3 November 2010

The editor

SAJEMS

**RESUBMISSION: 19-10: Estimating the demand elasticity for electricity by sector in South Africa**

Please find herewith the re-submission of our above-mentioned manuscript to SAJEMS*.* We greatly appreciate the comments by the referees on the previous draft and are convinced that the manuscript benefitted greatly from it. Addressing these comments will make the presentation of our findings stronger.

Below you will find our responses and ways of addressing the reviewers’ comments highlighted in yellow. We start by addressing the comments fond in the documents, and we conclude by the comments received in the reviewers’ letters.

Looking forward to hearing from you.

Kind Regards

Roula Inglesi

1. *Comments in the document*

*Surely simply “shortage”... the paper doesn’t look at the supply side*

Word “supply” deleted- the crisis in South Africa was not a supply side crisis only.

*Incentives may not have been significant, they were not zero.*

The phrase “...there was no incentive...” is replaced by the “...there was no significant incentive...”

*I realize what is meant, but this statement is not logically plausible. You need to establish whether or not this electricity is replacing extant in-situ energy sources (eg coal fired boilers in a factory, or domestic coal or gas fired stoves)*

Change from “...direct link between demand elasticity for electricity and CO2 emissions...” to “...direct link between the electricity generation and CO2 emissions...”

*The interesting change is in the non-ferrous metals sector between 1995 and 2000 (was this new aluminium smelters coming on stream?).*

Addition of the phrase “In addition, the ‘non-ferrous metals’ sector doubled its contribution to the country’s electricity consumption within the studied period.”.

*Where is residential?*

See the response to the following comment

*Most of these % changes don’t match the real prices above; even the signs are wrong. It needs some clarity! Try to explain the apparent anomalies.*

We changed Table 2 so that it includes the residential sector, and now it also presents the annual changes for all the years from 1993 to 2004.

*Why would greater growth cause a greater contraction in electricity demand?*

Typo.Changed.

*My intuition is that the output was driving electricity consumption, but that the composition of output may have been changing in each sector. Where products are homogeneous it is unlikely (except in non-ferrous metals) that this impacted on electricity consumption for each individual product produced*

The reviewer is right that products maybe heterogeneous within each sector. However, this paper is interested in each sector’s overall electricity consumption, output and price and we do not investigate product analysis.

*Some sort of a-priori hypothesis is needed here: and for this to make sense one needs to know what proportion of total variable costs is made up by electricity. If it is significant, then one expects it to make a difference, => price elasticity is relatively high. If small, then one expects the elasticity to be lower.*

We agree that the proportion of electricity costs to total variable costs might be a determinant for price elasticity, but here we wish to estimate the demand elasticity rather than explain its determinants.

*At this point I begin to worry. Is the supply of elasticity ordinarily fixed in any 24 hr period, or does it respond directly to demand (increase demand, and supply will expand to match it)? This relat’nship is at the core of this study, but is not discussed at all.*

Since electricity cannot be stored, electricity consumed and supplied is equal at any given point in time (allowing for transmission losses between the point of generation and the point of use, but that is not factored in as it is generally only about 3% of the total generation).

*This worries me a bit. In most manufacturing sectors (i.e.excepting agric and mining) there is no a-priori causality, rather, if technology is given then the firm’s use of electricity will be directly correlated with its output. The isoquant is rectangular and price of power should be irrelevant. This means only uptake of new technology is relevant Seeing R2 of .98 later makes me even more suspicious*

We use this theoretical equation following international best practice. We henceforth added a section “International literature review” to this effect. Technology is assumed to be fixed within the studied period and the correlation between the firms’ use of electricity and output is tested (see last paragraph of section “Data” as well as Table 4 in the Appendix).Also, a high R-squared is not an uncommon phenomenon in panel data modelling.

*Should this be physical or monetary output? Thinking behind this decision needs some elaboration.*

It is monetary output, following international literature. Also, output of different sectors should be measured in the same unit of measurement in order to be included in a panel dataset.

