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Fossil fuel subsidy reforms and their impacts on firms

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ABSTRACT

While the potential adverse effects of fossil fuel subsidy reform are well documented for households, the literature has largely ignored the effect of subsidy reform on firms' competitiveness. This paper discusses how firms are affected by, and respond to, energy price increases caused by subsidy reforms. It highlights that cost increases (both direct and indirect) do not necessarily reflect competitiveness losses, since firms have various ways to mitigate and pass on price shocks. This paper presents and discusses direct and indirect transmission channels for price shocks, and firms' response measures: absorbing cost shocks into profits, inter-fuel substitution, increasing energy and material efficiency, and passing on price increases. It argues that further micro-econometric studies using enterprise surveys are essential for quantifying the role of these mechanisms, and for designing policy measures that ensure that competitiveness losses due to subsidy reforms are minimised.

1. Introduction

In early 2016, the Kingdom of Saudi Arabia announced a significant reduction in fossil fuel subsidies (FFS) as a way to compensate shrinking government revenues – and the associated fiscal pressures – due to lower oil prices. As subsidies were removed across a range of fuel types, the subsequent price hikes hit consumers and industries to varying degrees. Gasoline prices increased by about 50%, mainly affecting motorists (MEES, 2016). A 67% increase in natural gas prices principally affected electricity generators and industrial sectors. One of the highest price increases (133%) was for ethane – a key input for the petro-chemical sector.

Soon after, some of the largest petro-chemical firms published estimates for the likely impacts on their production costs or profits (MEES, 2016). Several of these firms estimated the adverse impact on profits ranging from 6.5% to 44.1% relative to 2014. The Saudi Cement Company expected production costs to increase by $18.1 m as a direct consequence of FFS removal (Trade Arabia, 2015). While these self-reported figures may not be consistently comparable, they highlight a common political economy challenge of FFS removal: firms – and in particular energy intensive industries – tend to oppose FFS removal and exert their political clout to do so. Indeed, concerns about competitiveness and profitability have been a key argument of political opponents of FFS reform.

However, focussing on energy cost increases alone yields an incomplete picture of the effects of FFS reform on the competitiveness of firms – both direct and indirect transmission channels for energy prices must be considered, as well as firms' ability to respond. The ability to respond depends on various mechanisms used by firms to mitigate (or pass on) price shocks – and thus is crucial for estimating the net impacts on firms' competitiveness.

While the adverse effects of FFS removal are increasingly well understood for households, the existing literature has largely ignored the effect of subsidy reform on firms. This gap in the evidence base must be addressed in order to enable policy makers to design and implement FFS reforms more effectively.

This article outlines the most important transmission channels for energy price shocks, and response measures used by firms. In doing so, this article provides (i) a systematic conceptual framework for disentangling the effects of FFS reform and firms' response measures, (ii) guidance for future research by offering an overview of the main empirical methodologies for analysing these effects, and (iii) a discussion of key policy implications.

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2. Background

A comprehensive body of literature documents the economic, social, and environmental costs of FFS, and argues that by removing FFS these costs could be avoided (Coady et al., 2015; Arze del Granado et al., 2012; IEA, 2014; Rentschler and Bazilian, 2016). The political economy challenges of subsidy reform are increasingly well understood as case studies of past reforms are studied and lessons learnt (Commander, 2012; Fattouh and El-Katiri, 2015; Kojima, 2016; Strand, 2013).

A crucial factor in determining political economy challenges and public opposition to reforms are the potentially substantial adverse effects on livelihoods due to rising energy prices. Studies have shown how compensation schemes can protect vulnerable households from energy price shocks associated with FFS reform – and how this can increase public acceptance of subsidy reform (Arze del Granado et al., 2012; Rentschler, 2016; Ruggeri Laderchi et al., 2013).

However, with a strong focus on households, research has given far less attention to the potential impacts of FFS reform on firms. This is true despite concerns about competitiveness and profitability, which have been an important argument of political opponents of subsidy reform (Hayer, 2017; IMF, 2016a, 2016b). Particularly, energy intensive manufacturing firms have been argued to experience substantial changes to their cost structures, with adverse implications for profitability (Bazilian and Onyeji, 2012). Evidently such effects can have knock-on effects on economic activity, employment, and thus on households (Kilian, 2008).

