THE ROLE OF THE INFORMAL SECTOR IN THE ECONOMY OF THE DEMOCRATIC REPUBLIC OF CONGO

by

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I would like to declare that this thesis submitted to the University of Johannesburg for the degree of Doctor in Philosophy (Ph.D) in Economics has not been submitted as a document for a degree at any other university. It contains no material previously published or written by another person except when due reference is made in the text of the thesis.

Abstract

The main objective of this study is to assess the role of the informal sector in the economy of the Democratic Republic of Congo (DRC) by assessing its linkage with the formal sector. An attempt to assess the linkage between the formal and informal sectors was carried out by using quantitative techniques that range from the construction of a Social Accounting Matrix (SAM) to the building of a Computable General Equilibrium (CGE) model to assess the impact of each of the sectors in the DRC economy. A new SAM that incorporates formal and informal sector is constructed whereby different techniques and methodologies are applied. The data sources and techniques used to build the SAM and CGE model are described. The DRC Formal Informal Sector Model (DRCFIM) is constructed based on ORANI model of the Australian economy. The generic edition of the model, ORANI-G, developed for CGE modellers was constructed by Horridge (1998). The model has a theoretical composition which is typical of a static Applied General Equilibrium (AGE) model. Nonetheless, one particularity of the DRCFIM is that it is a multi-sectoral CGE model that depicts the reflected structure of the DRC's formal and informal sectors along with a diversity of linkages between various economic agents such as government, investors, traders and enterprises. DRCFIM is used to perform two policy simulations. The first policy simulation assessed the impact of land use on the DRC economy and the second is on trade liberalisation. In tracing the impact of the land use subsidy shock, output rises and domestic prices decline in most sectors, indicating considerable efficiency and lower costs per unit of output. Land use subsidy raises output in most sectors, stimulating the real GDP to rise by 0.34 and 0.26 percent in the short and long run respectively. Concerning the second policy simulation, we only allowed the import price to decrease by 5 percent in the model. As we would expect, gross domestic product, exports and employment rise when the import price on products is reduced by 5 percent in the short run.

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND AND PROBLEM STATEMENT

In a recent study the World Bank (2010) released the results of 'Doing business 2007', which ranked the Democratic Republic of Congo (DRC) 154 out of 178 countries. The low ranking of the DRC was mainly due to lengthy processing times and particularly high costs per container exported and imported. Furthermore, the country also lagged considerably behind the averages for Sub-Saharan Africa and low-income countries on all three governance indicators related to governance value, law enforcement and bribery. In this respect, its performance had worsened compared to the early 2000s. Moreover, serious damage due to the war in the DRC resulted in the deterioration of its economic and social infrastructure.

Besides its impact on the overall infrastructure, the war in the DRC has impacted negatively on the welfare of the population. The economy is constantly losing impetus and many economic activities now fall within the informal sector owing to the lack of opportunities in the formal sector. Economic activities are hampered by weak institutional capacity that fails to maintain the sustainable development of a dynamic private sector. In addition tax laws are enforced arbitrarily, making the informal sector more attractive to many people and enterprises. Although 80 percent of the economic activity in the DRC is attributed to the informal sector (World Bank, 2009: 86), its linkages with the formal sector have never been assessed. The assessment of the linkage will confirm the interrelatedness between both sectors. It is improper therefore to consider the informal sector as independent from the formal sector because it relies heavily on the formal sector and it stimulates economic growth, employment and business opportunities (Naidoo, 2002). A quantitative assessment of the linkage would show how both sectors could operate in specific areas. The identification of the linkage means that there will be impacts of economic policy particularly designed for the formal sector which will impact on the informal sector as well.

For instance, if the objective of policymakers is to promote firms from the informal sector to eventually be integrated into the formal sector, the assessment of the linkage involving both sectors should be quantified. If the linkage is not quantitatively assessed, it may mean that policies will continue to ignore the potential and importance of the informal sector within the economic system in terms of investment. In addition, a quantitative assessment of the linkage

between both sectors will offer evidence of the labour absorption and productivity implications if a decision is taken by government to promote specific informal sector activities. The main reason is that in the DRC more jobs have been created in the informal sector than in the formal sector.

Thus the main objective of this research was to evaluate the role of the informal sector in the DRC economy by assessing its linkage with the formal sector. This study constructed a Social Accounting Matrix (SAM) which incorporated the formal and informal sectors. The main reason for this was that the researcher did not find any previous research reports indicating the existence of linkages between the formal and informal sectors in the DRC. The advantage of such a SAM was in evaluating the impacts of the informal sector on various sectors, institutions and activities in the DRC. In addition, those impacts were assessed by means of a Computable General Equilibrium (CGE) model built by this study. Thus this study shows the need to assess the different implications of policies on formal and informal sectors.

As this study is the first attempt to assess the quantitative linkages related to both sectors in the DRC economic system, its findings will help policy makers in the country to promote and support the coexistence of the two sectors, given their importance to economic activities. Moreover, policymakers may be able to determine whether labour absorption in the informal sector is more useful in reducing unemployment in specific industries, and hence design policies for maximum effect.

The success of this study depended on the reliability of the data and information related to the formal and informal sectors. Due to a long period of political unrest and violence in the DRC, availability and reliability of the data may have been challenging. This study made use of various sources of data, ranging from the Central Bank of Congo (BCC), DRC Bureau of Statistics (INS), database of the DRC Department of Finance, PNUD, World Bank, International Monetary Fund (IMF) and others. The data collected were reconciled in order to render them reliable and the imputation method was used to reconcile the data. This is the method of substituting missing information with new elements because the missing information could give rise to uncertainty when analysing data. In the absence of important information, imputation is used to estimate acceptable data through the use of statistical

techniques in order to determine the parameter of position such as mean or average (Saunders, 2005).

In a nutshell, this study reports on an analysis of the informal sector's role in terms of its contribution to the DRC economic system. An attempt to assess the linkage between both sectors by using quantitative techniques that range from the construction of SAM to the building of a CGE model, will assess the impact of each of the sectors on the economic system of the DRC. Thus the three contributions of this study are presented as follows:

1. Provide a new SAM that incorporates the formal and informal sectors, whereby different techniques and methodologies of both linkages are applied.
2. Develop a standard CGE model for the DRC that includes the formal and informal sectors.
3. Apply different policy scenarios and simulations from the developed standard CGE model. Two policy simulations were performed with a view to analysing the economy-wide linkages between the formal and informal sectors, while accounting for different types of informal activities. The first policy simulation related to land use while the second focused on trade liberalisation in the DRC. In tracing the impact of the first shock applied to the land use on the economy, as expected gross domestic product and employment increased in the short run. The slight increase in employment was due to the land subsidy which stimulated the activity level both in the formal and informal sectors. The second policy shock applied to the trade liberalisation showed that formal employment and output increase but not in favour of informal sector producers. This is because the output decreased in some sectors of the informal sector due to tariff reduction. Nonetheless the considerable increase in output and employment in the formal sector increase import competition without providing further opportunities for the informal sector to access foreign export markets.

1.2 RESEARCH QUESTION

In terms of the real issue to investigate, the determination of the interaction between both sectors constituted the primary research question. In this respect, the study attempted to answer three fundamental questions:

- How does the informal sector interact with the formal sector?
- What are the requirements to build a standard CGE that incorporates the formal and informal sectors for the DRC?
- How should the outcomes for the formal and informal sectors and households be measured, which should ideally be considered when assessing alternative socioeconomic policies in trade and land use?

The third question will be answered from the different simulations that were undertaken through the newly constructed formal-informal SAM and CGE model for the DRC. The researcher did not find any prior studies that had attempted to answer the proposed three research questions.

1.3 OBJECTIVE OF THE STUDY

The most important objective of this study was to provide a quantitative assessment of the informal sector, with a specific focus on its contribution to the economy of the DRC in terms of employment and economic growth. This required an assessment of specific objectives as presented below:

(i) To determine the linkages and factors influencing the linkages between both sectors;
(ii) To develop a new SAM that incorporates the formal and informal sectors;
(iii) To provide a workable instrument and apply the developed model for impact analysis of the informal sector of the DRC; and
(iv) To provide different policy simulations from the constructed CGE model for assessing the different interactions of both formal and informal sectors on the economy of the DRC.

1.4 HYPOTHESIS

This study supports the hypothesis that the interaction between informal and formal sectors should have a positive socio-economic impact on the economy of any country, and in particular the Democratic Republic of Congo (Naidoo, 2002; ILO, 1993).

1.5 METHODOLOGY

A quantitative method was used to determine the interactions that involved both the formal and informal sectors and to develop a CGE model which considered the composition of the DRC's formal and informal sectors. The standard CGE model developed in this study depicts the performance of the DRC's economic system, which includes all major industry groups, markets and institutions. The parameters of this CGE model were based on the empirical information taken from a newly developed SAM which was used as the model's database. The SAM represents the database of the economic flows in the country for 2007. The method and construction of the model will be explained in detail in Chapters 3 and 4.

1.6 LIMITATIONS OF THE STUDY

Considering the data constraints, the informal sectors analysed in this study were limited to households, activities, commodities and labour. Moreover, the study limited the number in each sector to four households, 15 activities, 15 commodities and four employment categories used in the construction of the Formal-Informal SAM. Given the extensive conceptual debate in economic modelling literature, including debates within the community of modelers that use CGE modelling, a static CGE modelling technique was used for benchmarking purposes.

1.7 OUTLINE OF THE STUDY

The thesis will be structured in the following way: Chapter 2 will review the various techniques used to assess the informal sector. The aim is to describe the different available techniques used to assess and estimate the informal sector from the economy-wide database. In addition, recommendations are provided as to which technique is appropriate for the DRC. Chapter 3 will discuss the construction of the economy-wide database for the DRC - the 2007 DRC social accounting matrix that includes the formal and informal sectors (DRCSAMFI). This DRCSAMFI is constructed from data obtained from various sources, such as national accounts, household surveys and labour force surveys. It includes the DRC's formal and informal sectors, as well as several economic agents. Chapter 4 develops the CGE model for

the DRC, namely the DRC Formal-Informal Model (DRCFIM). The DRCFIM from which simulations were conducted in this study is mainly founded on a specific Australian model, i.e. the ORANI model (Horridge, 1998). Chapter 5 applies the DRCFIM to simulate a policy option related to land use. The application of the DRCFIM relates to the land use subsidy, whereby the effects of a 10 percent reduction in the price of land are assessed in the DRC's economy. Chapter 6 focuses on the policy related to trade liberalisation in the DRC's economy. The influences of this shock are particularly assessed on employment and production in the formal and informal sectors. Policy implications and conclusions are presented in Chapter 7.

CHAPTER 2: ASSESSMENT OF THE INFORMAL SECTOR

2.1 INTRODUCTION

This chapter explains the different techniques used to assess the size and impact of the informal sector from the economy-wide database (SAM). Also, recommendations are provided as to which technique is appropriate for the DRC. As pointed out by Naidoo (2002), the informal sector is recognised by academics and politicians as a safety net for both economic and social situations, due to a number of factors such as poor formal sector absorption capacity, lack of skills and organisational issues. Its transitional role as an interim between finding a temporary job and as a social safety net indicates that the informal sector could not be viewed as a short term solution; it has offered some assistance for individuals who would otherwise be incapable of making a living. The adoption of the apparent benefits of such a sector facilitates the assessment of its role in an economy. These should be assessed so that policy makers can take into consideration the influence of each sector in the entire economy.

A number of studies show that various techniques have been used to assess the informal sector. In summary, these techniques are simply classified as (1) direct, and (2) indirect (Schneider, 2009; Alderslade, 2006; Naidoo, 2002; Tanzi, 1999; Gërxhani, 1999:27-32). Direct techniques include household surveys, labour force surveys and other specific surveys, while indirect techniques for the assessment of the informal sector make use of macro-model techniques, global indicator techniques, monetary techniques and dormant variable techniques. In fact, direct techniques rely on primary sources of information and provide a more realistic or holistic picture of the informal sector. More importantly, they depict the issues related to the macro and micro-economy in a country. The indirect technique is based on secondary sources of information and identifies specific issues which are not necessarily noticeable in the direct technique.

This study used the direct technique because of its reliability, as the researcher aimed to collect data on the informal sector from primary sources in the form of surveys. It is in this context that Feld and Frey (2005) pointed out that when the informal sector is assessed, the

direct technique can identify with certainty any unambiguous issues observed during the process of assessment. For this reason the direct technique seemed appropriate for this study. The chapter will be divided in the following order: Section 2.2 will present the method of assessing the informal sector. Section 2.3 introduces the appropriate technique to be used during the informal sector's assessment in the DRC and Section 2.4 concludes the chapter.

2.2 TECHNIQUES FOR ASSESSING THE INFORMAL SECTOR

As stated earlier, two techniques can be used to assess the size and performance of the informal sector: direct and indirect techniques. The direct techniques are usually based on a much wider scope and incorporate more respondents than the indirect techniques. The results of the direct techniques remove much of the bias usually found in the indirect techniques, particularly when problems related to questionnaire design and stakeholder interaction ensure that more verification and evaluation with other sources can be undertaken. However, the indirect techniques are important as they can provide direction into newer fields of investigation and allow reasonable judgments using very limited resources. Naidoo (2002) acknowledge that complementarities between direct and indirect techniques are needed when assessing the informal sector, in that indirect techniques are used specifically for verification of some estimated data obtained from the direct techniques.

2.2.1 Direct techniques

The OECD (2001) described various direct techniques for the assessment of the informal sector. These techniques include household surveys, time-use surveys, labour force surveys and other surveys. Each of the techniques is described below.

2.2.1.1 Household Survey

According to the ILO (1993), a household survey is one type of survey used to assess the informal sector activity operating within the household, which estimates the level of expenditure against income earned. It also determines the degree of informal sector involvement in the economy and provides information on the industries, populations and professions in the informal economy. It further gives an indication of the performance of the

kinds of informal activity that take place within the household. A household survey assesses the informal sector based on the following information:

- The number of workers involved in the informal sector by gender, education, population group, industry and occupation.
- The designed questionnaire should capture demographic information such as number of people working, births, deaths, domestic workers, migrant workers and the head of households.
- The sample size can be derived from a population census to estimate the number of people per specific areas.

This technique facilitates the identification of the number of active individuals who are operating in the informal sector. Tokman (2007) argued that household surveys are important for poverty measurement and policy implementation.

2.2.1.2 Time-Use Survey

The Time-Use Survey (TUS) is a statistical technique used to estimate the time exploited in a remunerated and unremunerated job (ILO, 1993). The remunerated job is applied to both formal and informal employment, while the unremunerated job includes childcare, housework, and gathering firewood and water. According to Johnson *et al*. (1997), TUS can be used in the areas of education, gender inequality, entertainment and the frequency of child labour. Moreover, statisticians use TUS to estimate the time consumed by people for paid and unpaid jobs, both in the formal and informal sectors. The information is obtained from the satellite accounts recommended by the National System Account 93 (SNA93) for assessing the non-work time used. This technique is recommended where travel is an important element of someone's daily activities. The assessment of the informal sector is based on the following data:

- The amount of time spent on movement by individuals who are earning incomes.
- Changes to time allocation for activities over time and how work is distributed within a household from one period to another.
- Value of unpaid labour and the amount of informal sector activity taking place in a country.
- Share of people in the informal sector.

The TUS has valuable advantages, especially in assessing unpaid jobs and the role of the informal sector activities exerted in a nation. Noov (2000) assessed the informal sector through TUS when studying the case of Mongolia. He suggested that the harmonisation of the time-use system for comparability purposes should be taken into consideration. In 1996, for instance, a survey was conducted in Mexico which focused on eight year old individuals, while in South Africa, the same kind of survey undertaken in 2000 selected the minimum age limit of 10 years in their sample. In this case, comparability of the results obtained in these two countries is not easy.

In summary, TUS is definitely a useful technique for assessing the informal sector, even though very little experimental evidence currently exists relating to the assessment of the linkages involving formal and informal sectors. According to Arimah (2001), the issue of formal-informal linkages will be solved once the classification of informal sector activities is done by the majority of countries across the world.

2.2.1.3 Labour Force Survey

This technique is described in the System National Account developed in 1993 (SNA93). The main role of the Labour Force Survey (LFS) is to offer government or policymakers the required information on the labour market for economic policy formulation. Labour comprises every aspect of individuals' work, including the education and training needed to prepare people to work. Furthermore, it takes into consideration work such as job searching for the unemployed and income from work and benefits.

Most of the LFS performed were based on the following criteria:

- The ILO requires that the age category of the estimated number of employed people be at least 15 years old for the purpose of international comparison. An exception was noticed in the case of Great Britain and Thailand, where people aged 16 and 13 years old and above respectively were incorporated in the LFS in 2001.
- The sample recommended by the ILO is dwelling units, however the number of dwelling units varies from one country to another. For instance, the quarterly LFS in Great Britain contains 60 000 dwelling units, while the monthly Canadian LFS uses 54 000 dwelling units, Thailand's monthly LFS selects 26 121 households, South Africa's

semesteral LFS comprises a sample of 30 000 and Turkey's quarterly LFS considers a sample of 20 000 dwelling units.

- The economically active population is composed of employed and unemployed people.
- Unemployment status should be defined on the basis of the official and expanded unemployment rates. The official unemployment rate comprises people from the economically active population who were not working during the one week period preceding the interview, however they were active in seeking jobs and motivated to start a business. The expanded unemployment rate includes the discouraged job seekers during the one month period preceding the interview.

Williams (2005a) put forward the limitations of the LFS. The main limitation is related to the assessment of the number of employed and unemployed prejudiced by the factors not perceived during the survey. For instance, cultural factors hamper a category of people from working because of their behaviour of migrating from one city to another. In fact, factors such as migration, urbanisation and dislocation are not included in a LFS. Mazumdar (1983) acknowledged that the LFS does not cover the intensity of production when assessing employment in the formal and informal sectors. This was supported by Bhowmik (2008), who stated that child labour is not taken into consideration in the LFS from emerging and developing countries. In addition, for comparison purposes the level of employment can be inappropriately evaluated because of the classification system. The recommended classification system by the national accounts is Standard Industrial Classification (SIC), but this is not compatible with the one used in North America (Schneider, 2009).

2.2.1.4 Family Revenue and Spending Survey

According to Sanders (2007), the family revenue and spending survey serves to collect information from every expenditure item purchased from service providers. The information obtained gives an indication of the degree of interaction and the demand for goods from the informal sector. For instance, some products are purchased from informal activities such as roadside shops, boutiques, kiosks, and related purchasing stations. This technique assesses at least a minimum facet of the entire demand for informal sector goods, even though the data on the items purchased from the informal sector for the household final consumption spending are not systematically collected.

This technique assesses the informal sector based on the following information:

- Amount of expenditure by household
- Amount of income by household

The OECD (2005) conducted this kind of survey in Europe and Africa with a view to collecting important information on the informal sector. The results of the study provided an indication on the implication of income received from the informal activity and the allocation impacts of informal income on formal income.

2.2.1.5 Underground Sector Survey

According to Schneider (2009) 'underground' means informal, therefore the underground or informal sector survey consists of assessing underground economic activities by assuming that an available database containing information on underground activity exists. The information obtained from the survey depicts the true reflection of the informal sector's activities. These surveys were carried out in countries such as India (2000), Nigeria (1999), Ethiopia (1996), Philippines (1995), Tanzania (1995) and South Africa (1989). Despite the importance of these surveys, some deficiencies were noticed during the execution of these techniques. The establishment of the linkages involving the formal and informal sectors shed light on the kind of underground activities and the kind of direct interactions of entrepreneurs from the informal sector vis-à-vis the formal sectors. This is supported by Blunch *et al.* (2001), who stated that there is a concern about releasing complete information during the individual surveys. Moreover, there is risk of double counting the activities of one entrepreneur who runs his businesses at various venues.

2.2.1.6 Entity Survey

SNA93 gave meaning to 'entity' as an independent or individual. An Entity or Individual Survey is the kind of survey undertaken to assess a specific vicinity of the hidden economic activities. This survey usually comes after conducting a household or labour force survey for the purpose of assessing an unambiguous field of interest, and gathers extra information which is needed for the purpose of the study. The missing information can be obtained by contacting the surveyed entity. Therefore, the missing data are computed as a provisional

measure of informal sector business as they provide sufficient economic and political information about the informal sector. Nevertheless, this survey suffers from a number of deficiencies. According to Constant *et al*. (2006), the major deficiency of this category of surveys relates to the underestimation of the sample size and reliability of the survey results. Other minor difficulties encountered in applying this technique include:

- Only a few factors are taken into consideration for measuring the activities of the entrepreneur (Naidoo, 1993: 157-161).
- A focus on the "apparent" informal activity and neglecting the "backyard" informal activity.
- Information collected by type of activity is limited.
- Penchant to generalise on macro-economic matters while the sample size of the survey is reasonably small.

2.2.1.7 Counting of Employers and Self-Employed

Counting of Employers and Self-Employed is a technique undertaken to estimate the contribution of micro and small enterprises to a country's economy. Schneider (2002) stressed that the survey targets the firms that do not comply with Value Added Tax (VAT) requirements. These firms can only be identified through household surveys because of their lack of structure. The following criteria are required during the enumeration of employers and self-employed:

- An entrepreneur who is operating or undertaking any type of business alone or in the company of one or several associates; and
- The company is not inventoried for VAT.

During the interview questions are directed to the principal owner in cases where more than two members of the same household are performing an economic activity. If more than one person in a household is in separate firms not registered for VAT, all the participants should be interviewed.

The main deficiencies of the Survey on Employers and Self-Employed relate to the unavailability of the sample structure of unregistered firms for VAT. However, the individuals who own more than one firm are likely to declare only one firm during the survey (OECD, 2005).

2.2.1.8 Mixed Techniques of Survey

Also known as the "1-2-3" survey technique (Roubaud *et al.*, 2007), the informal sector is assessed in terms of dimension. It applies three phases even though the first phase uses, for instance, the labour force technique. The second phase consists of applying the shadow economy technique, where the informal sector is assessed in comparison with the results obtained from the labour force technique, while the third phase uses the household and spending technique. Countries such as Canada (2002), Madagascar (1996) and Cameroon (1994) have used this technique mainly for informal sector impact assessment. The findings show that the focus was in assessing particular variables inherent to the informal economic activity. These variables are, for instance, the value added, the sum of profits produced and the output. Schneider and Enste (2000: 106-107) showed that a "1-2-3" survey carried out in Colombia (1995) revealed that from the countrywide household survey, a sub-sample was depicted with a view to developing a trend in key variables of the informal sector. The trend represents the time series data which is analysed for the purpose of advising the government about job creation and reducing unemployment.

The assessment of the output and the amount of the income produced by the informal sector constitutes the major benefits of this technique. However Sakakibara (2008) asserted that this technique is deficient in the sense that biased information is provided by the respondents, especially when declaring the amount of the income generated by the informal businesses.

2.2.1.9 Multiple Indicators Multiple Causes (MIMIC) Technique

The Multiple Indicators Multiple Causes (MIMIC) technique is undertaken to assess a specific area of hidden economic activities. This technique takes into consideration an unambiguous field of interest. It gathers the missing information on the specific entity which

needs to assess the dimension of the underground sector. Even though this technique was developed in 1970 by Zellner, it has been used extensively to assess the underground economy taking place in a country. Other researchers pursued the example of Frey and Weck-Hannemann (1984) by using the same technique for statistically analysing the hidden economy. These researchers include Loayza (1996) who evaluated the case of South America and Schneider (2006) in the case of European countries.

Although this technique assesses the underground economy practiced in a country, it suffers from a number of deficiencies. Roubaud *et al.* (2007) challenged the significance of the fundamental variable used in the technique.

2.2.2 Indirect Techniques

The assessment of the informal sector through the use of indirect techniques consists of collecting a wide range of information at the macro-economic level on the informal sector for policy making purposes. Indirect techniques rely more on secondary data than primary data pertaining to the informal sector. These techniques analyse the secondary data to provide insight into the informal sector. Nonetheless, the major limitation of these techniques relates to the speculative assumptions used to define the kind of variables included in the informal activities. Indirect techniques include monetary transaction technique, cash or deposit ratio technique, cash-demand technique, tax audit technique, national indicator technique, and the dormant variable technique.

2.2.2.1 Monetary Transaction Technique

The monetary transaction technique assesses the existing cash disposition of informal operations, including tax management and deposits. It depicts the burden of taxation in the informal sector. As indicated earlier, some individuals feel that they are unable to operate within the constraints of rules, regulations and other impeding legislation. An econometric application using the regression method is also applied to evaluate the informal businesses (Ghosh, 1993). This technique plays an important role in the measurement of the customary cash nature of the informal transactions.

The literature review on the monetary theory shows that Fisher (1904) laid the foundation by focusing on the empirical theory of money. While all the financial operations of the informal sector are performed in cash, he defined the stock of money, the price level, the amount of transactions carried out using money, and the velocity of circulation of money. Fisher then proposed that these variables are interrelated by the equation of exchange and are continuously measured by real GDP.

Tanzi (1982) stated that the correct assessment of the flow and stock of money in a country provides an indication of the number of times paper money circulates in the market. When the real value of the amount of transactions multiplied by the general price level coincides with the transaction-velocity of the notes and demand deposits, then the assessment of the informal sector will provide an indication of the influence of the informal sector on the economy. According to Feige (1989), the empirical theory of money initiated by Fisher (1904) is used for the transaction technique.

This technique assesses the informal sector based on the amount of cash money that the informal businesses keep out of circulation. Generally the informal sector tends to circulate less significant quantities of bank notes. Individuals operating in the informal sector are constantly fearful of economic uncertainties such as inflation threats and an increase in interest rates, despite the usage of cheques, credit cards and internet transactions which reduce the circulation of the bank notes. Feige (1989) used the monetary transaction technique to measure the burden of taxation in the informal sector of the USA. He discovered that by considering 1939 as the base year when the value of the informal sector was nil, that the informal sector in that country contributes 27 percent of GDP. The empirical assessment was performed on the bank note wearing examination.

Although Schneider (2000) mentioned a valid limiting factor associated with the monetary transaction technique, all the financial operations of the informal sector performed in cash were measured successfully. The main deficiency consists of the increase in momentous transactions executed by both the formal and informal sectors through the Internet, which creates doubt on the validity of the transaction technique.

2.2.2.2 Cash or Deposit Ratio Technique

The cash or deposit ratio technique estimates the variation in the level of activity of the informal sector without assessing its real size. This technique assumes that there is increase in the ratio of currency for the informal sector relative to demand deposits from the bank (Naidoo, 2002).

Tanzi (1982) recommended that a base year be selected and the ratio of money to demand deposits be estimated. There is thus a need to assess the activities of the informal sector from the difference of the amount of cash stocks obtained between the observed and computed cash stocks during the year of assessment. The following assumptions form the basis of the cash or deposit ratio technique:

- All the financial operations of the informal sector are performed in cash.
- The ratio obtained by dividing the ratio of currency by the value of demand deposits is not related to organisational changes. This ratio is not affected by the static undertakings of a specific business.
- Some informal activities are not included in the base year.
- The income velocities of money are the same for the underground and formal economies when the transaction velocity of currency circulation is considered.

Despite the strength of this technique, the cash or deposit ratio technique has a number of deficiencies (Ghosh, 2007). First, the transactions undertaken in the informal sector businesses are not necessarily based on cash. Secondly, the number of transitional transactions per final product is small, i.e. there is net difference in financial transaction between both the formal and informal sectors. Lastly, the trend obtained from the value of the ratio of currency divided by the demand deposits is not easy to interpret when inflation threatens the currency versus the demand deposits. In addition, the kind of transactions in the informal sector is normally illegal and cannot be assessed against the formal sector.

2.2.2.3 The Cash-Demand Technique

Tanzi (1982) used the cash-demand technique to evaluate the informal sector in Nigeria. The function of money demand was broadly considered with independent variables to assess the cyclical disparities from the demand currency during the short and long run. The discrepancy revealed between the estimated currency (C_{est}) and the actual currency demand (C_{meas}) reflects the outcome of the informal sector. The regression equation taken from the model developed by Tanzi is shown below (Leiman and Hartzenberg, 1990; Naidoo, 2002):

$$C/M2 = b1R + b2W/Y + b3Y/N + b4Y + b5r \qquad (2.7)$$

where R, W/Y, Y/N, Y and r are the independent variables as described below:

R represents the tax rates;
W/Y represents labour's share of national income;
Y/N represents real income per capita;
Y and r represent permanent income and interest rate on time deposits respectively.

In his model, Schneider (2009) argued that where the tax rate is nil, the illegal businesses should not be recorded. The money related to taxation impacts is multiplied by the projected income velocity of the concealed business, (V_y), for the purpose of evaluating the missing GDP from the informal sector. Therefore, in the case where the velocity of illicit money competes with the legal currency, the mathematical representation will be as follow: (C_{est} - C_{meas}) V_y = missing GDP = b_1 R (V_y).

The technique used by Tanzi (1982) has the following deficiencies:

- Operations such as under-invoicing, haggle businesses and counter commerce, which are difficult to measure in the informal sector, are not captured in this technique.
- The kind of activities related to survival nature are not included in the model, while these activities consist of major component of the informal sector.
- The model does not insinuate the issue of the agent's behaviour related to money possessed from the effect of tax strain.

As described by Naidoo (2002), Tanzi (1982) assumed in his study that cash circulates in the economy with proportional velocities amongst both sectors. The results of the regression analysis show that in the USA the size of the informal sector was 3.4 – 5.1 percent and 8.1 – 11.7 percent of Gross National Product from the first variant and second variant in 1976 respectively. These values are not similar to the estimation performed by Ghuman *et al*. (2000). The cash/deposit and cash-demand techniques used by Barens (1982) to analyse the case of the Netherlands revealed that the informal sector has decreased since the 1970s, contradicting the conventional theory that the informal sector increased (OECD, 2001: 142) due to the incentives provided to small firms to stimulate production.

2.2.2.4 Tax Audit Technique

This technique is undertaken by the authority responsible for tax collection. Schneider and Enste (2000: 106-107) suggested that the amount to be paid by the entrepreneur from the informal sector should be audited versus the estimated tax that should be honoured by the entrepreneur. The assessment of the informal sector requires the following criteria:

- The amount of VAT paid by the informal traders on their acquisition of goods as they do not necessarily evade tax.
- Identification of the nature of the hidden economic activities.
- Setting the database of the entrepreneurs who exercise their activities in the informal sector with a view to performing a tax audit from the list of registered informal sector activity.
- Assessment of the underreporting of profits and non-compliance of tax by the informal sector activity.
- Ensure that the sample size of entrepreneurs to be audited is not biased. The entire region where the informal sector is established must be taken into consideration, thus tax dodgers will be evaluated during a particular period.

Schneider and Enste (2000) showed that the tax auditing technique used to assess hidden economic activities in Canada revealed that the assessed size of the informal sector was around 4.5 percent of GDP, versus 10 percent in the USA and 9 percent in Italy during the period 1986-1990.

2.2.2.5 National Indicator Technique

This technique is used mostly in the electricity sector, analysing the consumption of electricity in the informal sector as a unique indicator of general economic activity. The main assumption in the model used by Kaufmann and Kaliberda (1996), Lackó (1997) and Schneider and Kent (2006) is that there is strong correlation between output and electricity consumption in the informal sector. The value of the growth of official GDP should be estimated first, followed by the growth of electricity consumption. The informal sector is assessed by subtracting the value of growth of electricity consumption from the growth of real GDP.

Lackó (1997) acknowledged the main deficiencies of the National Indicator Technique, which are that the household industry is not a unique environment where informal businesses take place, and not all informal sector businesses necessitate the use of electricity. This technique is useless in a situation where the impact of the electricity sector on GDP is minimal. For instance, in some cases other sources of energy are used by the informal sector to operate their activities. The assumption is supported by Curran *et al*. (2008), who acknowledged that there is not a close relationship between the utilisation of electricity and output. Prior to applying this technique, the regularity of the usage of electricity should be taken into consideration. Moreover, the elasticity of the electricity sector should be surveyed first hand, as the price of electricity is sometimes funded by a specific institution.

2.2.2.6 The Dormant Variable Technique

The Dormant Variable Technique uses variables related to all aspects of the informal sector, such as the number of people employed in the specific informal activity. This technique is not similar to the monetary technique portrayed above, which assumes that a single or few variables can be included in the process of assessing the informal business. This technique assesses the expansion of the variables that affect the size and the growth of the informal businesses. Frey and Weck (1983) applied this technique by including several variables in the model and obtained reliable results which reflected the true situation of the informal sector in Poland. Likewise, Jöreskog and Sörbom (1993) justified the importance of the Dormant Variables technique by including even more variables as indicators, as well as several casual variables, to establish the structural relationships for a sound measurement of informal

businesses. Cross-section examination involving non-observable dependent variables and observable explanatory variables is permitted in the Dormant Variable technique. Where the non-observable variable is unknown, it will be swapped by an indicator and the time period is normally one year.

Even though this technique seems credible in assessing the size of the informal sector, it was criticised by Helberger and Knepel (1988) who proved that any minor preference in including or excluding a country in the model gives diverse results. They also concluded that data limitations constitute the major obstacle in using this technique for the estimation of the informal sector. Moreover, the tax evasion which is rampant in hidden economic activity is not captured properly in this technique.

2.3 RECOMMENDED TECHNIQUES FOR THE DRC

This study mainly makes use of information from a household survey to assess the linkage between the formal and informal sectors in the DRC. The household survey forms part of the direct technique, determines the degree of informal sector involvement in the economy, and estimates the level of expenditure against income earned. Moreover, it provides information on the industries, populations and professions in the informal economy. It also gives an indication of the performance of the informal sector and highlights the possibility that informal activity takes place within households. Given the scarcity of the data in the DRC, this study also made use of other methods from the direct technique, such as Labour Force Survey, Mixed Techniques of Survey, and the MIMIC technique, as well as indirect techniques such as the Tax Audit Technique and the National Indicator Technique in order to assess the linkage between the formal and informal sector. The complementarities between the direct and indirect techniques are needed when assessing the informal sector, because the indirect techniques are used specifically for verification of some estimated data obtained from the direct techniques. Nonetheless, the indirect techniques are prominent as they could provide direction into newer fields of investigation and allowed reasonable judgments on very limited resources. A typical example is taken from the study done by Schneider (2005).

Schneider (2005) used direct and indirect techniques to assess the underground economies in 37 developing African countries. The results of Schneider's study showed that the size of underground activities increased significantly for all the nations during the period 1999 to

2003. The countries increased their size of shadow economies from 41.3 percent of typical GDP in 1999/2000 to 43.2 percent in 2002/2003 (see Table 2.1). This reflects a general average of 0.9 percent during the four years. The 2002/2003 results show that Zimbabwe had the highest level of shadow economy with 63.2 percent, followed by Tanzania (60.2 percent) and Nigeria (59.4 percent). Mozambique fell into the median station with 42.4 percent and the DRC was in the upper median with 49.7 percent. The country with the smallest shadow economy was South Africa with 29.5 percent, followed by Lesotho (33.3 percent) and Namibia (33.4 percent).

