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SOME ECONOMIC IMPLICATIONS OF LARGE LARGE SALARY INCREASE FOR GOVERNMENT EMPLOYEES: A COMPUTABLE GENERAL EQUILIBRIUM MODEL ANALYSIS FOR BOTSWANA

BY

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DECLARATION

I the, undersigned, declare that the work presented in this dissertation has not been submitted to any institution for any degree. It is my original work except where references are acknowledged.

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APPROVAL

This dissertation has been examined, and approved as meeting the requirements for the partial fulfillment of Masters of Arts Degree in Economics.

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DEDICATION

To my family.

TABLE OF CONTENTS

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LIST OF FIGURES

LIST OF TABLES

ACRONYMS LIST

ASA	-	Annual Statement of Accounts
BAIS	-	Botswana AIDS Impact Survey
BCWIS	-	Botswana Core Welfare indicators Survey
BFHS	-	Botswana Family Health Survey
BMTHS	-	Botswana Multi-Topic Household Survey
BNPC	-	Botswana National Productivity Centre
BOB	-	Bank of Botswana
BPC	-	Botswana Power Corporation
BSP	-	Budget Strategy Paper
BWP	-	Botswana Pula
CGE	-	Computable General Equilibrium
COVID-19	-	Corona Virus Disease of 2019
CSO	-	Central Statistics Office
DHS	-	Demographics and Health Survey
EV	-	Equivalent Variation
FDI	-	Foreign Direct investment
GDP	-	Gross Domestic Product
HIES	-	Household Income and Expenditure Survey
IFPRI	-	International Food Policy Research Institute
IMF	-	International Monetary Fund
LFS	-	Labour Force Survey
MFDP	-	Ministry of Finance and Development Planning
MFED	-	Ministry of Finance and Economic Development
NDP	-	National Development Plan
PEP	-	Partnership for Economic Policy
PHC	-	Population and Housing Census
PSMD	-	Public Service Management Directive

SADC	-	Southern Africa Development Community
SAM	-	Social Account Matrix
SB	-	Statistics Botswana
UNDP	-	United Nations Development Programme
WHO	-	World Health Organisation

ABSTRACT

This study analysed the economic implications of the 2019 salary increase for Government employees in Botswana. The study used the static computable general equilibrium (CGE) model that has been calibrated to the 2011 social accounting matrix (SAM) database for Botswana for 2011. The shock examined is a 16.5 percent increase in Government employees' wages. The simulation results showed that increase in public sector incomes has contractionary effects on the economy. GDP at both market prices and at factor costs and absorption decreased in the short run. While household consumption and government budget deficit increased, investment, employment, indirect taxes, total imports and exports decreased and there was a depreciation of the exchange rate. Household welfare gain was disproportionately distributed to households in cities and towns and less to those in rural areas. The impact on activities was also uneven. The construction, other manufacturing, general government and other mining contracted whereas others sectors expanded. The policy implication that arise is that, the increase in government wages should be implemented with another policy tool to ensure that the beneficial effects of salary increase on households is not accompanied by contraction in economic activity.

CHAPTER ONE

INTRODUCTION

1.1 Background

The development of government wages or salaries usually draws interest of policy makers in both the government and private sector, as well as the public and researchers worldwide. By wages, it is meant, cash or in-kind compensations to employees, with the exception of social contributions payable by employers (International Monetary Fund (IMF), 2014b). The rationale behind wage adjustment by employers differs. In the case of profit-maximizing organizations, the adjustment decision may be productivity-inclined. For the public sector, it may be politically motivated. Employers may act in accordance with the efficiency wage hypothesis, which supposes that offering higher real wages motivate workers and, thus, lead to productivity improvement.

According to Borjas & Van Ours (2010), a wage increase lessens employee turnover and shirking as well as increase worker's productivity. They also assert that it increases consumer demand and economic activity. Notwithstanding, Borjas and Van Ours (2010) note that if the labour market conditions that exist outside the firm are taken into consideration, the expansionary effect wage rise may not work. In particular, "because public-sector workers are often a potent political force, some politicians might be willing to grant high wage increases to public-sector unions in exchange for votes" (Borjas & Van Ours, 2010, p. 453). As Borjas and Van Ours (2010) have alluded, bureaucrats' wages are but one of the never-ending dominant issues on the public sector agenda.

The public sector in Botswana also, are concerned about employee remuneration. For the past decade, Botswana government, as an employer, and the public sector unions, as workers' representatives, engaged in negotiations over wage adjustments without entirely arriving at a consensus. As articulated on the budget strategy paper (BSP, (2019)), the government of Botswana resolved to increase salaries for its employees by 16.5 percent for the financial years 2019 and 2020 (BSP, 2019). The BSP is one of the government budget documents and it lays out a framework for developing the national budget. The 2020 BSP contains the review of the 2019/20 budget and presents a preliminary budget for the financial year 2020/21.

The concerns among policy makers and analysts about the development of the government employees' wages is on its likely impact on economic development, public finance, labour market, competitiveness in the private sector, and the tradable sector. At the heart of the concern was the simple fact that the wage increments for these two financial years were relatively large when compared to the previous wage increases of public-sector employees. For example, the government employees received wages/salaries increments of 3, 3, 3, 4, and 16.5 percent in 2011, 2012, 2016, 2017 and 2019 respectively compared to about 2 percent per annum awarded in other years (BSP-Draft, 2019; Government, 2011, 2016a, 2016b, 2017).

The awarded increment in value terms amount to P2.2 billion in 2019/20 and an increase of P2.3 billion has been pledged for the 2020/21 financial year (BSP-Draft, 2019). A combination of factors contributed to awarding large salary adjustment by the Botswana Government. These included mounting pressures from the public sector unions, to gain political support for the 2019 general elections and the recommendations of the report of the performance management and delivery unit (PEMANDU). Unlike in the private sector, there is less incentive for politicians to

be concerned about labour costs since public sector costs overruns are passed on to the taxpayers (Borjas & Van Ours, 2010).

There are potential implications that may arise as a result of the large salary increase awarded in 2019. As the European Commission (2014) has pointed out, the increase in wages of civil servants, more often than not, yield significant effects on public finance, the country's labor market, and, ultimately, the overall economy. On one hand, the salary increment may negatively affect the economy. Such increment may result in slower hiring in the public sector, and may essentially diminish the entry-level jobs primarily accessible to youth in the public sector. Moreover, there are potential wage spill-over effects to the private sector, which may lead to loss of employment in the sector (Dybczak & Garcia-Escribano, 2019)[1]. This happens because the system exerts pressure on the private sector to generally raise labour costs (IMF, 2010). It may also unsustainably inflate the government wage bill and potentially induce a persistent budget deficit if the increment is not accompanied by a rise in government revenue. In contrast, the P2.2 billion expended on wages/salaries by the government is expected to circulate within the economy through various channels.

On the supply side, the increase in households' incomes will lead to increase in consumption of goods and services and savings and thereby stimulate domestic production. Thus, it induces local business activity. More goods and services may be produced. Thus, firms' output and profits increase, unemployment reduces, economic activity rises and revenues from value added taxes (VAT) and other taxes increase. However, the outcome may be different if the wage/salary

[1] The effect may raise the incentive for local and foreign investors to outsource labour to countries with cheap labour, increase prices to suppress increased labour costs or lay-off some workers. Again, employers may decide to automate processes, by investing in machinery and reduce human resources. In addition, increasing wages above the equilibrium market wage has the risk of having low wage and high wage sectors and the movement of labor across these sectors (Ehrenberg & Smith 2009).

increment is not adequate to encourage households to consume more. Therefore, the overall effect may be driven by the response from the affected economic agents, sectors, and the government policy measures in place to support private sector growth for a general mutual benefit.

In addition, there are potential implications on inflation and taxes. Generally, increase in government expenditure may lead to a rise in inflation, constraining the policy makers to abstain from raising the indirect taxes that are supposed to improve tax revenues. Nonetheless, given the fact that the expansionary fiscal policy is channeled through wages, the increment is not expected to have much of an impact on inflation. Therefore, inflation rate change could be insignificant because it turns out that wage increments poorly predict price inflation, while in fact price inflation does a very good job to predict wage inflation (Hess & Schweitzer, 2000).

In terms of taxes, the wage increment affects tax revenues in various ways. By means of taxes, the government alters households' incomes. The government retains a certain portion of this disbursement through direct income tax and indirect tax such as value-added tax (VAT), duties, etc. The direct income tax is deducted from the employee gross salary and the VAT and duties are earned from household consumption of goods and services. This translates into revenue to the government. However, if savings are increased or employees decide to purchase mortgages, they do not attract indirect taxes. On the other hand, if inflation rate accelerate, the tax revenues may reduce. The effect is a rising government expenditure against the declining government revenues, which leads to a rising fiscal deficit.

