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Faculty of Economic and Management Sciences

Fakulteit Ekonomiese en Bestuurswetenskappe
Lefapha la Disaense tša Ekonomi le Taolo

Determinants of residential demand for electricity in South Africa

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Outline

- Introduction
- Current research
- Literature review
- Methodology
- Motivation
- Conclusions



Introduction

My research aims to: *find the most effective suite of policies to reduce GHG emissions in South Africa while taking into consideration its effects on different households*

- 1) Understand household's electricity/energy consumption patterns;
- 2) Understand South Africa's CO₂ emissions profile;
- 3) Analyse the current and future-planned energy mix in South Africa;
- 4) **Determinants of residential demand for electricity**
- 5) Evaluate different policy scenarios

Today's Presentation

This paper will focus on examining the residential demand for electricity in South Africa for the period 1993- 2015

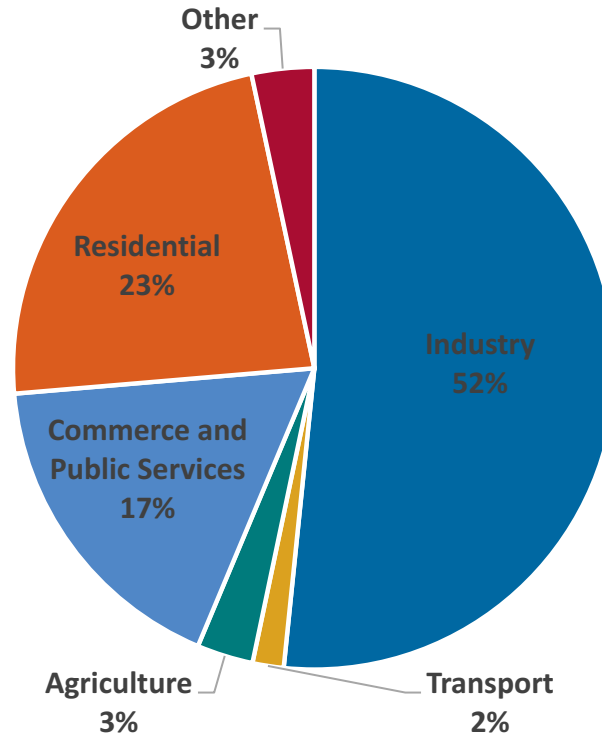
- To understand and quantify the determinants of residential demand for electricity in South Africa.
- This will ultimately allow us to accurately measure households' response to various energy related policy proposals.

Why is this important?

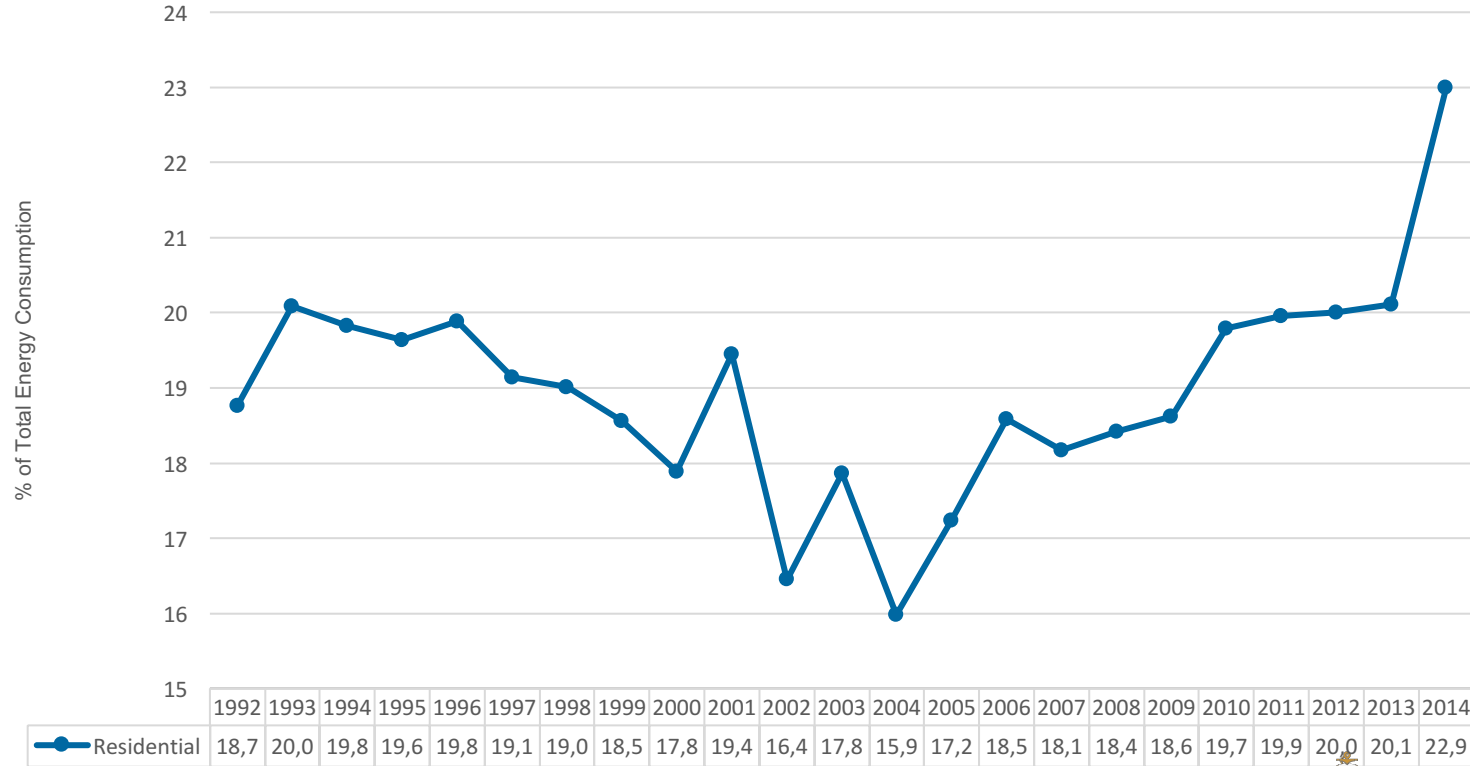
As argued by Narayan and Smyth (2005) and Blignaut et al. (2015), reliable estimates of price and income elasticities are necessary when formulating and evaluating policies (effects on households, environment, etc.)