Using a computable general equilibrium (CGE) model for Vietnam, Willenbockel and Hoa (2011) suggest that firms can cope with moderate energy price increases (5–10% per year) using common energy efficiency measures. In Egypt, a doubling of energy prices due to subsidy removal is estimated to reduce profit margins of firms in energy intensive sectors, e.g. in the cement (29–39% reduction), fertiliser (22%), and steel sectors (13%) (Khattab, 2007). Jamal and Ayarkwa (2014) provide evidence from Ghana suggesting that firms are strongly affected by the indirect effects of subsidy reform, as the costs of transportation and raw materials increase, while consumers' purchasing power decreases. Tambunan (2015) makes the same observation using data on Indonesian small enterprises, and emphasises that the ultimate effect of subsidy removal depends crucially on firms' ability to mitigate price shocks – which in turn can be strengthened by dedicated policy measures.

Studies on the impact of environmental taxes on firms also offer relevant insights. In a comprehensive literature review, Dechezlepretre and Sato (2014) assess the empirical evidence on the effect of environmental taxes on competitiveness, for a wide range of industries and countries. They conclude that – unlike market conditions and skills – environmental taxes (and regulation more generally) do not have a large adverse effect on firm or country-level indicators of competitiveness. In an empirical study on Germany, Flues and Lutz (2015) show that electricity taxes (EUR 20.5/MWh, or 32–68%) did not negatively affect common competitiveness indicators of firms, such as turnover, exports, value added, investment, and employment. In a review of earlier literature, Zhang and Baranzini (2004) also conclude that overall, the competitiveness losses due to carbon taxes are small and in many cases insignificant.

Arlinghaus (2015) reviews the empirical literature on the effects of carbon taxes on various indicators of competitiveness. The author concludes that studies consistently fail to identify any significant adverse competitiveness effect from the introduction of carbon taxes. This observation holds across various indicators of competitiveness, including employment, output, profits, and exports. Several other studies also conclude that stricter environmental policies have little adverse effect on competitiveness; and – in line with the Porter Hypothesis – find that some firms may even be able to increase their productivity (Albrizio et al., 2014; Ekins and Speck, 2010; Enevoldsen et al., 2009; Porter, 1990).

Reviewing the empirical literature on the determinants of competitiveness, Dethier et al. (2011) find that other factors such as infrastructure, finance, security, competition, and administrative capacity play a far more significant role than energy prices in determining firms' performance. A key reason is that energy costs tend to constitute a relatively small share of total production costs – e.g. typically 5% or lower in EU manufacturing sectors (Bergmann et al., 2007; Ro, 2013; Wilting and Hanemaaijer, 2014).

Conceptually, energy price increases due to FFS removal are directly comparable to energy price increases due to carbon or energy taxes. However, it should be noted that price increases due to subsidy removal can be particularly large: While depending on fuel-specific subsidisation rates, subsidy reforms have caused energy price increases of 100% and more in the past (Fattouh et al., 2016; Rentschler and Bazilian, 2016). This emphasises that case-specific analyses of FFS reforms are crucial.

3. Transmission channels and response measures

In the case of households, the literature on FFS reforms typically distinguishes direct and indirect price effects; i.e., the extent to which energy price changes *directly* affect households by increasing the cost of energy consumption, and *indirectly* by increasing the cost of other goods and services. In the case of firms these two transmission channels also apply. In addition to these transmission channels, several response measures play a crucial role in determining the net effect of subsidy removal on firms.

This section discusses the transmission channels for energy price shocks, and presents four common response measures (Fig. 1). As we discuss, empirical analyses of enterprise surveys can help to shed light on these aspects, and identify differences across sectors and regions. In the case of larger, publicly listed firms similar analyses can be conducted using balance sheets and accounts; this is of particular relevance when an economy or sector is dominated by few large firms which are in a strong political position to oppose reforms.

