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ANALYSIS

Assessment of the macroeconomic and sectoral effects of higher electricity and gas prices in the EU: A general equilibrium modeling approach

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ABSTRACT

The macroeconomic and sectoral effects of differentials in energy prices between the EU and the non-EU countries in the horizon to 2050 are assessed with the use of GEM-E3, a Computable General Equilibrium model. Alternative scenario variants are quantified: In the first case EU policies and market structures regarding taxation, penetration of RES in power generation and higher market power of EU energy producers lead to higher EU energy prices compared to those recorded in the non-EU countries. In the second variant developments in non-EU countries lead to lower energy prices as compared to those in the EU. Simulation results show that higher EU energy prices lower EU GDP compared to the baseline case. The impact ranges in magnitude between 0.02 and 0.41%, cumulatively over 2015–2050, depending on the drivers of price differentials and on the use of the additional tax revenues generated. Taxation and power generation mix policies are found to have the largest impact on economic activity. The results indicate the challenges of electricity and gas price developments that EU policy making needs to address in the following years so as to ensure long-term competitiveness and growth.

1. Introduction

Over the last two decades the European energy sector has been subject to a profound transformation associated with market liberalization and decarbonisation actions. Policies have focused on market integration and related cross-border issues addressing the long-term goal of creating a single EU energy market (see Ref. [9] for a review of directives). Decarbonisation policies have set ambitious targets for greenhouse gas emissions i.e. reduction by 80–95% in 2050 compared to 1990 levels and significant penetration of renewables (RES) in the power generation mix (see [19,20]). Given the dominant share of the power sector in the EU with regards to CO_2 emissions and its relatively high technological potential for abating CO_2 emissions, the move to a low-carbon economy implies the almost full decarbonisation of Europe's power sector. Recent studies show that this could be technically feasible [21,22] with attached though non-negligible economic costs [23,24]). Liberalization and decarbonisation policies are expected to impact positively on the long-term sustainability, efficiency and competitiveness of the EU energy market. Nevertheless, EU efforts to establish a more competitive and sustainable energy sector have coincided with the abrupt halt of the economic activity in the EU as a result of the latest economic crisis. In this context of economic downturn resistance to change might persist taking the form of job protection policies or of measures defending national energy industries at the detriment of market liberalization. Such actions could keep in place

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large players in the energy sector or they could enable players gaining significant market power.

In addition to the EU energy policies, developments and policy choices in the non-EU countries also play an important part in determining EU competitiveness. Exploitation of abundant non-conventional energy forms in non-EU countries, such as shale gas, or subsidization of the electricity prices can reduce energy costs in these countries (see Refs. [1,12,18], for a discussion of developments and implications). While in other regions the exploitation of non-conventional energy sources is facilitated by access to existing substantial and inexpensive drilling capacity-hence lower extraction and trading costs (for instance in the USA the drilling capacity is available as conventional gas production on land declines relatively fast), no such capacity is available in Europe. Exploitation of significant reserves of non-conventional energy forms which may lead to lower energy prices in non-EU countries may render EU countries vulnerable to international competitiveness. Additional policies of concern which could affect competitiveness of the EU could include subsidization policies with regards to energy prices followed by EU competitors or non-EU energy producers (see for instance [14,11,6], among others).

International and domestic developments in the energy sector can have significant economic implications for the EU. The need to quantify and understand the effects on the European economy and competitiveness has been recognized by the policy makers and formulated in the conclusions of the 2013 May European Council [4]. The present paper, aims at complementing the debate on the energy prices in the EU and their impact on the EU competitiveness. The goal is to assess the macroeconomic and sectoral consequences of an increase in electricity and gas prices in the EU as a result of domestic policies or international developments. For this purpose several stylized scenarios of divergence of electricity and gas prices between the EU and the non-EU regions in the horizon to 2050 are simulated with the use of GEM-E3 model, a Computable General Equilibrium (CGE) model. The scenarios simulated consider a set of plausible drivers of price differentials between EU and non-EU countries. Two distinct variants are modelled: The first variant includes scenarios of higher electricity and gas prices in the EU as a result of higher taxation, higher market power of the electricity and gas producers allowing for higher price mark-ups, and higher penetration of Renewable Energy Sources (RES) into the EU power generation mix. The second variant quantifies a scenario case where electricity and gas prices decrease in all non-EU countries as a result of lower-cost energy resources. The scenarios are compared to the baseline scenario which assumes full implementation of all energy-related policies which EU has adopted and full achievement of EU objectives (2020 Policy Package, Energy Efficiency and ETS Directives, etc).

To the best of our knowledge, this is a first time attempt to assess the implications of higher electricity and gas prices in the EU compared to the non-EU countries which can contribute to the understanding of the impact of such differentials on the short- and long-term competitiveness of the EU. In addition this is a first time attempt to assess the effects of electricity and gas differentials between EU and non-EU countries while distinguishing between the sources of such differentials. The paper assesses the effects of higher electricity and gas prices while it considers different drivers of price differentials providing insights on the significance of these differentials in terms of macroeconomic and sectoral results. In methodological terms this is a first time study of the overall macroeconomic and sectoral impact of higher electricity and gas prices in the EU with the use of a CGE model. The simulation results are obtained at sectoral and at regional level providing useful information for policy making on the sectors of production and on the macroeconomic components where it should focus when developing the EU energy strategies.

The remainder of the paper develops as follows: Section 2 reviews the methodology and the data used for the design and the quantification of the alternative scenarios. Section 3 summarizes and discusses the simulation results. Last section concludes.

2. Methods

In the alternative scenarios simulated EU records higher electricity and gas prices as compared to the non-EU regions. Two scenario variants of price differentials are considered: In the first variant higher prices in the EU are the result of EU policies and market structure. In the second variant EU ends up with relatively higher prices as a result of polices and developments taking place in the non-EU countries. Table 1 summarizes the alternative scenarios simulated while their details are discussed below.

Table 1
Scenarios of higher energy prices in the EU simulated with the GEM-E3 model.

Scenario variant	Scenario code	Scenario name	Scenario assumptions
Prices affected by developments in EU countries	B21a	Taxation of electricity and gas-recycling via social security contributions	- Excise taxes above baseline levels applied on gas and electricity prices in the EU - Public budget same as in the baseline scenario - Revenues from taxation recycled back into the EU economy via lower rates of social security contributions paid by employers
	B21b	Taxation of electricity and gas-recycling via lump-sum transfers to households	- Excise taxes above baseline levels applied on gas and electricity prices in the EU - Public budget same as in the baseline scenario - Revenues from taxation are recycled back into the EU economy via lump-sum transfers to households
	B22	Higher mark-ups on electricity and gas costs	- EU gas and electricity supply sectors experience excessive market power thus higher profit margins than in baseline - Cost mark-up generates higher gross operating surplus i.e. capital income which is distributed according to share of ownership (80% to households as additional income and 20% to firms which re-invest)
	B24	Higher price only for electricity driven by generation mix	- Electricity prices increase from baseline due to higher shares of renewable energy sources in the power generation mix
Prices affected by developments in non-EU countries	B23	Low electricity and gas prices in the non-EU countries	- Policies outside EU (exploitation of non-conventional energy sources, subsidization, etc.) lead to lower energy prices in non-EU countries