THE IMPACT OF ELECTRICITY PRICING SHOCK ON THE SOUTH AFRICAN ECONOMY: A CGE ANALYSIS[1]

Draft

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[1] The views expressed in this working paper are the views of the author and might not necessarily reflect the views of the KZN Department of Economic Development and Tourism.

ABSTRACT

After ESKOM[2] announced the company's largest loss of R9.7bn in August 2009, a new application for higher tariffs was due by the end of September. How an emerging country like South Africa can develop its economy under restrictive energy constraints is an interesting and important research subject. This article describes the impact of electricity pricing shock, such as increase by 35% in the prices set by ESKOM on South African's economy. In view to understand the interrelationships between the electricity price shocks and the economy of South Africa, a Computable General Equilibrium Model is used to analyse the issue. The results in this paper may be useful for providing important recommendations to the government of South Africa. The policy implication is that South African electricity consumers should use electricity more efficiently through market signals instead of interventionist rationing.

[2] ESKOM was created by government in 1992, and after nationalisation of the Victoria Falls and Transvaal Power Company (VFTPC) in 1948, became the dominant single electricity generator in South Africa (see Perkins et al., 2005). It is currently for 95 percent of all electricity generated. Electricity distribution takes place through ESKOM as well as 284 municipalities and 13 private distributors. Municipalities derive a significant portion of their income from reselling electricity to consumers.

1. Introduction

Due to a rising electricity demand, the economy is at risk of experiencing a shortage in electricity generation capacity by the year 2008 (NERSA, 2007). To prevent electricity shortages, investment in electricity infrastructure is required. This consequently implies that electricity prices in South Africa, which are among the lowest in the world, are expected to increase to fund these investments. Higher electricity prices will have major implications for the South African economy that is highly energy dependent. A recent World Bank study pointed out estimates on future electricity demand in South Africa and the required investment levels that would be compelled to fund the rising demand (World Bank, 2008).

South Africa's electricity supply crisis has been anticipated at least since 1998, when the government's own White Paper indicated that electricity supply capacity was not keeping up with the growth in electricity demand, and that further investments would be needed to expand electricity generating capacity (DME, 1998). Various other warnings were sounded since, pointing to problems in the country's electricity infrastructure and management thereof, such as that most of the country's power plants were all approaching the end of their life cycle and that maintenance was insufficient. Besides, concerns were raised about fundamental institutional weaknesses in the country's electricity sector (Cameron and Naude, 2008). The main electricity supplier ESKOM, a wholly government-owned entity was seen to be subject to weak governance and inadequate regulatory mechanisms. Poor management was amongst others leading to an outflow of skilled engineers and other operational errors such as running down coal reserves. Also in the economics literature, concerns were being voiced about the poor state of South Africa's electricity infrastructure and the possible adverse impacts of insufficient electricity infrastructure on economic growth. Thus Perkins *et al*. (2005) warned that unless supply capacity was expanded, it would be insufficient to meet demand by 2007.

Given that South Africa's total electricity supply capacity has remained fixed since 2001 at around 37,000 MW (with about 2,000 additional MW for peak demand periods) by 2005/2006 demand instigated to exceed supply. The crisis proper started in November 2005 when a number of regional power outages began affecting the country's Western Cape Province, the location of the country's only nuclear power plant (Koeberg), which was also at the time experiencing maintenance problems. Power outages in the province continued during December 2005 and became progressively worse during February 2006, to such an extent that it elicited a debate in South Africa's parliament in March 2006, during which the then State President, Thabo Mbeki maintained that, *there is no crisis* (Le Roux, 2006). This crisis soon spread country-wide in 2007 impacting more severely on the industrialised regions such as the Gauteng Province. It culminated in January 2008 in a series of particularly debilitating power shortages which resulted in the closure of much of the country's mining industry for 4 to 5 days. By this time there was no doubt that the country faced a serious crisis, and the State President apologized on 8 February 2008 for government's inability to prevent the crisis and acknowledged that, *we face an emergency* (Timberg, 2008).