3.1. Transmission channels of energy price increases

1) **Direct channel**

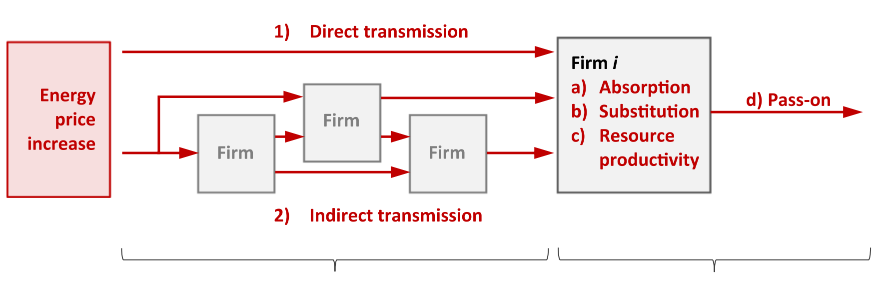

Fig. 1. Energy price shocks due to subsidy removal: Channels for shock transmission and response measures.

Removing subsidies on specific energy types will increase the energy input costs of firms. As subsidy removal affects energy prices "instantly", directly transmitted price shocks are typically the first impact felt by firms. This means that direct price shocks affect firms' energy costs almost instantaneously, unless the price of energy inputs has been hedged. Such immediate cost shocks cannot typically be coped with using structural measures (such as technological updates to increase energy efficiency), but require quickly deployable measures. In practice, energy-intensive industries, such as petrochemicals, cement, steel, manufacturing, or transport tend to be particularly exposed to the direct price shocks induced by subsidy reform. The potential effect of such energy price shocks on competitiveness has been a central concern of governments considering FFS reform (IMF, 2016a, 2016b).

The level of firms' exposure to *direct* energy price shocks depends on their energy intensity, which varies significantly across industries, and only changes slowly in line with innovation and technological progress (Worrell et al., 2008). Thus, in order to mitigate direct price shocks due to FFS reform, policy makers cannot easily reduce firms' exposure, but are instead required to moderate the price shock itself. For this purpose, measures to smoothen price shocks – e.g. through step-wise reduction of FFS, price stabilisation funds, or alignment with low international energy prices – have played a key role in reducing direct energy price shocks, and associated adverse effects on households and firms (Coady et al., 2012; Rentschler and Bazilian, 2017).

Quantitatively, a firm's exposure to direct energy price shocks can be approximated as the ratio between energy input costs and total input costs or revenues.[1] However, note that energy expenditure reported in firm surveys does not necessarily increase at the same rate as energy prices, as they may include various payments to energy suppliers that do not directly depend on energy prices (e.g. suppliers' labour costs, electricity transmission costs, or service fees (Grave et al., 2015; Marcu et al., 2014)). Moreover, it is important to distinguish between different types of energy inputs, as energy types are typically subsidised at different rates (and some not at all).

Studies on household-level effects offer empirical methodologies for simulating direct price shocks (i.e. partial equilibrium effects) associated with FFS reform as described by Coady (2006). Both the IMF (2016a) and Araar and Verme (2012) offer econometric models to assess the impact of FFS removal on household consumption and welfare using household expenditure surveys. Essentially, these models simulate the cost shock due to an energy price increase, and use elasticities to estimate changes in consumption bundles. These models can be adapted to the case of firms, by using enterprise surveys to consider the direct effect of price changes on profits, revenues, or other outcome variables.

2) **Indirect channel**

Energy prices also affect firms indirectly, via the production costs of intermediate inputs and capital equipment. More specifically, firms producing intermediate goods will incur direct energy price shocks, which they (at least partially) pass on to other firms by increasing the price of intermediate inputs (Castagneto-Gissey, 2014; Kim et al., 2010; Sijm et al., 2006). In this way energy price shocks can progress through supply chains in the form of price increases of non-energy goods. In practice, firms relying heavily on energy intensive intermediate inputs (e.g. materials with high embodied energy content, such as steel) tend to be affected most by indirect price shocks (Bassi et al., 2009). Moreover, wage costs may increase as higher energy costs drive consumer price inflation.