Lastly, the impact of wages/salaries increase on productivity, employment, welfare distribution, other sectors of the economy, and economic development has been widely researched world-wide. By convention, public sector wage hike results in the soaring of the government's recurrent

expenditure. Empirical studies conducted on the subject have reported mixed results across regions[2]. Dybczak and Garcia-Escribano (2019) observed that increasing government wage bill negatively affected the financial balance and crowds-out the private sector for low-income and developing countries. Fernández-de-Córdoba, Pérez, and Torres (2012, p. 1) on public and private sector wage using a general equilibrium model found that a "positive shock to public sector wages would lead to an increase in private-sector wages, via the flow of workers from private to the public sector". In terms of Botswana, there are currently no prior studies conducted on the impact of government wages/salaries increase in the economy. Nevertheless, few studies have been conducted on the minimum wage effect in the economy of Botswana[3].

The implications of the wages/salaries increment should be a subject to assess at a micro and macroeconomic level to capture the detailed response of the domestic economy. Hence, there is a need for the use of a general equilibrium analysis.

1.2 Problem Statement

The civil servants wages/salaries' upward adjustment has been awarded amid critical socio-economic development challenges, and mounting public fiscal problems. Some of which are exhibited by; persistent and high levels of unemployment, poverty, and the slow-down of the domestic economy. In some sense, a large upward salary adjustment may exacerbate the

[2] A few studies on government wage bill adjustments, and minimum wages, i.e., Cahuc and Carcillo (2012), Eckardt and Mills (2014), Broecke, Forti, and Vandeweyer (2015), Erero (2016), Strauss, Isaacs, and Capaldo (2017), and Dybczak and Garcia-Escribano (2019), revealed minor positive and negative conclusions due to varying variables, years, regions, data and methodologies used by researchers. Their conclusions were dependent mostly on the degree of the effect on GDP growth, labour market and fiscal balance.

[3] Most of the studies conducted did not follow a rigorous partial equilibrium approach that estimate elasticities, except studies by (Boyd & Mugabe and Mazonde & Gyekye, 1989). Their studies investigated the introduction of minimum wages in the domestic service and agriculture sectors. The effect was found to be negative and insignificant since some employers responded by laying off few workers to reduce labor costs, especially in the villages, while other employers continued productivity without layoffs but increased hours of work to increase production.

situation because the increment is likely to exert a substantial influence on the labour market conditions, government revenues, private sector performance, household consumption, government consumption, and economic growth. On another note, the rising levels of the recurrent budget from the large salary increment, while capital or development projects spending declines, i.e., by 29 percent (BSP-Draft, 2019), might not be desirable and sustainable because that may shrink the growth prospects for the economy. This further creates concerns on the country's ability to withstand and/or guard against future economic external shocks, rising debt levels, or meet acceptable creditworthiness and import obligations (BSP-Draft, 2019).

In addition, the government of Botswana is considered the largest employer in the domestic economy at 52 percent (IMF, 2017). This implies that the upward adjustment of wages without downsizing the public sector size undeniably inflates the wage bill, which IMF (2020) report projected to be 12.7 percent of Botswana's GDP in 2019. This may consequently put pressure on the government to reduce investment on capital expenditure. Study by Dybczak and Garcia-Escribano (2019) have found that, low-income and developing countries typically respond by reducing non-wage expenditures in order to compensate for higher wages while crowding-out crucial expenditures that could bolster economic growth and reduce poverty. Therefore, government should essentially be concerned of the undesirable shifts that may sometimes be inevitable.

Lastly, as far as the wages/salaries and employment relationship is concerned, the rising government wage bill may potentially exacerbate the existing high levels of unemployment. Government may freeze creation of new posts to minimize labour costs. In the private sector, the wage-spillover effects may manifest through elevated production costs, of which the net effect is indefinite because firms may respond by either resorting to passing the cost to consumers or

substitute labour with capital (BSP-Draft, 2019). As economic theory and empirical evidence suggest, the upward wage/salary adjustment is likely to have some influence on employment and unemployment levels in the economy. In this case, this is dependent on whether in the economy, there is full employment or there is high unemployment in the labour market[4]. Under high unemployment such as in Botswana, mainstream economists suggest that a high wage increase may lead to a reduction in labour demand.

Given the potential implications provided by the theoretical and empirical works in general, this study seeks to answer several questions for the case of Botswana. Such as, how will other sectors and the general economy respond towards the increase in government wages/salaries, what are the implications, and how can they be overcome. The economy-wide analysis output goals, render this study the first of its kind to conduct for the Botswana economy using a general equilibrium approach.

1.3 Objectives

The main objective of the study is to determine the impact of an increase in government employees' wages/salaries on the domestic economy.

1.4 Specific objectives

Specifically, the study seeks to:

a. To determine the impact of increased wages/salaries on;
    i. The macro-economy
    ii. Sectoral performance
    iii. Households (equivalent variations)

[4] When the labour force is fully employed, "higher wages increase the opportunity cost of being economically inactive and induce people to enter the labour force, while lower wages reduce the opportunity cost and lead to lower participation rates"(Banse et al., 2013).

iv. Government revenues (taxes)

v. Labour

b. To draw policy implications

1.5 Hypothesis

A *priori* expectation is a relatively modest effect on macroeconomic indicators with a slight downturn on investment since more funds are diverted to wages/salaries. The fall in investment suggest a decline in government tax revenues and weakening GDP. The fiscal deficit is expected to worsen. The response on sectorial value added is expected to be mixed since some sectors will benefit more while others does not benefit, hence positive and negative expectation. The welfare effects on households are expected to be positive with wide variations. Different taxes are expected to be both positive and negative, and employment to be negative but insignificant.

1.6 Significance of the study

This study aims to make a contribution of information that may be influential in future public policy initiatives in matters of government resource allocations to achieve human resource efficiency and productivity in the economy. The focus of the study is on providing the simulation of how will the change in government spending on the wage bill affect the GDP, households welfare, labour market, and other sectors of the economy. The output could inform public policy decisions in terms of targeting improvements to create a balanced and resilient economy when allocating government resources. Therefore, this study provides an empirical contribution to the body of knowledge on the impact of large salary increase for government employees.

Moreover, despite a series of salary adjustments made just in the past decade, to the researcher's best knowledge, there has never been a published empirical study to examine the effects of such

an adjustment in the economy of Botswana by local researchers. The previous scholarly studies frequently focused their investigations only on minimum wages. Hence, this study intends to assess the government wages/salaries increase' economy-wide effect. By so doing, the investigation will thus verify the expenditure theories on government spending (wages/salaries), and the past empirical findings done by CGE and the partial equilibrium approach under the same topic. The evaluation could essentially aid the policymakers to appreciate the likely spill-over-effects to other sectors of the economy and to what magnitude altogether.

1.7 Analytical framework

This study applies the computable general equilibrium (CGE) modelling approach for the analysis. The reason being that CGE models are widely used for analysis of economic policies. A CGE models are Walrasian tools, they capture the interactions between economic sectors. Hence, the use of a CGE model will enable the direct and indirect effects of increase in public service salary increase to be captured. The study applies the standard CGE model developed by Lofgren, *et al* (2002) for the International Food Policy Research Institute (IFPRI) that has been calibrated to the data base for the Botswana economy.

1.8 Organization of the study

The rest of this dissertation is structured as follows. Chapter 2 gives the narrative of the economy of Botswana whilst chapter 3 provides a review of the theoretical and empirical literature. Chapter 4 describes the theoretical and analytical basis of the model whilst chapter 5 discusses the implementation of the model. The simulation design and results are reported in chapter 6. Lastly, conclusions and policy implications are presented in chapter 7.

CHAPTER TWO

BOTSWANA ECONOMY

2.1 Introduction

This chapter provides a brief history of the Botswana economy. The economic structure in terms of sectors and their contribution to the GDP, the evolution of expenditure trends, and types are outlined in this section. Income distribution, employment, and unemployment statistics are also highlighted in this section. Lastly, a brief conclusion of the material presented is narrated in this chapter.

