CHAPTER 9

MODEL CLOSURE AND POLICY SHOCKS

9.1   INTRODUCTION

It is evident from the theoretical description of the CGE model that the model has more variables than equations. It is therefore necessary to choose which of the variables will be determined endogenously within the model, and which variables will be determined exogenously. The number of exogenous variables must be chosen such that the economic environment in which the policy shock is tested, best reflects the true economic environment in which the policy shock is applied. This must, however, take place with the constraint that the number of endogenous variables and the number of equations in the model are equal. Within modelling methodology, the assumptions about exogenous and endogenous variables are known as "model closure". Apart from reflecting the economic environment, the choice of model closure usually reflects two types of considerations.

The first consideration is the time frame under which economic variables are allowed to adjust to a new equilibrium after the shock. This assumption affects the manner in which factor markets are modelled. If one wants to analyse the effect of the policy shock on an economy in the short run, capital stocks are usually held fixed, as fixed capital takes time to adjust to economic shocks. Employment, however, is allowed to change in the short run as firms can employ more labour, or workers could supply more labour. In such a scenario, the price of capital is allowed to vary in order to keep the stock of capital constant, while the price of labour is fixed. If the time frame under consideration is deemed to be of long-term nature, capital stock is allowed to vary, while labour supply is assumed to be fixed. This reflects the economic reality that capital can adjust over time, but that employment is bound by demographic constraints over longer periods of time (the natural rate of unemployment). In a long-term scenario, the price of labour is allowed to vary, while the price of capital remains fixed.

The second consideration that must be taken into account in closing the model is the particular hypothesis that needs to be tested within a simulation, and the viewpoint of the modeller on those variables that the model does not explain. Because the ORANI-G methodology provides little theory to explain the size and composition of absorption, the major expenditure side aggregates for GDP are usually held fixed. Therefore, if a policy shock reduces GDP, the balance of trade could move into a deficit to reflect dissaving on a national level, or the balance of trade could be fixed to

allow consumption expenditure to change. The change in expenditure could then serve as an indication of the change in the welfare of society (Horridge, 2002, p54).

The distinction between short- and long run closures assists in the decision of an acceptable model closure. However, Horridge (2002) stresses that many different closures may be used for different purposes and that there is not a unique, or correct closure. Despite this, the choice of closure is bound by certain restrictions of which an important one is that the price variables in the model's equations always appear as price ratios, and that there has to be at least one exogenous variable measured in local currency in order to determine the overall price level (Horridge, 2002, p55).

Given this background, a suitable short-run and long-run closure needs to be established to test the effects of a revenue neutral tax on the intermediate use of coal in the South African economy. In establishing these closures, the features of the South African factor markets must be considered, as well as the economic variables that need to be evaluated in the experiment, such as coal consumption, labour absorption and the welfare of South African society.

9.2   A SUGGESTED SHORT-RUN CLOSURE FOR PERFORMING REVENUE NEUTRAL COAL TAX SHOCKS ON THE SOUTH AFRICAN ECONOMY

The hypothesis of the attainment of a double dividend in the South African economy is tested within a short-run setting. The reasons are:

i.   The double dividend literature indicates that the hypothesis holds positive benefits for an economy regardless of the level of technological change. Because the possibility of technological change cannot be ignored over a long-run perspective, a short-run analysis is deemed appropriate.

ii.   The possibility of obtaining a double dividend is appealing from both an environmental and a political perspective. The political time-horison is usually short-term.

The short-run assumptions of the closure are made keeping the realities of the South African labour market in mind (see Chapter 3). Chapter 3 indicated that the supply of unskilled and informal sector labour is highly elastic and that a significant amount of unemployment exists within the unskilled and informal labour markets. A realistic closure for these two components of the South African labour market would therefore be to fix the wages for these two groups (highly price

elastic). This will allow unskilled and informal sector employment to change in the face of a policy shock, while wages of these components of the labour market remain constant.

The supply of highly skilled and semi-skilled labour is different from unskilled and informal sector labour. There seem to be very little (if any) unemployment in these two groups of South Africa's labour force and wages tend to adjust as the demand for this type of labour increases or decreases. It is therefore plausible to assume that the labour supply of highly skilled and semi-skilled labour is fixed (highly wage inelastic) and that wages will adjust in the face of policy shocks without much scope for a change in the level of employment in these two groups.

Because of the short-run nature of the policy analysis, it is assumed that capital and land remains fixed within the model and that the price of capital and land will adjust in the face of any policy shocks. This assumption allows firms to change the amount of unskilled and informal sector workers that they employ in order to adjust output, while the quantity of capital, land and highly skilled and skilled labour remains fixed.