South African Electricity Consumption - 2014



Residential Sector Electricity Consumption (Share)



Literature Review

- The literature suggests that a *complete model of residential electricity demand should explain electricity demand as a function* of own price, price of a substitute of energy such as gas, real income, and other variables such as population and temperature that might explain household consumption of electricity (Madlener et al., 2011; Narayan and Smyth, 2005).
- However, due to data constraints most studies have explained residential electricity consumption as a function of *one explanatory variable* only: temperature by Al-Zayer and Al-Ibrahim (1996), real income by Dincer and Dost (1997); or as a function of own price, price of a substitute and real income (Al-Faris, 2002; Narayan and Smyth, 2005).

Literature Review

- Narayan and Smyth (2005) estimated the short and long-run elasticities of residential demand for electricity in Australia using, for the first time, the bounds testing approach to testing cointegration; and adding more explanatory variables.
- The authors explained electricity consumption as a function of *income per capita, temperature, electricity price and price of a substitute (gas)*.
- Narayan and Smyth (2005) found that, as expected, the income elasticity of demand was positive; the own price and cross-price electricity demand were negative; and that temperature was positive but only significant in the long-run.



Literature Review

- Ziramba (2008) estimated the residential demand for electricity in South Africa for the period 1978-2005.
- The author tested real GDP per capita and the price of electricity as the main explanatory variables following the bound testing Approach to cointegration by Pesaran (2001) used in Narayan and Smyth (2005).
- The results suggested that income is the main determinant of electricity demand while electricity price was found to be insignificant.



Methodology

- To estimate the determinants of electricity consumption, the ***bounds testing autoregressive distributed lag (ARDL) model*** is preferred for the analysis of level relationships (Pesaran and Shin, 1999; Pesaran et al., 2001).
- Apart from detecting the existence of a long-run relationship among time series, this method can also estimate the size of this relationship.
- ARDL does not require prior knowledge of the order of integration of the time series variables, provided that the series are up to second order of integration.