Table 2.1: The size of the Shadow Economy in 37 African Nations

		Shadow Economy (in % of official GDP) using the Multiple Industries and Multiple Courses (MIMIC) procedure and Currency Demand Method		
No	**Country**	**1999/00**	**2001/02**	**2002/03**
1	Algeria	34.1	35.0	35.6
2	Angola	43.2	44.1	45.2
3	Benin	47.3	48.2	49.1
4	Botswana	33.4	33.9	34.6
5	Burkina Faso	41.4	42.6	43.3
6	Burundi	36.9	37.6	38.7
7	Cameroon	32.8	33.7	34.9
8	Central African Republic	44.3	45.4	46.1
9	Chad	46.2	47.1	48.0
10	**Congo, Dem. Rep.**	**48.0**	**48.8**	**49.7**
11	Congo, Rep.	48.2	49.1	50.1
12	Cote d'Ivoire	43.2	44.3	45.2
13	Egypt, Arab Rep.	35.1	36.0	36.9
14	Ethiopia	40.3	41.4	42.1
15	Ghana	41.9	42.7	43.6
16	Guinea	39.6	40.8	41.3
17	Kenya	34.3	35.1	36.0
18	Lesotho	31.3	32.4	33.3
19	Madagascar	39.6	40.4	41.6
20	Malawi	40.3	41.2	42.1
21	Mali	42.3	43.9	44.7
22	Mauritania	36.1	37.2	38.0
23	Morocco	36.4	37.1	37.9
24	Mozambique	40.3	41.3	42.4
25	Namibia	31.4	32.6	33.4
26	Niger	41.9	42.6	43.8
27	Nigeria	57.9	58.6	59.4
28	Rwanda	40.3	41.4	42.2
29	Senegal	45.1	46.8	47.5
30	Sierra Leone	41.7	42.8	43.9
31	South Africa	28.4	29.1	29.5
32	Tanzania	58.3	59.4	60.2
33	Togo	35.1	39.2	40.4

34	Tunisia	38.4	39.1	39.9
35	Uganda	43.1	44.6	45.4
36	Zambia	48.9	49.7	50.8
37	Zimbabwe	59.4	61.0	63.2
Unweighted Average		**41.3**	**42.3**	**43.2**

Source: Schneider (2006)

Direct and indirect techniques have been used to complement each other in the cases of specific studies. Besides the study on the size of the shadow economy in 37 African nations, Schneider (2009) also used direct and indirect techniques to analyse the shadow economy in 21 developed nations. He used direct techniques such as MIMIC and indirect techniques such as monetary demand to show the role of the informal sector in the OECD countries. The findings of his study are reported in Table 2.2 below. The results show that USA has the smallest shadow economy at 7.6 percent, followed by Switzerland (8.3 percent) and Austria (8.5 percent). In contrast, Greece has the biggest shadow economy with 25.0 percent, followed by Italy (22.0 percent), Portugal (19.5 percent) and Spain (19.5 percent).

The results from Tables 2.1 and 2.2 indicate that the informal sector plays a considerable role in both developed and developing countries. The observation made from the results is that the sizes of the shadow economies in African nations are generally similar and higher than those of OECD countries. The main reason is that most of the people in Africa are making their livings from informal sector activities. Furthermore, income inequality is much more pronounced in African countries than in Europe and America.

The results provided by Schneider (2006) for the various countries show that it is possible to quantify and assess both the roles and the linkages between the formal and informal sector for each country. In this respect, this study intends to assess the role of the informal sector and its linkages with the informal sector in the DRC.

Table 2.2: The Size of the Shadow Economy in % of official GDP in 21 OECD Countries from 1989/90 to 2009

OECD Countries	Average 1989/90	Average 1994/95	Average 1997/98	Average 1999/00	Average 2001/02	2003	2004	2005	2006	2007	2008	2009
1.Australia	10.1	13.5	14	14.3	14.1	13.7	13.2	12.6	11.4	11.7	10.6	10.9
2.Austrai	6.9	8.6	9	9.8	10.6	10.8	11	10.3	9.7	9.4	8.1	8.47
3.Belguim	19.3	21.5	22.5	22.2	22	21.4	20.7	20.1	19.2	18.3	17.5	17.8
4.Canada	12.8	14.8	16.2	16	15.8	15.3	15.1	14.3	13.2	12.6	12	12.6
5.Denmark	10.8	17.8	18.3	18	17.9	17.4	17.1	16.5	15.4	14.8	13.9	14.2
6. France	9	14.5	14.9	15.2	15	14.7	14.3	13.8	12.4	11.8	11.1	11.6
7.Finland	13.4	18.2	18.9	18.1	18	17.6	17.6	16.6	15.3	14.5	13.8	14.2
8.Germany	11.8	13.5	14.9	16	16.3	17.1	16.1	15.4	15	14.7	14.2	14.6
9.Greece	22.6	28.6	29	28.7	28.5	28.2	28.1	27.6	26.2	25.1	24.3	25
10.Great Britain	9.6	12.5	13	12.7	12.5	12.2	12.3	12	11.1	10.6	10.1	10.9
11.Ireland	11	15.4	16.2	15.9	15.7	15.4	15.2	14.8	13.4	12.7	12.2	13.1
12.Italy	22.8	26	27.3	27.1	27	26.1	25.2	24.4	23.2	22.3	21.4	22
13.Japan	8.8	10.6	11.1	11.2	11.1	11	10.7	10.3	9.4	9	8.8	9.5
14.Netherlands	11.9	13.7	13.5	13.1	13	12.7	12.5	12	10.9	10.1	9.6	10.2
15.New Zealand	9.2	11.3	11.9	12.8	12.6	12.3	12.2	11.7	10.4	9.8	9.4	9.9
16.Norway	14.8	18.2	19.6	19.1	19	18.6	18.2	17.6	16.1	15.4	14.7	15.3
17.Portugal	15.9	22.1	23.1	22.7	22.5	22.2	21.7	21.2	20.1	19.2	18.7	19.5
18.Sweden	15.8	19.5	19.9	19.2	19.1	18.6	18.1	17.5	16.2	15.6	14.9	15.4
19.Switzerland	6.7	7.8	8.1	8.6	9.4	9.5	9.4	9	8.5	8.2	7.9	8.3
20.Spain	16.1	22.4	23.1	22.7	22.5	22.2	21.9	21.3	20.2	19.3	18.7	19.5
21. USA	6.7	8.8	8.9	8.7	8.7	8.5	8.4	8.2	7.5	7.2	7	7.6
Un-weighted Average over 21 OECD Counties	**12.7**	**16.2**	**16.8**	**16.8**	**16.7**	**16.5**	**16.1**	**15.6**	**14.5**	**13.9**	**13.3**	**13.8**

Source: Schneider (2009)

As discussed, the appropriate technique for assessing the informal sector in the DRC is the direct technique, because the information collected from the first source is more comprehensive. Usually the survey results offer reliable data for examination of linkages between sectors within the entire economy. Furthermore, the results obtained could offer government or policymakers information on the labour market for economic policy formulation. Labour includes every aspect of an individual's work, including education and the training needed to prepare people to work. Labour takes into consideration searching for work and income from work and benefits.

However due to data constraints with regards to financial information, indirect techniques were needed during the assessment of the informal sector. Indirect techniques rely heavily on secondary data sources and are used specifically for verification of estimated data. The direct and indirect techniques to assess the informal sector can complement each other, if they are used within specific terms of references.

2.4 CONCLUSION

This chapter explored the techniques used to assess the informal sector, namely direct and indirect techniques. The assessment process, together with its documentation, makes policymakers aware of how the informal sector stimulates the growth of the economy. The chapter indicated that the direct technique was preferred for the assessment of the informal sector in the DRC, but that due to data constraints, indirect techniques were needed during the assessment of the informal sector. The direct and indirect techniques used to assess the informal sector complemented each other in the course of this study.

CHAPTER 3: DEVELOPMENT OF THE ECONOMY-WIDE DATABASE

3.1 INTRODUCTION

This chapter aims to develop a complete database that captures the interdependence that exists within the DRC's socio-economic system. Such a database is crucial for policy makers to manage the economy efficiently, as an economy cannot be managed if it cannot be measured. This complete database for the DRC is presented in a SAM, which was used to assess the informal sector in terms of activities and employment factors and to capture both informal and formal linkages in product and labour markets within the entire economy of the DRC. This SAM captured all the monetary flows in the DRC economy during 2007. It is constructed from various data sources taken from national accounts, household surveys, and labour force surveys. The SAM was used as a database for the CGE model that will be discussed in Chapter 4. This study is the first attempt at undertaking such a task, as the researcher did not find any available SAM from previous studies, let alone a SAM that includes both the formal and informal sectors. For this reason, the construction of such a SAM is an important contribution of this study.

In a developing country such as the DRC, the economic information necessary for the construction of a SAM is dispersed. This is typical of most developing countries where data collection is problematic. Nonetheless an attempt was made in this study to collect and balance data from several sources, such as the DRC Central Bank (BCC), the DRC Bureau of Statistics (INS), the Department of Finance, the World Bank, and the International Monetary Fund (IMF). For instance, the approximation of the informal and formal sector of the mining industry was based on the value added obtained from the Household Survey conducted by BCC in 2007, whereas the intermediate consumption of the same sector was held as a predetermined ratio to output from the same source. Moreover, the survey on gross income obtained from the INS in 2007 was used to approximate the manufacturing sector.

This chapter is structured as follows: the theory and usefulness of SAM are presented in Section 3.2. Section 3.3 discusses the framework of the DRC Macro SAM (DRCMSAM) and undertakes its construction. Section 3.4 disaggregates the DRCMSAM and discusses the different steps for the construction of the disaggregate SAM for the DRC (DRCDSAM).

Section 3.5 discusses the process of the linkages between the formal and informal sector in the DRC, which culminated with the construction of the SAM composed of formal and informal sectors, namely the DRCFISAM. Finally, Section 3.6 concludes this chapter.

3.2 OBJECTIVES AND USEFULNESS OF THE SAM

King (1988) defined the primary objective of the SAM as an organisation of information, while Pyatt *et al*. (1976) offered a systematic and comprehensive description of the SAM as both database and model. A SAM is a double entry square matrix containing payments in the columns and receipts in the rows for all transactions among agents or accounts. Any income of an account in the SAM must balance with an outflow of a counterpart account. Thus the SAM contains sufficient information and provides a suitable standard for balancing data in the matrix.

The second important objective of a SAM is to provide data for developing models. Usually a SAM merely depicts the structure of an economy at a particular time, however an active model needs to be deployed for proper assessment and prediction of the economy. In this respect, the SAM serves as a database for developing a model. A focal point of the SAM model relates to the technical coefficients matrix containing the expenditure susceptibilities for each account in the matrix. The determination of the kind of endogenous accounts constitutes the first step of the application of the SAM model, however endogenous accounts are defined and based on the accounts for which variations in the level of expenditure automatically affect any variation in income, while exogenous accounts consist of expenditures that are set independently of income. Once the endogenous accounts are selected, the model can be used to analyse the impact of the shocks applied to the exogenous components on the endogenous accounts.

The product between prices and quantities is expressed in currency because each cell in the SAM is stated in value terms (currency). The typical SAM model assumes that prices are fixed when analysing the impacts of actual shocks. This is recognised as the accounting multipliers model. By fixing the quantities on the product between prices and quantities, the SAM model can be given a price model version. Consistent with this view, the SAM model is less a forecasting technique when a shock is applied both on price and quantity. It rather

analyses the economic structure of the economy through inverse multipliers and a multiplier matrix.

It is important to note that the Input-Output[1] and SAM multiplier models have been used widely to assess the impacts of policy change, by assuming perfect elasticity of supply on the tradability of all goods and inputs (Naidoo, 2002). Nonetheless, the subsistence of excess capacity and unused capitals under the SAM–based, demand-driven Keynesian framework must be assumed, in order that any exogenous adjustment in demand can be satisfied by a corresponding adjustment in supply. Exogenous changes in demand are also assumed not to influence local prices.

3.3 FRAMEWORK AND DEVELOPMENT OF THE DRC 2007 MACRO SAM

The 2007 DRCMSAM includes different database sources from 2007. The year 2007 is considered to be a benchmark because of its data availability and reliability, and it is normal enough to be used as a good basis for comparison. The macro SAM is constructed according to the basic structure of SAM and it fairly closely follows the guidelines described in the SNA93. The SNA93 describes all the techniques related to the classification of accounts required for the national accounts. It also describes the techniques of developing a SAM from the national account data.

Table 3.1 represents an example of a macro SAM containing a single or aggregated activity row and column. This also applies to household and commodity rows and columns. However in a disaggregated SAM, for instance, the commodities from the production accounts consist of goods and services rendered on the market at a price that includes their cost of production. These include both domestically produced goods and imports. Considering the matrix, the main inter-industry transactions matrix is composed of several commodities and industries. The intermediate inputs [Col 2 – Row 2] include the sets of imported and domestically produced goods, while usually the input-output transactions section simply contains domestically produced goods. Each column in the absorption matrix of Table 3.1 contains the total input usage by an activity, even if the commodities it produces are its primary product or

[1] Input_Output Table is nothing more than an extension of the National Accounts of a Country, i.e. disaggregating it into the various sectors of the economy. It forms the nucleus of any model that analyses and projects the economy on an industry-to-industry basis.

a secondary product. A disaggregated SAM generally includes a number of diverse activities and commodities. Activities can be divided into agriculture, manufacturing and services. The main data sources used for the construction of the detailed activity and commodity accounts are input-output tables, supply-use tables and national accounts. National Statistical Bureaus are generally the producers of all these data. In the DRC, INS is the National Statistical Bureau and the producer of most economic data. In this respect, the SNA93 recommendations were taken into consideration for the construction of the DRCMSAM and DRCDSAM. In conclusion, the main data sources considered for this study were national accounts, household surveys, and labour force surveys.

3.3.1 Activities column

With reference to Table 3.1, payment of activities to commodities and factors are known as intermediate demand or input (A) [Row 4 – Col 2]. In fact, the intermediate demand is a compensation given to commodities from activities. Activities purchase intermediate inputs for production purpose. These intermediate inputs are commodities produced in the economy which can be bought locally as intermediate inputs (A) for consumption by households (C), for investment by different institutions (I), or for recurrent spending by the government (G). Moreover, commodities produced locally can be exported to the rest of the world (E).

Activities compensate factors of production with rents, wages, and profits generated during the production process. The compensation by activities to factors is the value-added (V), which is shown in [Row 5 – Col 2]. Moreover, the total activity column, the gross output cost, is obtained from the summation of intermediate demand and value-added. In order to determine intermediate demand, value-added and gross output, this study used a variety of data sources, even though the largest part of these sources came from INS.

Table 3.1: Model of universal standard of a macro SAM

Receipts	**Expenditure**							
	Activities	Commodities	Factors	Households	Government	Savings and investment	World	**Total**
Activities		Domestics supply (D)						Activity income
Commodities	Intermediate Inputs (A)			Consumption spending (C)	Recurrent spending (G)	Investment demand (I)	Export earnings (E)	Total demand
Factors	Value added (Wages/ Rentals) (V)							Total factor income
Households			Factor income (F)		Social transfers (Y)		Foreign remittances (R)	Total household income
Government		Sales taxes and import tariffs (B)		Direct taxes (T)			Foreign grants and loans (L)	Government income
Savings and investment				Private savings (S)	Fiscal surplus (Z)		Current account balance (K)	Total savings
World		Import payments (M)						Foreign exchange outflow
Total	Gross output costs (N)	Total absorption (O)	Total factor (P)	Total household spending (H)	Government expenditure (W)	Total investment spending (J)	Foreign exchange inflow (X)	

Source: SNA93

The BCC provided a considerable amount of the National Accounts control data which formed part of the DRC 2007 SAM, while the quarterly bulletin of March 2008 provided information on household consumption spending, government's recurrent spending, and investment demand. It also contained total export earnings and import payments. Data are valued in trillions of DRC Congolese Franc (FC) at 2007 prices.

With reference to Table 3.1, the following information obtained from the different sources, as mentioned above, were used to provide data for the row and column of activities for the DRCMSAM:

The value added (V) includes the values of the compensation of employees in the various activities, gross operating surplus, and net other taxes on production and land. Thus the compensation of employees in the various activities/sectors was determined as follows:

- Total compensation of employees = CDF 3198.2
- Compensation of government employees =.CDF 899
- Compensation of employees in the various activities/sectors:
  CDF 3198.2 – CDF 899= **CDF 2299.2.**

The gross operating surplus was determined as follows:

- Consumption of fixed capital = CDF 535
- Net operating surplus =.CDF 1091
- Gross operating surplus: CDF 1091 + CDF 535 **= CDF1626**

The net other taxes on production:

- Other taxes on production = CDF 16.2
- Other subsidies on production =.CDF 3.0
- Net other taxes on production: CDF 16.2 – CDF 3.0 = **CDF13.1**

The net tax on land =**CDF 167.4**.
Thus, the Value Added (V) is obtained as:
CDF 2299.2 + CDF1626 + CDF13.1 + CDF167.4 = CDF4105.7

The data used to obtain these figures are available from the DRC Statistics Bureau (INS, 2007).

Total intermediate use of commodities by Activities (A) = **CDF 3486.8**. This data were calculated as the residual of total activities in column 1 minus other elements of row 1.

Thus total production in the economy or gross output costs (N) = CDF4105.7 + CDF 3486.8= CDF7592.5.

3.3.2 Commodities column

With reference to Table 3.1, the column of commodities is composed of domestics supply, sales taxes and import payments. The commodities are provided locally and usually known as domestic supply (D) [Row 3 – Col 3] or imported [Row 9 – Col 3]. Commodities are subject

to indirect sales taxes and import tariffs [Row 7 – Col 3]. In this case, the values in the commodity accounts are considered at market prices and the main purchasers of commodities are economic agents. Commodities relate specifically to goods and services that are rendered on the market at a price that includes their cost of production. However, the variables of the goods and services account which correspond to the commodities column and row of Table 3.1 show the total supply and uses of goods and services in the economy. The commodities column includes variables such as trade and transport margins, supply of goods and services that are produced by resident industries/output at basic prices, taxes less subsidies on products, and supply of goods and services that are imported at cash, insurance and freight (c.i.f) prices.

Data obtained from the BCC (2008) were used to provide information for the row and column of commodities and show the following:

Taxes on products or sales taxes and import tariffs (B):

- Taxes on products = CDF 48.8
- Subsidies on products =.CDF 4.1
- NET taxes on production: CDF 48.8 – CDF 4.1 **= CDF 44.7**

Imports of goods and services (M) = **CDF 215.6**

Output of domestic activities or domestic supply (D) equals total production calculated under commodities (CDF 53.6) and activities (CDF 6537.7)

3.3.3 Factors column

With reference to Table 3.1, the factors column shows that the households own the factors of production and generate incomes from factors throughout the production process, known as factor payment to households (F) [Row 6 – Col 4]. Factors include all data on various institutional accounts such as government and the households. The factors column is composed of labour, capital, land and enterprises. The 2007 data collected from the quarterly bulletin produced in March 2008 (BCC, 2008) showed the following:

3.3.3.1 The Labour data

Total compensation of employees distributed to households (L)

- Total compensation of employees for DRC citizens – domestics = CDF 2301.0
- Total compensation of employees for DRC citizens – foreign = CDF 2.3
- Total compensation of foreigners = CDF 13.7
- Total compensation of employees distributed to households (L):
  CDF 2301.0+ CDF 2.3 - CDF 13.7= **CDF 2289.6**

External balance payable = CDF 9.7

3.3.3.2 The Capital data

Dividends and interest to enterprises = CDF 1224.1. This element is calculated as a residual by subtracting from capital (GOS) all the other elements that form the data of capital

Property income received by the general government = CDF 280.2

External balance payable property income:

- Direct foreign investment = CDF 24.2
- Non-direct foreign investment = CDF 97.4
- External balance payable property income: CDF 24.2+CDF 97.4 = CDF 121.6

Discrepancy on GDP figure (Residual item) = CDF 0.0

Total factor payment – capital:

- Net operating surplus = CDF 1091.0
- Consumption of fixed capital = CDF 535
- Direct foreign investments (receipts) = CDF 24.2
- Non-direct foreign investment (receipts) = CDF 97.4
- Total factor payment - capital: CDF 1091.0+ CDF 535 + CDF 24.2+ CDF 97.4= CDF 1747.6

3.3.3.3 The Land data

Land = CDF 167.4. This data is obtained from DRC Bureau of Statistics (INS, 2000)

3.3.3.4 The Enterprise data

Dividends and interest to households = CDF 777.4. This element is calculated as a residual by subtracting from total enterprises all the rest of the elements that form the data of enterprises.

Corporate taxes:

- Current transfers from incorporated business enterprises = CDF 11.6
- Current taxes on income and wealth = CDF 435.1
- Corporate taxes: CDF 11.6+CDF 435.1 = CDF 446.7

3.3.4 Households column

With reference to Table 3.1, households purchase commodities known as consumption spending (C) [Row 4 – Col 5], and the remaining earnings are after that invested or disinvested if expenses exceed earnings (S) [Row 8 – Col 5]. Government receives taxes straight from households (T) [Row 7 – Col 5]. Data related to household accounts are taken from household surveys and national accounts. Compensation of employees is recorded as a transaction (compensation in return of work) between an industry (employer) and a person (employee). Table 3.1 shows that the employed persons are considered to be separate units who receive compensation and distribute this income to their households in the allocation of primary income account (in DRC 2007 SAM, these units are subsequently classified into institutional sectors). This is a deviation from standard national accounts, in which households receive the generated income directly. It illustrates that in reality, individuals, not households, work and receive compensation for labour provided.

Data related to household accounts were obtained from national accounts (BCC, 2007) and household survey (INS, 2007) and show the following:

Private consumption expenditure (C) = **CDF 2026**

- Household by activities = CDF 1054.8

Taxes on income and wealth paid by households (T):

- Current taxes on income and wealth = CDF 525.8
- Current transfers to general government = CDF 6.9
- Taxes on income and wealth paid by households: CDF 525.8+ CdF 6.9= **CDF 532.8**

Household savings or private savings (S) = **CDF 624.0** (Total household income is obtained from the factor income, social transfers and foreign remittances).

3.3.5 Government column

With reference to Table 3.1, the government utilises its revenue which is obtained from the different taxes collected and the transfer payments received from the rest of the world, to compensate for regular consumption spending or recurrent spending (G) [Row 4 – Col 6], transfers to households (Y) [Row 6 – Col 6], and to the rest of the world. The variation between total incomes and expenses is the fiscal surplus (Z) or deficit, if expenses exceed incomes [Row 8 – Col 6].

Data related to government accounts are obtained from public-sector budgets published by the Department of Finance in the DRC (DF, 2008) and show the following:

Consumption expenditure of commodities by the general government (G)

- Final consumption expenditure = CDF 1145.6
- Compensation of employees = CDF 815.8
- Consumption expenditure of commodities by the general government (G): CDF 1145.6 - CDF 815.8 = **CDF 329.9**

Current transfers to households (Y) = **CDF 703.3**

Subsidies = CDF 651.6

Net savings by the general government (Z) = **CDF 13.8**

3.3.6 Savings and investment column

With reference to Table 3.1, the savings and investment column simply reflects the gross capital formation indicated as investment demand (I) [Row 4 – Col 7]. Total saving is equivalent to investment or gross capital formation, which contains variations in inventories or stocks. Thus the SAM also includes private savings and public savings. The current account balance is evaluated from the difference between total domestic savings and total investment demand, which is the total capital inflows from foreign countries. The current account balance is proportional to the discrepancy between foreign exchange revenue (exports and foreign transfers acknowledged) and spending (imports and government transfers to other countries). Again, for the DRCMSAM, data related to current accounts or the rest of world are obtained from the balance of payments as published by the DRC Central Bank.

Furthermore, the capital account can show in which industry the type of capacity is expanded and probably which sector invests in what industry. One can also see which industries have expanded their production capacity or show the dynamics of an economy. Usually the information on the gross fixed capital formation and consumption of fixed capital are readily available. In this respect, the residual and the net fixed capital formation should be found and recorded. The data collected from the quarterly bulletin produced in March 2008 (BCC, 2008) show the following:

Gross capital formation by the general government (I) = **CDF 653.8**

3.3.7 Rest of world column

With reference to Table 3.1, the rest of the world column shows that the final demand for commodities is composed of export demand (E) [Row 4 – Col 8]. Households receive foreign remittances (R) from relative members residing in foreign countries [Row 6 – Col 8]. The current account balance (K) [Row 8 – Col 8] is the difference between total domestic savings and total investment demand, which is the total capital inflows from foreign countries. The current account balance is proportional to the discrepancy between foreign exchange revenue (exports and foreign transfers acknowledged) and spending (imports and government transfers to other countries). Furthermore, the total government revenue is obtained from the

different tax incomes collected and the transfer payments received from the rest of the world (L) [Row 7 – Col 8].

This account shows the current transactions of the rest of the world with the nation. The rest of the world column records the receipts from the rest of the world and the row contains the payments from the nation to the rest of the world. The elements in these accounts have all been reviewed above.

The balance of this account is done when the current external balance reflects the surplus (when negative) or the deficit (when positive), of the total economy on its current transactions with the rest of the world. When considering the current external balance from the national economy, the usage of the sign reversed is required in the column and row.

The data collected from the quarterly bulletin produced in March 2008 (BCC, 2008) show the following:

Total exports of goods and services (E) = **CDF 301.4**
External primary incomes – compensation of employees (R) = **CDF 15.9**
External transfers receivable – transfers to the government (L) = **CDF 15.9**

3.3.8 Technique used to balance the disaggregated and macro SAM

As indicated earlier, various data sources are used to construct the DRCMSAM and DRCDSAM. These sources are household surveys, national accounts, government budgets, and the balance of payments. Discrepancies between the revenues and expenditures of every account were noticed during the process of populating the DRCDSAM with data. A typical example is when data on government expenditure in national accounts show discrepancies with the data presented in the government budget. With a view to balance the SAM account, a variety of statistical estimation methods are used to adjust revenues and expenditures, namely the Row Address Strobe (RAS) and the Classic approaches.

The RAS method is preferred in this study even though other methods such as the cross entropy, deterministic and stochastic approaches could be used. RAS has been used for balancing SAMs since the 1970s and is relatively simple. Its application is fairly easy in

terms of computing the SAM and all that is needed is that the row and column sums be used as control variables (Robinson et al., 2000). In this respect, three parameters are needed for the balancing procedure: a tolerance level, maximum number of iterations, and the weight to assign to the column sum of the unbalanced SAM. If convergence cannot be achieved using the default value for tolerance and maximum number of iterations, there is a possibility of increasing either of the two or both to achieve convergence. The practical challenge in the estimation of the SAM relates to the issue of "updating" the input-output matrix when new data is available on the row and column sums, but not on the input-output flows. Another issue is the gathering of the complete SAM, instead of simply focusing on the input-output matrix. For instance we can consider a new SAM coefficient matrix, **A***, that is in some extent "close" to an existing coefficient matrix, but yields a SAM transactions matrix, **T**, with the new row and column sums. That is:

$$T_{ij}^{*} = A^{*}{}_{ij} Y_{j}^{*} \qquad \textbf{(3.1)}$$

$$\sum_{j} T*ij = \sum_{j} T*ji = y*i \qquad \textbf{(3.2)}$$

where **y*** are known as new row and column sums.

The researcher used the classic technique to solve this issue by generating a new matrix **A*** from the old matrix **A** by means of "bi-proportional" row and column operations, where **R** represents row and **S** is the sum of columns:

$$A*ij = R_{i},ijSj \qquad \textbf{(3.3)}$$

Or in matrix terms:

$$A* = \Lambda,\sum \qquad \textbf{(3.4)}$$

where the hat (Λ) designates a diagonal matrix of components of **R** which represents the row and **S** the column sums of the matrix. Bacharach (1970) indicated that this RAS technique operates in that a unique set of positive multipliers (normalised) exists, that satisfy the bi-proportionality condition and that the components of **R** and **S** can be discovered by a simple iterative procedure. For instance in this thesis, $(SAM)_{ij}$ represents the unbalanced disaggregated SAM, and CT_j represents the row / column totals to be used as control

variables which are computed as a weighted average of the rows and sum columns from the unbalanced SAM. The process of balancing the SAM requires computation. The research considered $(SAM)_{ij}^{t}$ as the SAM computed in the ***t***-th iteration of the system, and $(SAM)_{ij}^{0} = (SAM)_{ij}$. Furthermore the researcher considered R_j^t and S_j^t as row and column sums for $(SAM)_{ij}^{t}$. Then the following tasks were performed:

1. Verify if $R_j^0 = S_j^o$ for every ***j***. If the matrix $(SAM)_{ij}$ balances then stop the process, otherwise set *t*=0 and perform the next task.
2. Determine a new value V_i for every row ***i*** and calculate V_i as $V_i = \frac{CT_i}{R_i^t}$
3. Multiply each cell on row *i* by V_i to obtain $(SAM)_{ij}^{t+1} = SAM_{ij}^{t} * V_i$
4. Compute the column sums of $(SAM)_{ij}^{t+1}, S_j^{t+1}$. If $\sum_j \left| S_j^{t+1} - CT_j \right| < \delta$ for some small δ (convergence threshold), then stop the process soon the matrix $(SAM)_{ij}^{t+1}$ is balanced, otherwise perform the next task.
5. Determine $V_j = \frac{CT_j}{S_j^{t+1}}$ and compute V_i for every column ***j***
6. Multiply each cell on column ***j*** by V_i to obtain $SAM_{ij}^{t+2} = SAM_{ij}^{t+1} * V_j$
7. Compute the row sums of $(SAM)_{ij}^{t+2}, R_j^{t+2}$. If $\sum_j \left| R_j^{t+2} - CT_j \right| < \delta$ for some small δ (convergence threshold), then stop the process soon the matrix $(SAM)_{ij}^{t+2}$ is balanced, otherwise go back to task 2.

The researcher applied the three parameters to the RAS technique. The first parameter was weight. It applied the SAM row and column totals to compute the control totals V_i. The appropriate formula used was $CT_j = weight.C_j^0 + (1 - weight) * R_j^0$. The second parameter was the convergence threshold δ as defined in task 4, and the third parameter was the maximum number of executed iterations.

3.3.9 The DRCMSAM

The DRCMSAM and DRCDSAM were constructed simultaneously. Generally, MS Excel seems to be suitable software for SAM development, and in this case it was used to construct both DRCMSAM and DRCDSAM. The input datasets used to update the DRCMSAM and DRCDSAM are interlinked with other worksheets. Due to the volume of the DRCDSAM, the complete DRCDSAM is reported in the attached CD. In fact, data from the input DRCDSAM were updated automatically into the cells of the DRCMSAM in order to produce a balanced DRCMSAM as shown in Table 3.2.

Table 3.2: DRCMSAM using CDF trillion, 2007 prices

Receipts \ Payments	Activities	Commodities	Labour	Capital	Land	Enter-prises	House-holds	Gover-nment	Capital account	Rest of the world	Resi-dual	Total
Activities	0.0	6,537.7	0.0	0.0	0.0	0.0	1,054.8	0.0	0.0	0.0	0.0	**7,592.5**
Commodities	3,486.8	387.0	0.0	0.0	0.0	0.0	2,675.5	278.5	711.9	704.9	0.0	**8,244.6**
Labour	2,299.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2,299.2**
Capital	1,625.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1,625.9**
Land	167.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**167.4**
Enterprises	0.0	0.0	0.0	1,224.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1,224.1**
Households	0.0	0.0	2,289.6	387.9	167.4	1,172.0	0.0	33.0	0.0	218.1	0.0	**4,268.1**
Government	13.1	235.6	9.7	0.0	0.0	52.1	51.0	360.7	0.0	0.0	0.0	**722.3**
Capital account	0.0	0.0	0.0	0.0	0.0	0.0	486.8	49.9	0.0	175.1	0.0	**711.9**
Rest of the world	0.0	1,084.3	0.0	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1,098.1**
Residual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	**7,592.5**	**8,244.6**	**2,299.2**	**1,625.9**	**167.4**	**1,224.1**	**4,268.1**	**722.3**	**711.9**	**1,098.1**	**0.0**	**27,954.2**

3.4 STRUCTURE AND DEVELOPMENT OF THE DRCDSAM

It must be noted that the numbers of commodities and activities were limited to 15 due to data constraints. The DRCDSAM reconciles a wide variety of data sources, including national accounts, household income and expenditure surveys, as well as labour force surveys. The primary data sources used in constructing the DRCDSAM were the 2007 DRC bureau of statistics (INS) supply-and-use tables, 2008 DRC Reserve Bank (BCC) macroeconomic data and the 2007 Household Survey (HS).

The supply-and-use tables were utilised to establish the sector links and relationships, while the HS data provided information regarding employment levels and average wages across different labour groups and sectors. For lack of better information, the 1996 Income and Expenditure Survey data generated by INS was used to model household factor income distribution and consumption behaviour. The DRCDSAM consisted of comprehensive information on demand and supply for 15 activities or commodities. Four labour groups were specifically identified, namely: (1) subsistence factor, (2) child labour, (3) female adult labour and (4) male adult labour. The household sector of DRCDSAM was disaggregated according to income into rural and urban areas with four groups: i.e. (1) rural poor households, (2) rural non poor households, (3) urban poor households and (4) urban non poor households. Tables 3.3 and 3.4 below provide the structure of the DRCDSAM, however for multiplier decomposition purposes, it is important to note that there are endogenous and exogenous accounts in this DRCDSAM.

The endogenous accounts are composed of activities, commodities, labour, capital, land, enterprises and households, while the exogenous accounts consist of government, capital account, rest of the world and residual. Thus the DRCDSAM is an economy-wide database that captures all monetary flows in the DRC economy from 2007. This was used as a database for the construction of the DRCFIM and the parameters of the model equations were calibrated to observed data from the DRCDSAM.