Because of the short-run nature of the policy analysis, and because the model does not contain much information on the theory behind the macroeconomic aggregates, it is assumed that government spending and aggregate investment spending are exogenous. This allows consumer expenditure and the trade balance to be endogenised, which will allow for the analysis of both the welfare and balance of trade effects of the policy shock.

Apart from the above, all technical change and shift variables are exogenised as it is widely accepted that technological change is a long-term phenomenon and should therefore be evaluated under constraints that reflect a long-term economic scenario.

Finally, all tax rate variables are exogenised and the tax rate on the intermediate use of coal can be shocked to determine the effect of such a shock on the South African economy.


9.3   *T*HE PROPOSED SHORT-RUN POLICY SHOCKS

Given the closure backdrop, a number of policy simulations are tested in order to determine the effect of a revenue neutral tax on coal.

i.   The first policy shock that is simulated with the South African CGE model is an increase in the tax rate on the intermediate use of coal across all industries in the South African economy. The tax increase should increase the price of coal by 50 percent. The increase of 50 percent is chosen in order to get a clear indication of the economy-wide effects of such a tax. Of particular interest will be the effect of the tax on the demand for coal, consumer welfare, employment and GDP growth. It must also be determined whether the tax will result in a positive tax receipt for the government, and, if it does, the magnitude of this tax receipt.

ii.   The second policy proposal is a revenue neutral shock in which a 50 percent tax on coal is introduced. The revenue that is raised through the tax is then redistributed as a lump-sum transfer to the households that are included in the three lowest income groupings within the model (D0, D1, D2).

iii.   The third policy proposal is a revenue neutral shock in which a 50 percent tax on coal is introduced along with a revenue neutral cut in intermediate taxation of food and agricultural products. The assumption that is made in this scenario is that the revenue raised by the tax on coal is redistributed in the economy by reducing the cost of those products that constitute the bulk of the consumption expenditure of the poorest households of the South African economy. Figure 9.1 reflects a comparison of the expenditure patterns of the poorest household groups (D0), with that of the richest (D924) in South Africa.

Figure 9.1:   A comparison between the consumption expenditure patterns of the poorest and the richest households in South Africa
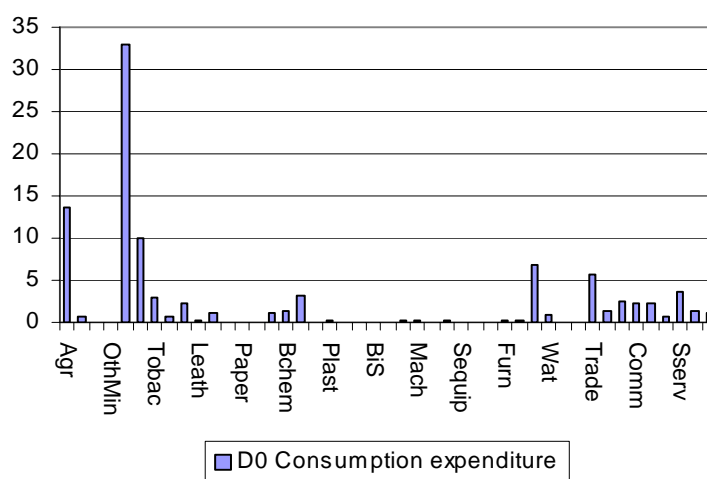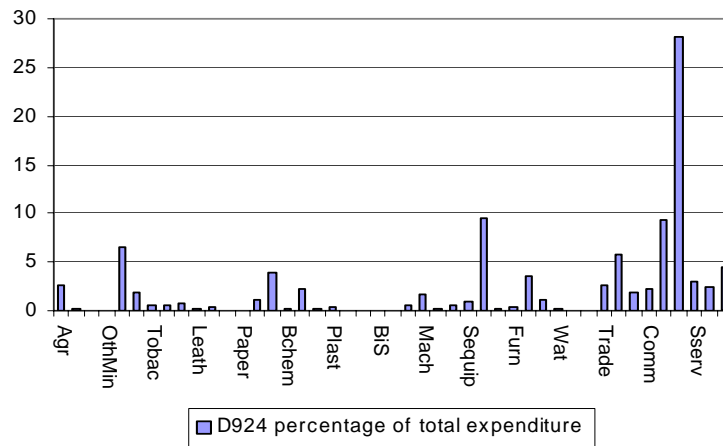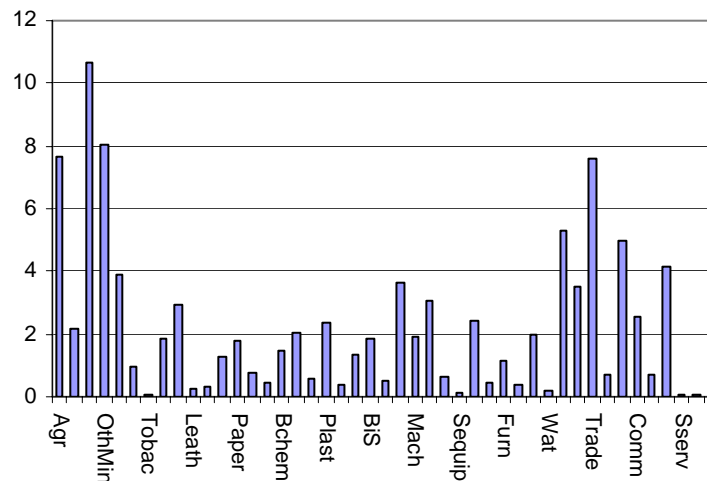
Source: SAM, 2001