Indirect price effects are likely to take longer to fully materialise, as price shocks are successively passed down supply chains. How quickly any given firm will incur the full indirect price shock depends not least on the number and interlinkages of preceding intermediate production stages. Thus, the magnitude and timing of indirect price shocks depends to a large extent on the response measures taken by intermediary firms (including their pass-on rate).

Besides the change in intermediate (non-energy) input costs, another potential indirect shock should be acknowledged: An increase in energy prices will (ceteris paribus) reduce the disposable income of consumers, thus potentially reducing aggregate demand (Jamal and Ayarkwa, 2014). This demand shock in turn is likely to affect firms' output and revenue levels. The magnitude of this effect will depend crucially on how FFS reform revenues are re-used (e.g. compensation of consumers, or government expenditure).

In a study on household consumption, Arze del Granado et al. (2012) suggest that on average indirect effects make up about 60% of the total impacts of a subsidy removal. Also in the context of firms it is likely that indirectly transmitted price shocks equal or exceed direct ones (Jamal and Ayarkwa, 2014). The reason is that energy input costs typically constitute a far smaller share of overall costs than non-energy inputs (Allwood et al., 2011; Flachenecker et al., 2016; Wilting and Hanemaaijer, 2014). Thus, it is crucial for policy makers not to underestimate potential price shocks by focusing solely on direct price effects. Since all indirect price shocks originate as direct shocks upstream in value chains, the policy measures for moderating direct energy price shocks – e.g. gradual FFS reduction, or price stabilisation funds – are also critical in the context of the indirect price channel.

The level of a firm's exposure to *indirect* energy price shocks depends above all on the energy intensity of its intermediate production inputs. Enterprise surveys provide detailed accounts of firms' expenditure on materials, and various databases exist which offer detailed estimates of the embodied energy of hundreds of the most common industrial materials (Hammond and Jones, 2011). Based on this data, the level of exposure can be approximated by determining the "embodied" energy content of a firm's production inputs. However, the geographical origin of materials is crucial to consider, as domestic energy price shocks due to FFS removal are irrelevant for imported materials – no matter their energy intensity.

The econometric simulation models by the IMF (2016a) and Araar and Verme (2012) also enable the integration of input-output tables. In this way energy price shocks can be simulated, not only for a firm's direct energy inputs, but also for the embodied energy component of all intermediate inputs and materials, and taking into account complex value chains. However, to take full general equilibrium effects of FFS reform into account – e.g. with respect to sectoral reallocation of resources – CGE models with detailed sectoral disaggregation are necessary (Durand-Lasserve et al., 2015; Hosoe et al., 2010; Siddig et al., 2014).

3.2. Four response measures

The transmission channels discussed above determine the size of the overall cost shock faced by a firm following a subsidy reform. This section discusses the four most important response measures that firms typically use to respond to the overall cost shock. Three of these – *absorption, substitution,* and *resource efficiency* – refer to internal responses within firms; the last response measure – *pass-on* – can help firms to forward remaining cost shocks to other firms or households. Only by assessing both the combined cost shock and firms' capacity to implement response measures, can the net effect of FFS reform on competitiveness be understood.

a) **Absorption**

If profit margins are large, firms can (temporarily) absorb energy price shocks by accepting smaller margins. If energy price shocks are fully absorbed into profit margins, firms can continue

[1] For instance, for industrial enterprises in Ireland energy costs are estimated to be up to 6% of total direct costs (Fergal O'Leary et al., 2007).

operations without making adjustments to technology and production quantities, or sales prices. In this case, consumption of both the (formerly) subsidised fuel and of all other energy inputs can remain constant. Absorbing price shocks into profits is a firm's direct analogy to a household absorbing shocks into savings (though note the difference between the stock and flow of savings).

Since more structural responses (e.g. fuel substitution, or increasing energy efficiency) require time and investment, the ability to absorb immediate cost increases into profits can be a crucial short-term transition measure. However, in the medium- to long-term reduced profit margins will result in wider welfare losses; for instance because wages in small enterprises typically depend on profits, or because it reduces capital reserves for productive investments.