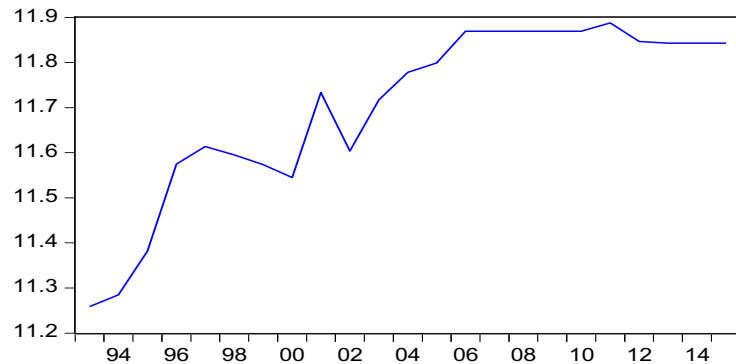
Methodology and a priori expectations

The aim is to estimate, for the period 1993-2015, residential electricity demand (EC) as a function of:

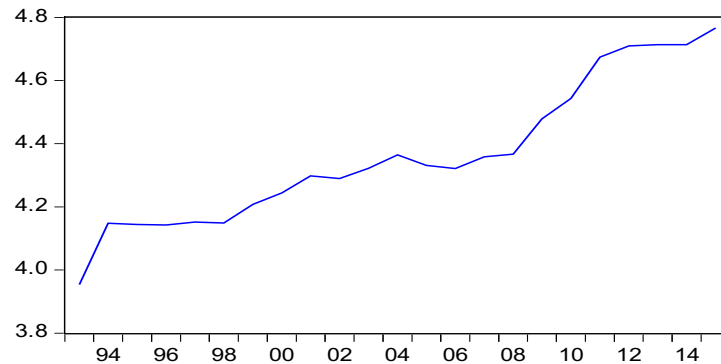
- Household income (GDP per capita) → *expected to be positive*; increases in Y will increase EC
- Price of electricity (*ESKOM*) (real residential electricity price) → *expected to be negative*; increase in price will decrease EC
- Price of substitute (paraffin or gas) → *expected to be positive*; increases in price of substitutes will increase EC
- Dummy for load shedding → This variable will be [1 – 2008 to 2015; 0 – Otherwise]

Stylised Facts

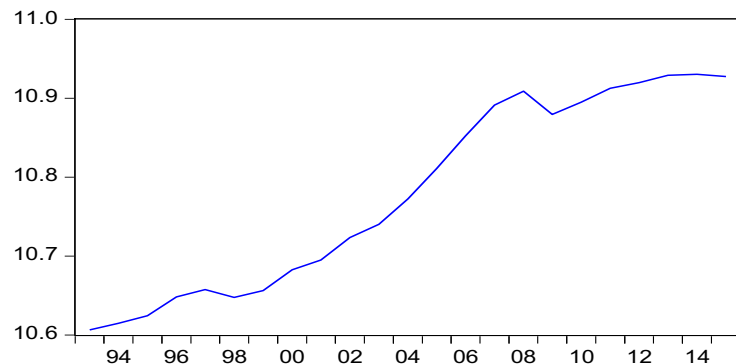
LCONS_ELEC



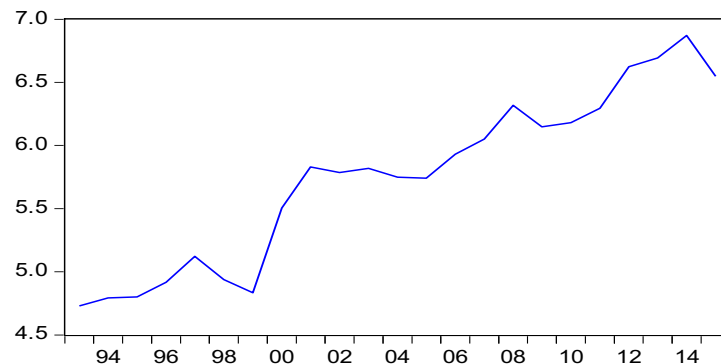
LPRICE_ELEC



LGDPPC



LPARAFFIN_P



Correlation coefficients

- 1993 -2015

| | LCONS_ELEC | LPRICE_E... | LGDPPC | LPARAFFIN_P |
|-------------|---------------|---------------|---------------|---------------|
| LCONS_ELEC | 1 | 0.78359839... | 0.89583895... | 0.86250886... |
| LPRICE_E... | 0.78359839... | 1 | 0.89983797... | 0.92280261... |
| LGDPPC | 0.89583895... | 0.89983797... | 1 | 0.94595435... |
| LPARAFFIN_P | 0.86250886... | 0.92280261... | 0.94595435... | 1 |

- 1993 -2007

| | LCONS_ELEC | LPRICE_E... | LGDPPC | LPARAFFIN_P |
|-------------|---------------|---------------|---------------|---------------|
| LCONS_ELEC | 1 | 0.86506971... | 0.87812569... | 0.84853526... |
| LPRICE_E... | 0.86506971... | 1 | 0.82659592... | 0.88969567... |
| LGDPPC | 0.87812569... | 0.82659592... | 1 | 0.87411451... |
| LPARAFFIN_P | 0.84853526... | 0.88969567... | 0.87411451... | 1 |