Table 3.3: The composition of the DRCDSAM

Group of accounts	Labels
Activities (15)/ Commodities (15)	
Agriculture	AGRIC
Livestock, fishery, hunting, and forestry	LIVES
Mining	MININ
Processed food	FOOD
Textiles	CLOTH
Manufacturing	MANUF
Machinery and equipment	EQUIP
Utilities	UTILI
Construction	CONST
Trade	TRADE
Hotels and restaurants	HOTEL
Transport and communications	TRANS
Real estate	ESTAT
Public administration	ADMN
Private services	PRIVS
Labour (4)	
Subsistence factor	FSUB
Child labour	LCHILD
Female adult labour	LFEMALE
Male adult labour	LMALE
Capital (2)	
Agricultural capital	CAPAG
Non agricultural capital	CAPNAG
Land (1)	LAND
Enterprises (1)	ENTR
Households (4)	
Rural poor households	RURPOOR
Rural non poor households	RURNPOOR
Urban poor households	URBPOOR
Urban non poor households	URBNPOOR
Government (6)	GOV
	DIRTAX
	IMPTAX
	VATAX
	INDTAX
	FACTAX
Capital account (1)	S-I
Rest of the world (1)	ROW

Activities are composed of firms that generate goods and services, and commodities are those goods and services made by activities. The distinction between activity and commodity is taken into consideration for the purpose of showing that an activity can manufacture more than one category of commodity or products. In the same way, commodities can be manufactured by more than one category of activity. A prominent example relates to the case of beans that can be produced by a small farmer or a big firm farmer. Generally, the values in the activity accounts are considered in producer prices.

DRCDSAM takes into consideration the income and expenditure flows of activities and commodities. It also includes the entire data on various institutional accounts such as government and households. Generally, households own the factors of production and generate incomes from factors throughout the production process.

Regarding the government, its total revenue is obtained from the different tax incomes collected and the transfer payments received from the rest of the world.

In the process of constructing the DRCDSAM, data entries were identified as row-column combinations and were valued in trillion of DRC Congolese Franc (FC) at 2007 prices. A MS Excel spreadsheet was used to capture data in the disaggregated SAM and macro SAM. The formulas set in the first MS Excel spreadsheet contained the DRCDSAM and linked to the second spreadsheet composed of DRCMSAM. Any modification in the first can be updated automatically in the second spreadsheet. The DRCDSAM is provided in the attached CD due to its huge volume. Table 3.3 above presents its composition and Table 3.4 below displays its matrix format.

Table 3.4: Matrix format of the DRCDSAM

Receipts \ Payments

	Activities 15	Commodities 15	Labour 4	Capital 2	Land 1	Enterprises 1	Households 4	Government 6	Capital account 1	Rest of the world 1	Residual 1
Activities 15											
Commodities 15											
Labour 4											
Capital 2											
Land 1											
Enterprises 1											
Households 4											
Government 6											
Capital account 1											
Rest of the world 1											
Residual 1											

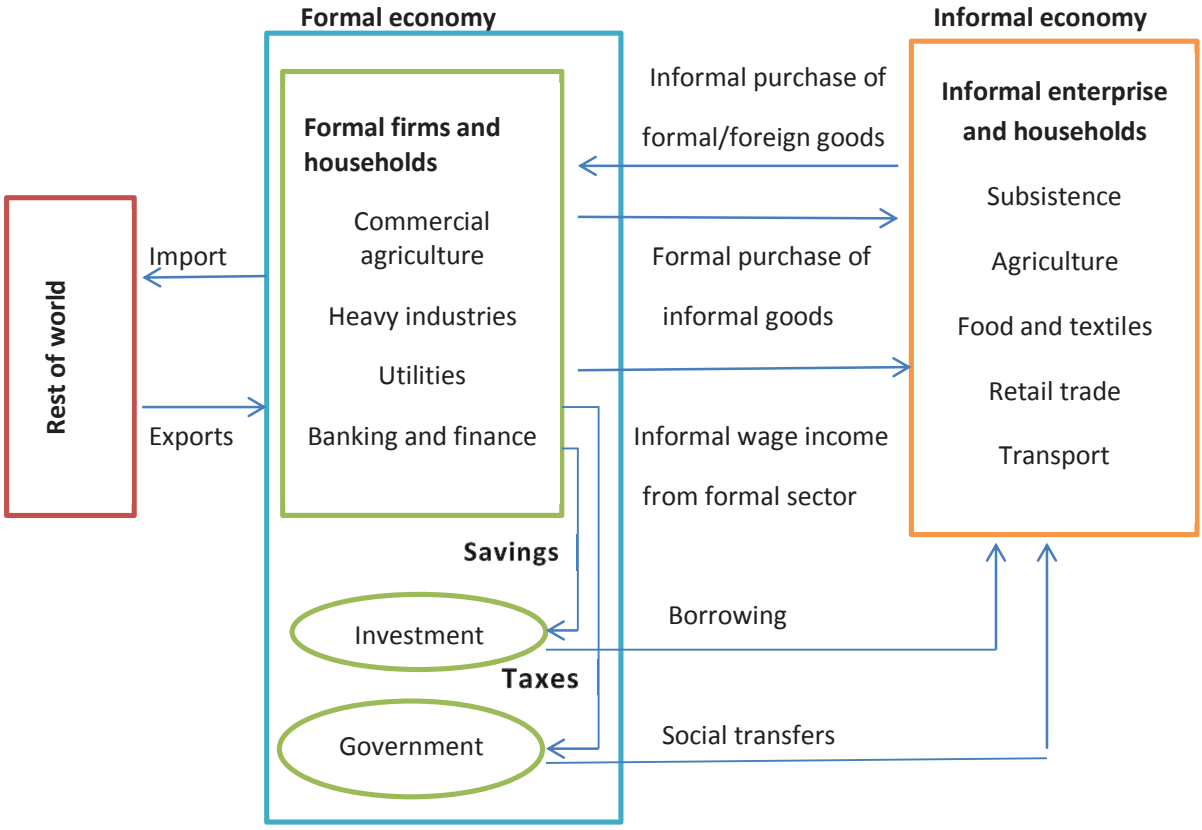
As indicated earlier, during the process of undertaking this task, Microsoft Excel was used extensively to construct the DRCMSAM and DRCDSAM. The actual numbers from the DRCDSAM (input datasets) were not just typed into the DRCMSAM, but rather, an advanced programme in MS Excel was employed to link the DRCMSAM entries to the corresponding input DRCDSAM. This was done by introducing the symbol "=" followed by the cell location where the data are kept. Linking the DRCMSAM to the input datasets allows one to trace back the source of each cell entry. Therefore, data presented in Section 3.3 are used to construct the DRCMSAM and DRCDSAM. In this respect, both SAMs are constructed from the Excel file containing the input datasets. The input datasets used to update the DRCDSAM and DRCMSAM are interlinked with other worksheets. The programme facilitates the checking of the validity of data and shows how the datasets have already been balanced so there are no discrepancies between incomes and expenditures. Data from the input DRCDSAM were updated automatically into the cells of the DRCMSAM in order to produce a balanced DRCMSAM. The row and column totals are also automatically calculated since the cells are progressively updated. Finally, the difference between row and column totals is calculated for the purpose of identifying the missing entries while the DRCDSAM and DRCMSAM are constructed simultaneously.

3.5 FORMAL-INFORMAL SECTOR LINKAGES AND THE DRCFISAM

Davies and Thurlow (2010) put forward a theoretical framework of the formal–informal sector linkages for South Africa. This theoretical framework depicts the reflected structure of the country's informal and formal economies, as well as the various linkages involving their different economic agents. The authors contended that in comparison with the typical dual-economy models, the informal economy is rather diverse and has multi-faceted interactions with the formal sector. Their strong view relates to the role of informal activities, which underlines the difficulty of developing policies that justify the disparity effects on informal and formal economies. Given such a framework, Figure 3.1 below describes the related theoretical framework in an economy composed of two main agents. They are operating in two distinctive environments - informal and formal economies. For instance, every agent produces and consumes what is produced. Nonetheless, the first agent operates in the formal economy which is autonomous and produces a variety of products. Given that he produces and consumes his own products, he also provides a market for his own products with the rest

of the world. As seen in Figure 3.1, the first agent is from the formal economy, which is well organised and belongs to the household. He contributes taxes to the government and invests his funds with banks and other official institutions. The second agent is from the informal economy, is not autonomous and produces a limited type of product. In this respect, he does not provide a market for his own products with the rest of the world. What is more, the informal sector purchases products from the formal sector due to its incapacity to generate its own products. In fact, the informal sector households consume more funds than they generate, which does not provide equilibrium between supply and demand. Figure 3.1 shows four types of informal activities which produce the necessary funds required to sponsor the informal economy's commerce shortfall with the formal economy. They are (i) informal producers competing with formal producers in product markets; (ii) informal traders selling and charging a minimum transaction cost margin for their products; (iii) workers who are informally employed by the formal sector; and (iv) noncompetitive producers including informally employed workers who produce goods and services that are not supplied by the formal sector.

Figure 3.1: Theoretical framework for the formal–informal economy wide model



Source: Davies and Thurlow (2010)

This study adapted this theoretical framework to assess the linkages between the formal and informal sectors in the DRC. The BCC (2007) made specific reference to the use of a national account to measure income flows to determine the impact of the informal sector on the DRC economy. For instance, the findings of the household survey carried out in 2007 by the BCC (2007) showed that 15.3 percent of food items bought by formal households, as well as 9.6 percent of the nonfood items bought by the same households, were produced in informal markets (see Table 3.5). Consequently, for illustration purposes, the percentages of formal households' food and nonfood items in the DRC are approximately three times more than those bought by the same households in South Africa. This information is crucial for establishing a linkage between the formal and informal sectors in the DRC in comparison to South Africa. While Davies and Thurlow (2010) found that in South Africa the formal households' food purchases (in value terms) is 5.1 percent and the non-food purchases made in informal markets is 3.2 percent, it is important to note that the market expenditure shares for the informal and formal households show similarity between the two households.

According to Naidoo (2002), migration between the formal and informal economy is done day by day in South Africa. This trend is also observed in the DRC economy because the individuals move to the formal economy on a daily basis and bring back their remuneration to households in the informal economy. For instance, some individuals are domestic workers who are formally employed by formal households. In fact, the remuneration earned is utilised to compensate for the rate of imports from the formal economy. The DRC 2007 household survey shows that the remuneration received from informally employed individuals compensated 30.2 percent of the informal sector's commerce shortfall (BCC, 2008).

Table 3.5: Expenditures shares for informal market in DRC, 2007

	Share of purchases (value) in informal markets (%)			
	Food products		Nonfood products	
	Formal households	Informal households	Formal households	Informal households
All expenditure deciles	15.3	30.3	9.6	19.8
Rural poor households	40.2	40.5	29.4	29.1
Rural non poor households	15.3	16.2	13.8	16.5
Urban poor households	27.6	33.9	20.4	21.3
Urban non poor households	5.7	9.3	4.8	12.1

Source: Own calculations using 2007 Household Survey (BCC, 2007)

Considering the case of the DRC, the origins of supplementary incomes for the informal economy are not derived from the manufactured goods and labour markets, as the informal economy can borrow from other sources in order to compensate for its formal economy acquisitions. Nonetheless, the cycle is broken whenever the informal households save from their remuneration.

Furthermore, as in most underdeveloped countries, the informal sectors and households in the DRC are not compelled to pay direct taxes (income and corporate). The government provides social transfers such as retirement funds to informal households; in this respect, the social transfers from the government are subject to indirect (sales and import) taxes and the informal households contribute to the sales or import taxes, especially on final and intermediate demand. Evaluating the indirect tax settlements from the DRC 2007 national account data, government internal transfers accrue for 14.8 percent of the informal sector's commerce shortfall with the formal economy. The information provided above, as well as the theoretical framework of the formal-informal sector linkages, were used to identify all possible linkages in products and labour factors between the formal and informal sectors in the DRCDSAM.

Davies and Thurlow (2010) used the data on income and expenditure for both formal and informal sectors with a view to determining the share of purchases in informal markets. A proportion rule was applied during the process of calculating the share of purchases from formal and informal households. Given such a theoretical framework, the final DRCFISAM was constructed based on the same technique. This was done through considering the information on expenditure share for the informal market, as presented in Table 3.5 and Table 3.6, with a view to estimating the contribution of the informal sector to GDP. For instance, GDP in the 2007 DRCMSAM was estimated and disaggregated across informal and formal sectors, applying labour revenue shares from the DRC 2007 HS. The production technologies of the formal and informal economies were assumed to be the same, and the allocation of the intermediate demand patterns was based on workers' earnings. Formal sector products are considered for foreign export demand, investment and government. The distinction between households' consumption demand for formal and informal goods was performed through informal market consumption shares taken from the 2007 HS (see Table 3.5). All this information was used to approximate the total demand of the formal and informal sectors. Moreover, the foreign import penetration was assumed to be equivalent across formal and informal economies. More detailed information on the household incomes and expenditures were established on government accounts and on reported nonfactor incomes from the 2007 HS. The final DRCDSAM and DRCMSAM comprising of incomes, commerce and production symbolise the conceptual distinctiveness of the formal and informal sectors. Table 3.6 below provides the structure of the formal-informal sector in the DRC.

Table 3.6: Economic structure of DRC's formal-informal economy, 2007

	Share of total GDP (%)			Informal sector's share of national total (%)		Informal trade shares and intensities (%)			
	Formal sector	Informal sector	National	GDP	Employment	Total exports	Total imports	Exports/output	Imports/demand
All sectors	25.2	74.8	100	74.6	80.9	100	100	75.7	79.5
AGRIC	8.4	26.9	9.5	87.5	91.6	11.4	12.3	83.6	82.4
LIVES	12.5	7.4	11.9	83.3	87.6	3.6	10.5	52.2	91.2
MININ	21.8	1.0	20.7	82.8	79.6	54.8	0.0	78.5	0.0
FOOD	0.9	12	1.1	80.1	88.4	0.9	11.9	92.3	98.1
CLOTH	14.1	2.1	11.4	54.7	51.6	3.9	8.6	74.8	87.9
MANUF	2.7	3.5	3.2	69.6	78.5	1.5	11.2	51.5	85.8
EQUIP	9.2	0.6	9.3	56.5	52.3	2.1	9.5	53.7	85.3
UTILI	4.1	0.0	4.4	0.0	0.0	0.0	0.0	0.0	100
CONST	2.1	7.2	2.4	98.1	65.3	0.0	5.4	0.0	100
TRADE	5.3	9.2	6.1	95.0	98.4	1.8	1.3	76.6	78.9
HOTEL	3.5	2.9	3.7	67.7	85.7	8.0	3.9	79.3	62.7
TRANS	7.9	6.2	8.2	95.4	97.5	0.0	8.2	62.5	78.3
ESTAT	2.1	17.5	2.5	90.2	91.3	1.2	2.5	21.3	88.7
ADMN	3.2	0.0	3.3	0.0	0.0	3.4	3.6	86.5	89.6
PRIVS	2.2	3.5	2.3	91.6	96.2	7.4	11.1	51.4	86.5

Source: Own calculations using the 2007 household survey and DRC Reserve Bank (2008)

Table 3.6 above shows that the informal sector contributes 74.6 percent to the DRC's total GDP but creates 80.9 percent of total employment (see columns 4 and 5), revealing the level of influence and high labour intensity of the informal sector. The biggest informal sectors are agriculture (26.9 percent), real estate (17.5 percent), food (12 percent), trade (9.2 percent), livestock (7.4 percent), construction (7.2 percent), and transport (6.2 percent) (see column 2). Agriculture and food processing are common traded goods between the formal and informal economies. Formal goods provide nearly all informal food consumption demand, and 92.3 percent of informal food production is delivered to the formal economy (see columns 8 and 9). Generally, the significant import and export intensities reveal the substantial reciprocal commerce that persists between the formal and informal sectors. The significant import intensity is justified by the commerce shortfall that the informal economy contributes to the formal economy; commerce between sectors contributes approximately one-third of the deficit. In this respect, almost half of the general shortfall is covered by informal "exports" of agriculture, food, real-estate, trade, livestock, construction and transport. This emphasises the significance of informal businesses over informal food and agricultural producers.

Based on the definition of informal households and according to 2007 HS, approximately 80 percent of the DRC's population form part of the informal sector (see Table 3.7 below). In fact, "informal households" are individuals who receive wages from the informal economy plus those informally working in the formal economy. Because the demand patterns and nonzero consumption intensity of the unemployed members of the households are similar to individuals of informal households, they were included as informal households. Informal households are usually poorer than formal households, with 75.7 percent (see column 2 in Table 3.7) of the informal population from the rural households classified in the lowest expenditure categories, compared with 23.8 percent (see column 1 in Table 3.7) of the formal population. Only 6.5 percent (4.2 and 2.3) of the informal population from urban households is in the highest expenditure categories.

Table 3.7: DRC household population patterns, 2007

	Formal households	Informal households	Total households
Population (1,000s)	12,660	50,640	63,300
All expenditure deciles (%)	100	100	100
Rural poor households	23.8	75.7	58
Rural non poor households	35.2	17.8	26
Urban poor households	18.1	4.2	12
Urban non poor households	22.9	2.3	4

Source: Own calculations using 2007 Household Survey (BCC, 2007) and INS (2007)

As indicated earlier, the role of the informal sector in the process of economic development is important and needs to be assessed. Despite the fact that the informal sector has been considered to be the economy of the poor, the assessment of the linkage between formal and informal sectors will facilitate the implementation of economic policy designed for the formal sector, which will stimulate the informal sector to participate actively in the economy. Taking into account the DRC's political and economic situation with the war still prevailing in the country, these data approximations are considered the best possible, with the hope that data quality and approximations should improve considerably in the near future. In the meantime, data produced by other institutions such as the IMF and World Bank are also taken into consideration for evaluating the linkages between the formal and informal sectors. The estimation of the total production of the informal sector as a portion of total production is presented in Table 3.8 below.

Table 3.8: Estimates for the informal-formal sector in the 2007 SAM

Sector (SIC)	Total production (a)	Total production formal sector	Total production informal sector (b)	Informal sector total production as portion of total production c = (b) / (a) %	Informal sector contribution %
		In CF trillion			
Agric (1)	1 740.1	218.3	1521.8	87.5	26.9
Lives (2)	502.5	84.1	418.4	83.3	7.4
Minin (3)	69.2	11.9	57.3	82.8	1
Food (4)	847.7	168.4	679.3	80.1	12
Cloth (5)	222.5	100.8	121.7	54.7	2.1
Manuf (6)	285.2	86.6	198.6	69.6	3.5
Equip (7)	62.1	27	35.1	56.5	0.6
Utili (8)	116.8	116.8	0	0	0
Const (9)	415.4	7.8	407.6	98.1	7.2
Trade (10)	547	27.3	519.7	95	9.2
Hotel (11)	244.9	79.1	165.8	67.7	2.9
Trans (12)	369.5	17	352.5	95.4	6.2
Estat (13)	1 097.1	107.3	989.8	90.2	17.5
Admin (14)	855.5	855.5	0	0	0
Prvs (15)	216.9	18.3	198.6	91.6	3.5
Total	**7 592.5**	**1926.2**	**5666.2**	**74.6**	**100**

Source: Own calculations using 2007 Household Survey (BCC 2007) and INS (2007)

Table 3.8 above shows that the informal sector activity is quite widespread in the DRC economy, fluctuating from insignificant amounts in the mining sector (less than 1 percent of total production), to higher echelons in the real estate (17.5 percent) and agriculture sectors (26.9 percent). Other sectors that make a fairly significant contribution to the total production consist of food (12.0 percent), livestock (7.4 percent), construction (7.2 percent) and transport (6.2 percent). The relative share of the informal sector is indicated in the last column of Table 3.8, for instance trade's contribution to the total informal sector production is over 9 percent (519.7 / 5666.2), while the agriculture sector contributes just less than a third of the informal sector. The transport, manufacturing, private services, hotels and other sectors are relatively small in comparison to the afore-mentioned sectors. This distribution describes the DRC situation, as it is fairly common to see informal sector activity more prevalent than the formal sector in almost all the sectors of the DRC's economy. Table 3.9 contains the split between the formal and informal sector. It was constructed based on the following assumptions:

a) The distribution of the intermediate inputs and the input coefficients of the informal sector is similar to that of the formal sector, however it is not easy to apply certain input coefficients or the distribution of intermediate inputs because of the cost structure of the informal sector.

b) Even though the informal sector may escape paying tax, it is still being included in the structure of the total economy. It is also significantly represented within the SAM via imputation.

c) The kinds of methods used to measure the informal sector were described in Chapter 2. The direct method is preferred for the measurement of the informal sector because it provides reliable data from the primary source on the informal sector in the form of surveys. It includes activities such as bartering, unpaid work and illegal activities estimated from informal sector activities. This assumption can also be applied for the formal sector because of the amounts collected from various sectors of the economy. For instance, in terms of cost structure, the approximation of non-financial activity should be imputed if a particular survey is carried out to measure the informal sector.

Table 3.9 includes only the input-output section of the DRCDSAM, reflecting the split between the formal and informal sector primary inputs, however it shows that the informal sector is the greatest contributor to the DRC's economy. All sectors performed well in the informal sector compared to the formal sector. In this respect, the biggest informal sectors are real estate agencies (677.4 trillion), agriculture (576.1 trillion), trade (208.5 trillion) and construction (171.5 trillion) (see last column in Table 3.9 - concluded). Political instability and war in the DRC could be the key reason driving the active population into the informal sector. Although, the informal sector is usually involuntary and informal employment is desired, there is a considerable barrier to entry in the informal sector, such as lack of access to finance and inability to invest in the labour intensive sectors.

Agriculture and food processing are major traded goods between the formal and informal economies. Goods produced from the formal sector provide sufficient food consumption demand for the informal sector, and a large percentage of informal food production is delivered to the formal economy. As previously mentioned in this section, the high import and export intensities reveal the significant reciprocal commerce that exists between the formal and informal sectors. The significant import intensity is justified by the commerce

shortfall that the informal economy contributes to the formal economy. Nonetheless, commerce between sectors contributes approximately one-third of the deficit. In this respect, almost half of the general shortfall is covered by informal "exports" of agriculture, food, real-estate, trade, livestock, construction and transport. This shows the significance of informal businesses over informal food and agricultural producers.

The principle of intra trade constitutes the basis for determining the linkage between the formal and informal sectors. This simply means that the formal and informal sectors are both purchasers and suppliers to the production system. In fact, the informal sector contributes to itself and the formal sector. Table 3.9 shows that the linkage is determined from the corresponding amount that should be purchased or sold from or by the informal sector to the formal sector. For instance, in the case of the mining sector, the assumption is that 82.8 percent of production originates from the informal mining sector to the total mining production; 95.0 percent of trade production originates from the informal trade sector to the total trade production, and 54.7 percent of clothing production originates from the informal clothing sector to the total clothing production.

Table 3.9: Input-Output Table - splitting informal and formal sectors (CDF trillion)

Sector (SIC)	Agric (1)			Lives (2)			Mining (3)			Food (4)			Cloth (5)		
	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal
Agric (1)	136.2	17.0	119.2	15.2	1.9	13.3	0.1	0.01	0.07	442.6	55.3	387.3	43.2	5.40	37.77
Lives (2)	5.4	0.9	4.5	7.9	1.3	6.6	0.1	0.02	0.08	65.0	10.8	54.1	0.5	0.08	0.42
Mining (3)	0.0	0.0	0.0	0.9	0.2	0.7	1.1	0.19	0.90	0.8	0.1	0.7	0.0	0.00	0.00
Food (4)	0.0	0.0	0.0	1.1	0.2	0.9	0.1	0.01	0.04	21.3	4.2	17.1	0.0	0.00	0.00
Cloth (5)	12.2	5.5	6.7	3.0	1.4	1.6	0.0	0.02	0.03	0.6	0.3	0.3	9.1	4.13	4.99
Manuf (6)	40.0	12.1	27.8	3.7	1.1	2.6	1.4	0.41	0.94	5.4	1.6	3.8	2.5	0.76	1.74
Equip (7)	1.1	0.5	0.6	2.6	1.1	1.5	0.7	0.30	0.39	3.8	1.7	2.2	0.0	0.00	0.00
Utili (8)	5.7	5.7	0.0	0.6	0.6	0.0	2.4	2.38	0.00	8.0	8.0	0.0	16.4	16.41	0.00
Const (9)	1.8	0.0	1.8	0.6	0.0	0.6	0.3	0.01	0.32	16.3	0.3	15.9	5.1	0.10	4.98
Trade (10)	64.2	3.2	61.0	10.9	0.5	10.4	1.0	0.05	0.95	29.6	1.5	28.1	13.7	0.68	13.01
Hotel (11)	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00
Trans (12)	26.2	1.2	25.0	4.3	0.2	4.1	0.9	0.04	0.90	6.2	0.3	6.0	3.1	0.14	2.92
Estat (13)	1.2	0.1	1.1	0.4	0.0	0.3	0.5	0.05	0.43	2.8	0.3	2.6	1.2	0.12	1.10
Admin (14)	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00
Privs (15)	0.8	0.1	0.7	2.8	0.2	2.6	1.0	0.08	0.92	4.6	0.4	4.2	3.4	0.28	3.08
Total I	294.7	**74.9**	**219.9**	**54.2**	**13.8**	**40.5**	**9.5**	**2.42**	**7.12**	**607.0**	**154.2**	**452.8**	**98.1**	**24.92**	**73.20**
Import	1044.2	**265.2**	**779.0**	288.7	**73.3**	**215.4**	1.0	**0.27**	**0.78**	140.6	**35.7**	**104.9**	64.9	**16.5**	**48.5**
Capital	279.5	**71.0**	**208.5**	111.4	**28.3**	83.1	58.5	**14.9**	43.7	98.4	**25.0**	73.4	58.8	**14.9**	43.9
Land	119.7	**30.4**	**89.3**	47.7	**12.1**	35.6	0	0	0	0	0	0	0	0	0
Government	2.0	0.5	**1.5**	0.5	0.1	0.4	0.1	0.02	0.05	1.7	0.4	1.3	0.7	0.2	0.5
Primary inputs (x)	**401.2**	**101.9**	**299.3**	**159.6**	**40.5**	**119.1**	**58.6**	**14.9**	**43.7**	**100.1**	**25.4**	**74.6**	**59.5**	**15.1**	**44.4**
Total production (y)	**1740.1**	**442.0**	**1298.1**	**502.5**	**127.6**	**374.9**	**69.2**	**17.6**	**51.6**	**847.7**	**215.3**	**632.4**	**222.5**	**56.5**	**166.0**
GDP coefficient (x/y)	**0.231**	**0.231**	**0.231**	**0.318**	**0.318**	**0.318**	**0.847**	**0.847**	**0.847**	**0.118**	**0.118**	**0.118**	**0.267**	**0.267**	**0.267**

Source: Own calculation using the 2007 Household Survey and INS (2007)

Table 3.9: Input-Output Table - splitting informal and formal sectors (CDF trillion) - continued

Sector (SIC)	Manuf (6)			Equip (7)			Utili (8)			Const (9)			Trade (10)		
	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal
Agric (1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lives (2)	11.9	2.0	9.9	0.0	0.0	0.0	0.0	0.0	0.0	12.3	2.0	10.2	0.0	0.0	0.0
Mining (3)	20.2	3.5	16.7	0.0	0.0	0.0	0.0	0.0	0.0	29.2	5.0	24.2	0.0	0.0	0.0
Food (4)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cloth (5)	1.1	0.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manuf (6)	85.9	26.1	59.8	16.0	4.9	11.2	11.4	11.4	0.0	23.6	7.2	16.5	2.4	0.7	1.7
Equip (7)	0.0	0.0	0.0	15.3	6.7	8.6	3.7	3.7	0.0	29.2	12.7	16.5	2.7	1.2	1.5
Utili (8)	25.7	25.7	0.0	0.5	0.5	0.0	6.6	6.6	0.0	1.6	1.6	0.0	2.1	2.1	0.0
Const (9)	5.3	0.1	5.2	0.7	0.0	0.6	2.6	2.6	0.0	62.2	1.2	61.0	4.3	0.1	4.2
Trade (10)	18.5	0.9	17.5	2.6	0.1	2.4	7.8	7.8	0.0	23.6	1.2	22.5	6.9	0.3	6.6
Hotel (11)	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	9.0	2.9	6.1	7.6	2.4	5.1
Trans (12)	6.1	0.3	5.8	0.9	0.0	0.9	6.0	6.0	0.0	19.1	0.9	18.2	39.6	1.8	37.8
Estat (13)	2.0	0.2	1.8	0.2	0.0	0.2	3.7	3.7	0.0	7.8	0.8	7.1	14.3	1.4	12.9
Admin (14)	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	5.0	5.0	0.0	9.3	9.3	0.0
Privs (15)	3.2	0.3	3.0	0.4	0.0	0.3	2.2	2.2	0.0	6.7	0.6	6.1	28.7	2.4	26.3
Total I	179.8	**45.668**	**134.1**	**36.6**	**9.3**	**27.3**	**45.3**	**45.3**	0.0	**229.5**	**58.3**	**171.2**	**117.9**	**29.9**	**88.0**
Import	30.3	**7.7**	**22.6**	2.3	**0.6**	**1.7**	14.5	14.5	0.0	125.4	**31.9**	**93.6**	33.9	**8.6**	**25.3**
Capital	74.3	**18.9**	**55.4**	23.1	**5.9**	17.2	56.8	56.8	0.0	59.3	**15.1**	44.2	394.1	**100.1**	294.0
Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Government	0.8	0.2	**0.6**	0.1	0.0	0.1	0.2	0.2	0.0	1.1	0.3	0.9	1.1	0.3	0.9
Primary inputs (x)	**75.1**	**19.1**	**56.0**	**23.2**	**5.9**	**17.3**	**57.0**	**57.0**	**42.5**	**60.4**	**15.3**	**45.1**	**395.1**	**100.4**	**294.8**
Total production (y)	**285.2**	**72.4**	**212.8**	**62.1**	**15.8**	**46.3**	**116.8**	**116.8**	0.0	**415.4**	**105.5**	**309.9**	**547.0**	**138.9**	**408.0**
GDP coefficient (x/y)	**0.263**	**0.263**	**0.263**	**0.374**	**0.374**	**0.374**	**0.488**	0.488	0.0	**0.145**	**0.145**	**0.145**	**0.722**	**0.723**	**0.723**

Source: Own calculation using the 2007 Household Survey and INS (2007)

Table 3.9: Input-Output Table - splitting informal and formal sectors (CDF trillion) - continued

Sector (SIC)	Hotel (11)			Trans (12)			Estat (13)			Admin (14)			Privs (15)		
	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal	Total	Formal	Informal
Agric (1)	21.2	2.6	18.5	0.0	0.0	0.0	0.0	0.0	0.0	6.5	6.5	0.0	0.0	0.0	0.0
Lives (2)	17.1	2.9	14.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2	0.0	0.0	0.0	0.0
Mining (3)	0.0	0.0	0.0	0.0	0.0	0.0	15.3	2.6	12.7	0.0	0.0	0.0	0.0	0.0	0.0
Food (4)	16.2	3.2	12.9	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.0	0.9	0.2	0.7
Cloth (5)	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Manuf (6)	7.5	2.3	5.2	7.9	2.4	5.5	3.3	1.0	2.3	19.9	19.9	0.0	16.6	5.1	11.6
Equip (7)	10.4	4.5	5.9	17.3	7.5	9.8	6.1	2.7	3.5	14.4	14.4	0.0	4.3	1.9	2.4
Utili (8)	6.0	6.0	0.0	1.8	1.8	0.0	0.7	0.7	0.0	1.2	1.2	0.0	3.7	3.7	0.0
Const (9)	2.5	0.0	2.5	4.0	0.1	3.9	69.9	1.3	68.6	11.8	11.8	0.0	1.8	0.0	1.8
Trade (10)	19.3	1.0	18.4	11.2	0.6	10.7	6.2	0.3	5.8	14.3	14.3	0.0	11.7	0.6	11.1
Hotel (11)	5.7	1.8	3.8	24.3	7.8	16.4	9.6	3.1	6.5	31.3	31.3	0.0	9.8	3.2	6.6
Trans (12)	7.6	0.3	7.2	19.4	0.9	18.5	4.1	0.2	3.9	15.4	15.4	0.0	12.2	0.6	11.6
Estat (13)	16.1	1.6	14.5	15.4	1.5	13.9	675.9	66.2	609.7	9.6	9.6	0.0	13.2	1.3	11.9
Admin (14)	1.8	1.8	0.0	10.4	10.4	0.0	29.8	29.8	0.0	461.4	461.4	0.0	2.5	2.5	0.0
Privs (15)	5.2	0.4	4.8	19.9	1.7	18.2	31.2	2.6	28.6	12.0	12.0	0.0	16.2	1.4	14.8
Total I	136.6	**34.7**	**101.9**	**131.6**	**33.4**	**98.2**	**852.0**	**216.4**	**635.6**	**600.8**	**600.8**	0.0	**93.1**	**23.6**	**69.4**
Import	25.2	**6.4**	**18.8**	30.1	**7.7**	**22.5**	215.0	**54.6**	**160.4**	243.5	243.5	0.0	39.5	**10.0**	**29.4**
Capital	81.9	**20.8**	**61.1**	206.5	**52.4**	154.0	29.4	**7.5**	21.9	10.4	10.4	0.0	83.5	**21.2**	62.3
Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Government	1.2	**0.3**	**0.9**	1.3	0.3	1.0	0.6	0.2	0.5	0.9	0.9	0.0	0.9	0.2	0.7
Primary inputs (x)	**83.2**	**21.1**	**62.0**	**207.8**	**52.8**	**155.0**	**30.0**	**7.6**	**22.4**	**11.3**	**11.3**	0.0	**84.4**	**21.4**	**63.0**
Total production (y)	**244.9**	**62.2**	**182.7**	**369.5**	94.2	**275.3**	**1097.1**	**278.7**	**818.4**	**855.5**	**855.5**	0.0	**216.9**	**55.1**	**161.8**
GDP coefficient (x/y)	**0.339**	**0.339**	**0.339**	**0.562**	**0.560**	**0.563**	**0.027**	**0.027**	**0.027**	**0.013**	**0.013**	0.0	**0.389**	**0.389**	**0.389**

Source: Own calculation using the 2007 Household Survey and INS (2007)

Table 3.9: Input-Output Table - splitting informal and formal sectors (CDF trillion) – concluded

Sector (SIC)	Total	Formal	Informal
Agric (1)	664.9	88.8	576.1
Lives (2)	122.4	22.3	100.1
Mining (3)	67.6	11.6	55.9
Food (4)	40.4	8.8	31.7
Cloth (5)	26.3	11.9	14.4
Manuf (6)	247.4	97.0	150.5
Equip (7)	111.7	58.8	52.9
Utili (8)	83.0	83.0	0.0
Const (9)	189.2	17.7	171.5
Trade (10)	241.4	33.0	208.5
Hotel (11)	98.4	53.6	44.8
Trans (12)	171.0	28.3	142.7
Estat (13)	764.3	86.9	677.4
Admin (14)	520.6	520.6	0.0
Privs (15)	138.1	24.6	113.6
Total I	3486.8	1367.6	2119.2
Import	2299.2	776.5	1522.8
Capital	1625.9	463.1	1162.8
Land	167.4	42.5	124.9
Government	13.1	4.2	9.0
Primary inputs (x)	1806.5	509.8	1339.2
Total production (y)	7592.5	2654.2	4938.2
GDP coefficient (x/y)	5.1	5.1	4.6

Source: Own calculation using the 2007 Household Survey and INS (2007)

Table 3.10 below shows the transaction matrix of the DRC informal sector. As indicated earlier, in terms of matrices, the main inter-industry transactions matrix is composed of several commodities and industries. An industry can purchase or sell from the same industry or others. For instance in the case of the construction sector, the total intermediate inputs of CDF 171.5 trillion comes primarily from the real estate sector (CDF 68.6 trillion), construction sector (CDF 61.0 trillion) and food sector (CDF 15.9 trillion). The total intermediate inputs of the informal sector equals CDF 2119.2 trillion, or more than 64.5 percent of the formal sector intermediate inputs, which amounts to CDF 1367.6 trillion. With regards to the sectoral contribution to the informal sector, the largest total intermediate inputs

come from the Real estate sector (CDF 677.4 trillion / CDF 2119.2 trillion, or 31.9 percent) followed by the agriculture sector (CDF 576.1 trillion / CDF 2119.2 trillion, or 27.2 percent) and trade sector (CDF 208.5 trillion / CDF 2119.2 trillion, or 9.8 percent). In this respect, it must be recalled that the distribution of intermediate inputs is similar for both the formal and informal sector. This assumption was used to determine the characteristics of the formal and informal sector. Naidoo (2002) showed the economic rationale of this assumption by arguing that for production purposes, every industrial sector has a demand for intermediate and primary inputs from various other sectors. Intermediate goods are usually considered to be those goods and services that are not utilised, or will not be used in a final form, but which are used in the production process for the manufacturing of products.