For policy makers it is essential to understand firms' ability to cope in the immediate aftermath of a FFS reform – not least to ensure public acceptance of reform. If profit margins are small, firms are likely to struggle to absorb cost increases, thus requiring policy makers to provide active support measures to mitigate and compensate shocks in the short-term, and facilitate the transition by facilitating more structural response measures in the medium- to long-term (such as supporting substitution and efficiency measures, Rentschler and Bazilian, 2017). In the above referenced example of Saudi Arabia, the 14 largest petro-chemical firms had jointly made total net profits of over $9bn in 2014 (MEES, 2016). It is plausible that high profits reaffirmed policy makers that energy price increases would enable these firms to absorb cost increases in the short-run, and invest in substitution and efficiency in the medium- to long-run.

The ability of firms to absorb energy price shocks can be approximated by comparing absolute net profits with the overall energy price shock. Since *direct* price effects dominate in the short-term (Araar and Verme, 2012), computing the ratio of profits and energy expenditures can also provide an indication of the short-term ability to absorb energy price shocks. The ability of firms to absorb *indirect* effects, can be understood by comparing the ratio of profits and expenditure on energy-intensive intermediate inputs. If profit margins significantly exceed the estimated energy cost shock, firms are likely to be able to rely on absorption as a short-term response measure.

In addition to the above indicators, firm surveys – specifically panels, or cross-sections with pronounced regional heterogeneity – also enable empirical analyses on the role and relevance of absorption. For instance, econometric methods can uncover whether profit margins are affected by price changes of different energy types (Smale et al., 2006).

b) **Substitution**

As subsidy reforms typically increase the price of selected energy types (e.g. electricity, petrol), firms may also respond by substituting these energy types with fuels that have become relatively cheaper (Chang, 1994; Koetse et al., 2008; Stern, 2012). Such inter-fuel substitution can be observed in the form of changing energy shares (i.e. the energy mix) in total energy usage as a response to energy price changes.

The ability to substitute energy types is constrained by technological characteristics of production, which can vary significantly across sectors (Ma et al., 2008). In fact, technological innovation and substitution may play a key role in determining how a green tax reform (e.g. FFS reform) affects competitiveness (Koskela et al., 2001). In addition, inter-fuel substitution depends critically on the access to alternative energy types and reliability of supply, which can vary across regions. For instance, lacking access to the electricity grid or frequent power outages may mean that rural firms are unable to rely on electricity as a substitute for fuels that are subject to FFS reform.

From a welfare perspective, substitution can be a desirable response measure if unsustainable fuels are replaced by cleaner or renewable alternatives. For policy makers this means that targeted measures for supporting alternative energies can be crucial – not only to help firms to use substitution as a coping measure, but also to guide the direction of substitution. Such support measures can include the provision of technology, or temporary subsidisation of alternative energies (e.g. renewables) (Matsuo and Schmidt, 2017). For instance, the government of Indonesia complemented their 2007 kerosene FFS reform with active support measures to natural gas (specifically, the provision of gas cook stoves) in order to prevent substitution towards other unsustainable fuels (such as charcoal or firewood; GSI, 2011; IMF 2013a, 2013b). For similar reasons, Kenya complemented their 2005 FFS reform with large-scale investments in rural electrification, thus enabling users to switch away from fossil fuels (IMF, 2013a, 2013b).

