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A SECTORAL BENCHMARK-AND-TRADE SYSTEM TO IMPROVE ELECTRICITY EFFICIENCY IN SOUTH AFRICA

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Dedication

To my dearest late grandparents – I am sure they are proud of me from heaven.

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Abstract

The continuously increasing energy intensity internationally is recognised as one of the greatest dangers the human race is facing nowadays with regards to future climate change and its detrimental consequences. Improving the intensity of energy consumption is an important step towards decreasing greenhouse gas emissions originating from fossil fuel-based electricity generation and consumption.

As a result of this, South Africa took the bold step in 2010 to commit itself to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) in taking all the necessary actions to decrease the country's greenhouse gas emissions by 34% to below the "business-as-usual" scenario by 2020 (Republic of South Africa, 2010). In order to do so, the country has to substantially reduce its energy consumption. This should be done without affecting the economic output; however, major energy consumers might prefer to decrease their output in order to comply with the rules focusing on the reduction of energy use.

In South Africa, harmful environmental effects are created mainly from the electricity consumption's unprecedented rise. The bulk of the country's greenhouse gas emissions (more than 60%) originate from the electricity generation sector which is heavily dependent on coal-fired power stations. The purpose of this study is to promote a benchmark-and-trade system to improve electricity efficiency in South Africa with the ultimate objective to improve the country's greenhouse gas emissions. The uniqueness of this study is two-fold. On the one side, South African policy-makers have rarely discussed or proposed the implementation of a cap-and-

trade system. On the other side, the same mechanism has never been proposed regarding electricity efficiency.

In order to do so, it is first required to acquire an in-depth knowledge of the electricity consumption and efficiency of the South African economy in its entirety and on a sectoral level. The key findings of the empirical analysis are as follows:

A decreasing effect of electricity prices to electricity consumption existed during the period 1980 to 2005, contrary to the increasing effect of total output to electricity consumption. Also, the results indicated that the higher the prices, the higher the price sensitivity of consumers to changes in prices (price elasticity) and vice versa.

The relationship between electricity consumption and electricity prices differ among various sectors. The findings of the exercise point towards ambiguous results and even lack of behavioural response towards price changes in all but the industrial sector, where electricity consumption increased with price decreases. On the other side, economic output affected the electricity consumption of two sectors (industrial and commercial) presenting high and statistically significant coefficients.

Based on a decomposition exercise, the change in production was the main factor that increased electricity consumption, while efficiency improvement was a driver in the decrease of electricity consumption. In the sectoral analysis, increases in production were part of the rising electricity usage for all the sectors with 'iron and steel', 'transport' and 'non-ferrous metals' being the main contributors to the effect. On the decreasing side of consumption, only five out of fourteen sectors were influenced by efficiency improvements.

The country's electricity intensity more than doubled from 1990 to 2007 and the country's weighted growth of intensity was higher than the majority of the OECD

countries by a considerable margin. Also, nine of the thirteen South African sectors were substantially more intensive than their OECD counterparts.

Although the picture presented is rather dismal, there is scope for improvement. This study proposes a sectoral benchmark-and-trade system. This system aspires to steadily improve the participants' efficiency performance by awarding the successful participants with monetary incentives through trading with the less successful ones.

The benchmark is chosen to be subject to the average of OECD members for each sector. Depending on the sectors' performance compared with the standard chosen, they will be awarded credits or allowances to sell if they do better than the benchmark. If they are worse-off, they will have to buy credits in the market created. The price per credit will be determined by the interaction of demand and supply in the market.

The findings of a comparison with a carbon tax system show that the proposed system benefits the majority of the sectors and gives them better incentives to change their behaviour and production methods to more efficient ones. The system also fulfils the desired characteristics of a benchmark-and-trade system: certainty of environmental performance; business certainty; flexibility; administrative ease and transparency.

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