Table 3.10: Transaction matrix of the DRC informal sector – 2007

Sector (SIC)	Agric (1)	Lives (2)	Minin (3)	Food (4)	Cloth (5)	Manuf (6)	Equip (7)	Utili -8	Const (9)	Trade (10)	Hotel (11)	Trans (12)	Estat (13)	Admin (14)	Privs (15)	Total
Agric (1)	119.2	13.3	0.1	387.3	37.8	0	0	0	0	0	18.5	0	0	0	0	576.1
Lives (2)	4.5	6.6	0.1	54.1	0.4	9.9	0	0	10.2	0	14.2	0	0	0	0	100.1
Minin (3)	0	0.7	0.9	0.7	0	16.7	0	0	24.2	0	0	0	12.7	0	0	55.9
Food (4)	0	0.9	0	17.1	0	0	0	0	0	0	12.9	0	0	0	0.7	31.7
Cloth (5)	6.7	1.6	0	0.3	5	0.6	0	0	0	0	0.1	0	0	0	0.1	14.4
Manuf(6)	27.8	2.6	0.9	3.8	1.7	59.8	11.2	0	16.5	1.7	5.2	5.5	2.3	0	11.6	150.5
Equip (7)	0.6	1.5	0.4	2.2	0	0	8.6	0	16.5	1.5	5.9	9.8	3.5	0	2.4	52.9
Utili (8)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Const (9)	1.8	0.6	0.3	15.9	5	5.2	0.6	0	61	4.2	2.5	3.9	68.6	0	1.8	171.5
Trade(10)	61	10.4	1	28.1	13	17.5	2.4	0	22.5	6.6	18.4	10.7	5.8	0	11.1	208.5
Hotel(11)	0	0.1	0	0	0	0	0	0	6.1	5.1	3.8	16.4	6.5	0	6.6	44.8
Trans(12)	25	4.1	0.9	6	2.9	5.8	0.9	0	18.2	37.8	7.2	18.5	3.9	0	11.6	142.7
Estat (13)	1.1	0.3	0.4	2.6	1.1	1.8	0.2	0	7.1	12.9	14.5	13.9	609.7	0	11.9	677.4
Admin(14)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Privs (15)	0.7	2.6	0.9	4.2	3.1	3	0.3	0	6.1	26.3	4.8	18.2	28.6	0	14.8	113.6
Total	**219.9**	**40.5**	**7.1**	**452.8**	**73.2**	**134.1**	**27.3**	0	**171.2**	**88**	**101.9**	**98.2**	**635.6**	0	**69.4**	2119.2

Source: Own calculation using the 2007 Household Survey and INS (2007)

The process of splitting the informal sector from the formal sector is based mainly on the kind of activities performed by the households. The formal and informal activities can be classified by sectors, and generate goods and services with the combination of the factors of production and intermediate inputs. In addition, both formal and informal activities compensate factors with rents, wages, and profits which are generated during the production process. In this respect, the informal sector contained in Table 3.10 above shows that various inputs and outputs from diverse sectors can be quantitatively assessed. However, the split table facilitates the measurement of the formal and informal sector relating to the inclusion of any other external factors associated with both sectors.

So far in this section, strong emphasis has been given to the significance of product markets, rather than employment. The product markets pointed out the level of linkages and formed an important element of our understanding of linkages between the formal and informal economy, because the informal economy is not autonomous and produces a limited type of products. It does not provide a market for its own produce with the rest of the world and its workers compete in product markets depending on the price at which their products are supplied.

Sectoral analysis and the interaction of one sector with others can be done through the SAM technique. This technique depicts the impacts of endogenous and exogenous shocks affecting the final demand within the economy. Therefore, for comparison purposes the detailed decomposition of DRCDSAM can provide a good indication with regard to the impact of a particular informal sector compared to another formal sector. Figure 3.2 below illustrates simply how one sector can interact with itself or with other sectors. It shows the regional interactions or linkages between the formal and informal sectors.

Figure 3.2: Regional technique for the linkages between the formal and informal sectors

Region A Formal sector	**Region C** Purchase from the formal sector to the informal sector
Region B Trade in by the formal sector from the informal sector	**Region D** Informal sector

Source: Naidoo (2002)

For instance, Region A shows that the formal sector receives its entire inputs from formal sector industries. The formal sector with its labour market does not depend on the informal sector regarding any additional inputs to the production process with a view to controlling the flux in final demand. This is applicable in countries where the informal sector is relatively unimportant, but is not the ideal case where the prevalence of the informal sector is imminent. This case gives the impression that the informal sector does not exist, instead it means that these sectors are mutually exclusive; each sector focuses on its own business without interfering with other sectors.

Region B shows that the formal sector purchases from the informal sector. A prominent example of how the informal sector sells to the formal sector is the case of arts and craft products, which are fabricated by informal sector entrepreneurs. These products are bought by the formal sector and in turn exported to foreign countries, where the products are sold in the formal sector markets. These activities bring less contribution to the economy, therefore this area will be assessed with less intensity in this study.

Region D shows that individuals in the informal sector trade exclusively with the informal sector, for instance a hunter will buy groceries from the informal sector spaza shop. The linkages within the informal sector seem significant, even though there is uncertainty regarding the importance of the linkages involving the informal and formal sectors.

Region C shows that the informal sector procures goods from the formal sector. Normally these are the usual transactions that take place between the informal and formal sectors, for example the informal vendor who purchases goods from the formal market and the informal electrician who buys his tools from the formal hardware shop. Therefore, the analysis of linkages between the formal and informal sectors shows the impact of private consumption expenditure on the final demand. In this respect the informal sector plays a major role in individual consumption, which directly impacts the constituents of final demand.

Region C shows the linkages involving the formal and informal sector based on the purchases from the formal sector by the informal sector. In fact, this region shows that there are significant linkages in the labour market between the formal and informal sectors. Further, the establishment of linkages between the formal and informal sectors sets a basis for

measuring the probable cause of oscillation in the final demand and its shock on the GDP. In order to prove this, the direct coefficients should be calculated from the DRCDSAM.

In addition, region C shows the linkages involving the formal and informal sector, which is reported in Table 3.11 below. Thus Table 3.8 reproduces the percentage allocation used to obtain Table 3.11. For instance the clothing sector contributes CDF 37.7 trillion to the economy, where CDF 33.0 trillion is supplied from the informal sector and the remaining CDF 4.7 trillion is from the formal sector (Table 3.11). Therefore the assessment of linkages between the formal and informal sectors within each region is important because the linkages are not only of importance to employment seekers, but also for the growth of the formal and informal sectors. Table 3.11 shows that there is an indication of significant linkages in the labour market between the formal and informal sectors. The establishment of linkages between the formal and informal sectors sets a basis for measuring the likely cause of oscillation in the final demand.

The considerable linkages in the labour market involving the formal and informal sectors presented in Table 3.11 form the basis for the construction of the DRCFISAM. However, the linkages between formal and informal sectors in both product and labour markets are assessed through the input-output section of the DRCDSAM. The input-output section considers the interaction of any sector with the remaining sectors within the economy. In fact, it considers the impacts of the endogenous or exogenous shocks to the economy that might impact on the final demand. Moreover, it can analyse these impacts on a regional basis because regional input-output table analysis is not a new theory, having been used by several researchers such as Arimah (2001) and Naidoo (2002). In this respect, the determination of detailed information for each region from the input-output section is required for comparison purposes. For instance, the labour impact assessment of a particular sector in one region is based on its own trading interactions with another region; each region is assessed separately as an exclusive unit. Therefore, the conceptual framework indicating the regional linkages between the formal and informal sectors put forward by researchers such as Naidoo (2002) and Davies and Thurlow (2010), are modified and used for the purpose of this study (Figure 3.2)[2].

[2] See http://www.state.nv.us/cnr/ndwp/home.htm, http://www.uiuc.edu/unit/real/staff/hewings.htm and http://faculty.washington.edu/krumme/207/inputoutput.html for examples of regional input-output tables theory and applications.

Table 3.11: Formal and informal sectors – Selling and purchasing from each other (CDF Trillion)

	Formal sector															Purchase from the Formal to Informal sector													
Sector	Agriculture	Livestock	Mining	Food	Clothing	Manufact	Equipment	Utility	Construct	Transport	Hotel	Trade	Estate	Adm	Private	Agriculture	Livestock	Mining	Food	Clothing	Manufact	Equipment	Utility	Construct	Transport	Hotel	Trade	Estate	Adm	Private
Agriculture	17	15.2	0.01	55.3	5.4	0	0	0	0	0	2.6	0	0	6.5	0	104.3	11.6	0.1	338.9	33	0	0	0	0	0	16.2	0	0	0	0
Livestock	0.9	7.9	0.02	10.8	0.08	2	0	0	2	0	2.9	0	0	2.2	0	3.7	5.5	0.1	45.1	0.3	8.2	0	0	8.5	0	11.8	0	0	0	0
Mining	0	0.9	0.19	0.1	0	3.5	0	0	5	0	0	0	2.6	0	0	0	0.6	0.7	0.6	0	13.8	0	0	20	0	0	0	10.5	0	0
Food	0	1.1	0.01	4.2	0	0	0	0	0	0	3.2	0	0	0.9	0.2	0	0.7	0	13.7	0	0	0	0	0	0	10.3	0	0	0	0.6
Clothing	5.5	3	0.02	0.3	4.13	0.5	0	0	0	0	0	0	0	0	0	3.7	0.9	0	0.2	2.7	0.3	0	0	0	0	0.1	0	0	0	0.1
Manufact	12.1	3.7	0.41	1.6	0.76	26.1	4.9	11.4	7.2	0.7	2.3	2.4	1	19.9	5.1	19.3	1.8	0.7	2.6	1.2	41.6	7.8	0	11.5	1.2	3.6	3.8	1.6	0	8.1
Equipment	0.5	2.6	0.3	1.7	0	0	6.7	3.7	12.7	1.2	4.5	7.5	2.7	14.4	1.9	0.3	0.8	0.2	1.2	0	0	4.9	0	9.3	0.8	3.3	5.5	2	0	1.4
Utility	5.7	0.6	2.38	8	16.41	25.7	0.5	6.6	1.6	2.1	6	1.8	0.7	1.2	3.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construct	0	0.6	0.01	0.3	0.1	0.1	0	2.6	1.2	0.1	0	0.1	1.3	11.8	0	1.8	0.6	0.3	15.6	4.9	5.1	0.6	0	59.8	4.1	2.5	3.8	67.3	0	1.8
Transport	3.2	10.9	0.05	1.5	0.68	0.9	0.1	7.8	1.2	0.3	1	0.6	0.3	14.3	0.6	58	9.9	0.9	26.7	12.4	16.6	2.3	0	21.4	6.3	17.5	10.2	5.5	0	10.5
Hotel	0	0.2	0	0	0	0	0	1	2.9	2.4	1.8	7.8	3.1	31.3	3.2	0	0.1	0	0	0	0	0	0	4.1	3.5	2.6	11.1	4.4	0	4.5
Trade	1.2	4.3	0.04	0.3	0.14	0.3	0	6	0.9	1.8	0.3	0.9	0.2	15.4	0.6	23.9	3.9	0.9	5.7	2.8	5.5	0.9	0	17.4	36.1	6.9	17.6	3.7	0	11.1
Estate	0.1	0.4	0.05	0.3	0.12	0.2	0	3.7	0.8	1.4	1.6	1.5	66.2	9.6	1.3	1	0.3	0.4	2.3	1	1.6	0.2	0	6.4	11.6	13.1	12.5	549.9	0	10.7
Adm	0	0.2	0	0	0	0	0	0.3	5	9.3	1.8	10.4	29.8	461.4	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Private	0.1	2.8	0.08	0.4	0.28	0.3	0	2.2	0.6	2.4	0.4	1.7	2.6	12	1.4	0.6	2.4	0.8	3.8	2.8	2.7	0.3	0	5.6	24.1	4.4	16.7	26.2	0	13.6
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.9	1.7	0	48.4	4.7	0	0	0	0	0	2.3	0	0	0	0
Livestock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	1.1	0	9	0.1	1.7	0	0	1.7	0	2.4	0	0	0	0
Mining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.2	0.1	0	2.9	0	0	4.2	0	0	0	2.2	0	0
Food	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	3.4	0	0	0	0	0	0	2.6	0	0	0	0.1
Clothing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.7	0	0.1	2.3	0.3	0	0	0	0	0	0	0	0	0
Manufact	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.5	0.8	0.3	1.2	0.5	18.2	3.4	0	5	0.5	1.6	1.7	0.7	0	3.5
Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.7	0.2	1	0	0	3.7	0	7.2	0.7	2.6	4.3	1.5	0	1
Utility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.1	0.1	0	0	1.2	0.1	0	0.1	1.3	0	0
Transport	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.1	0.5	0	1.4	0.7	0.9	0.1	0	1.1	0.3	0.9	0.5	0.3	0	0.6
Hotel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1.6	1.2	5.3	2.1	0	2.1
Trade	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.2	0.2	0	0.3	0.1	0.3	0	0	0.8	1.7	0.3	0.9	0.2	0	0.5
Estate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0.3	0.1	0.2	0	0	0.7	1.3	1.4	1.4	59.8	0	1.2
Adm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Private	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.2	0.1	0.4	0.3	0.3	0	0	0.5	2.2	0.4	1.5	2.4	0	1.2

Trade in by the Formal sector from the Informal sector **Informal sector**

The direct method is used to assess the formal-informal linkages with the assumption that the formal economy is the major supplier of inputs to the informal economy. A non-negligible labour market and quantity of inputs are supplied to the informal sector from the informal sector itself. In this respect, the labour market in the DRC informal economy is assessed in view of measuring the linkages between the formal and informal sectors. According to the IMF (2010), the underemployment rate is estimated at 81.7 percent in the DRC. Overall, unemployment and underemployment affect men and women proportionally, despite their level of schooling. Youth unemployment is a major concern because 28 percent of the unemployed are among the working population under 24 years of age. In addition, the employment rate is fairly low compared to the average rate in sub-Saharan Africa, at 63.1 percent (50.8 percent in urban areas as against 68.1 percent in rural areas). This situation essentially is a result of late entry into the labour market due to more years of education. Women, children and men are equally involved in the labour market (IMF, 2011).

High unemployment in the DRC is thus ascribed to an underperforming formal economy and the inability of the unemployed to penetrate informal labour markets. Therefore, it is imperative to investigate how the composition and size of the formal economy stimulates employment incentives and prospects in the informal economy. Researchers such as Schultz and Mwabu (1998) and Lucas and Hofmeyr (2001) studied the linkages between the formal and informal sectors, with a specific focus on tax policies and labour market protections in South Africa. Recently Davies and Thurlow (2010) studied the linkages between the informal and formal sectors on both production and employment in South Africa. They argued that the competition in product markets can directly influence the size and structure of the informal sector, and indirectly the high rate of unemployment.

Table 3.12 below summarises the DRC's employment profile in 2007. Out of the total 9.8 million employed individuals, 7.7 million operated in the informal sector, 1.9 million in the formal sector and 196, 800 were informally employed. In addition, 977, 300 workers were involved in an informal trade, which was the largest overall informal sector in the DRC (see column 4 in Table 3.12). This specific situation related mostly to the damage from the conflict over the past two decades, which saw the economic performance worsen considerably, the transport infrastructure deteriorate and the telecommunication infrastructure become inadequate.

Table 3.12: DRC employment profile, 2007

	All workers	Formal sector workers	Informally employed workers	Informal sector workers	Skilled workers	Semi-skilled workers	Unskilled workers
Total employment (1,000s)	9840	1968	196.8	7675.2	1909.1	4498.7	3432.3
Employment share (%)	100	100	100	100	100	100	100
Agriculture	2950	590	59	2301	572.3	1348.7	1029.0
Livestock, fishery, hunting, and Forestry	721	144.2	14.4	562.4	139.9	329.6	251.5
Mining	325	65	6.5	253.5	63.1	148.6	113.4
Processed food	603	120.6	12.1	470.3	117.0	275.7	210.3
Textiles	101	20.2	2.0	78.8	19.6	46.2	35.2
Manufacturing	91	18.2	1.8	71.0	17.7	41.6	31.7
Machinery and equipment	20	4	0.4	15.6	3.9	9.1	7.0
Utilities	436	87.2	8.7	340.1	84.6	199.3	152.1
Construction	85	17	1.7	66.3	16.5	38.9	29.6
Trade	1,253	250.6	25.1	977.3	243.1	572.8	437.1
Hotels and restaurants	109	21.8	2.2	85.0	21.1	49.8	38.0
Transport and communications	703	140.6	14.1	548.3	136.4	321.4	245.2
Real estate	1,121	224.2	22.4	874.4	217.5	512.5	391.0
Public administration	620	124	12.4	483.6	120.3	283.5	216.3
Private services	702	140.4	14.0	547.6	136.2	320.9	244.9
Average wage (CDF per worker)	103336	620016	51668	41334	1291700	102563	49754

Source: Author's calculations using the 2007 Labour Force Survey (INS, 2007).

Table 3.13 below provides the macro structure of the DRCFISAM. Its disaggregated form is attached in the accompanied CD due to its size. In this respect, the DRCFISAM is derived from the 2007 DRCDSAM.

It is clear from Table 3.13 that the formal economy is underperforming in terms of economic activities. Although this is due to the political instability in the country, it is not viable for the economy as a whole. In turn, the informal sector seems to produce a variety of products, even though it doesn't provide a market for the rest of the world to access its products. In fact, informal sector firms and households interact closely with the formal sector in product markets. The distinction between households' consumption demand for formal and informal goods is assessed through informal market consumption shares taken from the 2007 HS. All this information was used to approximate the total demand of the formal and informal sectors. Moreover, foreign import penetration is assumed to be equivalent across formal and informal economies, hence the value of categorical imports is obtained from assessing the difference between total demand and supply. More detailed information on the household survey was established from government accounts in the 2007 HS. The DRCMSAM comprising of trade, incomes and production symbolises the conceptual distinctiveness of the formal and informal sectors.

Table 3.13: Formal and informal DRC Macro SAM (DRCFIMSAM)

Receipts/Payments	Activ-F	Activ-I	Com-F	Com-I	Labor-F	Labor-I	Cap-F	Cap-I	Land-F	Land-I	Ent-F	Ent-I	House-F	House-I	Govern-ment	Capital account	Rest of the world	Residual	Total
Activ-F	0	0	2,068.2	0	0	0	0	0	0	0	0	0	131.3	0	0	0	0	0	**2,199.5**
Activ-I	0	0	0	4,469.5	0	0	0	0	0	0	0	0	0	923.5	0	0	0	0	**5,393.0**
Com-F	1,146.8	0	19.3	0	0	0	0	0	0	0	0	0	546	0	278.5	711.9	704.9	0	**3,407.5**
Com-I	0	2,339.9	0	367.6	0	0	0	0	0	0	0	0	0	2,129.6	0	0	0	0	**4,837.1**
Labor-F	584	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**584**
Labor-I	0	1,715.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1,715.2**
Cap-F	413	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**413**
Cap-I	0	1,212.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1,212.9**
Land-F	42.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**42.5**
Land-I	0	124.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**124.9**
Ent-F	0	0	0	0	0	0	11.2	1212.9	0	0	0	0	0	0	0	0	0	0	**1,224.1**
Ent-I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
House-F	0	0	0	0	574.3	1,715.2	387.9	0	42.5	124.9	1,172.0	0	0	0	33	0	218.1	0	**4,268.1**
House-I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Government	13.1	0	235.6	0	9.7	0	0	0	0	0	52.1	0	51	0	360.7	0	0	0	**722.3**
Capital account	0	0	0	0	0	0	0	0	0	0	0	0	486.8	0	49.9	0	175.1	0	**711.9**
Rest of the world	0	0	1,084.3	0	0	0	13.8	0	0	0	0	0	0	0	0	0	0	0	**1,098.1**
Residual	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Total	**2,199.5**	**5,393.0**	**3,407.5**	**4,837.1**	**584**	**1,715.2**	**413**	**1,212.9**	**42.5**	**124.9**	**1,224.1**	**0**	**1,215.1**	**3,053.1**	**722.3**	**711.9**	**1,098.1**	**0**	**27,954.2**

3.6 CONCLUSION

The primary objective of this chapter was to construct an economy-wide database for the DRC and to assess the formal and informal sector linkages. The chapter firstly considered the theoretical foundations of a SAM and examined some evidence put forth by similar studies. It became evident that in the case of the DRC, due to the war and political instability, there was no available SAM during the time of undertaking this study. For this reason, data constraints were a great challenge for the construction of a DRC SAM. Nonetheless, the SAM was developed from data produced by various institutions such as the DRC's Bureau of Statistics (INS), the DRC Central Bank (BCC), the World Bank (WB), the International Monetary Fund (IMF) and other sources. To ascertain data reliability, additional information was incorporated from the household sectors in order to improve the factors and institution accounts. With the constructed DRCDSAM it is possible for decision makers to assess the nationwide impact of a specific policy in the DRC. Nonetheless, this chapter endeavours to provide a SAM whereby the contribution of the formal and informal sectors of the DRC economy could be assessed. Thus the construction of the DRC SAM which included the formal and informal sectors of the economy was undertaken. The construction of this DRCFISAM was based on the conceptual framework developed by Davies and Thurlow (2010).

As a precursor to the construction of the DRCFISAM, the linkages between the formal and informal sectors in both product and labour markets were assessed through the input-output section of the DRCDSAM. The input-output section considers the interaction of any sector with other sectors within the economy, however the high unemployment rate in the DRC is ascribed to an underperforming formal economy and to the incapacity of the unemployed to penetrate informal labour markets.

This chapter has considered the literature by adopting a broader view of the linkages between the formal and informal sectors. The research found that most of the interactions between the formal and informal sectors occur within product markets. The researcher thus adopted an economy-wide perspective and accounted for formal–informal interactions in both factor and product markets. Finally, the constructed DRCFISAM was used as an important database for the CGE model to be constructed in the next chapter, as well as for policy simulations in subsequent chapters.

CHAPTER 4: DEVELOPMENT OF THE DRC FORMAL-INFORMAL MODEL

4.1 INTRODUCTION

This chapter constructs a CGE model for the DRC that fits the DRCFISAM database developed in Chapter 3. The starting point was the data from the DRCFISAM presented in spreadsheet format. The raw data was used to generate the specific series of data arrays needed by the related model, however two problems surfaced: Firstly, the data from the DRCFISAM had to be converted into files used by GEMPACK (General Equilibrium Modelling Package), and secondly, the final data needed by the model were composed of higher dimensionality numbers than the original DRCFISAM's raw data. With a view to converting the raw data into a CGE model, extensive use of the GEMPACK was required for the expansion of the raw data into its finishing form.

Previous CGE models (Pagan and Shannon, 1985; 1987; Wigle, 1991; Harrison and Vinod, 1992; Harrison, Jones, Kimbell and Wigle, 1992; DeVuyst and Preckel, 1997; Horridge, 1998; Logfrem, 2002) required a database; a description of the solution procedure; a brief description of the data; and software such as GEMPACK and GAMS (General Algebraic Modelling System). Most of these models focussed on the values of exogenously assigned elasticity parameters, while the calibrated parameters – those that are obtained from combining elasticity information with flow or stock data – have been essentially difficult to assess. The researcher followed the technique used by Horridge (1998) to construct a DRC Formal-Informal Model (DRCFIM) because of the considerable uncertainty surrounding the data used for calibration of parameter values. This uncertainty arises through measurement error and is amplified by the consistency adjustments made to the data so that they meet the equilibrium conditions of the model. DRCFIM is taken from the neoclassical modelling tradition that was originally presented in Dixon *et al.* (1977). This framework has been extended to allow for several new features, such as the home consumption of non-marketed goods, the explicit treatment of transaction costs, and the ability of producers to produce more than a single commodity. Given that this study offers a direct application of this generic model to the DRC context, the particularity of the model is about the incorporation of the informal sector as described in this chapter.

The chapter is divided as follows: The description of the DRC Formal-Informal CGE Model (DRCFIM) is given in Section 4.2. In Section 4.3 the construction of the DRCFIM is performed and the particularities of the model are also described in details. Finally, Section 4.4 concludes this chapter.

4.2 DESCRIPTION OF THE DRCFIM

The DRCFIM model is based on the ORANI model of the Australian economy. The generic edition of the model, ORANI-G[3], was developed for CGE modellers by Horridge (1998). The model has a theoretical composition which is typical of a static model, and is comprised of equations portraying periodical equations such as producers' demands for produced inputs and primary factors, producers' supplies of commodities, demands for inputs to capital formation, household demands, export demands, government demands; the relationship of basic values to production costs and to purchasers' prices, market-clearing conditions for commodities and primary factors, and numerous macroeconomic variables and price indices. Figure 4.1 below is a graphical illustration of the model's input-output database. It shows the main structure of the model. The absorption matrix from Figure 4.1 distinguishes the following economic agents:

(1) local producers composed of various industries;
(2) investors from various industries;
(3) one typical agent household;
(4) a comprehensive foreign purchaser of exports;
(5) an 'other' demand type, generally equivalent to government; and
(6) changes in inventories.

[3] Horridge, M. 1998. *ORANI-G: A generic single-country computable general equilibrium model* Paper prepared for the practical GE Modelling Course, February 7-11.

Figure 4.1: The ORANI-G Flows Database

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Household	Export	Government	Change in Inventories
	Size	← I →	← I →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	C×S ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	C×S×M ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
Taxes	C×S ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
Labour	O ↓	V1LAB					
Capital	1 ↓	V1CAP					
Land	1 ↓	V1LND					
Production Tax	1 ↓	V1PTX					
Other Costs	1 ↓	V1OCT					

C = Number of Commodities
I = Number of Industries
S = 2: Domestic, Imported
O = Number of Occupation Types
M = Number of Commodities used as Margins

	Joint Production Matrix
Size	← I →
C ↓	MAKE

	Import Duty
Size	← 1 →
C ↓	V0TAR

Source: Horridge (2002)

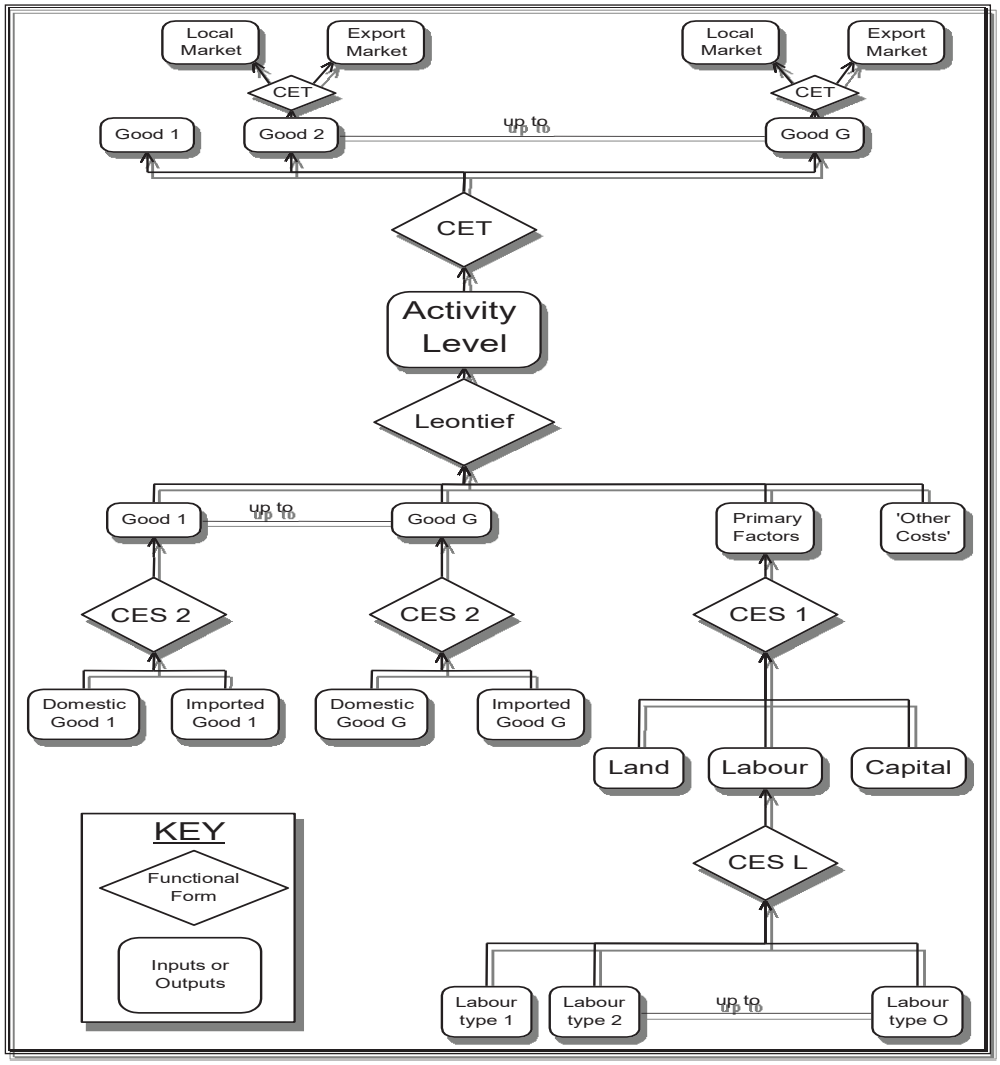
Every single section in the descriptive absorption matrix from Figure 4.1 includes the designation of the corresponding information matrix. For instance, V2MAR is a 4-dimensional array indicating the price of M (number of commodities used as margins services) on the flows of C (number of commodities or goods), both locally produced and imported (S), to investors I.

As a general rule, every single industry is qualified to produce whichever of the C commodity sorts. 'MAKE' from Figure 4.1 is a matrix which illustrates the amount of output of every single commodity by every single industry. Furthermore, tariffs imposed on imports are presumed to be taxed at rates which depend on the sort of commodity and not by user. 'V0TAR' represents the tariff vector after revenue collection.

As far as the modelling of different economic agents is concerned, one must take into account the relationship between commodities and activities. The database makes provision for two kinds of transactions on a sectoral level, namely the purchase of intermediate and primary inputs on the one side, and the supply of intermediate and final outputs on the other side.

The production structure of the model allows each industry (in this case in the formal and informal sectors) to produce a number of commodities and make use of local and imported commodities, labour of different kinds, capital and land as inputs. There is distinction between the commodities selected for exports and those for local consumption. The production function will be constrained to a system of nests based on particular assumptions. Figure 4.2 illustrates that the Leontief production function will be used to combine commodity composites, primary factor composites and 'other costs'. In this respect, the commodity composite is basically an intermediate input represented as a CES (constant elasticity of substitution) function of a domestic good and the corresponding imported good. The primary-factor composite is a CES aggregation of land, capital and composite labour. In fact, formal and informal sectors consider this to be a general production system, but input shares and behavioural factors can differ between industries.

Figure 4.2: Structure of production



Source: Horridge *et al.* (1998)

As mentioned above, the production function includes commodity composites, primary-factor composites and "other costs", which are linked using a Leontief production function, specified as follows:

$$X1TOT(i) = \frac{1}{A1TOT(i)} \times MIN[All, c, COM : \frac{X1\_S(c,i)}{A1\_S(c,i)}, \frac{X1PRIM(i)}{A1PRIM(i)}, \frac{X1OCT(i)}{A1OCT(i)}] \qquad (4.1)$$

- X1TOT (i) represents an index of industry activity by sector(i)
- X1OCT (i) represents demand for "other costs" by sector(i)
- A1TOT (i) represents an all input augmenting technical change by sector(i)
- A1_S (i) represents an intermediate input augmenting technical change by sector(i)
- A1PRIM (i) represents an all primary input augmenting technical change by sector(i)
- A1OCT (i) represents an "other cost" input augmenting technical change by sector(i)
- COM represents commodity
- MIN represents minimum
- X1_S(c,i) represents the total cost of imported and local good (i)
- A1_S(c,i) represents the technological change of intermediate imported and local good (i)

Thus a proportional input is demanded for every single category of the intermediate, primary and other costs. The variable A1TOT(i) is a Hicks-neutral technological-change expression, influencing all inputs in the same way (Horridge, 1998).

As for the household, the structure of its demand indicates that commodity composites can be combined according to the Klein-Rubin utility function instead of the Leontief function, which leads to the linear expenditure system (LES). The outflow on every single product is a linear function of prices and expenditure.

The modeling of export demands is done through the subdivision of commodities into two categories. The first category consists of *conventional* exports composed of primary products, while the second category consists of *non-conventional* exports. The largest share of total output for most commodities goes to conventional export, while the smallest share is total output for *non-conventional* export commodities. In this model, we exogenise the commodity composition of aggregate *non-conventional* exports by considering *non-conventional* exports as a Leontief aggregate.

The model contains numerous variables associated with every flow of goods and services between industries and final users. These variables are endogenous and exogenous. DRCFIM's detail related to both endogenous and exogenous variables will be used to address the considerable number of questions of relevance with the formal and informal sectors. The

list of variables is presented in Horridge (1998) and the GEMPACK programme written for creating the DRCFIM model is presented in Appendix A.