Data on energy access (e.g. rural electrification rates) can provide insights on potential inter-fuel substitution opportunities and constraints. Firm surveys also frequently collect information on energy access and supply quality, which can shed light on firms' ability to substitute across regions and sectors (Arnold et al., 2008). Moreover, the nature and magnitude of inter-fuel substitutability can be formally characterised and estimated on the basis of firm surveys, e.g. by estimating own and cross price elasticities, or partial elasticities of substitution – for details see Azlina et al. (2013), Bjørner and Jensen (2002), Blackorby and Russell (1989), Pindyck (1979), and Uzawa (1962).

c) **Resource efficiency**[2]

Firms may also respond to *direct* energy cost increases by increasing *energy* efficiency, i.e. reducing overall energy consumption while maintaining pre-reform output levels. Moreover, increasing *material* efficiency can play a crucial role in responding to *indirectly* transmitted price shocks, which are due to embodied energy in intermediate materials (Flachenecker et al., 2016). In fact, considering that material costs often significantly exceed energy costs even in energy intensive manufacturing sectors, the role of material efficiency is of particular importance (Allwood et al., 2011; Wilting and Hanemaaijer, 2014; Yilmaz et al., 2005).

Formally, energy (or material) efficiency relates to the marginal product of energy (or material inputs), i.e. the output obtainable from the last unit of energy input given the current production technology. This implies that gains in resource efficiency require an adjustment to the production function, for instance by updating production processes or technology. Thus, from a policy making perspective, improvements in resource efficiency are a desirable and welfare improving response to FFS reforms, as they are associated with modernisation, innovation, and reduction of negative externalities of inefficient energy usage (such as air pollution (Flachenecker et al., 2016)).

Similar to the case of substitution, the ability of firms to increase resource efficiency depends on a variety of factors, all of which mandate dedicated policy measures: e.g. to improve the availability and affordability of modern technology, and to provide support programmes for identifying, financing, and implementing efficiency enhancing measures (Rentschler and Bazilian, 2017; Rohdin et al., 2007; Trianni et al., 2013).

Single factor productivity measures can enable the approximation and benchmarking of energy or material efficiency at the national or sector level, hence allowing an estimate of the need and scope for efficiency improvements (Bringezu and Schütz, 2010; Dahlström and Ekins, 2005). In addition, the use of enterprise surveys can enable the estimation of resource efficiency levels with high sectoral and regional granularity (by computing the quantity of output per unit of energy or material input). Moreover, regression

[2] "Resources" comprise both energy and materials.

analyses of firm surveys can reveal empirically whether (and to what extent) resource efficiency levels have depended on energy prices in the past. If this link is weak, dedicated policy measures may be required to incentivise and enable firms to use efficiency improvements as a response to energy price increases (Rentschler et al., 2016).

d) **Pass-on**

The net impact of FFS reform on firms also depends on whether price shocks are passed-on to end-users. Essentially, this channel refers to the extent to which firms can adjust the unit sales price of output in response to changing input costs (without incurring excessive reductions of sales quantities).

Technically, a firm's ability to adjust its sales price depends on the consumer's demand choices, or more specifically the price elasticity of demand; i.e. the rate at which end-users (e.g. households) and other firms (consumers of intermediate goods) substitute away from a given firm's product following a price change. This in turn can depend on a variety of factors: the degree of competition, and the availability and affordability of alternatives (Kim et al., 2010; Sijm et al., 2006). Reviewing the empirical evidence on the pass-on of carbon taxes, Arlinghaus (2015) concludes that across industries pass-on rates vary between 0% and over 100% of the price shock – thus highlighting the important role of sector specific conditions.

Formally, the pass-on rate can be measured as the change in a good's unit sales price in response to energy price changes (Sijm et al., 2006). Firm surveys typically offer information on firm specific input and output prices, and – in particular panel data – can be used to estimate pass-on rates. For policy making purposes it is important to empirically estimate to what extent firms have in the past passed on energy price increases to consumers. This determines whether fuel price shocks due to FFS reform are simply passed on to consumers, thus causing inflationary pressures – i.e. whether additional measures are needed to achieve objectives such as modernisation, efficiency improvements, and reduction of fossil fuel usage and associated negative externalities.

4. Conclusion and policy implications

4.1. Need for further research

By building the evidence base on FFS reforms and firms, research can strengthen the design of FFS reforms and increase the momentum for reforms. Country-level studies for major subsidising economies are needed to estimate the likely effects of FFS reform on firms. CGE models can estimate effects at the sector level, and provide insights about interactions between sectors, dynamic effects, and both direct and indirect price shocks. Firm survey analyses can also shed light on both direct and indirect price effects, if combined with input-output tables.[3] Moreover, firm survey analyses can be critical for gaining a more granular understanding of how FFS reforms may affect certain types of firms, and how these may respond.