This article provides an overview of South Africa's electricity sector, namely, electricity supply, demand and prices. In this paper, the dti CGE model is used to perform a short run simulation by shocking the electricity sector in the model.

2. Electricity Supply

As presented in Table 1, coal-fired power stations in South Africa hold the largest electricity capacity, approximately 89%, contributing to the fact that the country is the world's 7th larger emitter of greenhouse gases per capita (Sebitosi & Pillay, 2008:2514). The Koeberg, nuclear station near Cape Town is responsible for 95% of South Africa's electricity capacity while the remaining 5% is collectively sourced from hydroelectric, biogases, gas turbines and pumped storage schemes. ESKOM holds 100% of the national transmission grid and 96% of all generation capacity in the country. 60% of electricity is distributed directly to end-use customers and the remaining 40% is distributed through municipal distributors (Republic of South Africa 2009).

Table 1: Sources of Electricity Capacity in South Africa

Source	Capacity (MW)	Percent of total
Coal	38 209	88.8
Nuclear	1 800	4.2
Bagasse	105	0.2
Hydro	668	1.6
Gas turbines	660	1.5
Pumped storage	1 580	3.7
Total	43 022	100

Source: *National Electricity Regulator, 2004, cited in Digest of South African Energy Statistics, DME, 2006*

Table 2 shows the production of electricity by fuel type from 1999 to 2004. Over the years, the production of electricity has been increasing across each fuel type. In fact, an increase in the region of 40% was reported during the period of 1990 to 2000 (Akinboade et al., 2002). In 2004, 93.2% of electricity was produced from coal, followed by nuclear (5.5%), pumped storage schemes (0.8%) and hydro schemes (0.4%).

Table 2: Electricity Generation by Fuel Type (GWh)

Year	Coal	Nuclear	Hydro	Pumped storage
1999	186,859	12,837	726	2,590
2000	193,419	13,010	1,343	2,591
2001	183,541	10,719	2,061	1,587
2002	190,019	11,991	2,357	1,738
2003	202,464	12,663	3,509	3,006
2004	212, 406	13,365	4,452	3,822

Source: *Adapted from National energy balances and Eskom Annual Report-2004, cited in Digest of South African Energy Statistics, DME, 2006*

The total volume of electricity produced in South Africa exhibits an upward trend over the period from 2002 to 2007 (see Table 3). During the same period, (except for imports in 2003) imports and exports of electricity also increased over the years. South Africa exports electricity to Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe (Akinboade et al., 2002).

Table 3: Electricity distribution/exports/imports in South Africa (GWh)

Year	Total volume of electricity available for distribution	Total volume of electricity imported	Total volume of electricity exported
2002	206 020	7873	6950
2003	213 461	6739	10 136
2004	221 938	8026	12 453
2005	223 257	9199	12 884
2006	231 323	9782	13 766
2007	241 170	11348	14496
2008	235 924	10572	14168
2009*	210741	11183	12789

* Data available up to November 2009
Source: *Adapted from Statistics SA, 2009*

The volume of electricity available for distribution has been increasing from 2002 to 2007 but changed the trend downward in 2008. As mentioned above, ESKOM, a State-owned enterprise, is responsible for supplying 95% of South Africa's electricity (DME, 2006). Although it is not the sole generator of electricity, it does have a very large market share, rendering it as a monopoly. In addition to generation of electricity, this state-owned enterprise is responsible for the transmission of electricity to the rest of the country.

Eight municipalities generate the remaining 5% of SA's electricity (Kohler, 2006). In 2003, Cabinet decided to encourage private-public partnerships in the electricity sector by ratifying the operations of independent power producers (IPPs). 70% of future power generation capacity was allocated to ESKOM and 30 % to IPPs. However, IPPs have not been forthcoming. According to ESKOM, this is due to low electricity prices and small returns from investments in the sector. Other barriers of entry identified by Kohler (2006) include lack of competition, the high cost of capital required for entry, specialised technology required and the non-conducive regulatory environment.