4.3 PARTICULARITIES OF THE DRCFIM

One particularity of the DRCFIM is that it is a multi-sectoral CGE model that depicts the reflected structure of the DRC's formal and informal sectors, along with a diversity of linkages between various economic agents such as government, investors, traders and enterprises. This model is a system of equations that depicts the performance of the DRC economy, encompassing all major industry groups, markets and institutions. In fact it is a comparative-static model by all accounts. Besides using its own core database, the DRCFIM is based on the 2007-DRCFISAM, which reconciles a wide variety of data sources such as national accounts, household surveys, as well as labour force surveys. The 2007-DRCFISAM consists of comprehensive data on demand and supply for 15 activities or commodities in both the formal and informal sectors. The labour component was divided between the formal and informal sector. Four labour groups were specifically identified in each of the formal and informal sector, namely: (1) subsistence factor, (2) child labour, (3) female adult labour and (4) male adult labour. The household sector of 2007-SAM was disaggregated according to income into rural and urban areas with four groups in both the formal and informal sectors, i.e. (1) rural poor households, (2) rural non poor households, (3) urban poor households and (4) urban non poor households. The land component was also divided between the formal and informal sectors.

The most important information provided by this particular economy-wide database relates to the differentiation between formal and informal economies in the areas of production, trade and incomes. Household consumption demand was divided into demand for formal and informal goods, using specified informal market consumption shares from the Household Survey (see Table 3.5 in Chapter 3).

The changes made to the generic model when constructing the DRCFIM model were related to the aim of this study, namely to assess the contribution of the informal sector to the economy through government policies such as land use (land use will be analysed in the next chapter). However, during the process of constructing DRCFIM, the researcher specifically included the land in the formal and informal sectors. To perform this task, the researcher

inserted all the parameters and equations related to the demand for land as well as primary factors. For instance the two specific equations which determine the demand for land are described below:

SAM (f,i) represents formal and informal land used by industry *i* in DRCFIM

xLAND_i is total land use

xFac is firm demand for land

pFac(f,i) is land prices

fFac(f,i) is real land price shift

fFac_i(f) is all-industry real land price shift

pTotHou is CPI (consumer price index)

Equation (1)

E_xLand_i sum{f,LAND,sum{i,IND, SAM(f,i)*[xLAND_i - xFac(f,i)]}} = 0 (4.1)

Equation (2)

E_fFacC (all,f,LAND)(all,i,IND) pFac(f,i) = fFac(f,i) + fFac_i(f) + pTotHou (4.2)

Equation (1) recognises two sets (f and i). Set "f" has two elements - formal and informal land (LAND_F and LAND_I), while Set "i" represents a set of industries. This equation represents the demand for land where the primary factors are chosen to minimise production costs.

Equation (2) determines the demand for land. The price term is the ratio of the price of factor, pFac (f,i), to the price of composite factors.

Overall, during the construction of the DRCFIM, data preparation started with the conversion of the raw data using ViewHar[4] technique. In addition, techniques of TABmate[5] text editor and an Excel spreadsheet to turn these raw data into header array files were used to construct DRCFIM.

[4] ViewHar is appropriate for the importation of data from spreadsheet format

[5] TABmate can be used directly, or from within WinGEM.

4.4 CONCLUSION

This chapter described the construction of a CGE model for the DRC that accounts for the interaction between the formal and informal sectors. GEMPACK was used to build up the DRCFIM. The computer language in which the programme was transcribed is basically conventional algebra, with descriptions for variables and coefficients selected to be expressive of their economic explanations. The model was based on the generic model proposed by Horridge (1998), however this study improved the model to account for the interaction between the formal and informal sectors. Indeed this model is an economic tool which can be used to assess the impact of policy shocks in the economy of the DRC.

This chapter has discussed the creation of a practical CGE model, which will be used in the next chapter to perform policy simulations. Despite the fact that this model can perform numerous types of simulations, the next two chapters will analyse policy shocks related to land use and trade liberalisation in the DRC.

CHAPTER 5: ASSESSMENT OF LAND USE IN THE DRC: POLICY SIMULATIONS

5.1 INTRODUCTION

The previous chapters alluded to the fact that the analysis of the role of informal sector on the DRC's economy would be best served within a general equilibrium framework. In this respect, a DRCFIM was developed as per Chapter 4. This chapter analyses the application of the DRCFIM model by assessing the impact of land use subsidies in the DRC's economy. The DRC is distinguished by its immense reserve of unused land that could be transformed for agricultural use, however land clearing for agriculture usually causes concern. According to Babcock (2009), land clearing for agriculture can be easily evaluated nowadays through satellite monitoring. He argued that "the argument concerning biofuels are crucial as their use triggers considerable transformation on ordinary lands to both crop and livestock output across the universe". This argument is of economic significance, as regulations concerning biofuels depend essentially on indirect land use conversions which are stimulated by the growth of agricultural products which generate energy.

It may be of interest to point out that land use in DRC is not necessarily a legal or political issue, but more precisely part of a broader agricultural crisis, with financial, social and economic facets (Huggins, 2010). The agricultural crisis derives from an amalgamation of organisational constraints on the income systems, the immense quantity of unused land, and the widespread crisis in terms of trade for agricultural produce that is being experienced across Africa, which is associated with the diverse practices of globalisation. This agricultural crisis is aggravated by the lack of access to finance, inaccessibility to agricultural equipment and armed conflict in the country.

Although the law made it relatively simple for individuals and corporations to purchase land, it is however problematic for the majority of Congolese to buy and register their land rights, as the process is very complicated and generally requires travel to major cities of the provinces and other expenses such as bribes. According to Huggins (2010:14), the cost of registering a small plot of land is approximately US$500 in Masisi (a very small district in the province of Kivu), but can exceed US$1,000 in some areas of North Kivu. This is an

exorbitant amount of money for the average Congolese citizen, placing registration out of reach for most.

Even with the legislation in place, the government is faced with challenges in land clearing for agricultural uses. The main reason for the problem of unused land can be traced to bureaucratic hassles and exorbitant prices of land, which prevent the majority of the population from owning land. Despite the considerable reserve of unused land, its exploitation is a big challenge for the DRC government because of poor regulatory quality, absence of law enforcement and corruption. A considerable number of land use development programmes and projects have been initiated not implemented (World Bank, 2007). One possible solution to land use could be that the government provides subsidies for land use, which could unleash the potential for more agricultural production and address an assortment of economic, social, environmental and political issues. In this chapter, an attempt to evaluate the impact of a land use subsidy and improvement in land productivity is undertaken to advise the DRC government about the importance of land use in the economy.

The studies of Ferreira Filho and Horridge (2011), Nassar *et al.* (2010) and Ferez (2010) are counted among research that has attempted to evaluate the indirect land use conversions related to the growth of the derived agricultural products. However, their methodological techniques are different to this research's, as they used a specific model database composed mainly of formal sectors in the Brazilian economy. Therefore, in contrast to existing research, this investigation on land use is based on the application of a CGE model based on a database that accounts for the formal and informal sectors in the DRC. This study thus applies a new method of measuring the land use in both the formal and informal sectors in the DRC. It adds to the debate by making use of a policy simulation, namely the land use subsidy, as there is a vast stock of unused land in the DRC.

This chapter is divided as follows: Section 5.2 portrays the current state of land use in the DRC. Section 5.3 introduces the land use legislation. Section 5.4 presents the methodology and modelling land use is described in Sections 5.5. The simulation results are given in Section 5.6. Policy implications are then discussed in Section 5.7 and the last Section concludes this chapter.

5.2 LAND USE IN THE DRC

Table 5.1 below provides statistics on land use for agriculture in the DRC. The "unused" land is described as the overall zone in the country less the used zones such as forests and grasslands, as taken from an Agricultural Survey (2000). It also includes the zones predominately composed of natural forests, rivers and roads, which are not yet used for agricultural purposes. The proportion of 78.3 percent of unused land is immense. This immense reserve of land could be transformed to agricultural uses. In this respect, the transformation of these zones into agricultural use is the main challenge for the government. This research will consider the transformation of the unused land as a substitution to the agricultural uses because of the growth of agricultural products.

These statistics demonstrate that the DRC has a considerable reserve of unused land. This implies that agricultural land can come from the immense reserve of unused land, although there is no need to transform the forests for agricultural use. Currently around 928 million hectares (Mha) of unused land are available for additional agricultural land use, according to the DRC Agricultural Survey of 2000. The 257.1 Mha of total agricultural land reflects only 27.69 percent of unused land.

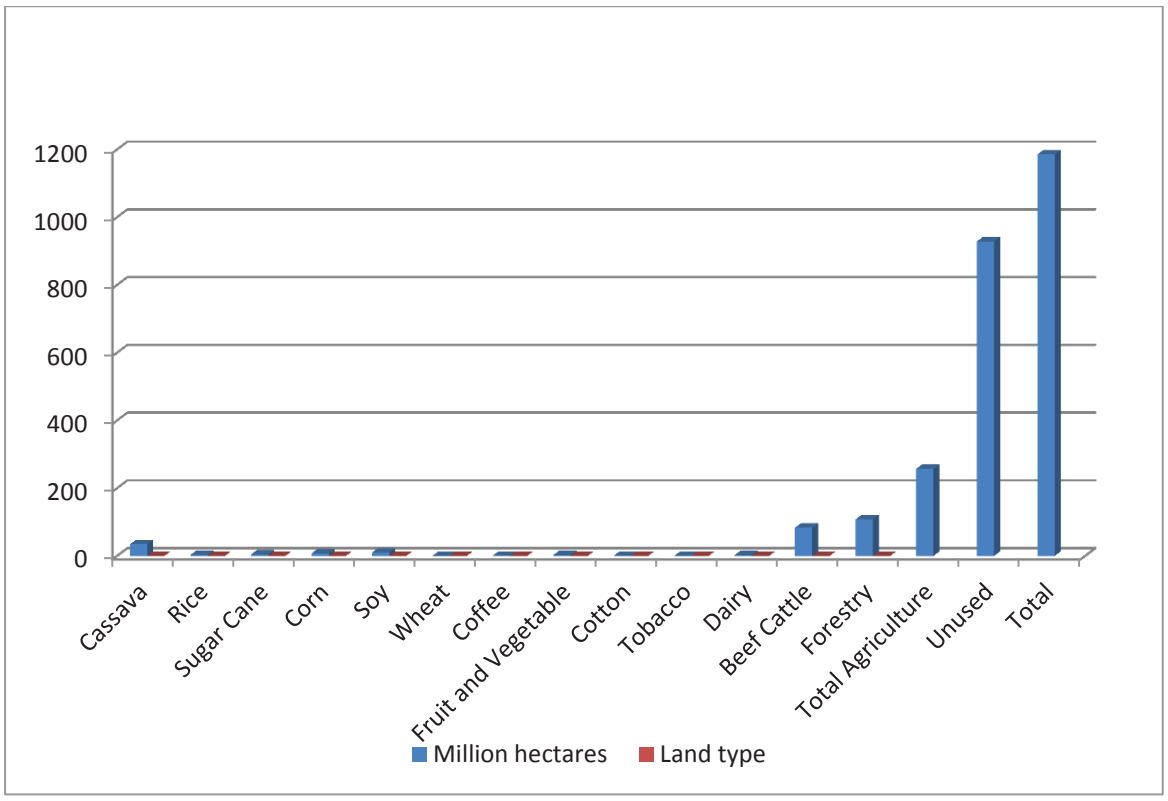
Table 5.1: Land Used by Agriculture in DRC, 2000 (Million Hectares)

	Million hectares	Land type
Cassava	34.8	Crop
Rice	3.1	Crop
Sugar Cane	4.3	Crop
Corn	7.2	Crop
Soy	9.7	Crop
Wheat	0	Crop
Coffee	0.8	Crop
Fruit and Vegetable	2.3	Crop
Cotton	0.5	Crop
Tobacco	0.1	Crop
Dairy	2.4	Pasture
Beef Cattle	83.6	Pasture
Forestry	108.3	Plant forest
Total Agriculture	257.1	
Unused	928.3	
Total	1185.4	

Source: DRC Agriculture Survey (2000)

Figure 5.1 below shows that there is no necessity for land substitution, especially for agriculture growth, because of the immense reserves of unused land. Babcock (2009) studied the indirect land use process and found that there is a need for land substitution and imputation for some specific crop zone or grassland growth in Brazil. This is acceptable because the land clearing for agriculture is a multi-faceted and complicated phenomenon that creates serious problems in Brazil. Contrary to Babcock (2009), in the DRC there is no need for land substitution because of the immense reserves of unused land.

Figure 5.1: Land Used by Agriculture in DRC, 2000 (Million Hectares)



Source: DRC Agriculture Survey (2000)

Recently, the DRC's Department of Agriculture (2010) pointed out that cassava, which is the main consumption product in the DRC, decreased considerably between 1995 and 2010. The biggest decrease occurred in 2010 with nine billion kilograms produced compared to 26 billion kilograms in 1995. The decrease emanated essentially from the Bandundu province, which produces 75 percent of the total cassava production in the country because of its rich

natural soil[6].

Although the International Monetary Fund provides technical and financial support based on an operational land use strategy, the DRC's contraction of agricultural production impacted negatively on food guarantees and food distribution, which is attributable to their inability to use all agricultural land. This phenomenon has caused the latest increases in food prices. In this respect, a considerable decrease was observed in per capita output of all agricultural products and land use during the same period (IMF, 2010).

5.3 DRC LAND USE LEGISLATION

The DRC, like other countries in the developing world, has a number of different systems which hold decision-making powers over land. Unruh (2005) identified three types of systems: (i) customary; (ii) informal; and (iii) statutory. The first, *customary* systems, are normally administered by local traditional leaders who regulate land use according to clan ownership. They tend to favour men while women and children are frequently deprived of their land rights. The second, *informal* land use systems, derive from the circumstances in which the government and traditional leaders are unable to regulate land use. A prominent example of informal systems is "squatter" townships, which accommodate desperate and displaced people. The last, *statutory* systems, relies on national laws and regulations in which land is owned and title deeds are obtained. They provide an adequate basis for the registration of urban land such as national parks, game ranches, commercial farms, production forests, wildlife reserves and other strict nature reserves. Nonetheless, in the DRC, statutory systems are not administered nationwide because of poor capacity or political will.

Prior to the DRC's independence in 1960, the Belgian colonial authorities applied indirect rule for land use (Huggins, 2010). They worked in collaboration with the traditional leaders to establish a form of "ethnic" governance. The central government applied the Belgian civil code to administer access to land, as most Congolese were accessing land in the traditional custom. In this respect, payment was made to the government in return for title deeds. A decree issued by King Leopold II in 1885 stipulated that all "vacant land" was the property of

[6] The largest part of growth of cassava planted zone occurred in Bandundu and Bas Congo provinces, which accounts for 60% of total agricultural production. Bandundu's planted zone decreased from 4.9 Mha in 1995 to 2.7 Mha in 2010.

the government and was therefore no longer under the regulation of the traditional leaders (Hochschild, 1998). The implementation of this legislation negatively affected the customary rights of ownership and land use practiced across the country. For instance 27 million hectares from customarily reserved land for periodic grazing, hunting and future habitation were transformed into vast agricultural plantations in certain provinces of the country, such as Ituri territory in Orientale Province and the Kivu Provinces (Leisz, 1998).

The customary and statutory systems of land access were practised after the independence of the DRC in 1960. Nonetheless, they were allegedly abolished by decree of the General Property Law in 1973 (amended 1980)[7]. This 1973 land law included an important amendment from the colonial system, as it offered an opportunity to purchase land by abolishing the customary system and preventing the local traditional leaders from receiving the usual payment (Mugangu, 2006). In reality, the land law brought all land in the country under government control. This was enforced by President Mobutu who ruled the country from 1965 to 1997. His administration took control over land away from customary authorities, who were acting as government administrators rather than decision makers. All rights were reduced to rights to use, not ownership anymore, as all land became government land. The main reason for the abolishment of the customary system was to establish the president's political power so that all citizens were dependent on him. As contended by researchers such as Chabal and Daloz (1999), the change of law in Zairean (Congolese) public life was to some extent a strategic political and economic diplomacy of the ruling party. The land law has not been modified since the time of President Mobutu due to political instability in the country.

5.4 METHODOLOGY

The DRCFIM developed in Chapter 4 was used to analyse the economic effects of the increase of land use in the DRC. A specific shock was applied to the model for this purpose. In fact, DRCFIM was developed as a research tool to assess the impact of policy options such as land use. As described in the previous chapter, the DRCFIM from which simulations are conducted is mainly based on the ORANI model of the Australian economy. The model has a theoretical composition which is typical of a static AGE model, however the most important

[7] République de Zaire, *Loi du 20 juillet 1973 portant régime général des biens, Régime foncier et immobilier et régime des sûretés*, Kinshasa, 1973.

particularity of the DRCFIM is that it is a multi-sectoral CGE model that depicts the reflected structure of the DRC's formal and informal sectors, along with a diversity of linkages between various economic agents such as government, investors, traders and enterprises. This model is a system of equations that depicts the performance or behaviour of the DRC economy, encompassing all major industry groups, markets and institutions.

5.5 MODELLING LAND USE

Land use is modelled through increasing production of the agriculture sector, which may expand due to technological improvement or by using more inputs, such as capital, labour or land. Given the reserve of unused land, it is important to assume that land is not in restricted supply in the short run, both in the formal and informal sectors. In order to generate considerable agricultural crops, there is no need to avert land from new crops because it will increase food prices, or transform unused land to agricultural — to the detriment of the natural zone. In fact, the agricultural domain could be expanded without influencing land accessibility for new crops. In order to assess these assertions, the CGE model required a specific modelling of land use. The expectation was that the land use subsidy would stimulate production and employment in the agricultural sector.

Agricultural sector and land use are modelled distinctly with a specific agricultural combination. The researcher assumed that land is not mobile, and data shows a number of distinctions in soil, environment and climate that motivates the usage of specific land for specific purposes.

The DRC land area statistics released by the DRC Bureau of Statistics distinguished three categories of agricultural land use: crop, pasture, and forestry (INS, 1996). The researcher assumed that both formal and informal sectors may use agricultural land.

Cropland is well developed in the DRC despite the fact that the model lets some cropland be redistributed among crops according to a Constant Elasticity of Transformation (CET).

The demands for primary factors were chosen to minimise production cost and are structured as follows:

Equation 1:

$$XFAC(f,i)/[XPRIM(i)*AFAC(i)] = [[PFAC(i)*AFAC(i)]/PRIM(i)]^{-SIGMAPRIM(i)} \quad (5.1)$$

Equation 2:

$$PPRIM(i) * XPRIM(i) = PFAC(j,i) * XFAC(j,i) \quad (5.2)$$

Equation 3:

$$WFAC(i) = PPRIM(i) * XPRIM(i) \quad (5.3)$$

Where the parameters and variables in the demands for primary factors are described as follows:

$SIGMAPRIM(i)$	represents the parameter CES substitution, primary factors
$AFAC(f,i)$	represents the factor usage technological change
$XFAC(f,i)$	represents the firm demand for factor
$XPRIM(i)$	represents the quantity value-added composite
$PFAC(f,i)$	represents the factor prices
$PPRIM(i)$	represents the effective price of value-added composite
$WFAC(i)$	represents the expenditure on factors by firms

- Equation (1) above explains that factors (labour, capital, and land) are combined using CES. Disregarding factor technological change expressions, demand of different factors (f) by different firms (i), $XFAC(f,i)$, is proportional to overall primary factor demands, $XPRIM(i)$ and to a price term powered by the elasticity of substitution between primary factors, $SIGMAPRIM(i)$. The price term is the ratio of the price of factor, $PFAC(f,i)$, to the price of composite factors, $PPRIM(i)$. Factor price changes induce substitution in favour of cheapening factors. Changes in $AFAC(f,i)$, a technological variable, will affect factor demanded per unit of value added. The price of the factor composite, $PPRIM(i)$ is determined by equation 2.
- Equation (2) determines the value of the composite primary factors equals the sum of all factor costs.
- Equation (3) explains that expenditure on factors by firms equals the sum of all value-added composite costs.

Note that index i represents a set for firms (industry) and index f represents a set for factors (labour, capital and land). The value of parameter $SIGMAPRIM$ by industry is 0.5 because the researcher did not find any empirical study of the DRC which provided an appropriate estimation of the parameter CES substitution, primary factors ($SIGMAPRIM$). Therefore

the researcher tested the value of *SIGMAPRIM* and opted for 0.5 for the simulations reported in this study.

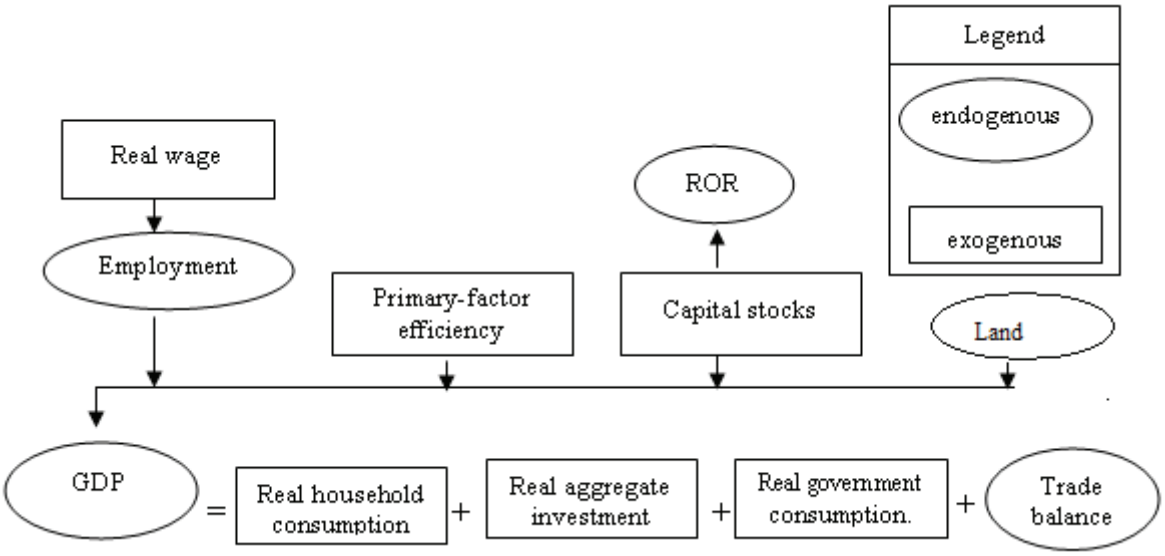
5.5.1 Closure and shock

The number of the variables and equations in the CGE model is important for the theoretical description of the CGE model. Usually the researcher must choose which variables will be determined endogenously within the model, and which variables will be determined exogenously. The number of exogenous variables must be chosen so that the economic environment in which the policy shock is tested best reflects the true economic environment in which the policy shock is applied. Within modelling methodology, the assumptions about exogenous and endogenous variables are known as 'model closure'. A suitable closure needs to be established to test the impact of the land use subsidy on the DRC economy. Many closures can be used for different purposes, and there is no unique natural or correct closure. Nonetheless, the hypothesis of testing the impact of a land use subsidy and the improvement of land use productivity in the DRC economy is performed within a short and long run setting. The main reason for using a short run closure is that the literature on land use demonstrates that the land use subsidy holds a positive advantage for the country's economy, irrespective of the effects of institutions and policies (Ferreira Filho and Horridge, 2010).

5.5.1.1 Short run closure

Figure 5.2 below shows the main assumptions underpinning the interactions between endogenous (oval) and exogenous (rectangular) macroeconomic variables in the model's short run closure. With the closure specified in Figure 5.2, it was assumed that there were more variables than equations. Thus, to close the model, the researcher chose which variables were to be exogenous and which endogenous. The exogenous variables were set while the endogenous variables are explained by the model. The number of endogenous variables must equal the number of equations.

Figure 5.2: Assumptions Underpinning Short-Run Closure



On the expenditure side of GDP as indicated in Figure 5.2, the sum of real household consumption, real aggregate investment, real government consumption and trade balance, produces the GDP. In this respect, real household consumption, real aggregate investment and real government consumption are assumed to be constant.

On the income side, GDP is obtained from labour, primary-factor efficiency, capital stocks and land. The primary-factor efficiency and capital stocks are assumed to be constant; only employment can adjust in the short run. Constant real wages in the short run closure determine employment. The model also allocates fixed investment following endogenously determined rates of return (ROR). Land is free to adjust as, the DRC is well known for its vast stock of land which could be transformed to agricultural use.

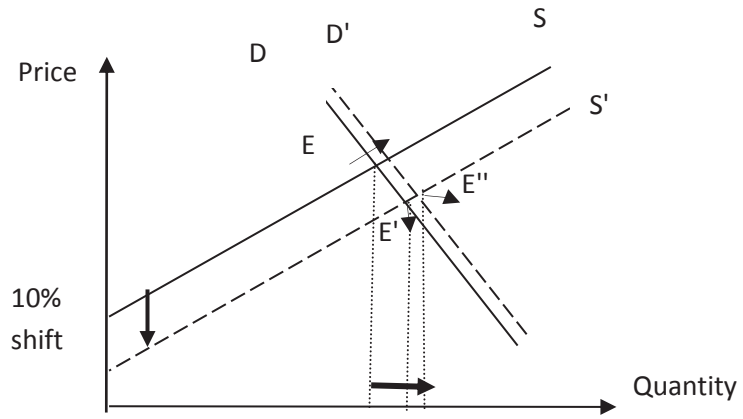
The best way of evaluating the effect of the land use subsidy is through shocking the appropriate variable in the model. In this case the variable that allows a shock to be applied as a percentage change is “pfac”. In ordinary simulations this variable is endogenous and cannot therefore be shocked when the specific hypothesis that needs to be tested within a simulation is not appropriately specified in the closure. The problem was solved by finding another appropriate exogenous variable to swap with “pfac”. Therefore, the investigation is done in the case of simulating the effects of a 10 percent price reduction in land use, and the variable

"pfac" is swapped with the exogenous variable "ffac" (all industry real factor price shift). The exogenous variable "ffac" represents all industry real factor price shifts in the model, where labour is mobile with wages indexed to a consumer price index[8].

Figure 5.3 below demonstrates the interaction between demand and supply in the short run closure. This implies that the equilibrium is reached from the right side of the land supply, which has lower price and higher quantity than initial price and quantity. The interaction has a less elastic supply curve and the original equilibrium is at point E. The shock shifts the supply curve downward from S to S'. Subsequently, the equilibrium shifts from point E to E', and has lower prices and higher quantities than originally specified. Therefore, because of input-output linkages, employment, wages and household income all increase. In this respect, the demand curve will move upward from D to D'. It forms a new equilibrium at point E'', which has larger quantities and higher prices than point E'. The researcher simulated the model by shifting the land supply schedule for agricultural and livestock sectors uniformly by 10 percent to the right side (Figure 5.3). Normally there are no specified formulas for determining the level of the shock and interpreting macroeconomic results, although one explanation can be offered to justify the choice of the shock (10 percent) - it is simply important to set the boundary within the scenario context and to identify the kind of variables, especially those which are affected by the shock, to provide realistic results from the simulation. Thus the government can provide a land use subsidy by reducing the price of the land by 10 percent. The model is shocked by setting "ffac (land,ind)=uniform -10" (see Equation 4). As indicated earlier, the 'ffac' represents a price-shift variable for the informal and formal factor of land, "land", used by industry, "ind". The "-10" means that the land supply function is shifted to the right side by 10 percent. This shock will affect agricultural and livestock land in the DRC.

[8] It must be noted that the GEMPACK technique recommends the swapping of an endogenous variable with an exogenous variable before its shock, while GAMS' technique allows that the endogenous variable be held fixed and shocked.

Figure 5.3: Interaction between demand and supply for land use subsidy (short run)



5.5.1.2 Long run closure

In the long run closure, labour is completely mobile between sectors. A wage differential is needed to induce labour movement between the formal and informal sectors. In percentage change form, the variable "xlab_i" is used as follows:

$$xlab\_i = \alpha * averealwage + \lambda$$

Where xlab_i is the total employment in the formal and informal sectors, λ is a slack variable determined by fixed national employment and α the DRC migration factor. The researcher did not find any empirical study of DRC migration factor which offered a suitable estimation of α. In this respect the researcher tested with α values, and selected 1 for the simulations reported in this chapter. Wage relativities are constant within both formal and informal sectors. It was further assumed that the national labour supply and population are fixed. ROR is exogenous and capital is not fixed, and foreign currency prices of imports are exogenous. Additional exogenous variables comprise price and quantity shift variables, rates of production tax and technological coefficients.

5.6 SIMULATION AND RESULTS

Short run (SR) and long run (LR) simulations were carried out to evaluate the effect of the land use subsidy and improvement in land productivity in the DRC economy. Four different simulations were performed. The first two simulations related to a 10 percent reduction in the

price of land in both the formal and informal sectors. The last two simulations related to land use productivity. By increasing the overall productivity of land use, a 10 percent reduction in all input augmenting technical change was achieved. The effects of such a gain have economy-wide impacts. The productivity is allowed to adjust due to low prices of land. The main purpose is not about investigating or postulating exactly how this productivity increase would be achieved in practice, but in assuming that all the human resources and financial supports are offered for improving the productivity of land use in the DRC economy. This increase of 10 percent in the model is achieved by shocking all input augmenting technical change (**aFac**) from the model production function specifically for the land use in the formal and informal sectors. The land use policy simulations affect various macro and micro economic variables. The rationale behind this empirical examination is not to point out how each one of these variables has changed, but to assess and illustrate changes in some macroeconomic and sector specific variables that could benefit both DRC official government and economic agents who are involved in socio-economic policies. For instance the macroeconomic aggregate variables consist of gross domestic product, employment, consumption, exports and prices of specific inputs.

5.6.1 Land use subsidy shock

5.6.1.1 Macroeconomic results

Table 5.2 below reports the simulation results for both short and long run effects of land use subsidies and improvement in land use productivity in the DRC economy for a series of macroeconomic variables. The expectations were confirmed by the policy simulation results. As expected, gross domestic product, exports and employment increase. In tracing the impact of the land use subsidy shock, output rises, indicating considerable efficiency which raises output in most sectors, stimulating the real GDP to rise by 0.34 percent and 0.26 percent in the SR and LR, respectively from the baseline economy (Table 5.2). The increased output and consequent drop in domestic prices (-0.68 percent in SR and -0.1 percent in LR) reflect significant efficiency and lower costs per unit output, resulting in increased real GDP. As a direct result of the growth in productivity, the consumer price index (CPI) declines by 0.79 percent and 0.11 percent in the SR and LR respectively. The significant level of real GDP allows consumers to enjoy a considerable level of consumption as the CPI declines. In this respect, higher factor earnings and higher consumption due to the low prices of commodities

raise household welfare, specifically for low-income households. In addition, a reduction in land prices causes a reduction in cost of production, which induces a reduction in export prices (0.37 percent in SR and 0.08 percent in LR), while export volumes increase by 1.87 percent and 0.41 percent in the SR and LR respectively. This stimulates the formal sector to export more as the export volume increases. Although the import price is fixed in the SR and LR, a fall in export price causes the terms of trade to decline. It can be observed that the balance of trade increases by 0.26 percent and 0.04 percent in the SR and LR respectively, due in particular to the considerable increase in exports.

Table 5.2: Macro Result (in percentage)

		Effect of 10% land subsidy		Effect of 10% land productivity	
Main Macro Variables	Description	Short run	Long run	Short run	Long run
RealHou	Real Household Expenditure	0	0.26	0	0.26
RealInv	Real Investment Expenditure	0	0	0	0
RealGov	Real Government Expenditure	0	0	0	0
ExpVol	Export Volume	1.87	0.41	1.74	0.41
ImpVol	Import Volume	-0.13	0.09	-0.12	0.09
RealGDP	Real GDP	0.34	0.26	0.31	0.26
AggEmploy	Aggregate Employment	0.25	0	0.23	0
AveRealWage	Average Real Wage	0	0.60	0	0.60
AggCapStock	Aggregate Capital Stock	0	0.19	0	0.19
AggLand	Aggregate Land	5.77	5.83	-5.18	-4.76
GDPPI	GDP Price Index	-0.68	-0.10	-0.64	-0.10
CPI	Consumer Price Index	-0.79	-0.11	-0.74	-0.11
ExportPI	Export Price Index	-0.37	-0.08	-0.34	-0.08
ImportPI	Import Price	0	0	0	0
BOT_GDP	Change in bal. of trade as % of GDP	0.26	0.04	0.24	0.04

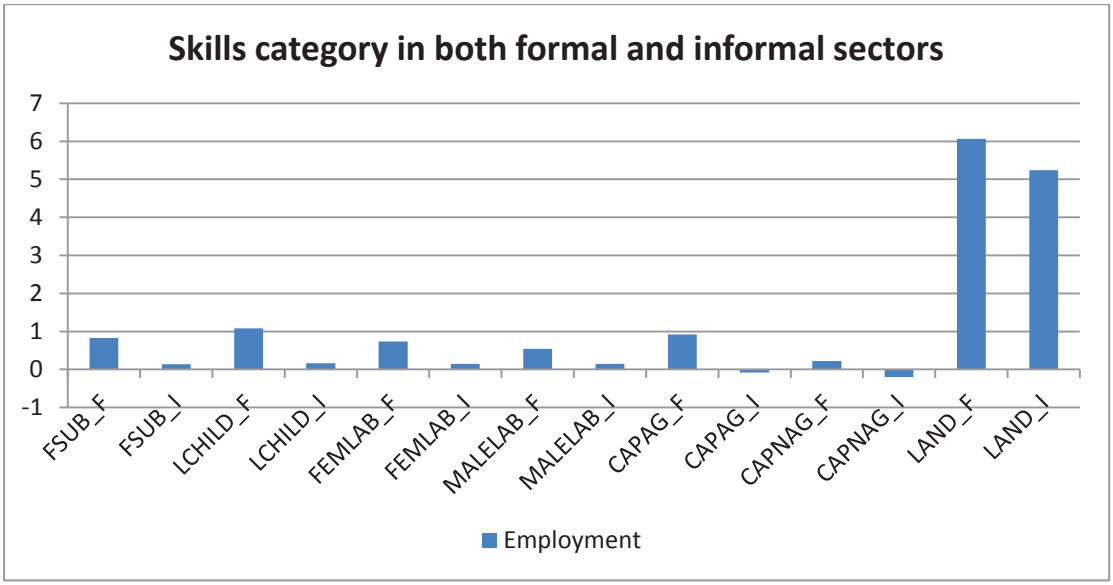
As there is substitutability among factors which favour the cheapening resources, a reduction in land price induces the aggregate land to increase by 5.77 percent and 5.83 percent in the SR and LR respectively, because the land is used as an intermediate input for some sectors. Economy-wide productivity improves considerably, as confirmed by the significant increase in domestic output.