Micro-level approaches using household surveys have offered crucial insights into how energy shocks due to fossil fuel subsidy reforms can affect the livelihoods of households (Coady et al., 2012; Rentschler and Bazilian, 2016; Verme and El-Massnaoui, 2015). Similarly, there is a clear need for empirical studies using micro-level firm data, which investigate exposure and vulnerability to energy price shocks (Dethier et al., 2011).

However, it is important not to equate cost increases with competitiveness losses. Empirical analyses using firm-level data can also be crucial for investigating the ability of firms to use response measures (i.e. absorption, substitution, efficiency, and pass-on), which determine to what extent cost increases do in fact translate into competitiveness losses. Thus, e.g. by computing elasticities empirical studies can provide detailed case-specific insights to inform the design of policy measures for strengthening coping and adjustment capacities. Research should also focus on how energy price increases may affect other firm level outcomes – employment in particular – in order to determine to what extent adverse effects of FFS reforms are passed on to households, and how they can be protected.

As policy measures are identified to mitigate the adverse effects on competitiveness, research is also needed on how such mitigation measures can be integrated into broader efforts to strengthen the business environment in which firms operate. Enterprise surveys, such as the Doing Business reports by the World Bank (2016), the Management, Organisation and Innovation surveys by the EBRD (2010), or the Competitiveness reports by the World Economic Forum (2016) provide useful starting points to explore the drivers of and barriers to competitiveness. Such research may demonstrate that FFS reforms should not only be associated competitiveness losses, but – in line with the Porter Hypothesis – may promote efficiency, innovation, modernisation, and thus increase competitiveness.

4.2. Policy implications

As case studies of past reforms are studied and lessons learnt, the political economy challenges of subsidy reform are increasingly well documented (Commander, 2012; Strand, 2013). Concerns about competitiveness and profitability have been a key part of these challenges, and key arguments of political opponents of subsidy reform. Particularly, energy intensive manufacturing firms have been argued to experience substantial changes to their cost structures, with adverse implications for profitability (Bazilian and Onyeji, 2012). Evidently such effects can have knock-on effects on jobs and thus on households.

Countless studies have rightly emphasised the need for social protection measures to protect vulnerable households, and thus to manage political economy challenges. In addition, this article argues, policy makers must also consider actions for strengthening the ability of firms to respond to energy price shocks. In particular:

- **Mitigate short-term losses:** This is crucial for ensuring business continuity, and allowing time to firms to implement more structural measures (including efficiency measures). In some cases, policy makers may decide that no major short-term assistance is required, as profit margins are large enough to absorb cost shocks and finance investments in efficiency and substitution. However, especially in competitive markets profit margins cannot always be assumed to be large, thus requiring policy makers to consider measures to mitigate potential competitiveness losses.
- **Enable substitution and efficiency measures:** Measures may be needed to help firms substitute towards alternative fuel types or to increase the efficiency of energy and material usage. In particular, policy makers must identify and address barriers (such as information, capacity, and financial constraints) that prevent firms from investing in efficiency enhancing measures; e.g. by providing technical assistance, information programmes, and financial support for technological modernisation (Rentschler et al., 2016). In addition, providing reliable and affordable access to alternative energies (e.g. through public investments in electrification, and renewable energy) can be critical for facilitating and directing inter-fuel substitution.

Finally, it should be recalled that energy costs are only one (minor) factor among many that determine a firm's or sector's competitiveness (Dethier et al., 2011; WEF, 2016). These factors offer alternative entry points for policy makers to counter-balance potential competitiveness losses due to energy price increases; for

[3] See Araar and Verme (2012) for a discussion on how input-output tables can be used in the context of household surveys.

instance by strengthening institutions and administrative capacity, or by investing in infrastructure and labour productivity, and ensuring a stable business environment through prudent long-term policy strategies (World Bank, 2017).

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