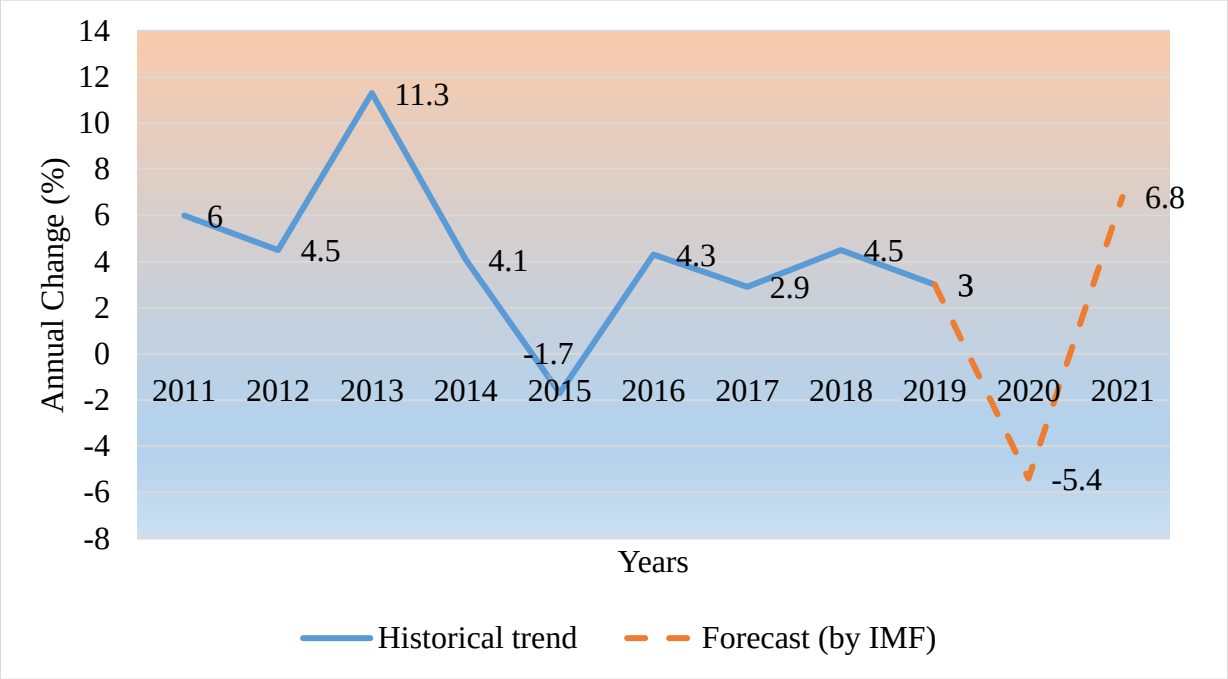
2.2 Economic performance

At the time Botswana gained independence in 1966, it was among the world's most impoverished countries. The country became one of the few success stories in Africa. Despite its great success, other sectors of the economy have lagged behind because of lack of economic diversification. The report by BOB (2018); SB (2015/16) details that the mining sector accounts for half of the country's revenues, and 85 percent of the export revenues were from the mining sector, contributing 35 percent share to the Gross Domestic Product (GDP).

A study by Freeman and Lindauer (1999) reported that the GDP growth per capita averaged 8.4 percent between 1965 and 1990, during the 1990s, the growth rates reduced to 1.7 percent on average. Between 2009 and 2018 the GDP per capita average growth rate was at 1.9 percent (BOB, 2018). In the present years, the BSP-Draft (2019) speculates that the domestic economy is expected to grow by 4.3 percent (2019), 4.6 percent (2020), and 4.0 percent (2021). The positive speculations are supported by the ongoing structural reforms to transform the economy into a knowledge-based from a resource-based economy. However, due to the emergence of COVID-

19, the IMF revised the global economic performance outlook with Botswana's GDP declining by -5.4 percent in 2020 and rising by 6.8 percent in 2021 (IMF, 2020a). This is depicted in figure 2.1 below.

Figure 2.1: Annual percentage change in real GDP



Source: *Statistics Botswana (April 2020), GDP fourth Quarter of 2019 & IMF (April 2020).*

The historical trend from figure 2.1 indicates that the economy grew by 4.5 percent on average between 2011 and 2018. There was an economic boom during 2013, indicated by a 13 percent upward spike, and a minor recession in 2015 indicated by a minus 1.7 percent, where after, the real GDP corrected to its common sideways consolidation range between 2.9 and 4.5 percent from 2016 through to 2019. The GDP further indicates another cycle of an economic recession caused by the novel COVID-19 virus, with an estimated minus 5.4 percent in 2020 and projected recovery of 6.8 percent in 2021. These are the early projections from the IMF, which may change given the uncertainty on the duration of the global pandemic (COVID-19).

2.3 Structure of the economy

The section describes the sectoral value-added share distribution that exists within the economy of Botswana. Table 2.1 below indicates the gross domestic product share distribution and composition of the economy of Botswana during the period 2011 - 2018.

Table 2.1: GDP sector ratio (constant 2006 prices): Annual percentage change

Period	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***Average Annual Growth***
Economic Activity									
Agriculture	0.2	-8.5	1.3	-0.4	0.3	0.6	2.2	2.9	1.1
Mining	-6.5	-5.8	24.2	0.5	-19.6	-3.5	-11.1	7.4	-3.6
Manufacturing	11.4	3.7	6.5	0.5	3.2	1.6	2.2	3.6	4.2
Water and electricity	-34.2	-27.5	67.5	-55.8	7.0	95.2	39.9	21.0	12.0
Water	4.3	2.9	-2.4	-11.6	-4.4	57.4	11.2	2.7	7.4
Electricity	-85.7	-628.4	130.2	-450.0	17.5	6.3	79.3	418.9	-52.8
Construction	23.1	14.4	4.1	3.7	4.0	4.2	3.5	3.7	7.7
Trade, hotels and restaurant	13.8	6.8	16.0	10.7	-3.9	13.4	9.0	3.2	8.2
Trade	12.5	8.0	21.9	13.4	-9.0	18.4	10.8	1.2	8.5
Hotels and restaurant	15.9	4.9	6.7	5.7	5.9	5.2	5.6	7.2	7.9
Transport and communications	6.1	10.9	7.6	9.8	4.5	6.6	4.7	6.4	7.8
Road transport	-10.7	19.1	10.3	3.7	1.2	11.1	7.5	5.5	5.3
Air transport	1.8	5.5	2.4	-3.6	-4.4	5.8	5.4	6.6	3.8
Communications	7.9	7.6	8.3	9.7	7.1	6.7	7.0	7.1	8.7
Finance and business services	7.7	9.1	8.7	2.7	4.5	3.3	4.1	5.0	5.8
Banks and insurance	-0.7	5.7	9.9	0.1	2.5	4.4	2.7	3.3	3.6
Real estate and business services	13.4	10.6	10.7	6.8	6.0	7.8	6.5	6.5	8.9
General government	6.3	2.8	6.0	4.6	3.3	2.4	1.5	3.0	4.0
Central	6.4	2.0	5.2	4.9	2.7	1.8	1.7	3.0	3.9
Local	5.0	7.1	10.4	2.8	6.4	6.9	0.9	2.9	4.4
Social and personal services	8.3	10.7	8.0	4.2	3.6	3.5	2.8	3.6	6.2

NPISHs4	7.3	14.2	7.0	4.4	3.6	3.2	2.9	3.8	6.2
Total value added	**6.1**	**4.5**	**11.8**	**4.1**	**-2.0**	**4.8**	**2.8**	**4.5**	**3.8**
Adjustment items	5.8	4.3	7.7	4.9	1.1	-	3.8	4.3	3.6
Taxes on imports	9.5	7.5	12.8	5.3	0.6	-0.4	3.6	2.9	2.4
Taxes on products/production	2.1	1.4	2.7	4.4	2.0	0.8	3.8	5.8	4.5
Subsidies on products/production	0.7	-3.1	-7.3	-3.8	-3.5	-3.2	-1.4	-6.1	-3.0
GDP at constant prices	**6.0**	**4.5**	**11.3**	**4.1**	**-1.7**	**4.3**	**2.9**	**4.5**	**3.7**
GDP per capita	**4.1**	**2.3**	**9.1**	**2.2**	**-3.3**	**2.7**	**1.3**	**2.9**	**1.9**

Source: *Bank of Botswana Annual Report, 2018. The 2016-18 figures are provisional.*

Subsequent to the 2008 financial crunch, the financial and business sector, which comprise of the banking and insurance, real estate, and business services, experienced consistent growth with an average share value of 5.8 percent of the GDP, this is indicated in table 2.1 above. The main contributing industry is the real estate and business services with a good 8.9 percent share to the GDP between 2011 and 2018. The manufacturing sector's performance on average had an annual growth rate of 4.2 percent share of the GDP during the same period. The largest share in manufacturing was observed during 2011, which later dropped in the succeeding years. Water and Electricity had an average annual growth rate of 12.0 percent share of GDP with a large share contributed by the water department.

Nonetheless, during the period between 2011 and 2018, the mining industry continued to hold the largest share despite the 2008 downfall on the demand for diamonds. The mining sector revenues were quite sluggish with many inconsistencies between 2011 and 2018. This is shown by a negative average growth rate of -3.6 percent of the GDP. The government sector on average grew its share by a rational 4.0 percent annually over 7 years. Trade, Hotels, and Restaurants surpassed the mining sector in terms of share of GDP, which on average grew by 8.2 percent

with consistency. The sector's improved performance is attributed to the trade industry that on average had a share of 8.5 percent on GDP between 2011 and 2018. Overall, the year 2013 was the best performing year for the majority of the sectoral economic activities in terms of value-added share (11.8 percent), GDP share at constant prices (11.3 percent), and GDP per capita share (9.1 percent).

The agricultural sector is still lagging behind and it is one of the issues articulated in the National Development Plan 11 strategy paper, see (BSP-Draft, 2019; NDP11, 2016). Overall, the total value added by all sectors to the GDP, averaged an annual growth rate of 3.8 percent, GDP at constant prices of 3.7 percent on average, and GDP per capita averaging an annual growth rate of 1.9 percent.

2.4 General government expenditure

Generally, government spending has been rising significantly in the past few decades. "There has been massive government intervention in the economy, detailed planning, and central government expenditure is now around 40% of GDP, well above average for Africa" (Acemoglu, Johnson, & Robinson, 2002, p. 4). The budget speech report presented in 2003 indicates that during the years between 1998 and 2002, government expenditure growth reached the highs of 124.7 percent against the total revenue and grant growth of 73.6 percent (Ministry of Finance & Development Planning) (MFDP, 2003). The separately planned expenditures by the recurrent and development fund have shown erratic adjustments in the recent years, signaling policy transformation that is possibly, made to adapt to economic and demographic dynamics.