The simulation results show that output has a positive impact on employment. The increase in employment represents an increase in labour in the production process, which naturally leads to a rise in productivity. This economy-wide improvement in productivity, in turn, has a

significant impact on employment with increased output stimulating more job creation. Employment increases by 0.25 percent in the SR, while it remains constant in the LR as declared in the closure. The main reason for this increase is that the economy-wide output, combined with increasing export demand, raises the demand for factors of productions. Because the capital is fixed in the SR, an increase in the demand for labour and land leads to a decrease in the output price index (-0.68 percent in SR and -0.1 percent in LR). Figure 5.4 below shows employment by skills category, with unskilled labour benefiting more than skilled labour in the SR. Skilled labour in the formal and informal sectors is composed of male labour (MALELAB_F and MALELAB_I), while unskilled labour includes female subsistence (FSUB_F and FSUB_I), child labour (LCHILD_F and LCHILD_I) and female labour (FEMLAB_F and FEMLAB_I). The largest rise of unskilled employment occurs in LCHILD_F (1.07 percent), followed by FSUB_F (0.83 percent) and FEMLAB_F (0.74 percent), because the agriculture and livestock sectors which increased in output are highly labour-intensive and absorb more unskilled labour.

Considering the rise of output, the land use subsidy shock stimulates more demand for unskilled labour than for skilled labour. As indicated earlier, there is substitutability among factors which favour the cheapening resources; a reduction on land price induces nominal wages to fall. Given the fact that real wages are fixed in the SR, the decrease in CPI by 0.79 percent indicates that the nominal wages have also decreased, which explain the increase in employment by 0.25 percent. The increase in land use has led to the increase in unskilled labours in the formal and informal sectors. The results support observations that the wage improvement reduces the cost of workers for firms and thus raises demand for labour (Davies and Thurlow, 2010:453). In addition, the aggregate land use in the formal and informal sectors increased in employment by 6.07 percent (LAND_F) and 5.24 percent (LAND_I) respectively (see Figure 5.4).

Figure 5.4: Land use short run percentage change in employment by category of factor (formal and informal sectors)



5.6.1.2 Sectoral results

Table 5.3 below reports on the percentage change in sectoral results caused by land use subsidies and land productivity policy simulations. Although all sectors increased in output in the LR, overall the land use subsidy had a positive economic impact on some industries in both the formal and informal sectors in the SR. For instance, the formal sectors benefit the most from the land use subsidy in terms of output. These sectors include livestock (LIVES_F at 0.89 percent in SR and 0.72 percent in LR), agriculture (AGRI_F at 0.72 percent in SR and 0.71 percent in LR), and processed food (FOOD_F at 0.09 percent in SR and 0.44 percent in LR), as is shown by the results in column 1 in Table 3. Most of these sectors are labour-intensive and absorb the majority of lower-skilled workers, hence the increase in output in these sectors is driven particularly by the land use subsidy allocation. The main reason for this improvement in output is that the land use subsidy cuts the cost of production in the formal sector. Furthermore, the formal sector production and employment also increases to a certain extent due to the enhanced production efficiency and improved export opportunities.

Table 5.3: Sectoral results, effect of land use subsidy and land productivity shocks (percentage changes)

Sectors (Formal & Informal)	Column 1				Column 2				Column 3				Column 4				Column 5			
	Land use subsidy		Land productivity		Land use subsidy		Land productivity		Land use subsidy		Land productivity		Land use subsidy		Land productivity		Land use subsidy		Land productivity	
	xTot (Output)				xExp (Export)				xFac (Employment)				xHou (Household demands)				pTot (output prices)			
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
AGRIC_F	0.72	0.71	0.67	0.71	8.11	2.53	6.11	2.53	0.34	0.00	0.92	0.00	0.84	0.65	0.45	0.65	-1.26	-0.50	-1.18	-0.50
AGRIC_I	0.32	0.18	0.29	0.18	3.13	0.12	3.21	0.12	0.36	0.00	0.32	0.00	-0.11	0.17	-0.11	0.17	-0.68	-0.02	-0.63	-0.02
LIVES_F	0.89	0.72	0.83	0.72	6.68	1.48	3.35	1.48	0.8	0.00	1.08	0.00	0.57	0.44	-0.08	0.44	-0.70	-0.29	-0.66	-0.29
LIVES_I	0.64	0.63	0.60	0.63	7.45	3.16	7.96	3.16	0.19	0.00	0.64	0.00	0.72	0.77	0.80	0.77	-1.63	-0.62	-1.52	-0.62
MININ_F	-0.24	0.02	-0.23	0.02	0.12	-0.04	-0.13	-0.04	0.06	0.00	0.00	0.00	-0.70	0.14	-0.76	0.14	0.03	0.01	0.03	0.01
MININ_I	-0.05	0.08	-0.05	0.08	0.18	-0.03	7.45	-0.03	-0.45	0.00	-0.01	0.00	-0.69	0.14	0.70	0.14	-1.53	0.01	-1.43	0.01
FOOD_F	0.09	0.44	0.08	0.44	5.54	1.13	3.43	1.13	0.13	0.00	0.07	0.00	0.35	0.37	-0.06	0.37	-0.72	-0.22	-0.67	-0.22
FOOD_I	0.03	0.15	0.02	0.15	3.08	-0.07	3.88	-0.07	0.02	0.00	0.01	0.00	-0.12	0.13	0.02	0.13	-0.81	0.01	-0.76	0.01
CLOTH_F	-0.37	0.09	-0.34	0.09	1.25	-0.29	1.28	-0.29	-0.18	0.00	-0.09	0.00	-0.48	0.09	-0.48	0.09	-0.27	0.06	-0.25	0.06
CLOTH_I	-0.08	0.09	-0.08	0.09	2.14	-0.43	3.36	-0.43	-0.06	0.00	-0.03	0.00	-0.30	0.06	-0.08	0.06	-0.71	0.09	-0.66	0.09
MANUF_F	-0.46	0.11	-0.43	0.11	0.26	-0.07	0.26	-0.07	-0.25	0.00	-0.07	0.00	-0.67	0.14	-0.68	0.14	-0.06	0.01	-0.05	0.01
MANUF_I	0.00	0.13	0.00	0.13	1.33	-0.11	3.40	-0.11	0.03	0.00	0.01	0.00	-0.46	0.13	-0.07	0.13	-0.71	0.02	-0.67	0.02
EQUIP_F	-0.05	0.02	-0.05	0.02	0.04	-0.01	-0.41	-0.01	0.35	0.00	0.03	0.00	-0.71	0.15	-0.82	0.15	0.09	0.00	0.08	0.00
EQUIP_I	-0.05	0.11	-0.05	0.11	0.65	-0.12	2.68	-0.12	0.04	0.00	0.00	0.00	-0.59	0.12	-0.21	0.12	-0.57	0.02	-0.53	0.02
UTILI_F	-0.31	0.15	-0.29	0.15	0.71	-0.29	3.03	-0.29	-0.35	0.00	-0.07	0.00	-0.58	0.09	-0.14	0.09	-0.64	0.06	-0.60	0.06
UTILI_I	0.26	0.34	0.24	0.34	0.00	0.00	0.00	0.00	0.59	0.00	0.36	0.00	-0.72	0.15	-0.74	0.15	0.00	0.00	0.00	0.00
CONST_F	-0.01	0.00	-0.01	0.00	1.59	-0.08	2.44	-0.08	0.09	0.00	0.06	0.00	-0.41	0.13	-0.26	0.13	-0.52	0.02	-0.48	0.02
CONST_I	-0.01	0.05	-0.01	0.05	1.71	-0.36	3.43	-0.36	0.01	0.00	0.01	0.00	-0.38	0.08	-0.06	0.08	-0.72	0.07	-0.67	0.07
TRADE_F	0.23	0.31	0.21	0.31	0.27	-0.12	-16.69	-0.12	2.68	0.00	0.09	0.00	-0.67	0.12	-4.29	0.12	4.00	0.02	3.72	0.02
TRADE_I	0.17	0.17	0.16	0.17	0.72	-0.27	-0.47	-0.27	0.66	0.00	0.08	0.00	-0.58	0.10	-0.83	0.10	0.10	0.05	0.10	0.05
HOTEL_F	0.08	0.04	0.08	0.04	1.66	0.10	2.05	0.10	0.27	0.00	0.06	0.00	-0.40	0.17	-0.33	0.17	-0.43	-0.02	-0.40	-0.02
HOTEL_I	-0.05	0.14	-0.05	0.14	1.90	-0.01	3.39	-0.01	-0.03	0.00	-0.01	0.00	-0.35	0.15	-0.07	0.15	-0.71	0.00	-0.66	0.00
TRANS_F	0.07	0.00	0.07	0.00	0.22	-0.01	0.09	-0.01	0.47	0.00	0.06	0.00	-0.68	0.15	-0.72	0.15	-0.02	0.00	-0.02	0.00
TRANS_I	0.11	0.07	0.11	0.07	0.80	-0.17	0.89	-0.17	0.45	0.00	0.05	0.00	-0.56	0.12	-0.56	0.12	-0.19	0.03	-0.18	0.03
ESTAT_F	-0.12	0.05	-0.11	0.05	2.69	-0.79	3.05	-0.79	-0.07	0.00	-0.06	0.00	-0.19	-0.01	-0.14	-0.01	-0.64	0.16	-0.60	0.16
ESTAT_I	-0.04	0.03	-0.04	0.03	2.48	-0.73	3.54	-0.73	-0.02	0.00	-0.02	0.00	-0.23	0.00	-0.04	0.00	-0.74	0.15	-0.69	0.15
ADMIN_F	0.13	0.01	0.12	0.01	2.70	-0.16	2.09	-0.16	0.25	0.00	0.22	0.00	-0.19	0.12	-0.32	0.12	-0.44	0.03	-0.41	0.03
ADMIN_I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.4	0.00	0.00	0.00	-0.72	0.15	-0.74	0.15	0.00	0.00	0.00	0.00
PRIVS_F	0.20	0.00	0.18	0.00	0.58	-0.03	0.27	-0.03	0.57	0.00	0.17	0.00	-0.61	0.14	-0.68	0.14	-0.06	0.01	-0.05	0.01
PRIVS_I	-0.03	0.10	-0.02	0.10	1.26	-0.38	2.89	-0.38	0.05	0.00	0.01	0.00	-0.47	0.07	-0.17	0.07	-0.61	0.08	-0.57	0.08

It is not surprising that the sectors that are closely linked to land use perform well, while those sectors that are not linked to land use perform poorly. The policy simulation results show that the livestock, agriculture and food sectors are the biggest winners under the proposed land use subsidy. These are the sectors that rely heavily on land use as an input in the production process. The outputs of these sectors increased considerably; this increase is a result of a rise in the export demands for these products. Moreover, the increase in the output of the related sectors implies an increase in the employment of unskilled and informal sector labour in these sectors.

The outcome of the land use subsidy shows that the cost of production is reduced both in the formal and informal sectors. In this respect the price of formal and informal goods decreases, therefore in the SR, it stimulates purchasers to demand more goods as the output increases for the sectors such as livestock formal sector (0.89 percent), agriculture formal sector (0.72 percent), livestock informal sector (0.64 percent), agriculture informal sector (0.32 percent), utilities informal sector (0.26 percent), trade formal sector (0.23 percent) and private service

formal sector (0.20 percent). Among the sectors which performed poorly were the manufacturing formal sector (-0.46 percent), followed by the clothing sector both formal (-0.37 percent) and informal (-0.08 percent), and real estate both formal (-0.12 percent) and informal (-0.04 percent) (see column 3 in Table 5.3). The main reason for poor performance could be that the demand for labour is derived from the increase in output, and sectors relating to land attract labour from other sectors.

The direct impact of land use subsidies in some sectors is a rise in employment, although it is marginally proportional to their output gain as land demand rises. Increased output stimulates sectors to improve their production process by increasing employment demand in various skill categories. The rise in employment in labour intensive sectors is stimulated by improved efficiency, which allows profit-maximising producers to grow by employing more resources, specifically labour, due to their increased marginal productivity. The simulation results show a positive employment increase in most labour intensive sectors. For instance in the SR, employment rises significantly in sectors such as agriculture - both formal (0.34 percent) and informal (0.36 percent), livestock - both formal (0.8 percent) and informal (0.19 percent), and food - both formal (0.13 percent) and informal (0.02 percent) (see column 3 in Table 5.3).

Even though employment increased in most sectors, a substantial increase occurred in the trade sector specifically, with increases in the formal and informal sectors by 2.68 percent and 0.66 percent respectively, due to the land subsidy allocation that influences the activity level of the sector. Falling output prices and increased trade with the formal sector does, however, benefit informal traders. Increased formal sector production also benefits workers who are informally employed in the formal sector, despite the substantial overall shift in labour demand toward formally employed workers. This is consistent with the findings of previous studies (see, for example, Davies and Thurlow 2010). Overall this policy shock related to land use subsidy shows that national employment increased by 0.25 percent.

5.6.1.3 The terms of trade

The terms of trade presume important meaningful results for the DRC's exports and competitiveness. However, the positive impact of the terms of trade depends on the adjustment in export prices, which decreased by 0.37 percent and 0.08 percent in the SR and LR respectively (Table 5.2). The simulation result appears more intuitive for a land use subsidy policy simulation because the considerable decrease in export prices was expected

with a positive impact on the DRC's competitiveness.

The prior expectation was confirmed by the policy simulation results. An evaluation of the adjustment in the terms of trade shows that the reduction in export prices justifies the two significant elements. Firstly, the land use subsidy is not completely generated on the export goods, but on the intermediate use of the land. Even though the intermediate land use subsidy could increase the export price, its inflationary impact on export prices is not as severe as it would be if the land use subsidy was completely imposed on exports. Secondly, the considerable reduction in the price of the fixed factors of production did offset the inflationary impact of the land use subsidy. It shows that the DRC's prevalent export goods demand the utilisation of unskilled labour and land. Thus these industries denote mainly the primary sector of the DRC's production, and comprise both formal and informal sectors such as the agricultural, livestock, food and mining informal sectors.

The reduction in the price of land therefore decreases the export prices of these products. In addition, the service sector usually requires intensive utilisation of capital and skilled-labour in the course of production. For this reason, the price reduction of these fixed factors of production leads to a reduction in the export prices of these products. Despite the fact that the formal sector stimulates certain demand for informal inputs from the informal sector, the informal sector experiences a reduction in production and faces considerable import competition without any enhanced strategy to penetrate foreign exports markets. The main reason is that it is the formal sector that is involved in foreign exports and not the informal sector. The formal sector produces and generates products that profit considerably from the reduction in export prices.

5.6.1.4 The effect on the demand for land use

The effect of a land use subsidy on the demand for land use appears to be substantial. The domestic demand for land use increases by 5.77 percent and 5.83 percent in the SR and LR respectively. The rise of the land use demand is mostly the result of an increase in output of the sectors that make significant use of land in the production process (the agriculture formal sector, the livestock formal-informal sector and the food formal sector). Due to the fact that the structure of the DRC economy provides enough reserves of land, the final user benefits the most from the land use subsidy. The price reduction for the consumers results in a rise in the demand for these products, and subsequently a rise in the domestic demand for land use.

Nevertheless, because the elasticity of demand for these products is relatively low, the rise in the demand for land intensive products is not limited, and the positive dividend that arises from the subsidy is also substantial.

Furthermore, due to the lack of alternative sources of land, there is no substitution effect and the considerable level of subsidies results in a relatively high increase in land use. As the land use subsidy has a positive land use benefit, this indicates a further motivation for availing considerable resources for systematic investment in land research, development and technological innovation to maximise land use in the DRC economy.

5.6.2 Land use productivity shock

5.6.2.1 Macroeconomic results

Improvement in land use productivity is simulated by shocking the overall factor technical change ("aFac" from the model) for the land in both the formal and informal sectors. The overall economic impact of the improvement in the land use productivity has positive results on most macro-economic variables. The simulation results show that GDP increases by 0.31 percent and 0.26 percent in the SR and LR respectively (see the last two columns in Table 5.2 in Section 5.6.1.1). This means that the shock applied to the factor technical change causes the producers to make use of the three primary inputs, namely labour, capital and land, as well as intermediate inputs, in a more efficient way. The productivity gains for the land use sector translate into lower output prices, in effect causing consumer inflation to decline by 0.74 percent and 0.11 percent in the SR and LR respectively. The advantages of the productivity increase cause producers to gain considerable enhancement in competitiveness, which leads to markedly higher growth in exports, with export volumes increasing by 1.74 percent and 0.41 percent in the SR and LR respectively. This increase in export volumes is expected since the land use sector plays a major role in the intermediate inputs for some sectors, such as agriculture and livestock.

The results of economy-wide land use productivity increases show output having a positive impact on employment. The expansionary economy, combined with increasing export demand, increases the demand for factors of production. The increase in employment by 0.23 percent in the SR represents an increase of labour in the production process. Usually, where producers conserve their labour force through labour saving technical change improvements, the improvement in labour productivity can be achieved through better management and a

focus on the training and development of staff. Without any reduction in the growth rate of the average real wage in the LR (0.6 percent), the unit cost of labour is actually reduced through productivity improvements. This ensures significant improvements in competitiveness and a shift from production for the local market to exports, which consequently result in positive GDP effects. In this respect, to attract labour from both formal and informal sectors, wages had to rise by 0.6 percent, even though the aggregate employment is constant in the LR.

5.6.2.2 Sectoral output

Table 5.3 in Section 5.6.1.2 reports on the changes in sectoral results caused by the improvement in land use productivity. All sectors experience an increase in output in the LR. This shows that the improvement in land use productivity has positive effects on the DRC's economy over the LR. The largest increase in output occurred in both formal and informal sectors that are heavily dependent on land in their production processes. Nonetheless, in the SR, for instance, the formal sectors benefit the most from the improvement in land use productivity in terms of output. These sectors include livestock (LIVES_F at 0.83 percent), agriculture (AGRI_F at 0.67 percent), and food (FOOD_F at 0.08 percent), as is proven by the results in column 1 in Table 5.3. Most of these sectors are labour-intensive and absorb the majority of lower-skilled workers. The main reason for this increase in output is that the improvement in land use productivity cuts the cost of production in the formal sector.

The researcher noticed on one hand that non-traded sectors such as formal administration (ADMIN_F at 0.12 percent), formal private sector (PRIVS_F at 0.18 percent), and informal utility (UTIL_I at 0.24 percent) increased in output in the SR. This increase is due to the improvement in land use productivity. On the other hand, some trade-exposed sectors increased because users did not substitute products as a result of the dropping costs caused by the improvement in the factor technical change in the land use. In this simulation, the improvement in land use productivity was used to support all sectors. Column 2 in Table 5.3 shows that in the SR most sectors report an increase in exports, reflecting the considerable mutual trade that takes place between the formal and informal sectors. The increase in export volumes is to be expected as it is the formal sector that deals with international trade and not the informal sector.

Sectoral employment shows an increase in most sectors due to factor productivity increase in those selected sectors. Nonetheless, sectors with initial low output levels witness the worst employment contraction in the SR. These sectors include clothing (CLOTH_F at -0.09 percent), manufacturing (MANUF_F at -0.07 percent) and utilities (UTILI_F at -0.07 percent), as is proven by the results in column 3 in Table 5.3. This is consistent with the findings of previous studies (see Punt *et al*., 2003) which indicate that productivity increases in sectors such as agriculture reduce employment sectorally, while increasing their output in an expanding economy. This outcome shows that efficiency gains in specific sectors have economy-wide positive employment effects when there is a linkage between the formal and informal sectors.

5.6.2.3 Terms of trade

Improvement in land use productivity allows the price of exports and the cost of production to fall. The price of exports decreases by 0.34 percent and 0.08 percent in the SR and LR respectively (see Table 5.2). It denotes the terms of trade and its decrease means positive effects for the DRC's exports and international competitiveness. Export volume increases by 1.74 percent and 0.41 percent in the SR and LR respectively, because the competitiveness of producers is stimulated by foreign markets. This can stimulate a slight depreciation of the real exchange rate required to boost exports. Thus economic activity expands (real GDP increases by 0.31 percent and 0.26 percent in the SR and LR respectively) to stimulate growth in employment. The increase in income stimulates households to spend more. Although the volume of imports contracted by 0.12 percent in the SR, the researcher noticed that the rest of the world's import volumes increase by 0.09 percent in the LR because demand expands and imports gain market share. The rise in import is indeed the result of expanded economic activity in the LR.

5.7 POLICY IMPLICATION

In this chapter we attempted to assess the DRC's land use challenges through the CGE technique by assessing two important policy shocks. The first related to the land use subsidy and the second to the land use productivity shock. In the first shock the researcher performed short and long run simulations to test the hypothesis that the land use subsidy could be used to address the problems of low economic growth, unemployment, and poverty, which persist in the economy. There are also challenges in the incapacity to transform the unused land to

agricultural use. The considerable reserve of unused land demonstrates the extent of the need for government to provide subsidies on land use that should unleash the potential for more agricultural production. In the second shock, short and long run simulations were performed to assess the impact of improving land use productivity in the DRC economy.

The researcher concluded two important policy implications that derived from the four simulations performed in this chapter.

Firstly, although the results showed that the land use subsidy could achieve some welfare benefits, it became apparent that the price of land is a big concern in the DRC. The vast reserve of unused land is partly due to the lack of access to finance. The short and long run simulations in which the DRC government provides land use subsidies to both the formal and informal sectors show that the government is capable of improving the deficiencies of formal and informal households' incomes in a significant way. Moreover, the policy simulation results show that a subsidy through a price decrease in land use would have a positive impact on the DRC's competitiveness in the short and long run, and that exports would increase. This assumption is confirmed by our simulation result which shows that exports increased by 1.87 percent and 0.41 percent in the short and long run simulation respectively (Table 5.2). In addition, because the price of fixed factors of production and the price of the DRC's aggregate exports decreased, the economic effects of land use subsidies could attract investment to the DRC.

Secondly, land use productivity can be achieved through an improvement in factor technical change in the efficient use of land in order for the economy to reap a socio-economic benefit. Because the achievement of land use productivity could result in considerable political impact for the government, the improvement of the factor technical change in the land use was tested within a short and long run setting. Due to the lack of alternative expansion of land use, factor technical change that improves the efficiency of land use in the production process across all DRC sectors was proposed. The results show that an improvement in the factor technical change in land use causes efficiency gains in most sectors, which have economy-wide positive employment effects because of the intersectoral linkages. The DRC's policy makers should therefore consider an improvement in land use productivity policy that would stimulate economic growth, employment and welfare in the country.

5.8 CONCLUSION

The main purpose of this chapter was to assess the effects of a land use subsidy and improvement in land use productivity in the DRC's economy. The chapter presented the literature and adopted a broader view of land use in the formal and informal sectors. The researcher adopted an economywide perspective and accounted for formal–informal interactions in both factor and product markets. A multi-sectoral CGE model was also developed, which was empirically based on the structure and behaviour of the DRC's formal and informal economies. The model was used to examine two policies designed to expand land use production and employment.

The results for the first policy shock indicated that a cut in price by 10 percent for land use in the formal and informal sectors essentially reduced the cost of production. With decreased prices of domestic output, the demand for domestically produced goods spurred domestic production, hence the real GDP increased by 0.34 percent and 0.26 percent in the short and long run respectively from the baseline economy. Results of economy-wide productivity increases show output having a significant positive impact on employment. Labour increases by 0.25 percent in the short run can be explained by the increase occurring in output and the factors of production. The expansionary economy, combined with increasing export demand, increases the demand for factors of productions. As more people are employed, the rise in income stimulates the export volume to increase by 1.87 percent and 0.41 percent respectively in the short and long run, which creates less demand for imported goods (-0.13 percent) in the short run. The rise in export is the result of the expanded economic activity. Formal sectors such as agriculture (AGRIC_F at 8.11 percent in SR and 2.53 percent in LR) and livestock (LIVES_F at 6.68 percent in SR and 1.48 percent in LR) contributed significantly to the increase in exports, thus the balance of trade is on the positive side, with an increase of 0.26 percent and 0.04 percent in the short and long run respectively. In general, the land price decrease has a relatively large impact on GDP and employment.

Results for the second policy related to the land use productivity shock indicated that an improvement of factor technical change of 10 percent for land use in the formal and informal sectors essentially reduces the cost of production. GDP increases by 0.31 percent and 0.26 percent in the SR and LR respectively. This means that the shock applied to the factor technical change causes the producers to make use of the three primary inputs, namely

labour, capital and land, as well as intermediate inputs in a more efficient way. The advantages of the productivity increase causes producers to gain considerable enhancement in competitiveness, which leads to considerably higher growth in exports with export volumes increasing by 1.74 percent and 0.41 percent in the SR and LR respectively. This increase in export volumes was expected, as land use plays a major role in the intermediate inputs for some sectors such as agriculture and livestock. This shed light on a critical topic for public policies, since the higher productivity gains in agricultural and livestock production can be regarded as critical instruments to reduce the immense reserves of unused land in the country. These findings highlight the linkages and effects of socioeconomic policies between the formal and informal sectors. In general, these findings warn policy makers against implementing formal sector policies without taking into account informal sector effects. Future research should consider updating the DRCFIM economy wide database.

CHAPTER 6: ASSESSMENT OF THE EFFECTS OF TARIFF REDUCTION IN THE DRC'S ECONOMY: POLICY SIMULATIONS

6.1 INTRODUCTION

According to the IMF (2011), the DRC was one of the most highly developed countries in Africa in the 1960s, positioned second after South Africa. However its economy was progressively ruined because of the two disastrous wars which caused the deaths of approximately five million people. In 2011 the country was ranked among the poorest performers in Africa, and was ranked 20th in terms of Gross Domestic Product (GDP). In an attempt to boost its economy the DRC underwent significant trade liberalisation during the 1990s, however this did not result in any improvements and unemployment and poverty worsened. The economy started to lose impetus and many economic activities fell into the informal sector owing to the lack of opportunities in the formal sector. Economic activities are currently hampered by weak institutional capacity that fails to maintain the sustainable development of a dynamic private sector. Tax laws are enforced arbitrarily, which results in the informal sector absorbing many people and enterprises. Recent statistics show that 80 percent of the economic activity in the DRC is attributed to the informal sector (World Bank, 2009: 86). In fact, from 1990 to 2001, the DRC experienced a considerable period of economic recession, with an average GDP growth rate of -5.4 percent. Indeed the economy collapsed, with a negative growth rate of -13.5 percent, in 1993. In addition, current GDP per capita dropped 37.9 percent from US$204.9 in 1990 to US$127.32 in 2001, and unemployment contracted to approximately 70 percent (WTO, 2010).

The poverty level is increasing in the DRC although the process of trade liberalisation continues. Currently, the DRC is liberalising the electricity industry by extending its energy resources with the assistance of the World Bank and the African Development Bank. This project will supply electric power to South Africa through Witkop (World Bank, 2013). Consequently, trade liberalisation has had diverse consequences for the DRC's formal and informal sectors. It has considerably increased informal employment by enhancing import competition, without offering further opportunities for the informal sector to penetrate foreign export markets. Notably, the formal sector is unable to improve its production despite the new foreign market opportunities. Davies and Thurlow (2010) pointed out that trade

liberalisation adjusts the structure of the informal sector by shrinking product market capacity for informal entrepreneurs, providing opportunities for informal traders, and stimulating informal entrepreneurs to look for available jobs in the formal sector. Despite the new employment opportunities in the formal sector, trade liberalisation has an adverse impact on the informal sector because it decreases employment in the country (Thurlow, 2007). This is supported by Bhorat (1999) and Edwards (2001), who found that trade liberalisation decreased industrial employment, although only marginally.

However it may be of interest to point out that inadequate and inefficient infrastructure, complex regulations, burdensome and complex bureaucracy, inefficient customs administration and corruption add to the cost of trade, and there is substantial unrecorded trade in the DRC. According to the WTO (2010), fifteen points were deducted from the DRC's trade freedom score to account for non-tariff barriers. The weighted average tariff rate was 11.4 percent in 2010. Past moderation of trade constraints has been an element of concern in the DRC. The trade deficit worsened from 6.6 percent of GDP in 1998 to -5.6 percent in 2006. As soon as it had decreased by more than US$468 million, the shadow balance rose to more than US$355 million in deficit. Consequently the profits balance likewise indicated a loss accumulated to US$293.7 million (IMF, 2011). For instance, the DRC was ranked the 136th export market for the United States of America (US) in 2011. US goods exports in 2011 were US$166 million, up 78.3 percent from the previous year. Its imports from the DRC were US$606 million, up 14.8 percent. The US goods trade deficit with the DRC was US$439 million in 2011, up US$5 million from 2010. Its stock of US foreign direct investment (FDI) in the DRC was US$129 million in 2010, down from US$169 million in 2009 (WTO, 2013). In addition, the DRC’s trade integration ratio was 45.9 percent during the 1990s compared to 92.8 percent in 2007 — higher than the Sub Sahara African (SSA) countries (88.4 percent) and low-income groups’ (80.1 percent) averages. With an absorption index of 38.4, the DRC’s export base seems relatively varied, but nevertheless remains subjugated by primary commodities. The DRC’s major products exports are nonferrous ores, diamonds, coffee, and crude oils; services accounted for only 7.1 percent of total exports in 2007. The country’s main imports are mining, machinery, transport equipment, and food products. The DRC's main trading partners are the European Union, Belgium and France, followed by China, South Africa and the United States. As indicated earlier, there is significant unrecorded or under recorded trade in goods and services in the

east part of the country across the borders with Tanzania, Burundi, Rwanda, and Uganda (WTO, 2010).

The DRC's trade barriers are exacerbated by the intricate regulations, a diversity of interdependent organisational bureaux, and a common lack of capacity and political will. Despite the fact that the country has various organisations relating to trade matters, it is difficult to get the necessary permits for trading. There is a lack of law enforcement, although various local traders are striving to promote trade opportunities through their own private systems. In assessing trade performance it is important to keep in mind that countries do not trade — firms do. Analysing the dynamics of firms in trade markets is therefore crucial for adopting policy solutions (Wiley, 2012). The DRC government recently attempted to modify various regulations because of the economic slowdown from the 1990s, combined with the increasing amount of bribery. In this respect tariffs have dropped, with the decline driven by the country's WTO requirements (World Bank, 2010). The DRC has liberalised its importation regime since the beginning of the 1990s; the country's average applied tariff rate was 12 percent in 2008. All its tariffs are *ad valorem* and charged on a cost, insurance and freight (CIF) basis. A new value-added tax (VAT) ratio of 16 percent came into effect on January 1, 2012, replacing the previous consumption tax. The adoption of VAT should increase collection of fiscal revenues and appears to be more transparent than the previous system, however businesses fear that it could lead to price inflation. In addition to tariffs, several taxes are collected on imported goods by different government agencies. These additional taxes that importers pay on goods and services average between 10 and 40 percent (WTO, 2013).

Trade theory indicates that no country can reap negative benefits by permitting trade liberalisation (Mosley, 2009). This finding depends on some fundamental assumptions. Considering the case of the DRC, imperfect capital markets and unfair exorbitant transportation costs indicate that trade liberalisation can have adverse outcomes. The main reason could be that trade liberalisation reduces national employment (Davies and Thurlow, 2010). Instead, considering procedures of protection for specific industries in the economy should form the basis of a competitive sector which should stimulate viable long-term development – comparable to policies adopted in Asia during the last two decades (Wiley, 2012).

According to Stiglitz *et al*. (2005), trade can expend in the long run as a result of trade liberalisation, although there could be relatively considerable costs related to resource re-allocation in the short term. The magnitude of the costs related to such an adjustment will essentially depend on the new adaptation of labour and capital. Ngeleza and Muhammad (2009) studied the free trade agreement involving the Economic and Monetary Community of Central Africa and the European Union, and found that the DRC's trade agreements need to be harmonised and be in line with a trade partner's bilateral agreement. Their research did not focus on the trade liberalisation and competition in product markets in the formal and informal sectors. Any study addressing these shortcomings will add value by assessing the growth effects of trade liberalisation. These deficiencies are directly addressed in this chapter. The aim of this chapter is to assess the effects of tariff reduction on productivity, unemployment and poverty in the DRC. The researcher evaluated how the tariff reduction affected formal and informal production and employment. Section 6.2 describes the methodology used to analyse tariff reduction in the DRC. The model is used in Section 6.3 to analyse one policy that features prominently in the DRC's current unemployment figures related to trade liberalisation. The model results show that policy can produce divergent effects for both the formal and informal sectors. The last section examines these findings and their implications for future research.

6.2 METHODOLOGY

As described in Chapter 4, DRCFIM is a multi-sectoral CGE model that depicts the reflected structure of the DRC's formal and informal economies. In fact, the specific model of the DRC Formal-Informal Model contains significant linkages involving numerous economic agents such as firms, traders, investors and government. It also includes a sequence of equations that depict the performance of the current economy of the DRC, which consist of all major industries, markets, and organisations. The parameters of the DRCFIM's equations are developed from a DRCDSAM composed of formal and informal sectors. The DRCDSAM is an economy wide database that depicts all monetary flows in the DRC economy during 2007. DRCFIM uses a variety of data sources such as household surveys, national accounts, and labour force surveys. Furthermore, DRCFIM includes 30 sectors, eight household types, eight different labour types, and a land with specific structures of formal and informal sector.

6.2.1 The modelling framework

Previous studies show that trade liberalisation is assessed through changes in import prices (Mai, 2003; Davies and Thurlow, 2010; Michael, 1997; Jayant, 1994). In this respect, the researcher assessed tariff reduction in the DRC by reducing import prices by 5 percent across all industries. Although Mai (2003) used the same percentage to analyse tariff reductions in China, no previous studies related to tariff reductions in the DRC could be found. Therefore a small tariff reduction was applied based on the realities of the country, and the required impact was in line with the DRC's tariff composition.

According to the WTO (2011), almost all tariffs in the DRC are *ad valorem*, following the international standard by charging on the basis of cost, insurance, and freight (CIF). The composition of the DRC's tariff includes three tariff categories: 5 percent for machinery products, agricultural and livestock items, raw materials, and unassembled machinery; 10 percent for food products, manufacturing inputs, replacement parts, and hospital equipment; and 20 percent for remaining manufactured goods. These percentages are recommended by the WTO (2011), although in reality they are lower in the DRC when compared with other regional unions in sub-Saharan Africa, where for instance import tariffs of 23 percent or more, on average, is applied on footwear, wood products, and agricultural produce (Lamy, 2002). In addition, the Office of Congolese Control (OCC), the DRC's import-export regulator body, imposes a 1.5 percent tax (*ad valorem*) on the CIF cost of every import greater than US$10,000, and applies a descending calibration for imports with a value lesser than the amount of US$10,000. Importers of duty-free goods pay an *ad valorem* administrative fee of 5 percent.

