table 20: Ordered probit regression, marginal effects, outcome 3 = unreasonable

_at	Margin	Std. Err	z	P>|z|	[95% Conf.	Interval]
1	0.3534605	0.0171351	20.63	0.000	0.3198763	0.3870448
2	0.2768341	0.0164088	16.87	0.000	0.2446734	0.3089948

Table 20: Marginal effects for information and no information, ordered probit regression (holding all other variables at their means). A higher marginal effect indicates an increased likelihood of belonging to a certain outcome.
1. _at: No information = 0, 2. _at: No information = 1.

Table 21: Ordered probit regression, marginal effects, outcome 4 = highly unreasonable

_at	Margin	Std. Err	z	P>|z|	[95% Conf.	Interval]
1	0.4120635	0.021174	19.46	0.000	0.3705633	0.4535637
2	0.615884	0.0231368	26.62	0.000	0.5705367	0.6612313

Table 21: Marginal effects for information and no information, ordered probit regression (holding all other variables at their means). A higher marginal effect indicates an increased likelihood of belonging to a certain outcome.
1. _at: No information = 0, 2. _at: No information = 1.