Notably, as indicated in table 2.2 below, the recurrent budget share of government total expenditure since 2011 grew from 74.6 percent to a projected 81.9 percent by 2020/21, and wages/salaries share ranges between 44.9 and 49.3 percent as from 2011 to 2020/21 (BSP-Draft,

2019). The development budget allocation has declined over the years, i.e., from 25.7 percent in 2011, to 18.2 percent by 2020/21, this is shown in table 2.2 below. This, concisely, portrays the direction of a policy shift from the reduction on the development venture activity funding, to the increase of the wages/salaries and operational activity funding.

Table 2.2: Annual expenditure distribution of the total government budget

Financial year	Development Budget share	Recurrent Budget share	Wages/salaries annual share	Wage bill increase rate
2011/12	25.7%	74.6%	44.9%	7.9%
2012/13	20.3%	78.8%	45.3%	12.4%
2013/14	21.3%	79.6%	46.2%	5.4%
2014/15	25.9%	74.3%	44.1%	8.2%
2015/16	23.5%	74.3%	45.9%	11.8%
2016/17	26.9%	73.2%	46.7%	3.7%
2017/18	25.3%	74.6%	48.4%	9.6%
2018/19	25.6%	75.4%	47.8%	4.2%
2019/20	25.8%	74.3%	49.3%	10.1%
2020/21	18.2%	81.9%	48.9%	9.3%

Source: *Botswana Financial Statistics, 2019, Annual Statements of Accounts (ASA) table-2018-19, Budget Strategy Paper & Author's calculations*.

2.5 Government wage bill

The government wage-bill trend continues to evolve with the years as depicted in table 2.2 above. The table provide the breakdown of the annual expenditures incurred by the government on employee wages/salaries from financial year 2011 to 2020. These annual amounts include; the 2 percent annual increment across notches for all the eligible employees, the separations, replacement, and new employees' wages. The table displays a pattern of wage bill growth over the years despite the inconsistency of the increments. This may typically imply that the government size has enlarged because of the increasing labour force participation rate, or employees' wages/salaries have indeed improved to match the evolving cost of living.

As indicated in table 2.2, the annual wage bill ranged between 3.7 and 12.4 percent from 2011 through to 2020. The largest wage bill growth was experienced in 2012 at 12.4 percent and the lowest in 2016 at 3.7 percent. In 2019 and 2020, the wage bill increased by 10.1 and 9.3 percent respectively. The wage bill increase was a result of salary increment while new posts are frozen as alluded by the government (BSP-Draft, 2019).

Moreover, since 2010, Botswana government has been under immense pressure from the International Monetary Fund (IMF) to reduce the wage bill (IMF, 2015). IMF's argument was that the government wage bill is higher than for comparable upper-middle-income countries. According to IMF (2010), the status-quo gives the government as an employer an edge over labour bidding against the private sector. The report by IMF (2010) indicated that the government wage bill accounts for roughly 9.4 percent of the country's GDP. The latest report by IMF (2020) projected a wage bill share of 12.7 percent of Botswana's GDP for the year 2019.

Reflecting on the above, the status quo suggest that the government is yet unable to relegate some of its functions to the private sector to cut and shift labour costs to the private sector. This in essence, empowers and increasing the private sector role in the economy. The lack of sharing of some of government roles that can bring efficiency and growth through the private sector, denies the government to increase the tax revenue base already established from the private sector. This can mostly be achieved by transferring activities that can be carried out more efficiently by the private sector while most public expenditures are channeled to critical programs that promote capital development.

2.6 Government tax revenue

Indeed, government receive income in the form of taxes as already mentioned in chapter one, and most of these variety of taxes are affected by the government upward salary adjustment.

These are taxes drawn from households and firms' income, taxes on commodities, imports, and other taxes on production. The indirect taxes that are attached to all the final and intermediate domestic consumption, and VAT imposed on household consumption and government investment, are improved by the fact that government has virtually injected P2.2billion on the economy in the form of wages. At least the sales and import taxes contributes 23.3 percent (P9, 836million) as government tax revenue from commodities. This is indicated in table 4.3 in Appendix A.

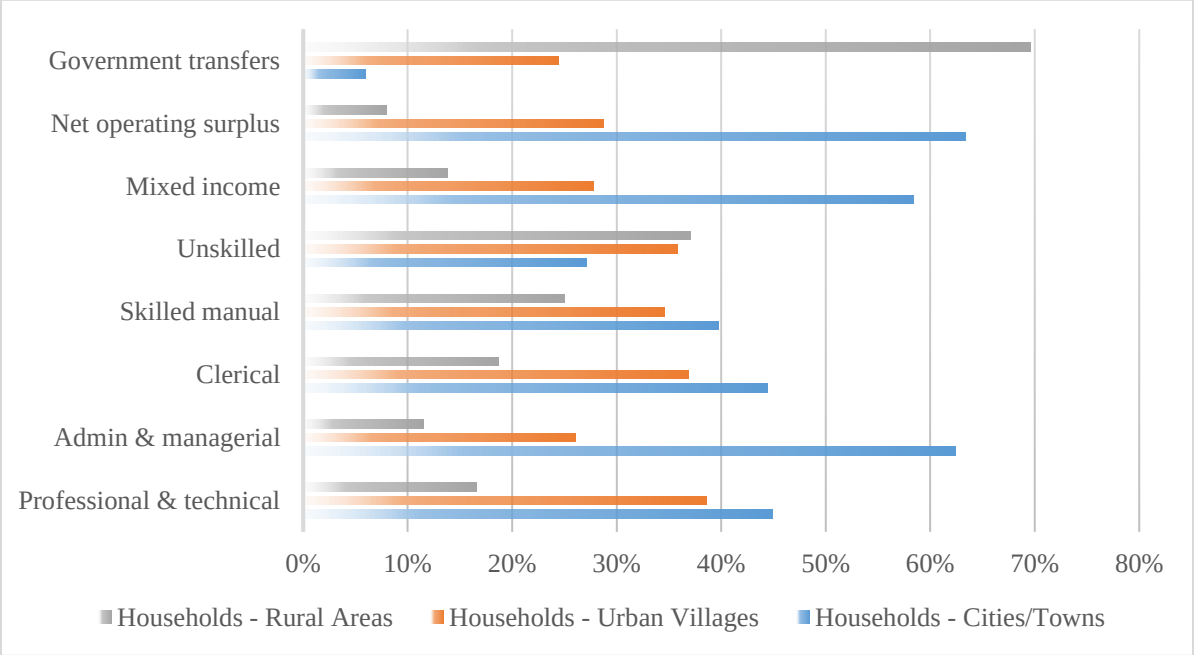
In view of the rise in government employees' salary, obviously government expenditure and household consumption raises. This partly imply that investment expenditure is reduced. Therefore, if investment is highly depressed, government may suffer the loss of revenue from taxes paid through capital returns. However, if the increase in government spending is of productive nature and it does stimulate the economy, then the government overall tax revenue base will be able to grow without having to intervene by raising households' income tax, value added tax, or private business tax. This will generally prevent inefficient spending that promote unsolicited fiscal deficits.

2.7 Households Income distribution

This sub-section explains the income distribution across households as of 2011. This is captured in figure 2.2 below. The data analyzed is obtained from the 2011 Botswana Social Accounting Matrix (SAM) database. The income distribution between rural, urban villages, and cities/town households shows that the economy has a skewed distribution of income towards cities/town households. The average income distribution for household groups is 43 percent, for cities/towns, 32 percent for urban villages, and 25 percent for rural areas. In terms of the following categories of income, i.e.

Government transfers; the rural households receive most of the government transfers in terms of social safety nets programs at about 70 percent. The expenditure is mainly to uplift the economically marginalized groups in terms of no or extremely low household income, no access to good health, and the socially vulnerable in general. In the urban villages, the programs benefit households by only 24 percent, while only 6 percent is shared in the cities.

Figure 2.2: Distribution of labour income by household group



Source: *2011 Botswana SAM data framework*

Net operating surplus; the other higher-income received by households is from the capital investment by cities/town households. Their net operating surplus stood at 63 percent, which implies that it is one of their main sources of income. Urban villagers with 29 percent followed, and lastly, rural households by a low 8 percent income.

Unskilled and skilled labour; the other higher recorded percentage for rural households is the incomes of unskilled labour at 37 percent. The distribution of income in the unskilled labor force is densely distributed between 27 and 37 percent, with the cities/Towns at 27 percent and Urban

villages at 36 percent. In terms of the skilled labour, the households in the cities/towns receive 40 percent of the skilled income, whereas urban villages and rural areas respectively receive 35 and 25 percent respectively.

Admin & managerial; the income distribution is sparsely distributed with 62 percent earned by urban households. Urban villages receiving only 26 percent, which is less than half of the cities/town household incomes in this area. Rural households receive very little income of only 12 percent share from this division.