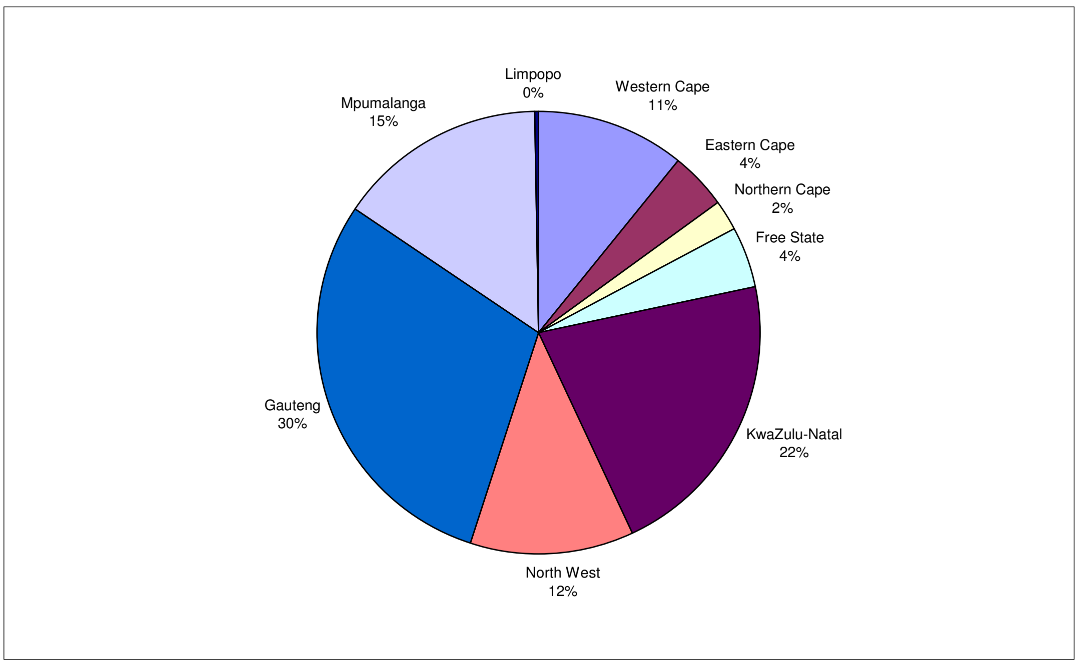
There are currently 172 municipalities as well as ESKOM who comprise the South African Electricity Distribution Industry (EDI) (NERSA, 2007). On average, the EDI posts a turnover of about R35 billion per annum. It is responsible for the employment of 31 000 people and distributes electricity to approximately 8.2 million customers (NERSA, 2007:6). Presently, there exists a proposal aimed at increasing regional electricity producers (REDS) to six. The primary mandate of REDs would be to “manage and drive all electricity distribution throughout the country” (Eskom, 2007c).

ESKOM has a total of thirteen coal-fired power stations. 11 are located in Mpumalanga and one each in the Free State and Limpopo provinces. Three of the older stations in Mpumalanga were previously mothballed due to past surplus capacity. In July 2005, the first unit at the Camden power station entered into commercial production. It is planned for Camden, Grootvlei and Komati to become fully operational by 2011, supplying approximately 3600MW of electricity (Eskom, 2007). The costs for the capital expansion has been estimated around R150 billion over 5 years (Hill, 2007). Other projects include combined cycle gas turbine plants (1800MW), a coal power plant in Lephalale (2100 MW) and a pumped storage facility in the Drakensberg (1330 MW).

3. Electricity Demand

The total volume of electricity consumed (available for distribution) in South Africa exhibits an upward trend over the period from 2002 to 2007 (see Table 3 above).