Due to the fact that the DRC is not actively involved in the Common Market for Eastern and South African Countries (COMESA) or the South African Development Community (SADC) free trade agreements, mainly because of the DRC government's high dependency on revenues from tariffs, a 5 percent reduction in import prices will reflect the level of public consumption spending in the contry. The revenue from tariffs was last measured at 34.5 percent in 2010, according to the World Bank (2010). This scenario will shed light on import competition in various sectors and the dynamic export industry in the country. In the case of South Africa, recently Davies and Thurlow (2010) found that trade liberalisation increases employment in the formal sector and assists traders from the informal sector who profit from

lower import prices. We allowed the import price to decrease by shocking the variable "pImp" (import price) in the model. This variable was declared exogenous in the command file. Moreover, it should be noted that the equations are in percentage changes form. The equations assessing the tariff reduction in the DRCFIM model are presented below:

Equation 1:

$$E\_x\mathrm{Im}p(all,e,IMP)(all,i,IND)$$
$$x\mathrm{Im}p(e,i) = xIMP\_e(i) - CESM(i)*[p\mathrm{Im}p(e,i) - p\mathrm{Im}p\_e(i)] \quad (6.1)$$

Equation 2:

$$E\_w\mathrm{Im}p\_e(all,i,IND)$$
$$ID01[VIMP(i)]*w\mathrm{Im}p\_e(i) = sum\{e,IMP,SAM(e,i)*[p\mathrm{Im}p(e,i) + x\mathrm{Im}p(e,i)]\} \quad (6.2)$$

Equation 3:

$$E\_p\mathrm{Im}p\_e(all,i,IND)wIMmp\_e(i) = p\mathrm{Im}p\_e(i) + x\mathrm{Im}p\_e(i) \quad (6.3)$$

Where

`xImp(e,i)` is the Firm demand for Imports

`pImp(e,i)` is the import prices.

`CESM(i)` is the constant elasticity of substitution between ROW and DRC Imports

`pImp_e(i)` is the price import composite

`xImp_e(i)` is the quantity import composite

`wImp_e(i)` is the expenditure on imports

- Equation (1) represents the trade liberalisation for industry *i*. It is determined by the quantity import composite less the multiplication of the constant elasticity of substitution between ROW and DRC imports, with the differential obtained from subtracting the price import composite from the real import prices.
- Equation (2) represents the expenditure on imports. It includes the sum of import prices with the firm demand for imports multiplied by the firm import cost.
- Equation (3) represents the impact of the import prices. It considers the sum of the price import composite with the quantity import composite.

According to the World Bank (2010), the DRC-applied simple and import weighted tariff averages are classified in the same category with the low income country group means. Therefore tariffs remain a dominant tool through which government can considerably

influence global trade and product market incorporation. Although they are not essentially the primary obstacle to economic incorporation (Anderson and van Wincoop, 2004), tariffs do constrain imports and create a wedge between local and foreign prices.

6.2.2 Closure and shock

We used both short and long run closures. In the short run closure, capital and land are static while labour is in elastic supply at fixed real wages. A constant real wages define employment. When considering the national expenditure, one can assume that the real consumption, real aggregate investment, and real government consumption are constant. An allocation of fixed national investment is preferred across industries following rate of return (ROR). Foreign currency prices of imports are exogenous while the exchange rate is fixed as numeraire. Population is also held constant. Other exogenous variables include changes in technology, price and quantity shift variables.

In the long run closure, one can assume that labour is fully mobile between the formal and informal sectors, however a wage differential is required to stimulate labour movement between the sectors. One can further assume that the national labour supply and population are fixed however ROR is exogenous and capital is not fixed. Foreign currency prices of imports are exogenous; other exogenous variables consist of price and quantity shift variables, rates of production tax and technological coefficients.

In the command file, we perform the shock by setting "pImp (*"ImpROW"*, IND)" = **uniform** -5". As indicated earlier, the 'pImp' represents the import price variable for industry, "ind". The *"ImpROW"* is the import from the rest of the world and "-5" means that import price from the rest of the world is reduced uniformly across industries.

6.3 SIMULATION RESULTS

The results of short run (SR) and long run (LR) policy simulation on various macro-economic variables are reported in Table 6.1. As one would expect, gross domestic product, exports and employment rise. The policy simulation results show that the GDP increases by 0.57 percent and 0.61 percent in the SR and LR respectively from the baseline economy. This means that output increases and domestic prices drop in most sectors, reflecting more efficiency and

lower costs per unit of output. Greater efficiency increases output in all formal sectors resulting in increased real GDP, both in the SR and LR. Given constant real government consumption, the significant level of real GDP allows consumers to enjoy a higher level of consumption. The productivity improvements based on the tariff reduction causes the output prices to decrease, while also causing consumer inflation to decrease by 0.99 percent in the SR. In fact, the advantage of the tariff reduction is that it causes producers to improve competitiveness, which stimulates a considerable improvement in exports following an increase in export volumes by 12.1 percent and 5.73 percent in the SR and LR respectively.

The expectation was that export volumes should increase because tariff reductions play an important role in trade liberalisation. All sectors benefit from a tariff reduction and an increase in exports. It is evident from the macroeconomic results that the fall in the terms of trade holds positive consequences for DRC's exports and therefore also for the country's competitiveness. Furthermore, import volumes increase by 5.63 percent and 5.15 percent in the SR and LR respectively, which in turn improve the productivity capacity by showing an increase in GDP. This result is in line with the findings of previous studies, which show that the DRC economy is very import intensive (World Bank, 2007). The rise in income creates demand for imported goods, however the balance of trade is on the positive side with a slight increase of 1.47 percent and 0.82 percent respectively. Overall, tariff reduction has a considerable impact on GDP and employment. Households in the formal sector can consume more as employment increases in the SR and consumer price levels decline. The results of tariff reductions show output having a significant positive impact on employment in the SR. The expansionary economy, coupled with rising export demand, raises the demand for factors of production. The increase in employment (0.56 percent) represents an increase in labour in production process, especially in the formal sector. Nonetheless, producers can protect their labour force by means of labour saving technological change enhancements. In addition, the unit cost of labour can also be improved through tariff reduction without necessarily reducing the growth rate of the average real wage. In this respect, competitiveness can be stimulated from the production side with a view to shifting from the local market to exports.

Table 6.1: Main macro variables under trade liberalisation policy simulations

Main Macro Variables	Description	Simulation % change	
		Short run	Long run
RealGDP	Real GDP	0.57	0.61
AggEmploy	Employment	0.56	0
AveRealWage	Average Real Wage	0	1.52
ExpVol	Export Volume	12.11	5.73
ImpVol	Import Volume	5.63	5.15
RealHou	Real Household Consumption	0	1.09
RealInv	Investment	0	0
RealGov	Government Consumption	0	0
AggCapStock	Capital Stock	0.69	1.38
AggLand	Land	-0.02	0.9
GDPPI	GDP Price Index	-0.47	1.24
CPI	Consumer Price Effect	-0.99	0.53
ExportPI	Export Price Index	-2.26	-1.11
ImportPI	Import Price Index	-5	-5
BOT_GDP	Contribution of BOT to real GDP	1.47	0.82

The simulation results show that tariff reduction causes employment and production to increase in the formal sector. This is in line with the results of previous studies (Davies and Thurlow, 2010). The total production in the case of the DRC conceals divergent effects for the formal and informal sectors. In this respect the total production increases considerably, showing a similar increase in employment. Consequently, formal sector producers and their workers profit from enhanced penetration in foreign export markets. The increase in the total GDP generates new formal sector employment opportunities in the SR. In the context of the current analysis, tariff reduction stimulated both the formal and informal sectors to enhance trade in the country. Producers from the formal sector profit the most from the policy simulation shock because it is only the formal sector that is involved in foreign exports. Thus while production increases in the formal sector, it decreases in the informal sector due to the greater import competition. Usually the informal sector does not access foreign export markets directly - rather, tariff reduction can adjust the structure of the informal sector. In this respect, opportunity is given to the informal sector to grow in employment from the informal traders to the formal traders. This is consistent with the observation that the DRC has a large informal sector and a substantial informal trader sector (World Bank, 2010).

As reported in Table 6.2, the tariff reduction policy simulations show the changes in sectoral output. The overall economic impact of the tariff reduction has positive results on all formal sectors and negative results on a large number of informal sectors. The policy simulation results demonstrate that all formal sectors benefit from an import price reduction, for instance the formal sectors which benefit the most from the shock are transport and communications (17.4 percent in SR and 13.27 percent in LR), private services (12.4 percent in SR and 5.86 percent in LR), mining (3.2 percent in SR and 3.0 percent in LR) and manufacturing (2.5 percent in SR and 3.78 percent in LR) (see the first column in Table 6.2). The rise in output in the formal sector was especially driven by intensifying exports. This creates more opportunities for jobs in the formal sector, where skilled and semiskilled workers can be absorbed in those sectors which improve their output. It is further noticed that the demand for informally employed workers expanded in the formal sector, even though this profits mostly unskilled workers.

Table 6.2: Sectoral production under trade liberalisation policy shock

Sector	xTot		xExp		xFac_f		xHou	
	SR	LR	SR	LR	SR	LR	SR	LR
AGRIC_F	0.62254	0.37303	5.22391	-4.24057	0.55000	0.17276	0.01751	0.74593
AGRIC_I	0.06477	0.31318	3.14658	-3.73461	0.06000	0.27186	-0.38056	0.85217
LIVES_F	0.99930	0.23752	3.55698	-1.96158	0.98000	0.16563	-0.30141	1.22097
LIVES_I	-0.33145	0.41529	3.23156	-6.32448	-0.33000	0.38235	-0.36415	0.30358
MININ_F	3.18540	3.00103	6.75183	5.88937	2.72000	2.56516	0.30630	2.79256
MININ_I	0.07926	0.59079	0.43427	-0.18078	0.06000	0.59555	-0.91007	1.58604
FOOD_F	0.37837	0.99883	6.63516	-1.72773	0.14000	0.55594	0.28437	1.26921
FOOD_I	-0.37935	0.57101	3.09557	-5.18342	-0.38000	0.46909	-0.39041	0.54676
CLOTH_F	1.37188	1.92685	10.14438	2.56361	0.81000	0.90528	0.93589	2.13859
CLOTH_I	-0.38684	0.66927	2.84122	-4.79184	-0.40000	0.56876	-0.43961	0.62967
MANUF_F	2.48637	3.78257	21.28887	19.02470	1.20000	1.91943	2.90047	5.22493
MANUF_I	0.16684	0.93062	2.54951	-1.80437	0.10000	0.82266	-0.49615	1.25341
EQUIP_F	0.92135	0.89208	26.39973	26.29245	-0.64000	-0.64681	3.75341	6.47967
EQUIP_I	0.80600	1.45513	3.34941	0.73765	0.62000	1.31868	-0.34141	1.77230
UTILI_F	1.74456	2.30274	5.33929	-0.18164	1.46000	1.96769	0.03943	1.58587
UTILI_I	0.29666	0.20777	0.00000	0.00000	0.44000	0.31026	-0.99591	1.62281
CONST_F	0.19374	0.12133	7.75023	5.33929	-0.07000	-0.09137	0.49323	2.68554
CONST_I	-0.05607	0.32476	3.79911	-1.45031	-0.08000	0.17267	-0.25483	1.32632
TRADE_F	0.62061	0.59722	0.84844	-0.19272	0.58000	0.59458	-0.82848	1.58362
TRADE_I	-0.02514	0.57716	1.31009	-1.34578	-0.07000	0.60607	-0.73785	1.34781
HOTEL_F	1.85051	0.98666	4.33078	-0.70400	1.64000	0.85460	-0.15286	1.47932
HOTEL_I	-0.32846	0.90081	2.42041	-2.97407	-0.41000	0.91205	-0.52122	1.01103
TRANS_F	17.37035	13.27777	21.07958	16.11516	15.94000	10.94886	2.86493	4.70538
TRANS_I	0.16623	0.45391	1.55120	-1.17916	0.11000	0.48448	-0.69065	1.38202
ESTAT_F	0.88100	0.81850	5.79663	-10.29642	0.80000	0.25584	0.12615	-0.56182
ESTAT_I	-0.11541	0.39692	4.04634	-6.99481	-0.09000	0.14703	-0.20736	0.15962
ADMIN_F	1.45132	0.43370	7.64412	-3.03621	1.28000	0.03770	0.47343	0.99808
ADMIN_I	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.99591	1.62281
PRIVS_F	12.40923	5.86170	16.21125	7.39430	11.42000	4.00584	2.02410	3.08310
PRIVS_I	-0.11584	0.78029	2.32002	-2.85418	-0.16000	0.73599	-0.54073	1.03597

Simulation results show that tariff reduction increases demand for imported goods. The largest tariffs in 2007 were in the textile and clothing sector. In this respect, this sector would be exposed to the biggest rise in import competition when tariffs are reduced. In the SR the output of textiles and clothing increases by 1.37 percent for the formal sector and declines by 0.39 percent for the informal sector (see the first column in Table 6.2). The main reason could be that the producers from the textile and clothing sector in both the formal and informal sectors are negatively impacted by inexpensive imported goods. In fact, the general rise in imports has macroeconomic connotations, because it creates a burden to the current

account balance which is supposed to be fixed in a foreign currency. Nonetheless, foreign import demand and foreign exports increased as the real exchange rate is fixed in the SR. Consequently production increased in non-textile sectors, which are equipment and machinery, livestock, food processing and manufacturing. In view of this, the formal sector producers of food processing (0.38 percent in SR and 0.99 percent in LR), equipment and machinery (0.92 percent in SR and 0.89 percent in LR), livestock (0.99 percent in SR and 0.23 percent in LR) and manufacturing (2.48 percent in SR and 3.78 percent in LR) products benefit the most, as the informal sector producers are not directly involved in foreign exports.

Table 6.3 shows changes in employment under tariff reduction policy simulations in the SR. It reflects a diverse distributional effect from tariff reduction shock for formal and informal sectors. The increase in employment among formal producers is due to the growth in formal sector production. The main beneficiaries of this growth are the skilled and semi-skilled formal producers and workers operating extensively in the transport and communications (17.4 percent), private services (12.4 percent), mining (3.2 percent) and manufacturing (2.48 percent) sectors. The main losers include unskilled people in the formal sector and all the skilled, semi-skilled and unskilled people in the informal sector. Although employment decreases in the informal sector due to tariff reduction, more job opportunities have been created in the formal sector. The formal sector will demand more jobs with a possibility of them absorbing unemployed people from the labour market.

The policy simulation results demonstrate that policy makers should consider policies which promote employment creation both in the formal and informal sectors. The unskilled in both sectors include child labour and female subsistence workers, as evidenced in the DRC's labour markets. The decrease in the informal sector's output and foreign import prices means that consumers from the informal sector have to depend on foreign imported products. The change in consumer preferences then stimulates the intensity of commerce between the informal and formal sectors. The traders from the informal sector benefit the most through the collection of fixed transaction margins from the trade's volume. In contrast, employment decreases in the informal sector, especially amongst the skilled, semi-skilled and unskilled, due to tariff reduction. Another reason is that the informal sector has more unemployed people when compared with the formal sector. While the semi-skilled and skilled from the formal sector receive improvements in their incomes, those in the informal sector suffer from

diminishing incomes. As a result, the decrease in incomes noticed in the poorer households is due to a decrease in the incomes from the informal sector.

Table 6.3: Changes in employment under trade liberalisation policy simulations

	Base employment (1,000s)	Change in employment from base (%)
Formal sector		
Unskilled (FSUB)	324	-0.31
Unskilled (LCHILD)	231	-0.25
Semiskilled (FEMLAB)	867	0.01
Skilled (MALELAB)	974	0.52
Informal sector		
Unskilled (FSUB)	5998.2	-0.94
Unskilled (LCHILD)	1532	-1.05
Semiskilled (FEMLAB)	122	-0.96
Skilled (MALELAB)	23	-0.89

Table 6.4 reports the results of the policy shock on the household incomes in the SR. It shows a general decrease across the informal sector in real household disposable incomes because of declining employment. Nonetheless, impacts across household groups differ considerably. For instance, high wage employment composed of male labour increased by 0.52 percent in the formal sector, while it decreased by 0.89 percent in the informal sector. The same trend was observed in the category of medium wage employment, where female labour increased by 0.01 percent in the formal sector and decreased by 0.96 percent in the informal sector. Low wage employment composed of child labour and female subsistence workers decreased across both the formal and informal sectors. Previous studies from countries such as South Africa established that trade liberalisation profited households from the middle income category (Thurlow, 2007; Pauw *et al.,* 2006). The findings of this research are consistent with the previous study (Thurlow, 2007), as incomes increase for middle and high salary income groups in the formal sector, but fall for the low income group which is composed of child labour and female subsistence workers. The simulation results show that efficient tariff

reduction must be promoted in the DRC with view to narrow the income gap between high and low income households, and between formal and informal sectors.

Table 6.4: Changes in incomes under trade liberalisation policy simulations

Employment by occupation	Description	Formal sector	Informal sector
MALELAB	High wage employment (Male)	0.52	-0.89
FEMLAB	Medium wage employment (Female)	0.01	-0.96
LCHILD	Low wage employment (Child)	-0.25	-1.05
FSUB	Low wage employment (Female sub)	-0.31	-0.94

In brief, tariff reduction has diverse effects for the formal and informal sectors in the DRC. It considerably increases the output of, and employment in, the formal sector, by increasing import competition without offering further opportunities for the informal sector to penetrate foreign export markets. The formal sector is stimulated and can therefore act based on the current foreign market opportunities as its output increases. In addition, tariff reduction adjusts the structure of the informal sector by tightening product market freedom for informal sectors, expanding opportunities for informal traders, and motivating workers from the informal sector to seek decent jobs in the formal sector. Despite the negative impact that tariff reduction may have on the informal sector, which sheds jobs, there are still new job opportunities in the formal sector. This emphasises the need for policies to stimulate further job creation and improve incomes among low income households.

6.4 CONCLUSION AND POLICY IMPLICATION

This chapter evaluates the DRC's tariff reduction effects on formal and informal production and employment. An empirical DRCFIM was used to perform a policy simulation. In particular, this study draws the attention of policy makers to a different employment outcome when tariff reduction policy is taken into consideration. Tariff reductions increase formal employment and output, but hurt informal producers as the output decreases in sectors such as livestock and clothing in the informal sector. It considerably increases the output and employment of the formal sector by raising import competition, without proposing further opportunities for the informal sector to access foreign export markets. Furthermore, it induces productivity improvements when local producers survive import competition by seeking input-saving technologies and production practices. The formal sector is stimulated to boost

exports based on the new foreign market opportunities as its output increases. In addition, tariff reduction adjusts the structure of the informal sector by tightening market freedom and motivating informal workers to seek decent jobs in the formal sector. Despite the negative impact that tariff reductions may have on the informal sector, there are still new employment opportunities in the formal sector. This emphasises the need for policies to stimulate more employment creation and improve incomes among low income households. These results highlight the consequence of differentiating between formal and informal sector socioeconomic policies.

Regarding the welfare issues related to tariff reduction policy, as the consumption increases across all households in the DRC it means that the tariff reduction has a positive effect on welfare distribution. Considering the DRC's welfare issues, such a policy seems appropriate to policy makers. The researcher's policy simulation results show that the DRC Government can deal with welfare issues by applying tariff reductions to products. Household demand shows mixed results however, as only the high income households from the formal sector benefited as a result of the tariff reduction across sectors.

Finally, the DRC's government may have failed in the past to consider the success of tariff-reduction in generating a dynamic export industry, but it is not too late to do so now. Committing openly to reducing tariffs would make a significant contribution to increasing the global competitiveness of the DRC economy, as well as reminding the DRC that there is still a considerable distance to travel before the economic health of the country produces the level of prosperity expected by the community.

CHAPTER 7: SUMMARY AND CONCLUSIONS

7.1 SUMMARY

This study aimed to assess the linkage between the formal and informal sectors in the DRC. Given the prevalence of wars and other social challenges, the informal sector has grown considerably and accounts for more than 80 percent of economic activities (World Bank, 2009). In such a context, the dynamics of the relationship between the formal and informal sectors is important for policy making. No study, to the researcher's knowledge, has ever assessed the linkage between the formal and informal sectors in the DRC. This study contributes to the literature by constructing a new SAM that accounts for the linkage between the two sectors in the DRC. In addition, a CGE model is built to assess policy issues related to the linkage between the formal and informal sectors.

Chapter 2 reviewed various techniques used to assess the informal sector. It showed that the assessment of the informal sector can be done through direct and indirect techniques. Direct techniques include household surveys, labour force surveys and other specific surveys, while indirect techniques for the assessment of the informal sector make use of macro-model techniques, global indicator techniques, monetary techniques and dormant variable techniques. More interest was given to the direct technique because it collects reliable data on the informal sector. It provides sufficient information both on the macro and micro-economic issues in the country.

Chapter 3 provided a comprehensive, disaggregated, consistent and complete database, which captured the interdependence that exists within the DRC's socio-economic system. The comprehensive database was presented in a SAM which was used to assess the informal sector in terms of activities and employment factors, and to capture both formal and informal linkages in product and labour markets within the entire economy of the DRC. This SAM is an economy-wide database that captured all monetary flows from the DRC's economy during 2007. It was constructed from various data sources taken from national accounts, household surveys, and labour force surveys. The 2007 SAM consisted of comprehensive data on

demand and supply for 15 activities or commodities in each of the formal and informal sectors. Four labour groups were specifically identified in the formal and informal sectors, namely: (1) subsistence factor, (2) child labour, (3) female adult labour, and (4) male adult labour. The household sector of 2007-SAM was disaggregated according to income into rural and urban areas, with four groups in each of the formal and informal sectors, i.e. (1) rural poor households, (2) rural non poor households, (3) urban poor households, and (4) urban non poor households. The land component was also divided between the formal and informal sector. Indeed, the 2007-SAM was used as a database for the Computable General Equilibrium (CGE) model developed in Chapter 4.

Chapters 2 and 3 set the scene for the construction of the CGE model as an instrument to assess the role of the informal sector in the DRC economy. Chapter 4 developed a CGE model for the DRC Formal-Informal Economy (DRCFIM). The model captured the observed structure of the DRC's formal and informal sectors, as well as the numerous transmission networks linking their various economic agents. It is a multi-sectoral empirically calibrated general equilibrium model capturing both product and labour markets. DRCFIM is a system of equations and contains profit maximising or cost minimising firms, utility maximising households, investors, government, and an overseas sector. The parameters of this DRCFIM equation were calibrated to observed data from the DRCDSAM developed in Chapter 3.

Chapters 5 and 6 provided the application of the DRCFIM model developed in Chapter 4. Two policy simulations were performed to analyse the economy-wide linkages between the formal and informal sectors, while accounting for different types of informal activities. The first policy simulation related to land use and the second focused on trade liberalisation in the DRC. In tracing the impact of the first shock applied to land use on the economy, as expected, gross domestic product and employment increased. The slight increase in employment was due to the land subsidy, which stimulated the activity level both in the formal and informal sectors. The second policy shock related to the trade liberalisation showed that formal employment and output increased, but not in favour of informal producers, as the output decreased in some areas of the informal sector. It considerably increased the output and employment of the formal sector by increasing import competition,

without providing further opportunities for the informal sector to access foreign export markets.

7.2 POLICY IMPLICATION

It is important to mention that the role of the informal sector in the DRC economy was evaluated through a computable general analysis. However, based on the two policy issues, there was a need to find out whether the government could provide a land use subsidy and trade liberalisation without worsening the issues that still persist in the economy. An overview of the "Formal-Informal Sector" and the "CGE model" showed that, under certain conditions, economic growth could be accomplished by designing formal-informal sector policies. The formal-informal sector literature highlighted the significance of efficient redistribution of revenue raised through the policy and the role of informal sector in the economy. The government could resolve this problem by granting a subsidy for land use and promoting trade liberalisation. This motivated the kind of policy shocks which were performed in this study. These policy shocks were chosen in order to get an indication of the role of the informal sector in the DRC economy and to advise policy makers accordingly.

Considering the land use subsidy, policy makers should be committed to sustainable land use in the DRC. The transparency in setting land use prices could be best resolved by the government granting subsidies for land use and the labour market, which could reap positive benefits. The simulation results give an insightful indication for future land use planning by policy makers. It was tested within a short run framework by performing a 10 percent price reduction in that specific land use.

Regarding a trade liberalisation policy, as consumption increases across all households in the DRC, it means that tariff reduction has a positive effect on welfare distribution. Considering the DRC's welfare issues, such a policy seems appropriate. Our policy simulation results show that the DRC Government can deal with the welfare issues by applying tariff reductions on products. Household demand showed mixed results; only high income households from the formal sector benefited as a result of the tariff reduction across sectors. In this respect, policymakers should rather consider both labour and production market conditions when developing policies to address the DRC's competitiveness and unemployment challenge.

7.3 CONCLUSIONS

This study has made three essential contributions:

- Firstly, it assessed linkages between the formal and informal sectors by means of the Social Accounting Matrix.
- Secondly, it provided a comprehensive, disaggregated, consistent and complete database that captures the interdependence that exists within the DRC's socio-economic system. A SAM that incorporates formal and informal sectors was constructed and used as a conceptual framework to empirically explore the linkages between the formal and informal sectors in the DRC's economy.
- Thirdly, it provided a workable tool and contributed toward analysing a real policy question in the country. It applied the CGE model to provide answers to the crucial issues currently affecting the DRC's economy. These issues include the high level of unemployment caused by the underperforming formal sector and ineffectiveness of the unemployed to penetrate labour markets. Two policy simulations related to land use and trade liberalisation were performed in this study in order to assess the impact of the informal sector on the total economy of the DRC. As far as policy is concerned, the simulation results have proven useful in guiding policy makers on the dynamics of the linkages, as well as developing and encouraging the continuum of the formal-informal sectors further.

7.4 SUGGESTIONS FOR FURTHER RESEARCH

Although these results hold significant consequences for policy makers, the analysis could be extended. Scope for further research on the role of the informal sector in the DRC economy is to be encouraged. This study has shown that it is now possible to quantify the linkages between the formal and informal sectors. Future research should attempt to update the Democratic Republic of Congo Formal-Informal sector (DRCFIM) model database by including more sectors and further disaggregating some accounts within the SAM, however this depends on the accuracy and availability of socio-economic data. The model developed in this study is indeed a powerful economic tool to analyse other policy issues in the various socioeconomic areas in the DRC. The policy simulation results can also be implemented to determine whether the DRCFIM model is the most adequate tool to assess the interaction

between the formal and informal sectors. The government will need to take into account a number of factors when considering policies for the informal sector. Therefore, the role of the informal sector can be expanded and viewed in terms of savings, investment and other identities – not only GDP. The techniques used to develop the DRCFIM model are properly documented for the development of other models to be used for various purposes.