Mixed-income; the distribution favors the urban households because it shows large dependency on the income received at 58 percent followed by urban villages at 28 percent and rural households at only 14 percent. The rural households' incomes are at the bottom of the list. There is a sign of income inequality in the domestic economy.

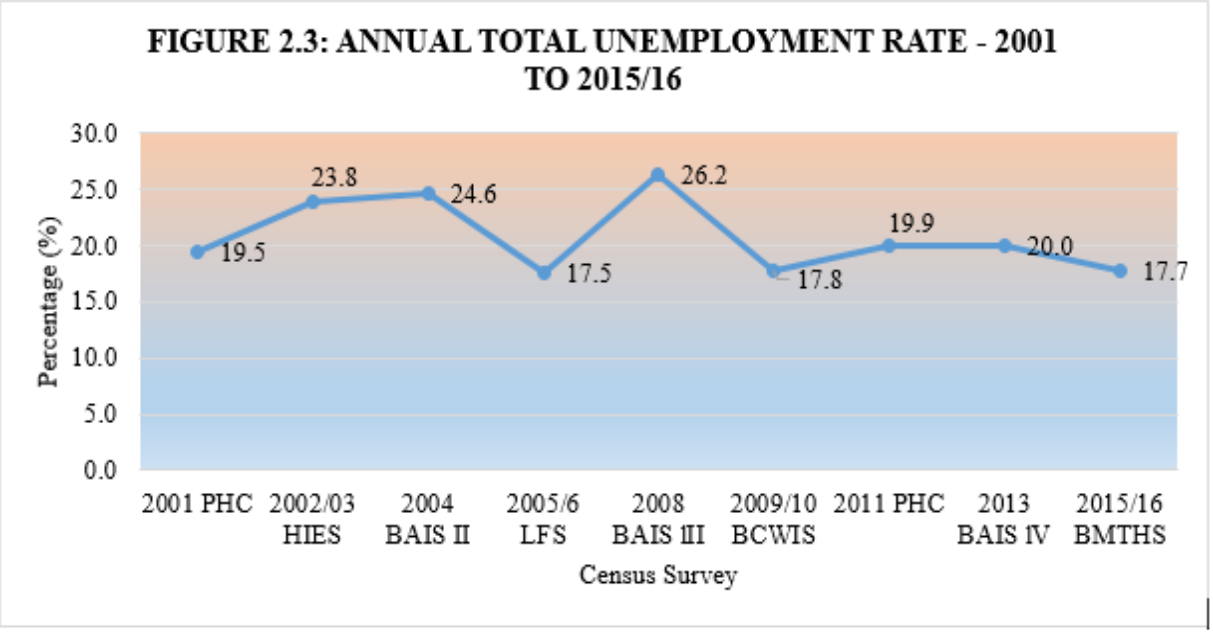
Technical & professional, and clerical; these areas experience the same income inequality challenge but at a smaller scale when compared to the administration and managerial division. Cities/town households in both the tech-prof and clerical work receive income just above 40 percent, whereas urban villages receive just above 30 percent and rural areas above 10 percent. In conclusion, the cities/town households get the most shares of income distribution except for the unskilled labor and government transfers. This is corroborated by the government's intervention by distributing some of the urban villages and more of the urban cities/towns' income to the rural households to uplift their livelihoods (see figure 2.2).

2.8 Unemployment and employment

The rising government wage bill and declining capital development spending indeed may compromise economic growth prospects and employment creation. Statistics from figure 2.3

below indicate that employment creation has not been sufficient to reduce unemployment in the economy. Because of lack of economic diversification and employment creation, undesirable unemployment continues to be a disturbing issue in the economy of Botswana, mostly because it is rife among the youth of this country. Figure 2.3 below indicate the annual unemployment rate in Botswana between 2001 and 2015.

Figure 2.3: Annual total unemployment



Source: Botswana Multi-Topic Household Survey Report 2015/16 – Statistics Botswana

As indicated by figure 2.3 above, unemployment rate ranged between 17.5 and 26.2 percent between 2001 and 2015. During 2015, 844,050 people were in the labor force, 694,750 (82.3%) were employed while 149,300 (17.7%) were unemployed. 2008 recorded the highest unemployment rate at 26.2 percent of the labor force. Given the statistics shown above, the increase in government wages as discussed in chapter one, certainly may have some influence (positive and negative) in other sectors of the economy. Some of the influence may emerge from the wage spillover effects, which can encourage firms to consider alternative ways of reducing

factors of production costs. This has the potential to exacerbate unemployment levels in the domestic economy.

On the employment side, the public sector i.e., general government and parastatals, is the single largest employer with a share of 51.5 percent from the total employment of 387,426 in 2011, while the private sector is at 48.5 percent, see table 2.3 below. Such a sheer size of government as an employer implies that government has a strong influence in the overall labour market. The European-commission (2014), argued that such influence can be persistent and measurably relevant, in countries that are less open to international trade. In contrast, where the government represents a high share of total employment and is open to international trade, the response of private sector wages to a rise in government wages is weaker. This is yet to be investigated since for the case of Botswana, the government is confirmed to be the largest employer in the economy.

Among the many reasons that may explain why Botswana government is the largest employer, is lack of economic diversification and employment creation. Study conducted by Hillbom (2008) reported that, over many years, Botswana has not experienced advancement in terms of technology in the industries, and productivity has remained very low except for the mining industry that employed only 4 percent of the labour force. By intervention, to counterbalance the deficiency in the private sector, the government had to come in as a substitute for stagnating sectors via increasing the public sector growth/size through large employment and other expenditures to enhance economic activity. In addition, the country's population have increased over the years, and so is the level of unemployment. The persistent high levels of unemployment ranging between 17.5 and 26.2 percent recorded between 2009 and 2018, predominantly in

youth, is relatively a threat to socio-economic improvement (Statistics Botswana(SB) (SB, 2015/16)).

Table 2.3. Number of employees paid by sector as of June 2011

Economic Sectors	***Total***	***Sector Share***
Agriculture	6,528	1.7%
Mining & Quarrying	12,201	3.1%
Manufacturing	36,638	9.5%
Water & Electricity	4,105	1.1%
Construction	23,347	6.0%
Wholesale & Retail Trade	47,436	12.2%
Hotels & Restaurants	17,150	4.4%
Transport & Communication	12,969	3.3%
Financial Intermediaries	8,563	2.2%
Real Estate	18,899	4.9%
Education	10,060	2.6%
Health & Social work	2,891	0.7%
Other Community Services	4,173	1.1%
Private	187,968	48.5%
Parastatal	16,992	4.4%
Central Government	101,912	26.3%
Local Government	80,554	20.8%
All Sectors	**387,426**	100.0%

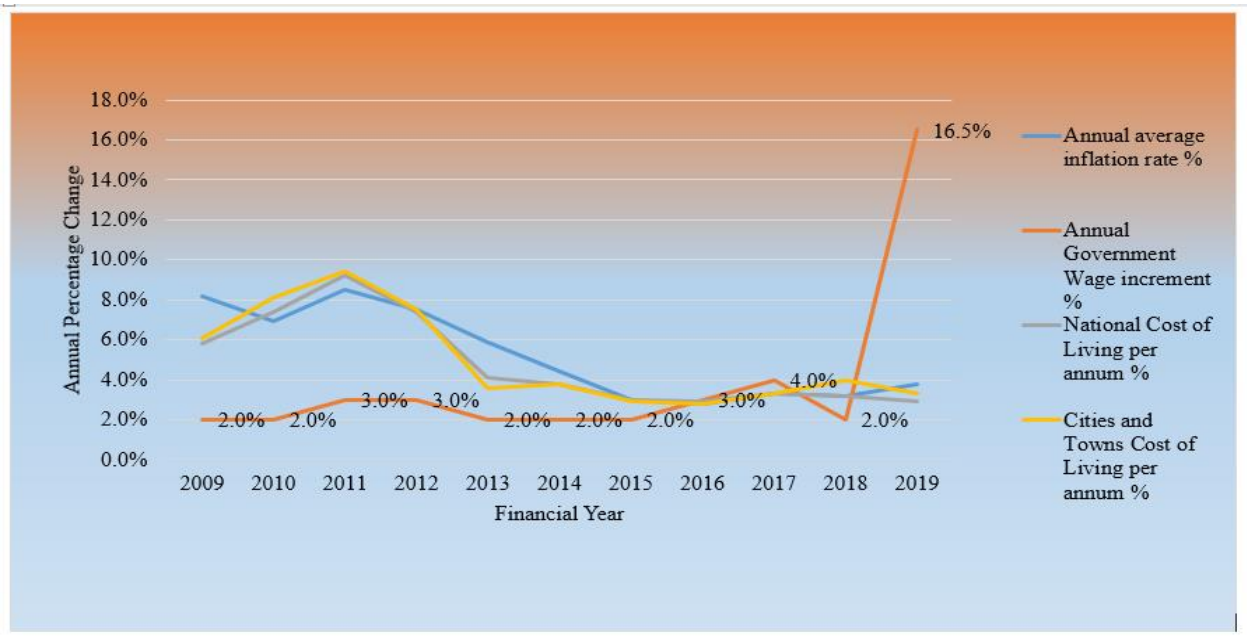
Source: *Statistics Botswana, 2017*

Lastly, from table 2.3 above, there are outstanding areas to point out such as the health & social work sector that employed the least at 0.7 percent. The sector shows that there is an extreme shortage of health and social work staff in the private sector, which is not a good sign of capacity to complement and relieve the public sector during times of disasters. The wholesale and retail trade sector ranks highest within the private sector by 12.2 percent. This sector employs the largest numbers of unskilled and clerical workers in Botswana's labor market.