Figure 1: Electricity distribution by ESKOM to province for 2007 (GWh)



Source: *Adapted from Statistics SA, 2007*

In 2007, Gauteng (30%) and KwaZulu-Natal (22%) account for the largest proportion of electricity consumed (53%) as can be seen from figure 1. Electricity distributed by ESKOM to the provinces increased by 5% in the first 10 months of 2007 compared to the first 10 months of 2006 (StatsSA, 2007: 2) All of the provinces, except two, KwaZulu-Natal and Limpopo, reported lower consumption levels over the period.

Table 4 shows the consumption of electricity across the various sectors in South Africa. In general, the consumption of electricity in each sector has been increasing, with the industrial sector being the largest consumer of electricity. Many of South Africa's industries have an international competitive advantage because of low electricity prices. In 2004, the industrial sector was responsible for 65% of total consumption of electricity in South Africa. Other sectors with high electricity demands include residential, commerce, transport and agriculture.

The Integrated National Electrification Programme resulted in approximately 3 million poor households being connected to the national electricity grid between 1994 and 2003. Furthermore, poor households receive up to 50% KW of free basic electricity. The new connections and the 50% subsidy have resulted in an increase of electricity usage in some areas, which in turn has increased demand during peak periods.

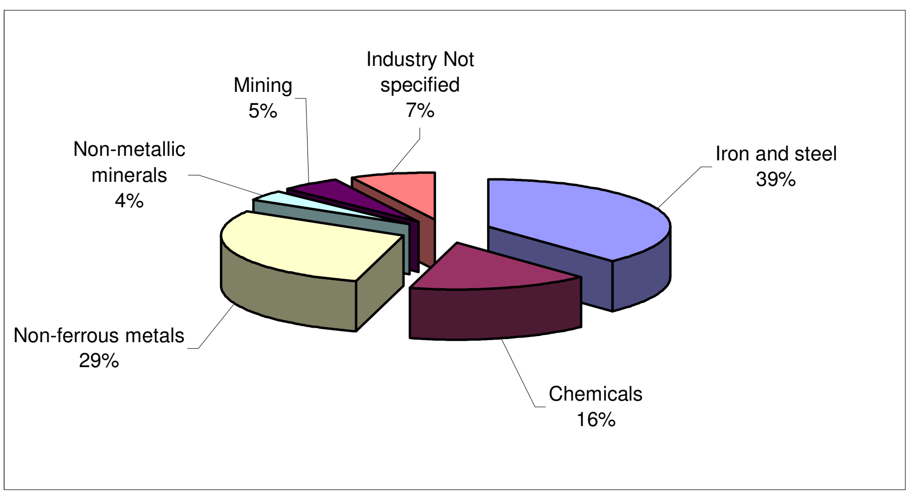
Table 4: Final consumption of electricity (GWh)

Year	Industry	Transport	Agriculture	Commerce	Residential
1999	99673	4429	5755	17709	29511
2000	99703	5411	3954	17164	28680
2001	106469	5562	4175	18301	34623
2002	115785	6246	4644	18227	30418
2003	109589	5565	5142	21071	34074
2004	134384	6302	6158	24990	36231

Source: *Adapted from National energy balances, cited in Digest of South African Energy Statistics, DME, 2006*

In 2004, the iron and steel industry, non-ferrous metals and chemicals, were responsible for 84% of total consumption of electricity by the industrial sector. Notably, the iron and steel industry was the largest consumer of electricity during this period.

Figure 2: Industrial Consumption of Electricity (2004)



Source: *Adapted from National energy balances, cited in Digest of South African Energy Statistics, DME, 2006*

4. Price of electricity in South Africa

In 1995, ESKOM agreed to reduce the real price of electricity by 15% over five years. This meant that price increases were kept constant at least 2% below the existing inflation rate (Eskom, 2007d). In 2006, ESKOM's annual price adjustment was determined through a Multi-Year Price Determination (MYPD) process. The National Energy Regulator of South Africa (NERSA), which is also responsible for regulation of the generation, transmission and distribution of electricity in South Africa, guided this process.