Consumption expenditure on food and agricultural products constitute nearly 50 percent of the total consumption expenditure of the poorest households, while it only constitutes about 10 percent of the total expenditure of the richest households.

Apart from the potential impact that cheaper food and agricultural products will have on the poorest households, these industries are relatively labour intensive and contribute towards 12.5 percent of the unskilled employment in South Africa, and 6.5 percent of total employment in the country. Figure 9.2 shows that only the gold mining sector employs more unskilled labour than the agricultural sector.

Figure 9.2: Employment of unskilled labour in South African industries

Source: SAM, 2001

Given that the agricultural and food industries are relatively intensive in the use of unskilled labour, a tax that reduces the cost of these products should indirectly result in a decrease in the tax burden that this factor carries in the economy.

The results of the policy shocks will indicate whether these policy proposals could result in a double dividend for the South African economy in the short term. This will be the case if the net result of the policy shock is a decrease in pollution that results from the use of coal, while unemployment decreases and welfare increases as a result of the lump sum transfer to households or the lower cost of food and agricultural products. Other economic variables that are of interest include the change in the level of unskilled and informal sector employment and the effect that these proposals have on South Africa's external competitiveness.

9.4   A SUGGESTED LONG-RUN CLOSURE FOR PERFORMING REVENUE NEUTRAL COAL TAX SHOCKS ON THE SOUTH AFRICAN ECONOMY.

The literature review on technological change and environmental policy has indicated that technological change could be induced by environmental policy. Technological change is more of a long-run phenomena than a short-run phenomenon, and therefore the effect of technological change is tested over the long-term.

To allow the analysis of the long-term effects of a tax on coal, capital is allowed to change, while the rate of return on investment is fixed. Convention would dictate that, in the long run, employment would be fixed, while real wages would adjust to accommodate policy changes. However, because of the high unemployment rate that persist in the unskilled and informal labour sectors of the South Africa economy, it is assumed that the real wages of these two groups remain fixed while employment can adjust in reaction to the policy shock.

As is the case in the short-run closure, all tax and technological change variables are fixed by assumption.

9.5   THE PROPOSED LONG-RUN POLICY SHOCKS

Despite the double dividend literature, the review of the literature on technological innovation and the environment have indicated that technological innovation could also result in a "free-lunch".

This would be the case if environmental regulation results in technological innovation that reduces environmental damage and increases economic growth. Apart from this, taxing coal without any technological innovation would only delay the environmental impacts of the use of coal. Because technological innovation develops over a time frame that should extend beyond a short-run perspective, the effect of technological innovation on the environment and South African economic performance is tested within a long-run time frame.

Therefore, a policy proposal is tested in which the use of coal in production processes is taxed by 50 percent. However, instead of returning the tax revenue to the economy solely by means of a reduction in other intermediate taxes or a lump-sum transfer, the revenue is used to fund research and development in technology that will reduce the use of coal across the production processes of all industries. In this case, a number of policy proposals are tested, of which two proposals will be discussed in detail. These are:

i.   the long-run effects of a 50 percent tax on coal if the tax revenue were not returned to the economy.

ii.   the long-run effects of a 50 percent tax on coal if the revenue were used to fund research and development that would reduce the use of coal in the production process by 50 percent.

Because of the uncertainty that surrounds the outcome of investments in research and development expenditure, the results of policy simulations with differing levels of taxation and technological change are also reported.

9.6   CONCLUSION

The short-run and long-run closures that are adopted to test the policy proposals reflect the realities of the South African economy. They allow a relevant analysis of the economy-wide effect of coal-tax proposals on the South African economy in both the short run, as well as the long run. Important assumptions within this context are that unskilled and informal sector labour is supplied elastically within all industries, and highly skilled and skilled labour is supplied inelastically.

These policy proposals can now be tested within the CGE model described in Chapters 7 and 8. The software that is used for solving the model is the Gempack software that has been developed at the Centre for Policy Studies at the University of Monash, Clayton Campus, Melbourne.