2.9 Inflation and cost of living

Large government wage/salary increase may trigger a rise in price inflation, especially when wage adjustments are not made on a systematic basis. From both government and private business (through wage-spillover effects), perspective, economic theory suggest that wage rise may elevate labour costs for these institutions, leading to a wage push inflation. While from an increased consumer spending perspective, the demand-pull inflation may occur. Nonetheless, this outcome does not seem to have ascended in the case of Botswana over the past decade. The country has experienced low levels of inflations, despite unsystematic government wage adjustments.

Figure 2.4: Inflation, wages, and cost of living annual change



Source: *Botswana Financial Statistics & PSMD*

As displayed in figure 2.4 above, the effect on inflation and cost of living is observed from the historical data patterns and relationship between the annual salary increments for government employees, and inflation & national cost of living, for the past 10 years. It is evident from figure 2.4 above that, there has been a consistent decline of inflation and the national cost of living

which generally share the same pattern from as high as 8.5 percent in 2009 to as low as 2.8 percent during the period between 2009 and 2019.

Some notable observation from figure 2.4 is the horizontal flatness of the wages and salaries adjustment over the past decade. The wage percentage change has been well below the cost of living and inflation changes over the past decade except in 2016, 2017 and 2019. This implies that households' consumption has been struggling to keep up with the changes in prices of food, accommodation, and other necessities.

Lastly, although the salary adjustment is quite steep in 2019, it does not portray an improvement in the living standards or cheaper cost of living for the larger population of government employees that make up more than 80 percent of the public service[5]. The majority of government employees and the private sector may only be caught-up by the rate of consumer price inflation and heightened indirect taxes responding to the sheer size of the imbalanced wages/salaries adjustment in favor of the disciplined forces beneath the renowned surface of the general public wages/salaries increment[6].

2.10 Conclusion

Given the overall description of the country's economic structure and analysis shown in this section, few landmarks were realized over the years as indicated by some signs of economic diversification efforts. This is revealed by the economic share output growth for the rising

[5] Reason being that members of the public service in the disciplined forces' such as prisons, police, and military service's salary adjustment share is 84 percent (P1, 856 million) of the P2.2billion total increment. The share percentage was calculated from the figures obtained from the annual statements of accounts (ASA) for 2018 and 2019 published by the Ministry of Finance and Economic Development (MFED).

[6] Given the wage disparity between the uniformed and non-uniformed public servants, there is the possibility of increased morale decline and reduced work effort by the non-uniformed members of the public service. Consequently, this could compromise performance and labour productivity in the larger public sector, and the widening of the income inequality gap that already exist.

private sector, particularly the financial and business services, and manufacturing sectors' expansion. However, critical areas such as the health sector with the lowest share in the labour market is an area that shows there is a lack of sector development or growth. Particularly expansion of the sector in specialized areas and general growth of the sector. The agricultural sector reveals an extreme weakness that requires outright attention to ensure that the sector can sustain domestic consumption entirely. Meaning that there is plenty of room for development and commercialization of the sector. The government's position to engage all sectors to change the economy's source of strength is somehow bearing fruits but at a snail pace.

The relocation of the Diamond Trading Centre to Botswana from London in 2013 has increased economic activity shown by the value-added results displayed in table 2.1. Despite the tremendous economic leap and having avoided the natural resource curse as alleged by the researchers over the past decades, there is evidence of soaring and persistent levels of unemployment and poverty. The high levels of unemployment are seen particularly in the youth. The tenacious structural unemployment mostly for white-collar jobs and persistent blue-collar jobs are still a nightmare to this economy. Given the circumstances, Statistics Botswana (2013), argues that the country's inability to diversify the economy and its reliance on the mining sector that is largely capital intensive contributes to the large numbers of unemployed youth.

As mentioned by Hirschman (1958) cited by Hillbom (2008, p. 195), small countries that are rich in valuable natural resources, tend to have limited linkages to other economic sectors and the society, unless the government actively intervenes to cover for stagnating economic sectors. Hilbom's reference describes the circumstance Botswana has encountered and is a predicament to keenly address in essence. Furthermore, government spending has been rising significantly in the past decade. Notably, the recurrent budget allocation has grown rapidly to date, while the

development budget allocations have declined annually since 2009. This, concisely, portrays the direction of a policy shift from the reduction on the development ventures activity funding, to the increase of the wages and operational activity funding.

The income distribution between rural, urban villages, and cities/town households shows that the economy has a skewed distribution of income towards urban households. The rural households' incomes are at the bottom of the list. This is corroborated by the government's intervention by distributing some of the urban villages and more of the urban cities/towns' income to the rural households to uplift their livelihoods.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter presents a review of literature. It begins with a survey of the theoretical literature review. This is followed by an empirical literature review. Lastly, the synthesis of the literature is provided. The literature found to be related to wages/salaries' literature is on minimum wage, hence its review, and the other works of literature on government wage bill adjustments.

3.2 Theoretical literature review

3.2.1 Theoretical CGE models

Basically, CGE models are a "class of economic-wide, multi-sectorial, price endogenous models that are based on actual data and solved numerically" (Devarajan & Lewis, 1989). These models are widely used in many countries for policy analysis. According to Dervis, De Melo, and Robinson (1982), the development of a multisector growth model for Norway by Johansen (1960) lead to several CGE models being used to evaluate economic policies and empirical analysis. On the same vein, Dervis et al. (1982) hold a view that the suitability of the CGE analysis is in the mixed market economies for policy analysis and planning.

The CGE model for this study provide a method to specify the flows embodied in the SAM for Botswana as a set of non-linear and linear simultaneous equations. "The model therefore follows the SAM disaggregation of factors, activities, commodities and institutions" (Thurlow & Van Seventer, 2002, p. 15). The CGE captures simultaneous equations in sets that are mostly non-linear and these equations define different actor's behavior following rules captured by the fixed coefficient (Lofgren et al., 2002).

Moreover, these equations are used to capture the behavior of consumers and producers' decisions by obtaining first-order optimality conditions because their decisions are utility and profit maximization driven, respectively (Lofgren et al., 2002). Set of constraints are defined and covers commodities and factor markets, and macroeconomic aggregates, which are balances for government, savings-investment, and the rest of the world current account (Lofgren et al., 2002). According to Thurlow and Van Seventer (2002, p. 15):

> "The model equations are used to define the interrelationships of the macroeconomy. The data in the SAM provides actual values for the coefficients in these equations through a process known as calibration. The model is initially solved for equilibrium to ensure that the base-year dataset is reproduced. It is then possible to shock the model with a change in the value of one of the exogenous variables. The model is re-solved for equilibrium and the changes in the values of the endogenous variables are compared to those of the base-year equilibrium to determine the modelled impact of the exogenous shock.of the rest of the world)".

There are of-course advantages and shortcomings of using the CGE models. According to Tlhalefang (2019), some of the important advantages of the CGE models are; (i.) the established strong linkages to microeconomic theory; (ii.) the crucial market inclusions such as of the commodities, factors, government accounts, and key macro-balances; (iii.) its ability to determine specific shock on the economy, and the counterfactual analysis capability. Furthermore, the model's "structure accommodates a wide range of features of Southern Africa economies, such as unemployment and activity-inspired restrictions, contains a wide range of policy instruments and its code structure is available without cost" (Tlhalefang, 2011, p. 9).

In terms of CGE model criticisms, there are shortcomings closely tied to the economy's factor and product markets such as the structural and some institutional rigidities, which often lead to persistent disequilibrium or deviate from the neoclassical theory (Thurlow, 2004). These shortcomings are, however, overcome by the use of macro closures as discussed in the next chapter. Given the CGE increased latitude of analysis as shown by the vast empirical studies in the southern Africa region, such as McDonald and Walmsley (2001) in Botswana, Lofgren et al. (2001) for Malawi, Thurlow and Van Seventer (2002) applied it in South Africa, Tsheko (2007) for Botswana, Zambia by Lofgren et al. (2002), and Tlhalefang (2011) for Botswana. The paper intends to adopt the comparative static standard CGE model to expand on the experimentation output of this technique.

3.2.2 Other theoretical literature

The theoretical basis for the effects of wages on productivity, employment, unemployment, inflation, household welfare, and the economy is discussed in this section. The wage adjustment, either positive or negative effect on the economy depends on a couple of factors such as the economy concerned, the structure of the labour market, and the wage relative levels. A few theoretical models are reviewed to understand the potential effects on the labour market, productivity, inflation, household welfare, and the economy.