The average price for electricity in South Africa is currently 17 c/KWh (Swanepoel, 2007) and is amongst the cheapest in the world. Kohler (2006) provides several reasons for this. Some of them are stated below:

- Large coal reserves
- The use of technology that maximizes economies of scale
- The exclusion of externality costs
- The protection of ESKOM investments against exchange rate fluctuations through the Reserve Bank forward cover
- Exemption of ESKOM from taxation and payment dividends

Due to the present electricity generation capacity problems experienced by ESKOM, plans are underway to upgrade current infrastructure and build new infrastructure to the cost of R150 billion over 5 years (Hill, 2007). Prices are expected to increase to support the new electricity capacity. Prices are expected to increase in the region around 25c/KWh to 30c/KWh (Swanepoel, 2007).

5. Future demand for electricity in South Africa

The study conducted by Bogetic and Fedderke (2006), estimated and forecasted the demand for electricity in South Africa. Using a panel data of 52 countries for the period 1980-2002, the authors estimated the demand for electricity in South Africa. The estimated demand equation was then used to forecast the level of demand until 2010. Finally, the level of investment required to meet the forecasted demand was estimated based on two growth scenarios; an annual average growth rate of 3.6% and an annual average growth rate of 6%.

The dependent variable used was electricity production per capita (KWh). This was regressed on the following independent variables: GDP per capita, share of agriculture in real GDP, and share of manufacturing in real GDP.

The regression analysis shows that the share of agriculture is statistically significant at the 5% significance level and negatively related to electricity production per capita. The share of manufacturing in output is statistically significant and is positively related to electricity production per capita.

Based on an annual average growth rate of 3.6%, the estimation indicated that electricity production would grow from 4,815.47KWh per capita in 2002 to 6,453.19 KWh per capita in 2010. In order to meet the estimated demand in 2010, an average annual investment of R 1.87 billion (lower bound estimate) will be required. The upper bound estimated value was R3.37 billion. These figures only apply to generation of electricity and exclude transmission, distribution, operations and maintenance expenditure.

Under the accelerated growth scenario, which is based on an annual average GDP growth rate of 6%, electricity production would increase from 4815.47 KWh per capita in 2002 to 8179.43 KWh per capita in 2010. The average annual investment in electricity infrastructure to support the projected demand would be R6.23 billion (upper bound estimate).

6. Methodology

Dervis (1985) defined a Computable General Equilibrium model as an economy-wide model that includes feedback between demand, income and production structure, and where all prices adjust until decisions made in production are consistent with decisions made in demand.

Demand and supply equations for private-sector agents are derived from the solutions to the optimisation problems (cost minimisation and utility maximisation) which are assumed to underlie the behaviour of the agents in conventional neoclassical microeconomics. Producers select inputs in order to minimise costs of a given output subject to non-increasing returns to scale industry production functions. At the same time consumers are assumed to select purchases in order to maximise utility functions subject to their budget constraints. Production factors are paid according to their marginal productivity. The government sector is included and imperfect competition can be introduced via price fixing, rationing and quantitative restrictions. At the equilibrium level these models' solutions provide a set of prices that ensures that all commodity and factor markets are cleared as well as making all individual agents' optimisations feasible and mutually consistent (Bandara, 1991:12).

CGE models share three common features, the first being that they focus on the real side of the economy. Second, their supply and demand functions explicitly reflect the behaviour of profit maximising producers and utility maximising consumers. Third, both quantities and relative prices endogenous to these models, as well as the resource allocation patterns determined by them, have their roots in the Walrasian general equilibrium (Weintraub, 1977:8). These features make them particularly suitable to model the role and impact of energy in the economy.

In this paper we used a South African adaptation of ORANI-G to solve the model. It is known as the DTIGEM and was developed for the Department of Trade and Industry. It is composed of 27 sectors and 4 household types.