- 2008 -2015

| | LCONS_ELEC | LPRICE_E... | LGDPPC | LPARAFFIN_P |
|-------------|---------------|---------------|---------------|---------------|
| LCONS_ELEC | 1 | -0.5733029... | -0.6581085... | -0.8260676... |
| LPRICE_E... | -0.5733029... | 1 | 0.72845274... | 0.69636202... |
| LGDPPC | -0.6581085... | 0.72845274... | 1 | 0.88737941... |
| LPARAFFIN_P | -0.8260676... | 0.69636202... | 0.88737941... | 1 |



Motivation

Ziramba
(2008)

- ARDL
- Residential demand for electricity
- South Africa 1978-2005
- As a function of real GDP per capita and the price of electricity

Bohlmann
et al. (2017)

- ARDL
- Residential demand for electricity
- South Africa 1993-2015
- As a function of real GDP per capita, the price of electricity, price of a substitute, dummy for load shedding/ price restructuring/ financial crisis effects



Conclusion

This paper focuses on ***examining the residential demand for electricity in South Africa for the period 1993-2015***, it is one part of a multidimensional study of energy and environmental policy in South Africa

The main contribution of this research will be:

- The addition of different determinants of electricity consumption such as the *price of substitutes of energy*
- Consideration and accounting of the *effects of the 2008-2009 electricity supply crisis*
- Additionally, it includes the period after *sharp rises in electricity tariffs in 2007/2008* following a period of load-shedding and insecurity in electricity supply
- Required to design a tailored policy response aimed at generating a triple dividend



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Thank you

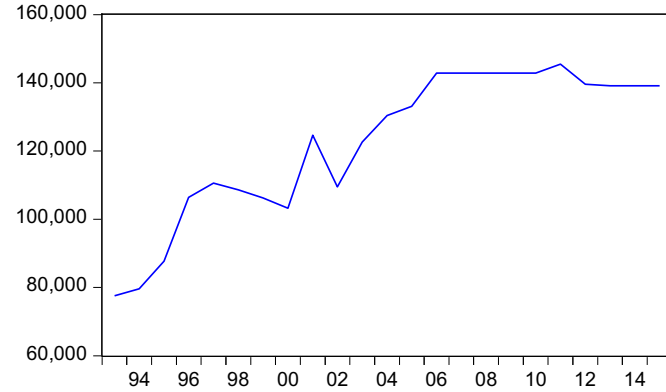
Suggestions, questions and comments are welcome

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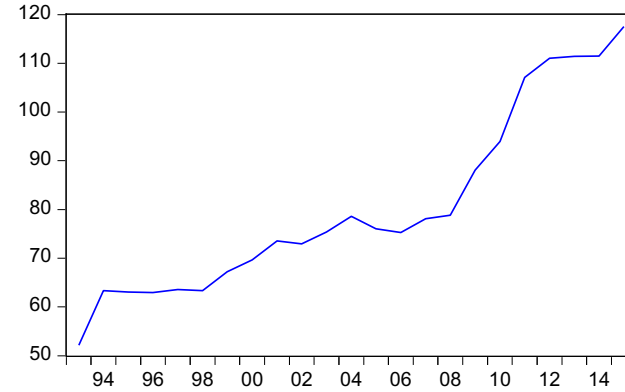


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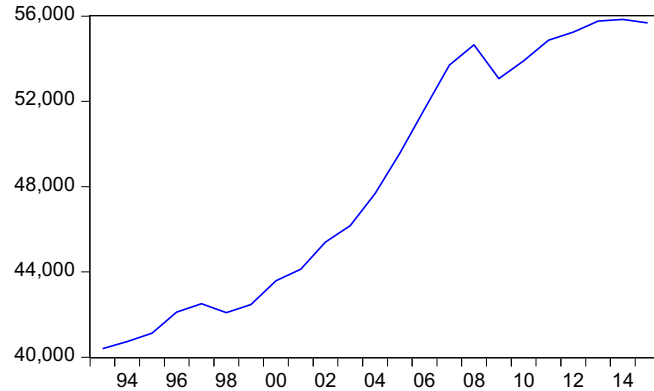
ELEC_RES_CONS



ELEC_RES_PRICE



GDPPC



PARAF_PRIC