*If log why not use use Ln - a more standard notation. Maybe also mention that this would be useful in estimating elasticity*

Changed to Ln

*For example?? Econometrics is no substitute for thinking things through and saying what happened over this ten year period.*

The phrase “The results of the fixed effects analysis show that inter-sectoral dynamics might be the cause of the insignificance of the electricity prices” was replaced by “The results of the fixed effects analysis show that inter-sectoral dynamics might be the cause of the insignificance of the electricity prices because in the fixed effects model, we allow for sectoral differences, and the price became insignificant.”

*This is factor demand not household demand. Within any sector why would there be income effects?*

We added the phrase “or production” effect since the income effect in this context refers to increased production/output.

*Given the extent of sunk capital in production and the small proportion of product price made up by electricity it is surprising to find any correlation at all over short periods and with small changes in price.*

This is very much a statement in support of our research findings as illustrated by the fact that the price elasticity is only significant in a selection of sectors, and very small for those sectors with statistically significant elasticities.

*No, this suggests substitutes and a budget constraint. In the LR industry can switch to coal or natural gas perhaps, but electricity is not normally inferior!*

This possible explanation for the results will only apply for the period and sectors in question. Within this period (1993-2004), technology has not changed, decisions of technology switching were not possible and there was a budget constraint.

*Surely a comment on household rather than industrial demand.*

We do not provide such an explanation for the electricity as a good in general but rather only for some sectors and specific time periods.

1. *Comments by the reviewers*

B.1 Reviewer 1

*The authors estimate the demand elasticities for electricity in different production sectors in South Africa and find amongst others that electricity is a Giffen good, with positive elasticities of demand in some sectors of production. This shows that the authors approached the estimation process from the viewpoint of consumer theory, rather than the theory of production. Else (1971) and Landsburg (2008) both claim that there could be no such thing as a “Giffen factor of production”.*

We did indeed approached the electricity demand issue treating five sectors as consumers of electricity and hence, one of the possible explanations of the findings was the electricity being a *Giffen good, (or factor of consumption)*for a number of sectors during the studied period. Approaching electricity demand in such manner follows international energy literature.

*The authors should therefore start by applying Shephard’s lemma whereby the Cost of production functions (of some products that use electricity as factor of production) are differentiated to obtain the cost-minimizing factor cost shares and the elasticities of factor substitution. The own price elasticities could then be derived from the product of these two. (See Econometric Analysis by William H Greene, and E. Berndt and D. Wood, “Technology, prices and derived demand for energy,” Review of Economics and Statistics, 57, 1975, pp. 376-384).So, the authors should start with appropriate economic theory from which they derive the Cost of production and other functions mentioned above, which could then be used in the estimation process.*

The reviewer proposes a very interesting way of examining the role of electricity as a factor of production. However, in such a way the price elasticities will not be able to be estimated per sector. In an attempt to deal with the electricity as an input to each sector’s output, we run a number of OLS regressions, trying to explain each sector’s output as a function of capital, labour and electricity consumption (see section “Data” and Table 4 in Appendix).

Reviewer 2

*My major problem with the paper comes with equation 1. As the following thoughts indicate, I simply don’t see that it can be used to achieve the results claimed for it. The basic idea seems simple, the demand for any factor is a derived demand. Electricity demand could therefore be found using a single equation approach in which the quantity of electricity demanded is a function of the electricity price, and the demand for the goods it is being used to produce.*

Equation 1 is used in the majority of international energy papers investigating the determinants and price elasticities of electricity consumption. As discussed in the, newly introduced, section “International literature review”, all the papers use a single equation approach in which quantity of electricity demanded is a function of the electricity price and the output or production of the goods and services it is being used to produce.

*In this case however, the price of the product being produced is replaced by the value of output. In other words it assumes some level of substitutability between factors, and by implicitly keeping output on a single isoquant shows the effect of a changing electricity price on the demand for electricity.*

The price of electricity is not replaced by the value of output produced. On the contrary, we consider both as important factors of explaining electricity demand.