7. Short run simulation of economic effects of a price change in the electricity sector

The mechanism through which the price shock on the electricity sector is modelled in this paper is through the all input augmenting technical change coefficient (A1TOT is a variable in the dti CGE model) for the electricity sector. In normal simulations the price variable (P1TOT is a variable in the dti CGE model) is endogenous. In order to simulate the effect of a price increase, the price variable for the electricity sector is substituted with the all input augmenting technical change coefficient.

The substitution effect between price and all input augmenting technical change has an impact on the productivity of the factors of production. Other effects due to changes in relative prices will be calculated for the purpose of reaching a new general equilibrium for the economy as a whole. In this case the average input/output price of the electricity sector is shocked by +35 % while productivity is allowed to adjust in order to achieve this price increase. This will show therefore by how much, should productivity improve, to have prices increase by 35%.

7.1 Closure

A short-run closure is used. The capital stock in each sector is assumed fixed, while the rate of return on capital is allowed to change. The supply of land is also assumed to be inelastic. Labour is everywhere in elastic supply at fixed real wages. Constant real wages in the short-run closure determine employment.

On the national expenditure side, real consumption, real aggregate investment, and real government consumption are exogenous. The trade balance is endogenous. Technological change variables and all tax rates are exogenous to the model. Furthermore, the nominal exchange rate is the numeraire in the simulation.

In the short-run closure applied for this analysis, wages do not adjust in the labour market. It is assumed that real wage is fixed and total investment. However, total consumption and total government demand are assumed to be fixed. Compared to the standard closure (Horridge *et.al.* 1993), real household consumption is exogenous instead of total nominal supernumerary household expenditure. This implies that the aggregate level of household consumption is fixed. Aggregate real investment expenditure is exogenous instead of the economy-wide rate of return. This means that the level of investment is fixed. Aggregate real government demand, is exogenous instead of shift parameter. Consequently, net export is the only demand changing endogenously. For the purpose of this research, we have to make certain industry-specific assumptions over and above the general closure described above. We therefore have to assume that:

- electricity under these circumstance will not be exported – we know this in practice not to be the case, but the current treatment of the electricity industry in the model's database assumes no imports or exports for the non-metallic mineral products; and
- employment in the electricity sector will not be shed in reaction to the decline in output as most other sectors under normal market circumstances would. Since this is a sensitive issue to labour union pressure, labour shedding is not a short term option;

As with any attempt to simplify and quantify real world processes and actions with a mathematical representation, one has to make a host of assumptions. This is captured by the well-known broad assumption *ceterus paribus*. Therefore this implies some of the following (non-exhaustive) more detailed assumptions below:

- Assumption of no mitigation: No short-term change in the production technology of mining for these sectors is effected to mitigate the impacts of the lower consumption of electricity.
- Assumption of no alternative energy sources applied in the short-term.
- Assumption of no international market demand changes as a result of changes in output (especially of commodities such as gold, platinum etc.).

Due to the definition constraint of electricity sector in the model, we applied the ratio of the Supply and Use Tables of SP139 – electricity, gas, steam and hot water supply (containing SIC411 to SIC413) and SP140 - collection, purification and distribution of water (containing SIC420). These were calculated at 75% and 25% for electricity and water respectively. In order to calculate the relevant shock for the output price of the composite electricity sector, based on the fact that the model is in linear form, we therefore applied these ratios to the shock. Thus, a 35% increase for the electricity share of the composite sector would translate to an overall composite sector shock of (35/0.75) = 47% effective shock. The results obtained for the suggested 35% increase is valid for the first three years.

7.2 Shock

The variable P1TOT in the model is shocked by +47 % which allows the simulation of a 35 % price increase to be obtained as a result of the productivity increases, and the impact of such a gain on the South African economy is analyzed[3].

7.3 Results expected

Before examining the simulation results, it would be informative to obtain a prior expectation of the macroeconomic impact of the electricity sector. Turning to the intuition about economy-wide impacts, it is useful to consider those operating through the supply side vis-à-vis those operating on the demand side. The supply side effects are initiated by the increases in prices of the concerned services, which feed through as increased input costs for other sectors. This should stimulate output in all sectors. The supply side effects thus tend to be expansionary, drawing more labour into production and income generation. It is largely through this outcome that the demand side effects kick in. Higher incomes stimulate demand, not only for final goods, but also for intermediate inputs. These demand effects are also likely to be positive.