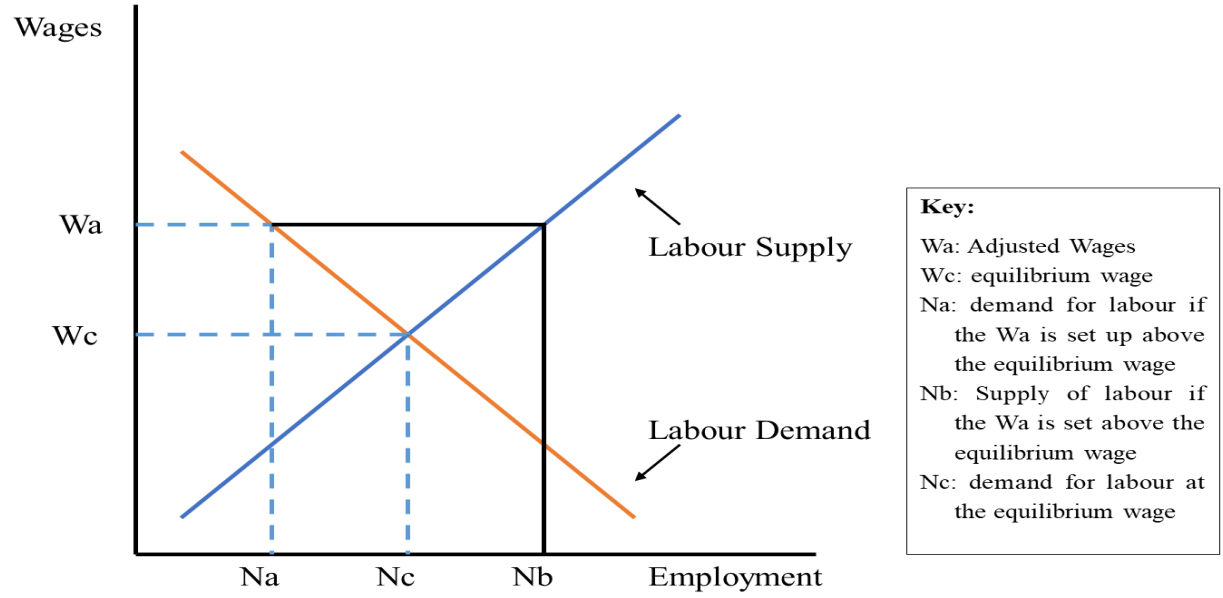
3.2.2.1 Competitive model hypothesis

The government wage increment as discussed in chapter one and two, indeed may affect the private sector, which as of 2017, employed only 48.5 percent (refer to subsection 2.7) of the active labour force. Assuming, due to the upward wage adjustment in the government sector, the private sector then experienced the wage spillover effects, the effects in this case may be discussed by borrowing the insight of the competitive model and alternative models hypothesis

for purpose of elucidation. The competitive labour market describes the effects of wage/salary adjustment on unemployment and employment as shown in figure 3.1. The labour force is homogenous in this model and the labour demand decreases as real wages rise for this firm in its simple form, as an example.

All other things being equal, if the wage level is set above the equilibrium wage level Wa, the demand for labour will fall. At wage rate Wa, the supply of labour has increased yet the labour demand is only Na. In this case, Nc to Nb workers are attracted to the labour market because of the increased wages, but Nc to Na workers lose their jobs as a result of the wage increase effect. Concisely, the competitive model suggests a negative effect of the wage increase on employment because of two elements. When wages rise, the scale effect encourages the firms to contract, reducing the firm's employment.

Figure 3.1: The competitive labour market



Source: (Borjas & Van Ours, 2010)

The substitution effect encourages the firms to be more capital intensive when labor becomes costly, hence reduction in employment. Employee layoffs as explained by the 'scale effect' and "substitution effect' exacerbate unemployment because reduced incomes in the households reduce demand and spending, and ultimately slow output and growth. This model essentially predicts that increasing wages will lead to a reduction in employment in the covered sectors.

Because of the conditions of the competitive model, the model does not hold in reality since the labour markets are neither oversaw by the strict competitive rules nor are they homogeneous. The functioning differs from sector to country to region; hence, the theoretical analysis of the wage increments has to incorporate such realities for better analysis.

3.2.2.2 Alternative models hypothesis

The alternative models such as the efficiency wage hypothesis and monopsony model, predict the possibility of a positive effect on the labour market and growth. The efficiency wage theory hypothesized by Borjas and Van Ours (2010), posits that higher wages motivate and lead to improved employee performance and lessen shirking and job turnover. The expectation is the increased productivity, and output responding to higher domestic demand. However, during a fall in demand, efficiency wages are less responsive, hence a fall on employment. According to Ehrenberg and Smith (2017), the efficiency wage theory suggests that if firms pay high wages than the equilibrium market wage, unemployment will increase due to supply exceeding demand. There is also the risk of having low wage and high wage sector and movement of labor across these sectors (Ehrenberg & Smith, 2017). Unemployment affects efficiency wages because a high level of unemployment discourages shirking in the society since workers are less likely to risk losing their jobs as they can be easily replaced (Ehrenberg & Smith, 2017).

Monopsony model postulates that employers have the market power to set wages so that labour supply is a positive function of the paid wages. Typically, the labour market is compared to that of a single company in a village, where there is only a single buyer of labour. The employer attracts labour force in this village by paying higher wages to retain his workers, hence maintaining a higher level of employment. Given that the marginal cost of labour (MCL) is lower than the marginal revenue product of labour (MRPL) under this condition, employment and wages can both be increased up to the point where there is equality among them. This model's main criticism is the fact that market conditions rarely exist in reality.

Another theoretical model that could motivate the potential implications of wage increase is the Malthus theory of wages and growth. Whether the government wage/salary increment will enhance economic activity across sectors is entirely dependent on; the policy measures in place to balance the imminent policy shock; households' consumption appetite; and whether the real wage is sufficient to influence the private sector to respond in a certain way that will contribute to economic growth. Costabile and Rowthorn (1985) on the "Malthus' theory of wages and growth", states that workers wages' purchasing power depends entirely on the price levels during the time that the salaries are spent.

Malthus theory thus posits that, regardless of the upward salary adjustment, real wages will be low if the demand for goods is greater than the supply. This is so because the net effect is high prices due to increased demand leading to high profits, followed by increased investment, rapid growth in the economy, and increased employment. The theory also suggests the opposite if the demand for goods is low in relation to supply. Under this condition, if the demand for goods and services is inadequate, unemployment occurs because inadequate demand leads to low output

prices, real wages become high, and the employers will not hire anymore hence the increase in unemployment (Costabile & Rowthorn, 1985).

The theory articulates the potential effects that may in this research's perspective describe sectors in the economy that will benefit as a result of an increase in demand, as well as those that will lose out because of a fall or no change in demand for their goods or services. The opposing effects will thus determine the overall net effect that essentially contributes to the growth of the economy.

3.2.2.3 The Philips curve model - implications of the wage-price dynamics

The increase in government expenditure is well known to potentially accelerate inflation. However, raising government expenditure through wages may bring another dimension, which has to be examined empirically given that inflation is one indicator that can be controlled with some monetary policy tools. Theoretically, the study borrowed the influential Philips curve model to discuss the potential effect of wages/salaries increase on inflation. According to Mehra (1991), the supposition that there is a relationship between the methodical movements of prices and wages is derived from the inflation process given by the expectations-augmented Phillips curve model. The Philips curve models are explained by the following set of equations by (Stockton & Glassman, 1987; Gordon, 1988, cited by Mehra, 1991).

$$\Delta P_t = H_0 + H_1\,\Delta(\mathrm{W}_t - \mathrm{q}_t) + \mathrm{H}_2\mathrm{X}_t + \mathrm{H}_3\mathrm{S}_{pt} \quad \ldots\ldots(1)$$

$$\Delta(\mathrm{W}_t - \mathrm{q}_t) = K_0 + K_1\,\Delta P_t + \mathrm{K}_2\mathrm{X}_t + \mathrm{K}_3\mathrm{S}_{wt} \quad \ldots\ldots(2)$$

$$\Delta P_t^e = \sum_{j=1}^{n} \gamma_j\ \Delta P_{t-j} \quad \ldots\ldots(3)$$

Where; all the variables in these equations are in natural logs, and P denote the price level. W is the wage rate, x denotes the demand pressure variable, q is the labor productivity, P^e denote expected price level, the wage equation affecting the supply shocks is denoted by S_t and the price equation is affected by the supply shock denoted by S_{pt}. The first difference operator is given by Δ. The mark-up behavior is described by equation 1. Both S_p, the exogenous relative price shocks, and the cyclical demand (X), influences (w-q), which is the productivity-adjusted labour costs that give a markup price for the equation.

According to Mehra (1991), given the pressures from the demand side, the price level is therefore determined by the productivity-adjusted wages from equation 1. The wages are depicted by equation 2. "Wages are assumed to be a function of cyclical demand (x) and expected price level, the latter modeled as a lag on past prices as in equation (3)"(Mehra, 1991, p. 3). The implication by the wage equation is that, wages are dependent on past prices, all other things being equal. The model thus suggests that productivity growth and money growth predict wage inflation much better than the opposite causality relationship. The policy supposition to be elicited is that price inflation can occur without any warning indication from the labor market. Therefore, the implication is that, only sectors that will benefit from increased demand for their goods and services, may increase their commodity prices, while other sectors do not, hence the overall effect of the wage increase on inflation is vague.