APPENDIX A: DRC FORMAL-INFORMAL MODEL (DRCFIM)

```
!note: this model recognises informal and formal land!
File
         INFILE # Input file #;
  (new) SUMMARY # Output file #;

Set   ! Construct set of SAM row labels!
 COM # Commodities # read elements from file INFILE header
"SEC";
 LAB # Labour types # read elements from file INFILE header
"LAB";
 CAP # Capital # (CAPAG_F, CAPAG_I, CAPNAG_F, CAPNAG_I);
 LAND # Capital # ( LAND_F,LAND_I);
 FAC # Primary Factors #
(FSUB_F,FSUB_I,LCHILD_F,LCHILD_I,FEMLAB_F,FEMLAB_I,
MALELAB_F,MALELAB_I, CAPAG_F, CAPAG_I, CAPNAG_F, CAPNAG_I,
LAND_F,LAND_I );
 INPUTS = COM + FAC;
 MOREROWS(Hou, Tax, Sav, ImpROW, ImpDRC);
! ImpDRC: imports from rest of DRC; ImpROW: imports from rest
of world!
 SAMROWS = INPUTS + MOREROWS;
Subset CAP is subset of FAC;
Subset LAND is subset of FAC;
Subset LAB is subset of FAC;

Set   ! Construct set of SAM col labels!
 IND # Industries # read elements from file INFILE header
"SEC";
 AAX = IND + FAC;
 FINDEM (Hou, Gov, Inv, ExpROW, ExpDRC);
 SAMCOLS = AAX + FINDEM;
```

```
Coefficient (all,r,SAMROWS)(all,c,SAMCOLS) SAM(r,c) # DRC SAM
#;
Read  SAM from file INFILE header "OSAM";
Write SAM to file SUMMARY header "OSAM" longname "DRC SAM";

! Check SAM balance!
Set SAMCHK (RowTot,ColTot,Diff,Percent);
Coefficient (all,r,SAMROWS)(all,s,SAMCHK) SAMCHEK(r,s) # SAM
balance check #;
Mapping ROWTOCOL from SAMROWS to SAMCOLS;
Formula (all,r,SAMROWS) ROWTOCOL(r) = $pos(r); ! identity
mapping!
Formula
(all,r,SAMROWS) SAMCHEK(r,"RowTot") = sum{c,SAMCOLS,
SAM(r,c)};
(all,r,SAMROWS) SAMCHEK(r,"ColTot") = sum{rr,SAMROWS,
SAM(rr,ROWTOCOL(r))};
(all,r,SAMROWS) SAMCHEK(r,"Diff")    = SAMCHEK(r,"RowTot")-
SAMCHEK(r,"ColTot");
(all,r,SAMROWS) SAMCHEK(r,"Percent")=
100*SAMCHEK(r,"Diff")/SAMCHEK(r,"ColTot");
Write SAMCHEK to file SUMMARY header "SAMC";
!Assertion # Check SAM balance # (all,r,SAMROWS)
ABS[SAMCHEK(r,"Percent")]<0.1;!

! Primary Factor CES nest!
Coefficient (all,i,IND) VFAC(i) # Firm Factor cost #;
Formula     (all,i,IND) VFAC(i) = sum{f,FAC, SAM(f,i)};
Coefficient (parameter) (all,i,IND) CESPRIM(i) # CES between
primary Factors #;
Read CESPRIM from file INFILE header "CESP";

Variable
(all,f,FAC)(all,i,IND) xFac(f,i) # Firm demand for Factors #;
```

```
(all,f,FAC)(all,i,IND) pFac(f,i) # Factor prices #;
(all,f,FAC)(all,i,IND) aFac(f,i) # Factor tech change #;
(all,i,IND) pFac_f(i) # Effective price of value-added
composite #;
(all,i,IND) xFac_f(i) # Quantity value-added composite #;
(all,i,IND) wFac_f(i) # Expenditure on Factors by firms #;

Update (all,f,FAC)(all,i,IND) SAM(f,i) = pFac(f,i)*xFac(f,i);

Equation
E_xFac (all,f,FAC)(all,i,IND)
 xFac(f,i) = xFac_f(i) + aFac(f,i) -
CESPRIM(i)*[pFac(f,i)+aFac(f,i)-pFac_f(i)];

E_wFac_f (all,i,IND)
 ID01[VFAC(i)]*wFac_f(i) = sum{f,FAC,
SAM(f,i)*[pFac(f,i)+xFac(f,i)]};

E_pFac_f (all,i,IND) wFac_f(i) = pFac_f(i) + xFac_f(i);

Backsolve pFac_f using E_pFac_f;
Backsolve wFac_f using E_wFac_f;

! CES between Imports form ROW and DRC!
Set IMP(ImpROW, ImpDRC);
Subset IMP is subset of SAMROWS;
Coefficient  (all,i,IND) VIMP(i) # Firm Import cost #;
Formula  (all,i,IND) VIMP(i) = sum{e,IMP, SAM(e,i)};
Coefficient (parameter) (all,i,IND) CESM(i) # CES between ROW
and ROB Imports #;
Read CESM from file INFILE header "CESM";
Variable
(all,e,IMP)(all,i,IND) xImp(e,i) # Firm demand for Imports #;
(all,e,IMP)(all,i,IND) pImp(e,i) # Import prices #;
```

```
(all,i,IND) pImp_e(i) # Price Import composite #;
(all,i,IND) xImp_e(i) # Quantity Import composite #;
(all,i,IND) wImp_e(i) # Expenditure on Imports #;

Update (all,e,IMP)(all,i,IND) SAM(e,i) = pImp(e,i)*xImp(e,i);

Equation
E_xImp (all,e,IMP)(all,i,IND)
     xImp(e,i) = xImp_e(i) - CESM(i)*[pImp(e,i)-pImp_e(i)];

E_wImp_e (all,i,IND)
  ID01[VIMP(i)]*wImp_e(i) =  sum{e,IMP,
SAM(e,i)*[pImp(e,i)+xImp(e,i)]};

E_pImp_e (all,i,IND) wImp_e(i) = pImp_e(i) + xImp_e(i);

Backsolve xImp using E_xImp;
Backsolve pImp_e using E_pImp_e;

! Intermediate Leontief nest!
Coefficient (all,i,IND) VINT(i) # Firm Intermediate cost #;
Formula     (all,i,IND) VINT(i) = sum{c,COM, SAM(c,i)};

Variable
(all,c,COM)(all,i,IND) x(c,i) # Intermediate demands for Local
goods #;
(all,c,COM)(all,i,IND) a(c,i) # Tech change, firm demands for
Local goods #;
(all,c,COM) pLoc(c)     # Prices of Locally produced goods #;
(all,i,IND) xLocInt(i) # Intermediate quantity index #;
(all,i,IND) pLocInt(i) # Effective Intermediate price index #;
(all,i,IND) wLocInt(i) # Expenditure on Intermediate inputs #;

Update (all,c,COM)(all,i,IND) SAM(c,i) = pLoc(c)*x(c,i);
```

```
Equation
E_x (all,c,COM)(all,i,IND) x(c,i) = xLocInt(i) + a(c,i);

E_wLocInt (all,i,IND) ID01[VINT(i)]*wLocInt(i) =
                        sum{c,COM, SAM(c,i)*[pLoc(c)+x(c,i)]};

E_pLocInt (all,i,IND) wLocInt(i) = pLocInt(i) + xLocInt(i);

Backsolve x using E_x;
Backsolve pLocInt using E_pLocInt;

! top nest!
Coefficient  (all,i,IND) VCST(i) # Firm Total cost, ex Net VAT
#;
Formula  (all,i,IND) VCST(i) = VINT(i) + VIMP(i) + VFAC(i);
Coefficient (parameter) (all,i,IND) CEST(i) # Top level firm
CES #;
Read CEST from file INFILE header "CEST";
Variable
(all,i,IND) xTot(i) # Output, ind i #;
(all,i,IND) aTot(i) # Neutral tech change, ind i #;
(all,i,IND) w1Cst(i) # Cost of inputs, ind i #;
(all,i,IND) p1Cst(i) # Price, ind i, ex Tax #;

Equation
E_xLocInt (all,i,IND) xLocInt(i) = xTot(i) + aTot(i)
                                    - CEST(i)*[pLocInt(i)-
p1Cst(i)];
E_xImp_e  (all,i,IND) xImp_e(i)  = xTot(i) + aTot(i)
                                    - CEST(i)*[pImp_e(i)-
p1Cst(i)];
E_xFac_f  (all,i,IND) xFac_f(i)  = xTot(i) + aTot(i)
                                    - CEST(i)*[pFac_f(i)-
```

```
p1Cst(i)];
E_w1Cst    (all,i,IND) VCST(i)*w1Cst(i) =
    VINT(i)*wLocInt(i) + VIMP(i)*wImp_e(i) +
VFAC(i)*wFac_f(i);

E_p1Cst    (all,i,IND) w1Cst(i) = p1Cst(i) + xTot(i);

! Add in VAT!
Coefficient  (all,i,IND) VTOT(i) # Firm Total cost, Inc Net
VAT #;
Formula      (all,i,IND) VTOT(i) = VCST(i) + SAM("Tax",i);
Variable
                  rVAT # % Change in ad valorem rate of VAT #;
(all,i,IND) pTot(i)     # Price Inc VAT #;
(all,i,IND) wprodTax(i) # Net VAT cost #;

Update  (all,i,IND) SAM("Tax",i) = wprodTax(i);

Equation ! VAT Interpreted as Tax on primary costs!
E_wprodTax (all,i,IND) wprodTax(i) = rVAT + wFac_f(i);

E_pTot (all,i,IND)
VTOT(i)*[pTot(i)+xTot(i)] = VCST(i)*w1Cst(i) +
SAM("Tax",i)*wprodTax(i);

Backsolve wprodTax using E_wprodTax;

! Constant Elasticity of demand for Exports to ROW and DRC!
Set EXP (ExpROW, ExpDRC);
Subset EXP is subset of SAMCOLS;

Coefficient (parameter)
  (all,c,COM)(all,e,EXP) EXPELAST(c,e) # Export demand
elasticities #;
```

```
Read EXPELAST from file INFILE header "XLST";
Variable
(all,c,COM)(all,e,EXP) xExp(c,e) # Exports #;
(all,c,COM)(all,e,EXP) fpExp(c,e) # Export demand shift #;

Update (all,c,COM)(all,e,EXP) SAM(c,e) = xExp(c,e)*pLoc(c);

Equation E_xExp
(all,c,COM)(all,e,EXP) xExp(c,e) = -
ABS[EXPELAST(c,e)]*[pLoc(c)-fpExp(c,e)];
Backsolve xExp using E_xExp;

! Cobb-Douglas Household demands!
Variable
(all,c,COM) xHou(c) # Household demands #;
 wTotHou # Household spending on goods #;
Update (all,c,COM)  SAM(c,"Hou") = xHou(c)*pLoc(c);

Equation E_xHou (all,c,COM) pLoc(c) + xHou(c)= wTotHou;

! Investment and Government demands are exogenous!

Variable
(all,c,COM) xGov(c) # Gov demands #;
(all,c,COM) xInv(c) # Inv demands #;
Update
(all,c,COM)  SAM(c,"Gov") = xGov(c)*pLoc(c);
(all,c,COM)  SAM(c,"Inv") = xInv(c)*pLoc(c);

! Market clearing!
Coefficient (all,c,COM) SALES(c) # Sales of Local good #;
Formula     (all,c,COM) SALES(c) = sum{i,IND,SAM(c,i)} +
sum{f,FINDEM,SAM(c,f)};
```

```
Set SEC = COM Intersect IND;
Equation
 E_pLoc (all,s,SEC) pLoc(s) = pTot(s);

 E_xTot (all,c,SEC) SALES(c)*xTot(c) = sum{i,IND,
SAM(c,i)*x(c,i)}
   + SAM(c,"Hou")*xHou(c) + SAM(c,"Inv")*xInv(c)
   + SAM(c,"Gov")*xGov(c)  + sum{e,EXP,SAM(c,e)*xExp(c,e)};

Backsolve pTot using E_pTot;

! GDP from expenditure side: price, quantity and value
components!

Set GDPEXP = FINDEM + IMP;
Subset EXP is subset of GDPEXP;
Set TOTAL (TOTAL);
Set GDPEXPALL = GDPEXP + TOTAL;
Coefficient
               VGDPEXP         # Expenditure side GDP #;
(all,g,GDPEXP) VGDPEXPBITS(g)  # Components of Expenditure side
GDP #;
Formula
(all,g,FINDEM) VGDPEXPBITS(g) = sum{c,COM, SAM(c,g)};
(all,g,IMP)    VGDPEXPBITS(g) = - sum{i,IND, SAM(g,i)};
               VGDPEXP = sum{g,GDPEXP, VGDPEXPBITS(g)};

Write VGDPEXPBITS to file SUMMARY header "GDPE";
Set INDX (Price,Quantity,Value);
Variable
(all,g,GDPEXPALL)(all,i,INDX) gdpExpBits(g,i) # Indices
Expenditure side GDP #;
Equation
E_gdpExpBitsA (all,g,FINDEM)
```

```
    VGDPEXPBITS(g)*gdpExpBits(g,"price") = sum{c,COM,
SAM(c,g)*pLoc(c)};
E_gdpExpBitsB (all,g,IMP)
    VGDPEXPBITS(g)*gdpExpBits(g,"price") = - sum{i,IND,
SAM(g,i)*pImp(g,i)};
E_gdpExpBitsC
 VGDPEXPBITS("Hou")*gdpExpBits("Hou","quantity")
  = sum{c,COM, SAM(c,"Hou")*xHou(c)};
E_gdpExpBitsD
 VGDPEXPBITS("Gov")*gdpExpBits("Gov","quantity")
  = sum{c,COM, SAM(c,"Gov")*xGov(c)};
E_gdpExpBitsE
 VGDPEXPBITS("Inv")*gdpExpBits("Inv","quantity")
  = sum{c,COM, SAM(c,"Inv")*xInv(c)};
E_gdpExpBitsF (all,g,EXP)
    VGDPEXPBITS(g)*gdpExpBits(g,"quantity") = sum{c,COM,
SAM(c,g)*xExp(c,g)};
E_gdpExpBitsG (all,g,IMP)
    VGDPEXPBITS(g)*gdpExpBits(g,"quantity") = - sum{i,IND,
SAM(g,i)*xImp(g,i)};
E_gdpExpBitsH (all,g,GDPEXP)
 gdpExpBits(g,"value") = gdpExpBits(g,"price") +
gdpExpBits(g,"quantity");
E_gdpExpBitsI (all,i,INDX)
 VGDPEXP*gdpExpBits("Total",i) = sum{g,GDPEXP,
VGDPEXPBITS(g)*gdpExpBits(g,i)};

Variable wgdpExp # Nominal GDP from Expenditure side #;
Equation E_wgdpExp wgdpExp = gdpExpBits("Total","value");

! Total Export and Import Price Indices!
Variable
 xExpTot # Total (ROW+ROB) export volume #;
 pExpTot # Total (ROW+ROB) export price index #;
```

```
 xImpTot # Total (ROW+ROB) import volume #;
 pImpTot # Total (ROW+ROB) import price index #;
Equation
 E_xExpTot sum{c,COM, sum{e,EXP, SAM(c,e)*[xExp(c,e)-
xExpTot]}}=0;
 E_pExpTot sum{c,COM, sum{e,EXP, SAM(c,e)*[pLoc(c)-
pExpTot]}}=0;
 E_xImpTot sum{i,IND, sum{g,IMP, SAM(g,i)*[xImp(g,i)-
xImpTot]}}=0;
 E_pImpTot sum{i,IND, sum{g,IMP, SAM(g,i)*[pImp(g,i)-
pImpTot]}}=0;

Set ITAX (ITAX);
Set GDPINC = FAC + ITAX;
Coefficient
               VGDPINC         # Income side GDP #;
(all,g,GDPINC) VGDPINCBITS(g) # Components of Income side GDP
#;
Formula
(all,f,FAC)    VGDPINCBITS(f) = sum{i,IND, SAM(f,i)};
          VGDPINCBITS("ITax") = sum{i,IND, SAM("Tax",i)};
                      VGDPINC = sum{g,GDPINC, VGDPINCBITS(g)};
Write VGDPINCBITS to file SUMMARY header "GDPI";

Variable wgdpInc # Nominal GDP from Income side #;
Equation E_wgdpInc
VGDPINC*wgdpInc = sum{i,IND, VFAC(i)*wFac_f(i) +
SAM("Tax",i)*wprodTax(i)};

! CPI and IPI!
Variable pTotHou # CPI - consumer price index #;
Equation e_pTotHou pTotHou = gdpExpBits("Hou","price");
Variable pTotInv # IPI - Investment price index #;
Equation e_pTotInv pTotInv = gdpExpBits("Inv","price");
```

```
Variable xTotHou # Aggregate real household consumption #;
Equation e_xTotHou xTotHou = gdpExpBits("Hou","quantity");

! Factor Markets - allow wage or supply to be fixed!
Variable
(all,f,FAC)(all,i,IND) fFac(f,i) # Real Factor price shift #;
(all,f,FAC) fFac_i(f) # All-Industry Real Factor price shift
#;
(all,f,FAC) xFac_i(f) # Total Factor use, wage-weighted #;
(all,f,FAC) wFac_i(f) # Gross Income of Factors from industry
#;
(all,f,FAC) pFac_i(f) # Average wage to factors #;
            aveWage # Average labour wage #;
            aveRealWage # Average labour real wage #;
            xLab_i # Total Labour use, wage-weighted #;
            xCAP_i # Total Labour use, wage-weighted #; !DNL!
            xLand_i # Total Labour use, wage-weighted #; !DNL!
Equation
 E_fFacA  (all,f,LAB)(all,i,IND) pFac(f,i) = fFac(f,i) +
fFac_i(f) + pTotHou;
 E_fFacB  (all,f,CAP)(all,i,IND) pFac(f,i) = fFac(f,i) +
fFac_i(f) + pTotInv;

 E_fFacC  (all,f,LAND)(all,i,IND) pFac(f,i) = fFac(f,i) +
fFac_i(f) + pTotHou;

 E_xFac_i (all,f,FAC)     sum{i,IND,SAM(f,i)*[xFac_i(f) -
xFac(f,i)]} = 0;
 E_pFac_i (all,f,FAC)     sum{i,IND,SAM(f,i)*[pFac_i(f) -
pFac(f,i)]} = 0;
 E_wFac_i (all,f,FAC)     wFac_i(f) = pFac_i(f) + xFac_i(f);
 E_aveWage sum{f,LAB,sum{i,IND, SAM(f,i)*[aveWage -
pFac(f,i)]}} = 0;
 E_aveRealWage aveRealWage = aveWage - pTotHou;
```

```
 E_xLab_i sum{f,LAB,sum{i,IND, SAM(f,i)*[xLab_i - xFac(f,i)]}}
= 0;
E_xCap_i sum{f,CAP,sum{i,IND, SAM(f,i)*[xCap_i - xFac(f,i)]}}
= 0;
E_xLand_i sum{f,LAND,sum{i,IND, SAM(f,i)*[xLAND_i -
xFac(f,i)]}} = 0;

!
Input-Output Closure (all factors in elastic supply at fixed
price)
    exogenous pFac(f,i) fFac_i(f)   endogenous: fFac(f,i)
xFac(f,i)
Short-Run ORANI closure (capital usage fixed by sector, fixed
real wage)
   Labour:    exogenous fFac(f,i) fFac_i(f)   endogenous:
pFac(f,i) xFac(f,i)
   Capital:   exogenous xFac(f,i) fFac_i(f)   endogenous:
pFac(f,i) fFac(f,i)
Neoclassical closure (all factors mobile between sectors,
fixed total supply)
   exogenous fFac(f,i) xFac_i(f)   endogenous: pFac(f,i)
fFac_i(i)
!

! Total Income of Factors from industry!
Coefficient (all,f,FAC) GROSSFACINC(f) # Gross Factor Income
#;
Formula     (all,f,FAC) GROSSFACINC(f) = sum{i,IND, SAM(f,i)};
! above goes to Households, Tax and Depreciation!

! Tax on Income of Factors from industry!
Variable
 rFacTax # Factor Tax rate #;
(all,f,FAC) wTaxFac(f) # Tax on Income of Factors from
```

```
industry  #;
Equation
E_wTaxFac (all,f,FAC)  wTaxFac(f)= rFacTax + wFac_i(f);
Update (all,f,FAC) SAM("Tax",f)=wTaxFac(f);

! Depreciation: will be zero for labour!
Variable (all,f,FAC) wDepFac(f) # Factor Depreciation #;
Equation E_wDepFac (all,f,FAC) wDepFac(f) = wFac_i(f);
Update (all,f,FAC) SAM("Sav",f)= wDepFac(f);

! Net Factor Income after Tax and Depreciation!
Coefficient (all,f,FAC) NETFACINC(f) # Net Factor Income #;
Formula  (all,f,FAC)
NETFACINC(f) = GROSSFACINC(f) - SAM("Sav",f) - SAM("Tax",f);

Variable  (all,f,FAC) wNetFacInc(f) # Net Factor Income #;
Equation E_wNetFacInc (all,f,FAC)
NETFACINC(f)* wNetFacInc(f) =  GROSSFACINC(f)*wFac_i(f)
  - SAM("Sav",f)*wDepFac(f) - SAM("Tax",f)*wTaxFac(f);

! Total Income of Households from Factors!

Variable
(all,f,FAC) wHouFac(f) # Income to Households from Factors  #;
Equation E_wHouFac (all,f,FAC) wHouFac(f) = wNetFacInc(f);
Update (all,f,FAC) SAM("Hou",f)= wHouFac(f);

! Total Household Income Including Transfers!
Variable wTrans # Transfers from Gov to Hou #;
Update  SAM("Hou","Gov") = wTrans;

Coefficient  VHouTotInc # Total Household Income Including
Transfers #;
Formula  VHouTotInc =  SAM("Hou","Gov") +
```

```
sum{f,FAC,NETFACINC(f)};
Variable wHouTotInc # Total Household Income Including
Transfers #;
Equation E_wHouTotInc  VHouTotInc*wHouTotInc =
      SAM("Hou","Gov")*wTrans +
sum{f,FAC,NETFACINC(f)*wHouFac(f)};

! find disposable Household Income after Taxes and Saving !
Variable
wHouTax # Income Tax revenue #;
rHouTax # Income Tax rate #;
Equation E_wHouTax wHouTax = rHouTax + wHouTotInc;
Update  SAM("Tax","Hou")= wHouTax;

Variable wHouNetInc # Income after Tax #;
Coefficient VHOUNETINC # Income after Tax #;
Formula  VHOUNETINC  = VHouTotInc -  SAM("Tax","Hou");
Equation E_wHouNetInc  VHOUNETINC*wHouNetInc  =
VHouTotInc*wHouTotInc
  -  SAM("Tax","Hou")*wHouTax;

Variable
wSavHou # Household Saving #;
rSavHou # Household Saving rate #;
Update  SAM("Sav","Hou")= wSavHou;
Equation E_wSavHou  wSavHou = rSavHou + wHouNetInc;

Coefficient VHOUEXP # Disposable Household Income after Taxes
and Saving #;
Formula VHOUEXP = sum{c,COM,SAM(c,"Hou")};
Variable wHouExp # Disposable Household Income after Taxes and
Saving #;
Equation
 E_wHouExp VHOUEXP*wHouExp = VHOUNETINC*wHouNetInc -
```

```
SAM("Sav","Hou")*wSavHou;

 E_wTotHou wTotHou = wHouExp;

! Gov balance!

Coefficient VTAXTOT # Total Tax revenue #;
Formula VTAXTOT =
sum{i,IND,SAM("Tax",i)}+sum{f,FAC,SAM("Tax",f)}
+ SAM("Tax","Hou");
Variable wTaxTot # Total Tax revenue #;
Equation E_wTaxTot VTAXTOT*wTaxTot =
sum{i,IND,SAM("Tax",i)*[rVAT +wFac_f(i)]}
+sum{f,FAC,SAM("Tax",f)*wTaxFac(f)}+
SAM("Tax","Hou")*wHouTax;

Coefficient VGOVTOT # Total Gov spend on goods #;
Formula  VGOVTOT = sum{c,COM, SAM(c,"Gov")};
Variable wGovTot # Total Gov spend on goods #;
Equation E_wGovTot wGovTot = gdpExpBits("Gov","value");

Variable (change) delSavGov # Ord change in Gov Saving #;
Equation E_delSavGov VTAXTOT*wTaxTot =
VGOVTOT*wGovTot + SAM("Hou","Gov")*wTrans +100*delSavGov;
Update (change) SAM("Sav","Gov") = delSavGov;

! Total Imports!
Coefficient (all,e,IMP) VIMPTOT(e) # Total Imports #;
Formula  (all,e,IMP) VIMPTOT(e) = sum{i,IND, SAM(e,i)};
Variable  (all,e,IMP) wImpTot(e) # Total Imports #;
Equation  E_wImpTot (all,e,IMP)
 VIMPTOT(e)*wImpTot(e) =  sum{i,IND,
SAM(e,i)*[pImp(e,i)+xImp(e,i)]};
```

```
! Total Exports!
Coefficient (all,e,EXP) VEXPTOT(e) # Total Exports #;
Formula  (all,e,EXP) VEXPTOT(e) = sum{c,COM, SAM(c,e)};
Variable  (all,e,EXP) wExpTot(e) # Total Exports #;
Equation  E_wExpTot (all,e,EXP)
 VEXPTOT(e)*wExpTot(e) =  sum{c,COM,
SAM(c,e)*[pLoc(c)+xExp(c,e)]};

! Trade balances!
Variable
(change) delBROW # Trade balance ROW #;
(change) delBROB # Trade balance ROB #;
(change) delBTot # Trade balance (ROB+ROW)/GDP #;
Update
(change) SAM("Sav","ExpROW") = -delBROW; !nb, sign convention
!
(change) SAM("Sav","ExpDRC") = -delBROB;
Equation
E_delBROW  100*delBROW =  VEXPTOT("ExpROW")*wExpTot("ExpROW")
                        - VIMPTOT("ImpROW")*wImpTot("ImpROW");
E_delBROB  100*delBROB =  VEXPTOT("ExpDRC")*wExpTot("ExpDRC")
                        - VIMPTOT("ImpDRC")*wImpTot("ImpDRC");
E_delBTot  VGDPEXP*delBTot =  delBROB + delBROW
   + 0.01*[SAM("Sav","ExpROW")+SAM("Sav","ExpDRC")]*wgdpExp;

! Total of Saving row!

Variable (change) delSavTot # Total of Saving row #;
Equation E_delSavTot delSavTot = 0.01*sum{f,FAC,
SAM("Sav",f)*wDepFac(f)}
 + 0.01*SAM("Sav","Hou")*wSavHou + delSavGov - delBROW -
delBROB;

! Investment Totals!
```

```
Variable wTotInv # Total of Investment #;
Coefficient VTotInv # Total of Investment #;
Formula  VTotInv  = sum{c,COM,SAM(c,"Inv")};
Equation  E_wTotInv
VTotInv*wTotInv=sum{c,COM,SAM(c,"Inv")*[xInv(c)+pLoc(c)]};
Variable (change)  delVTotInv # Total of Investment #;
Equation  E_delVTotInv 100*delVTotInv = VTotInv*wTotInv;

Variable (change)  delSAMCHEK # SAM balance/GDP - should be
tiny #;
Equation  E_delSAMCHEK VGDPEXP*delSAMCHEK = delVTotInv -
delSavTot;

Set MAINMACROS # Convenient macro variables for reporting #
 (RealHou, RealInv, RealGov, ExpVol, ImpVol, RealGDP,
AggEmploy,
  AveRealWage, AggCapStock,AggLand, GDPPI, CPI, ExportPI,
ImportPI,BOT_GDP);
Variable
(all,m,MAINMACROS) MainMacro(m) # Convenient macro variables
for reporting#;
Equation
 E_MainMacroA MainMacro("RealHou") = xTotHou;
 E_MainMacroB MainMacro("RealInv") =
gdpExpBits("Inv","quantity");
 E_MainMacroC MainMacro("RealGov") =
gdpExpBits("Gov","quantity");
 E_MainMacroD MainMacro("ExpVol") = xExpTot;
 E_MainMacroE MainMacro("ImpVol") = xImpTot;
 E_MainMacroG MainMacro("RealGDP") =
gdpExpBits("Total","quantity");
 E_MainMacroH MainMacro("AggEmploy") = xLab_i;
 E_MainMacroI MainMacro("AveRealWage") = aveRealWage;
 E_MainMacroP MainMacro("AggLand") = xLand_i;
```

```
 E_MainMacroJ MainMacro("AggCapStock") = xCAP_i;
 E_MainMacroL MainMacro("GDPPI") =
gdpExpBits("Total","price");
 E_MainMacroK MainMacro("CPI") = pTotHou;
 E_MainMacroM MainMacro("ExportPI") = pExpTot;
 E_MainMacroN MainMacro("ImportPI") = pImpTot;
 E_MainMacroO MainMacro("BOT_GDP") = 100*delBTot;

! Write out aggregated SAM!
Set AGGA (Sectors,Labour,Land, Capital);
Set AGGSAMCOLS = AGGA + FINDEM;
Mapping MAPCOL from SAMCOLS to AGGSAMCOLS;
Formula
 (all,i,IND) MAPCOL(i) = "Sectors";
 (all,f,LAB) MAPCOL(f) = "Labour";
 (all,f,CAP) MAPCOL(f) = "Capital";
 (all,f,land) MAPCOL(f) = "Land";
 (all,f,FINDEM) MAPCOL(f) = $pos(f,AGGSAMCOLS);
Set AGGSAMROWS = AGGA + MOREROWS;
Mapping MAPROW from SAMROWS to AGGSAMROWS;
Formula
 (all,r,COM) MAPROW(r) = "Sectors";
 (all,r,LAB) MAPROW(r) = "Labour";
 (all,r,CAP) MAPROW(r) = "Capital";
 (all,r,Land) MAPROW(r) = "Land";
 (all,r,MOREROWS) MAPROW(r) = $pos(r,AGGSAMROWS);
Coefficient (all,r,AGGSAMROWS)(all,c,AGGSAMCOLS) AGGSAM(r,c) #
Aggregated SAM #;
Formula (all,r,AGGSAMROWS)(all,c,AGGSAMCOLS) AGGSAM(r,c) =
  sum{cc,SAMCOLS: MAPCOL(cc)=c, sum{rr,SAMROWS: MAPROW(rr)=r,
SAM(rr,cc)}};
Write AGGSAM to file SUMMARY header "ASAM";
! end of file !
```

APPENDIX B: STYLISED MACRO MODEL WHICH IS IMPORTANT IN ANALYSING THE OUTCOME OF THIS CGE MODEL

Level equations

$$Y^{MP} = C + I + G + (X - M) \quad (1)$$

$$Y^{FC} xA = F_Y(L, K) \quad (2)$$

$$Y^{MP} = Y^{FC} + Y^{TAX} \quad (3)$$

$$P^C C = P^{FC}_{GDF}\ Y^{FC} X\Omega \quad (4)$$

$$\frac{C}{G} = \Gamma \quad (5)$$

$$M = F_M(Y^{MP}, RER) \quad (6)$$

$$X = F_X(-RER) XY_W \quad (7)$$

$$\frac{I}{K} = G_I\left(\frac{ROR}{ROR^{REQ}}\right) \quad (8)$$

$$RER = \frac{P^{MP}_{GDP}}{(\phi PW)} \quad (9)$$

$$P^{MP}_{GDP} = P^{FC}_{GDP}(1 + T) \quad (10)$$

$$TOT = \frac{1}{\{F_{TOT}(X) XP_W\}} \quad (11)$$

$$\frac{P^C}{P^{MP}} = \frac{1}{F_{PGDP(TOT)}} \quad (12)$$

$$\frac{K}{L} = F_{KL}\left(\frac{RP_L}{RP_K}\right) \quad (13)$$

$$\frac{RP^S_L}{L} = \frac{RP^{-S}_K}{K} \quad (14)$$

$$RP_L = F_{RPL}\left(RW, \frac{1}{TOT}, (1+T)\right) \quad (15)$$

$$RP_K = F_{RPK}\left(ROR, \frac{1}{TOT}, (1+T)\right) \quad (16)$$

Source: Adams, 2003

APPENDIX C: COMMAND FILE FOR THE LAND USE SIMULATION (SR)

```
auxiliary files = DRC2;
File InFile = LAB1.har;
File summary = summaryLAB.har;
log file = yes;
updated file INFILE = <cmf>.upd;
check-on-read all = yes;
check-on-read exact = yes;

! method = Johansen;
 method = Gragg;
 steps = 3 5 7;

! Automatic closure generated by TABmate Tools...Closure
command
!               Variable     Size
Exogenous              a ; ! COM*IND   Tech change, firm
demands for Local goods
Exogenous           aFac ; ! FAC*IND   Factor tech change
Exogenous           aTot ; ! IND   Neutral tech change, ind i
Exogenous         fFac_i ; ! FAC   All-Industry Real Factor
price shift
Exogenous          fpExp ; ! COM*EXP   Export demand shift
Exogenous           pFac ; ! FAC*IND   Factor prices
Exogenous           pImp ; ! IMP*IND   Import prices
Exogenous        rFacTax ; ! 1   Factor Tax rate
Exogenous        rSavHou ; ! 1   Household Saving rate
Exogenous        rHouTax ; ! 1   Income Tax rate
Exogenous           rVAT ; ! 1   % Change in ad valorem rate
of VAT
Exogenous         wTrans ; ! 1   Transfers from Gov to Hou
Exogenous           xGov ; ! COM   Gov demands
Exogenous           xInv ; ! COM   Inv demands
Rest endogenous; ! end of TABmate automatic closure

! Automatic closure above is a basic input-output closure:
!    factors and imports in elastic supply at fixed prices
!    consumption and savings linked to income

! Note: in SWAP statements below, NEW exogenous is on left.

! ORANI short-run closure:
!swap xfac("Capital",IND) = pfac("Capital",IND); ! capital
fixed by sector
!swap xfac(CAP,IND) = pfac(CAP,IND); ! capital fixed by sector
daniel
swap ffac(LAB,IND) = pfac(LAB,IND); ! labour mobile with wages
indexed to CPI
```

```
swap xTotHou = rSavHou; ! real consumption fixed, savings rate
free

verbal description = 10% land use subsidy, ORANI short-run
closure;
!shock xgov = uniform 10;
shock pfac("land_F",IND) = uniform -10;
shock pfac("land_i",IND) = uniform -10;
```

APPENDIX D: DRCMSAM USING CDF TRILLION, 2007 PRICES

Receipts \ Payments	Activities	Commodities	Labour	Capital	Land	Enter-prises	House-holds	Gover-nment	Capital account	Rest of the world	Resi-dual	Total
Activities	0.0	6,537.7	0.0	0.0	0.0	0.0	1,054.8	0.0	0.0	0.0	0.0	**7,592.5**
Commodities	3,486.8	387.0	0.0	0.0	0.0	0.0	2,675.5	278.5	711.9	704.9	0.0	**8,244.6**
Labour	2,299.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2,299.2**
Capital	1,625.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1,625.9**
Land	167.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**167.4**
Enterprises	0.0	0.0	0.0	1,224.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1,224.1**
Households	0.0	0.0	2,289.6	387.9	167.4	1,172.0	0.0	33.0	0.0	218.1	0.0	**4,268.1**
Government	13.1	235.6	9.7	0.0	0.0	52.1	51.0	360.7	0.0	0.0	0.0	**722.3**
Capital account	0.0	0.0	0.0	0.0	0.0	0.0	486.8	49.9	0.0	175.1	0.0	**711.9**
Rest of the world	0.0	1,084.3	0.0	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1,098.1**
Residual	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	**7,592.5**	**8,244.6**	**2,299.2**	**1,625.9**	**167.4**	**1,224.1**	**4,268.1**	**722.3**	**711.9**	**1,098.1**	**0.0**	**27,954.2**

APPENDIX E: FORMAL-INFORMAL DRC MACRO SAM USING CDF TRILLION, 2007 PRICES

Receipts/Payments	Activ-F	Activ-I	Com-F	Com-I	Labor-F	Labor-I	Cap-F	Cap-I	Land-F	Land-I	Ent-F	Ent-I	House-F	House-I	Govern-ment	Capital account	Rest of the world	Residual	Total
Activ-F	0	0	2,068.2	0	0	0	0	0	0	0	0	0	131.3	0	0	0	0	0	2,199.5
Activ-I	0	0	0	4,469.5	0	0	0	0	0	0	0	0	0	923.5	0	0	0	0	5,393.0
Com-F	1,146.8	0	19.3	0	0	0	0	0	0	0	0	0	546	0	278.5	711.9	704.9	0	3,407.5
Com-I	0	2,339.9	0	367.6	0	0	0	0	0	0	0	0	0	2,129.6	0	0	0	0	4,837.1
Labor-F	584	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	584
Labor-I	0	1,715.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,715.2
Cap-F	413	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	413
Cap-I	0	1,212.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,212.9
Land-F	42.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42.5
Land-I	0	124.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	124.9
Ent-F	0	0	0	0	0	0	11.2	1212.9	0	0	0	0	0	0	0	0	0	0	1,224.1
Ent-I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
House-F	0	0	0	0	574.3	1,715.2	387.9	0	42.5	124.9	1,172.0	0	0	0	33	0	218.1	0	4,268.1
House-I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Government	13.1	0	235.6	0	9.7	0	0	0	0	0	52.1	0	51	0	360.7	0	0	0	722.3
Capital account	0	0	0	0	0	0	0	0	0	0	0	0	486.8	0	49.9	0	175.1	0	711.9
Rest of the world	0	0	1,084.3	0	0	0	13.8	0	0	0	0	0	0	0	0	0	0	0	1,098.1
Residual	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,199.5	5,393.0	3,407.5	4,837.1	584	1,715.2	413	1,212.9	42.5	124.9	1,224.1	0	1,215.1	3,053.1	722.3	711.9	1,098.1	0	27,954.2

APPENDIC F: COMMAND FILE FOR THE LAND USE PRODUCTIVITY (LONG RUN)

```
auxiliary files = DRC2;
File InFile = LAB1.har;
File summary = summary.har;
log file = yes;
updated file INFILE = <cmf>.upd;
check-on-read all = yes;
check-on-read exact = yes;

! method = Johansen;
 method = Gragg;
 steps = 3 5 7;

! Automatic closure generated by TABmate Tools...Closure
command
!               Variable     Size
Exogenous               a ; ! COM*IND   Tech change, firm
demands for Local goods
Exogenous            aFac ; ! FAC*IND   Factor tech change
Exogenous            aTot ; ! IND   Neutral tech change, ind i
Exogenous          fFac_i ; ! FAC   All-Industry Real Factor
price shift
Exogenous           fpExp ; ! COM*EXP   Export demand shift
Exogenous            pFac ; ! FAC*IND   Factor prices
Exogenous            pImp ; ! IMP*IND   Import prices
Exogenous         rFacTax ; ! 1   Factor Tax rate
Exogenous         rSavHou ; ! 1   Household Saving rate
Exogenous         rHouTax ; ! 1   Income Tax rate
Exogenous            rVAT ; ! 1   % Change in ad valorem rate
of VAT
Exogenous          wTrans ; ! 1   Transfers from Gov to Hou
Exogenous            xGov ; ! COM   Gov demands
Exogenous            xInv ; ! COM   Inv demands
Rest endogenous;            ! end of TABmate automatic closure

! Automatic closure above is a basic input-output closure:
!    factors and imports in elastic supply at fixed prices
!    consumption and savings linked to income

! Note: in SWAP statements below, NEW exogenous is on left.

! ORANI long-run closure:
!swap xfac("Capital",IND) = pfac("Capital",IND); ! capital
fixed by sector
!swap ffac(LAB,IND) = pfac(LAB,IND); ! labour mobile with
wages indexed to CPI
!swap xTotHou = rSavHou; ! real consumption fixed, savings
```

```
rate free

swap xfac(LAB,IND) = pfac(LAB,IND); ! capital fixed by sector

verbal description = 10% improvement in land productivity
long-run closure;

shock aFac("LAND_F",IND) = uniform -10;
shock aFac("LAND_I",IND) = uniform -10;
```

APPENDIX G: COMMAND FILE FOR THE TARIFF SHOCK (SHORT RUN)

```
auxiliary files = DRC2;
File InFile = LAB1.har;
File summary = summaryLAB.har;
log file = yes;
updated file INFILE = <cmf>.upd;
check-on-read all = yes;
check-on-read exact = yes;

! method = Johansen;
 method = Gragg;
 steps = 3 5 7;

! Automatic closure generated by TABmate Tools...Closure
command
!               Variable     Size
Exogenous              a ; ! COM*IND   Tech change, firm
demands for Local goods
Exogenous           aFac ; ! FAC*IND   Factor tech change
Exogenous           aTot ; ! IND   Neutral tech change, ind i
Exogenous         fFac_i ; ! FAC   All-Industry Real Factor
price shift
Exogenous          fpExp ; ! COM*EXP   Export demand shift
Exogenous           pFac ; ! FAC*IND   Factor prices
Exogenous           pImp ; ! IMP*IND   Import prices
Exogenous        rFacTax ; ! 1   Factor Tax rate
Exogenous        rSavHou ; ! 1   Household Saving rate
Exogenous        rHouTax ; ! 1   Income Tax rate
Exogenous           rVAT ; ! 1   % Change in ad valorem rate
of VAT
Exogenous         wTrans ; ! 1   Transfers from Gov to Hou
Exogenous           xGov ; ! COM   Gov demands
Exogenous           xInv ; ! COM   Inv demands
Rest endogenous; ! end of TABmate automatic closure

! Automatic closure above is a basic input-output closure:
!    factors and imports in elastic supply at fixed prices
!    consumption and savings linked to income

! Note: in SWAP statements below, NEW exogenous is on left.

! ORANI short-run closure:
!swap xfac("Capital",IND) = pfac("Capital",IND); ! capital
fixed by sector
!swap xfac(CAP,IND) = pfac(CAP,IND); ! capital fixed by sector
!swap ffac(LAB,IND) = pfac(LAB,IND); ! labour mobile with
wages indexed to CPI
!swap xTotHou = rSavHou; ! real consumption fixed, savings
```

```
rate free
swap xfac(LAB,IND) = pfac(LAB,IND); ! capital fixed by sector

verbal description = 5% import price  decrease, ORANI s-r
closure;
!shock xgov = uniform 10;
shock pImp("ImpROW",IND) = uniform -5;
```

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