The macro-economic variables presented in Table 5 are described in detail in the dti CGE model developed from the ORANI model (DPSV, 1982) which was designed originally for comparative-static simulations. Its equations and variables refer implicitly to the economy at some future time period. ORANI has a theoretical structure which is typical of a static Applied General Equilibrium (AGE) model. It consists of equations describing for some time period the linear form of the model.

[3] This model was shocked by applying p1tot("Electricity")= +47%. The shock affects only the electricity sector.

The description is organised around the TABLO file which implements the model in GEMPACK. The complete text of the TABLO input file is presented and divided into a sequence of excerpts and supplemented by tables, figures and explanatory text. Moreover, familiarity with the TABLO format is essential for users who may wish to make modifications to the model's structure (Horridge, 1999).

Table 5: Impact on selected macro-economic variables

Description	**Macro-economic variables**	**% change**
Contribution of BOT to real expenditure-side GDP (change)	contBOT	-1.53
Aggregate employment: wage bill weights	employ_i	-2.99
Terms of trade	p0toft	1.78
Consumer price index	p3tot	4.12
Real GDP from expenditure side	x0gdpexp	-1.53
Decomposition of real GDP from income side	x0gdpinc	-1.53
Import volume index, duty-paid weights	x0imp_c	0.52
Export volume index	x4tot	-4.88
Real Exchange Rate (Depr/Appr)	Phi	-4.45

Source*: DTIGEM simulation calculations*

The simulation results presented in Table 5 are plausible and the price increase in the electricity sector has a relatively large impact on the GDP and employment. The Real GDP from the expenditure side decreased by 1.53 % from the baseline economy, while employment decreased even more by 2.99%. This can be explained in terms of decrease in export volumes by 4.88% that resulted from the decreased demand inherent to the increase in price. As the demand for export decreases, economic activity in the electricity sector decreases as well, since this sector plays a major role in the economy. This has a lot to do with the closure which only allows exports and imports to change on the expenditure side. Domestic consumption is assumed fixed even though change occurs on income group level. The resulting general domestic price increase that needs to realise in view to achieve equilibrium is roughly 4.12% (Consumer Price Index). It is evident that the increase in electricity tariffs of 35% will have a significant impact on inflation. Besides, the imported price index stays constant as South Africa is assumed to be a price taker in the international market. While South African's economy has a high import propensity, import volumes increased by 0.52%. However, one should be cautious of regarding the assumptions of achieving the required productivity efficiencies within a 3-year window, since a substantial up-front investment and reorganisation of the electricity sector has to take place first, followed by the re-adjustment of the rest of the economy to these structural changes.