*The question is whether the resulting price coefficient is really a demand curve. My concern is that it is not. It simply shows that the recorded demand for electricity has been changing. There is no indication of the effects of changes in prices of other factors, and I have a suspicion that the ‘total output’ could be industry real revenue rather than an index of industrial physical production.*

“Total output” is the gross value added of each sector and this variable is used in other papers as an indication of the sectors’ output. To avoid fluctuations in prices affecting the value added, we employ real gross value added. The resulting price coefficient is the estimated price elasticity of electricity answering the main purpose of the analysis, showing that prices have various effects on electricity demand depending on the sector.

*The paper tries to identify the determinants of demand for electricity and in particular of its demand elasticity. Some idea of the proportional contribution of electricity costs to total variable costs would be a useful starter; intuitively this is likely to be a primary determinant of its price elasticity.*

The purpose of the analysis is to identify the significance of the electricity demand’s determinants such as price and output, by estimating the relevant elasticities. We agree that the proportion of electricity costs to total variable costs might be a determinant for price elasticity but in our study, we want to estimate the elasticity rather than explain its determinants.

*The demand for the finished product is also likely to influence the outcome. Instead the paper identifies a regression equation in which an industry’s demand for electricity is made a function of the electricity price and of the industry’s output.*

Following international energy literature.

*Ordinarily this approach in a set of time series data would fail because of under-identification (electricity supply is omitted), however, the price of electricity is not determined by the intersection of demand and supply, it is exogenously determined.*

This regression does not have problems of misspecification (see Hausman test results) and electricity prices are treated as exogenously determined, as it is the case in South Africa.

*In most industrial applications, however, technology is given and reflects a sunk cost. If there is only one technology available for production then the isoquant appears rectangular, and the price of electricity is irrelevant. Each unit of the product embodies the same amount of power. This might not be the case if there were a range of old and new technologies available and electricity made up a large proportion of the costs (an example might be the operation of zinc or aluminium smelters). In such a situation a rise in electricity price might occasion the mothballing of old technology, which would only come back into use if demand for the product (and its price) were to surge. However, adopting this approach, the notion that changing electricity price induces use of more (or less) electricity efficient technologies cannot simply be assumed.*

By and large we fully agree with this statement. Within the context of fixed technologies, it is output that drives electricity consumption and the price of electricity becomes irrelevant. That is if the consumer uses its electricity in the most efficient way possible given the available technology. Price changes, however, is invaluable to induce behavioural change to use electricity more effectively given the existing technology. Technology changes will rarely be linked only to electricity price changes, but is link to a myriad of factors. The demand elasticity, however, informs us that price does have an important signalling effect with respect to behaviour and the manner in which the technology (and the entire production value chain) is managed.

*When one sees an R2 of 0.98 one becomes even more suspicious and wonders whether this is not simply reflecting a strong correlation between electricity used in production and the amount of production.*

A R2 of 0.98 is not an unusual result for panel data analysis.

*One other possibility is that output is not being measured in physical units but in terms of its value.This makes the approach even less convincing; one is simply looking at electricity’s share of total value added in the sector. Presumably if all factors of production were included and the production function were linear homogeneous, a single equation approach could be used test for an Euler relationship, in this case the value of marginal products, but still not for the price elasticity of factor demand.*

It is monetary output, following international literature. Also, output of different sectors should be measured in the same unit of measurement in order to be included in a panel dataset.

*In trying to extract the underlying rationale for this methodology one other possibility emerges. Within each sector there is a broad spread of products, some more electricity intensive than others. Could the change in electricity price shift the production focus from one good to another, thereby changing the sectoral demand for electricity? Logically this could be the case, but again a single equation approach is not the way to show it. The mix of products could be changing for all manner of reasons and there’s little reason a priori to assume that the changing electricity price will be dominant among them.*

(Same as in Comment 6) The reviewer is right that products maybe heterogeneous within each sector. However, this paper is interested in each sector’s overall electricity consumption, output and price and we do not go into product analysis.

***Recommendations***

*There are a number of other lesser problems with the paper, which I have identified using track changes. These can be passed on to the author, but my primary concern is that the underlying logic behind the regression approach used has not been persuasively put forward despite the single equation approach used being controversial and some of the variables themselves being a little unclear.*

The choice of the methodology, regression approach and variables was based on international best practice and hence, we added the section “international comparison”.