Table 6: Sectoral results

		Value Added		Exports		Imports		Employment	
	Sector Annualized % Change	Volume	Price	Volume	Price (Rand)	Volume	Price (Foreign Currency)	Volume	Nominal Wage
1	Agriculture, forestry, fishing and hunting	-1	1.3	-4.1	1.2	1	0	-3.4	4.1
2	Mining of coal and lignite	-8.1	0	-8.1	0.1	-0.5	0	-17.5	4.1
3	Mining of gold and uranium ore	-3.4	0	-4.1	0.2	-2.2	0	-11.3	4.1
4	Other mining and quarrying (incl 22)	-2.7	0.6	-2.2	0.7	-3.4	0	-6.9	4.1
5	Food, beverages & tobacco products	-0.4	3.2	-6.7	2.9	5.1	0	-1.4	4.1
6	Textiles, clothing & leather goods	-2.7	2.3	-3.4	2.3	3.6	0	-4.2	4.1
7	Wood and wood products	-3.8	1.7	-5.2	1.6	0.2	0	-4.7	4.1
8	Fuel, petrolium, chemical & rubber products	-1.3	2	-2.4	2	1	0	-3.1	4.1
9	Other non-metallic mineral products	-1.2	2.7	-3.5	3.2	0.6	0	-1.9	4.1
10	Metal products, machinery & household appliances	-3.2	2.5	-6.2	2.5	-1.5	0	-11.2	4.1
11	Electrical machinery & apparatus	-1.3	2	-2.1	2	-0.3	0	-2	4.1
12	Electronic, sound/vision, medical & other appliances	-1.1	1.9	-2.5	1.8	-0.1	0	-2	4.1
13	Transport equipment	-3.2	1.4	-2.4	2.9	1.3	0	-3.1	4.1
14	Furniture & other items NEC & recycling	-2	2	-3.1	2	0.6	0	-3.2	4.1
15	Electricity, gas, steam & hot water supply	-14.2	47.4	0	0	0	0	0	4.1
16	Collection, purification & distribution of water	-1.5	2.7	-2.8	2.7	1.1	0	-3.1	4.1
17	Construction	-0.1	3.3	0	0	0	0	-0.1	4.1
18	Trade services	-1.2	3.7	-3.1	3.7	0	0	-3.3	4.1
19	Accommodation	-0.5	2.7	-2.9	2.7	0.5	0	-2.3	4.1
20	Transport Services	-1.2	2.5	-2.9	2.5	1.6	0	-2.8	4.1
21	Post and telecommunication	-0.3	2	-1.6	2.2	0	0	-1	4.1
22	Finance and insurance	-0.3	2.9	-2.7	2.5	0	0	-2.1	4.1
23	Real estate activities	-0.4	1.6	-2.6	1.5	0	0	-1.2	4.1
24	Other business activities	-0.3	1.1	-3.5	1.1	0.8	0	-1.2	4.1
25	General government services	0	2.6	0	2.6	0	0	0	4.1
26	Health and social work	-0.2	3.1	-4.1	3.6	-1	0	-0.3	4.1
27	Other service activities	-1.2	4	-4.1	3.5	-1	0	-1.4	4.1

Source: *DTIGEM simulation calculations*

The first expectation from these results should be that there are winners and losers in this kind of simulation. Outstandingly, the overall economic impact of this shock has negative results on all sectors. Output and employment decline substantially in all sectors (see Table 6). The modeling exercise shows that the 35% (47.4 x 0.75) effective increase in electricity prices leads to a volume reduction (14.2 x 0.75) in energy supplied by approximately 10.68%. Thus, based on this model, the current effective increase in electricity price as approved by NERSA and effective from 1 July 2008 *should be sufficient to lower demand to approximately 10% of previous electricity consumption levels* as required by ESKOM. The effect of such a price increased would admittedly not be instantaneous. However, the analysis showed the potential cost to the economy in the short run in terms of loss of GDP and employment.

8. Conclusion

In this paper, the results of a short-run simulation regarding a price increase in the electricity sector is discussed. The price increase is achieved by modelling the electricity sector productivity increase. The simulation results show that a 35% increase in prices results in decreased output and employment by 1.53% and 2.99% respectively.

The short-run closure that is adapted to this scenario reflects the realities of the South African economy. It allows a relevant analysis of the economy-wide effect of the electricity sector on the South African economy in the short-run. The results of the simulation indicate that a 35% price increase in the electricity sector's output price leads to a relatively large impact on the GDP and employment.

The policy implication is that a price-signal induced decrease in the demand for electricity has much less severe implications for the economy than an approach that makes use of rationing. Besides, the combined effect of both electricity rationing and price increases have an even larger potential for negative impacts on the economy – especially without compensation to firms and households that suffer unnecessarily as a result of such rationing.

Again, one must be cautious of regarding the assumptions of achieving the required productivity efficiencies within a three year window, since a substantial upfront investment and reorganization of the electricity sector has to take place first, followed by the re-adjustment of the rest of the economy to these structural changes.

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