3.2.2.4 The welfare effect - equivalent variation (EV)

The increase in government spending is facilitated through employee wages, which directly influence the welfare of the households. Therefore, measuring the welfare effect is considered to analyse the real benefits and distribution of the benefits across households' categories. In the

context of CGE, the Hicksian equivalent variation (EV) is used to measure the consumers' benefit/loss as a result of a change in price. "EV is the amount of money which would have to be given to the consumer when he faces the initial price, to make him as well off as he would be facing the new price with his initial income" (Gravelle & Rees, 2004, p. 60). Assuming the consumer maximizes utility by apportioning his income between good 1 and 2 so that the marginal utility (MU) of expenditure on good 1 is equal to good 2's MU of expenditure. A small income increase for the consumer would imply that she/he will be indifferent between spending it on either good; in either case, the utility would rise. "In the initial situation, the consumer faces prices $p^0(p_1^0 \ldots\ldots, p_n^0)$ with income m^0 and maximized utility is $U^*(p^0, m_0) = U^0$. With the new prices $p^1(p_1^1 \ldots\ldots, p_n^1)$ and the same income, maximized utility becomes $U^*(p^1, m_0) = U^1$" (Gravelle & Rees, 2004, p. 60).

"EV is the change in *m* necessary to make utility when facing p^0 equal to utility when facing p^1 with income of m_0" (Gravelle & Rees, 2004, p. 60). According to Just, Hueth, and Schmitz (2005) on the Hicksian equivalent variation method, EV is implicitly defined by the use of the indirect utility function as;

$$U^1 = V(\boldsymbol{p^1}, m_1) = V(\boldsymbol{p^0}, m_0 + EV) \quad \text{(3.2.2.D1)}$$

Solving for E, yields;

$$EV = e(\boldsymbol{p^0}, U^1) - m_0 \quad \text{(3.2.2.D2)}$$

To measure the welfare of factor owners using the EV, which is a more applicable alternative to capture multiple changes such as wages-price-income changes, as suggested by Just et al. (2005, p. 221) "we consider the consumer-laborer's utility-maximization problem from the alternative viewpoint of minimizing the exogenous income required for a particular level of utility",

$$\bar{e}(w, \boldsymbol{p}, \bar{U}) = \min[w(l-\tau) + \boldsymbol{pq} | U(l,q) = \bar{U}, \tau \geq l \geq 0, q \geq 0] \ldots\ldots\ldots\ldots\ldots\ldots \text{(3.2.2.D3)}$$

According to Just et al. (2005, pp. 221 - 222), the expenditure function $\bar{e}(w, \boldsymbol{p}, \bar{U})$, "specify the minimum exogenous income required to attain a given utility level with wage–price vector (w,$\boldsymbol{p}$). The equivalent variation of a wage-price–income change from w^0, p^0, m^0 to w^1, p^1, m^1 that causes a change in utility from U^0 to U^1" is given by;

$$EV = \bar{e}(w^0, \boldsymbol{p^0}, U^1) - \bar{m}_0 = \Delta\bar{m} - \int_L \sum_{j=0}^{N} \bar{e}_{p_j}(w, p, U^1)\, dp_j$$

$$= \Delta\bar{m} + \int_{w^0}^{w^1} \bar{h}(\hat{p}_0(w), U^1)\, dw - \sum_{j=1}^{N} \int_{p_j}^{p_j^1} \bar{q}_j\left(\bar{p}_j(p_j), U^1\right) dp_j$$

$$= \Delta m^* - \int_{w^0}^{w^1} \bar{l}(\hat{p}_0(w), U^1)\, dw - \sum_{j=1}^{N} \int_{p_j^0}^{p_j^1} \bar{q}_j\left(\hat{p}_j(p_j), U^1\right) dp_j \ldots\ldots\ldots\ldots\ldots\ldots \text{(3.2.2.D4)}$$

Where; $\Delta m^* = \Delta\bar{m} + \tau(w^1 - w^1)$, L is any path from (w^0, p^0) to (w^1, p^1) and

$$\hat{p}_j(p_j) \equiv \left(p_0^1, \ldots\ldots, p_{j-1}^1, p_j, p_{j+1}^1, \ldots\ldots p_N^0, \bar{m}_1\right)$$

$$w^0 = p_0^0$$

$$w^1 = p_0^1$$

The results in (3.2.2.D4) simply facilitate the measurement of willingness-to-pay (WTP) concepts for the wage/price changes. The EV for a general wage/price/income change is distinctively "measured by adding the change in full income to the change in the compensated demand for leisure and consumer goods. Each demand is evaluated at the final utility level but successively conditioned on previously considered wage or price changes"(Just et al., 2005, p. 222). Where only the wage rate changes ($d\bar{m} \equiv 0, dp \equiv 0$), the EV results indicate that the WTP

for a wage change is captured where compensation corresponds to the final utility level(Just et al., 2005).

3.3 Empirical literature

The empirical literature reviewed is a combination of the minimum wage and government wage-bill studies. This is done to obtain an encompassing coverage of the subject since few studies have been conducted at the microeconomic level for wages/salaries adjustments.

3.3.1 CGE models literature

3.3.1.1 CGE studies on minimum wages

As summarized by Strauss et al. (2017), there are a few studies on minimum wage in the context of the South African economy that used CGE models. The authors are of the view that CGE models' predictions for the high minimum wage effect on the economy are negative and large. Their main argument reflects upon MacLeod (2015) who found out that a gradual increase in the general minimum wage, negatively affected the economy. Where the economy extremely contracted in terms of real GDP, government investment, gross fixed capital formation, household consumption, exports, and imports all fall by a range between 3 to 4 percent in the short run while all these indicators declined within a range between 11 and 15 percent in the long-run. Pauw (2009) estimated the impact of an increase in national minimum wages on poverty and employment using a Standard General Equilibrium model (STAGE). In this study, employment for low skilled workers declined significantly both in the short and long run.

Mwangi, Simiyu, Beyene, and Onderi (2017) evaluated minimum wage effects on labor and its influence on growth in Kenya. The paper used the PEP-1-1 single country static model, and the 2009 Kenya social accounting matrix (SAM). The focus was on urban and rural area labour markets, their income distribution, and labour migration. Three scenarios were simulated;

increasing minimum wages by 5% and 10% for both urban and rural, and reduction on minimum wages for both regions. The results revealed that upward minimum wage adjustment raises labour migration to urban areas, and suppresses economic expansion. Implying a largely negative effect on rural households' incomes while urban households benefit from the upward minimum wage adjustment, which further widens income inequality among the regions. The study also discovered that a reduction in minimum wages supports employment expansion and output.

Erero (2016) examined the economy-wide effect of an increase in the national minimum wage for the economy of South Africa (SA) using a CGE model with the 2010 SAM for SA economic structure. Three scenarios were evaluated, and the results showed a negative effect on the following; employment, welfare, and GDP declined significantly. For example, GDP fell by 1.85% in the first scenario when the minimum wage increased to R3000.00 for all sectors.

3.3.1.2 Other studies on minimum wages in Botswana

A few studies were conducted on the impact of the minimum wage in Botswana. These are, *inter alia*, Szawelski (1978), Scoville and Nyamadzabo (1988), Mazonde and Gyekye (1989), Boyd and Mugabe (1989). These studies investigated the impact of minimum wages in all sectors covered by minimum wages. The effect was found to be negative and insignificant for most of these studies. Some employers laid-off some workers to reduce labor costs especially in the villages. However, only two studies by Mazonde and Gyekye, and Boyd and Mugabe, performed the rigorous econometric analysis that estimated elasticities. The findings from Botswana studies on minimum wages are close to those from some of the emerging economies[7].

[7] Broecke et al. (2015) study reviewed the impact of the increase in minimum wage on employment for ten major emerging economies (Mexico, India, South Africa, Colombia, Brazil, Indonesia, China, Russia, and Chile) using meta-regression analysis. The results showed minimal or no impact on employment in these countries. However, the unskilled, youth and low wages income earners were slightly affected. The impact was said to be small.

3.3.2 Other empirical literature

3.3.2.1 Government wage bill

A study by Amusa and Oyinlola (2019) examined government expenditure and economic growth relationship in Botswana between 1985 and 2016. Using the Auto Regressive Distributed Lag (ADRL) bounds testing approach, they found out that a high increase in aggregate spending gave negative results in the short run and positive effect in the long-run on economic growth. However, for a disaggregated expenditure into recurrent and development, it gave a positive effect for both short and long-run analyses.

Dybczak and Garcia-Escribano (2019) examined the "short and medium-term fiscal implications of government wage bill spending". Their study sampled 137 countries; low-income, emerging, and developed, using panel data for the period between 1992 and 2015. The method of estimation used was the Vector Auto-Regression (VAR) approach. They found a worsening fiscal balance in the medium term but reduces as revenues rise while non-wage expenditure remains unchanged. However, developing natural resource-rich countries with a high level of debt exhibited a negative effect on the fiscal balance. The analysis showed that it depends on the characteristics of a country, in terms of debt levels, access to natural resources, and the level of development of a country.

Bermperoglou, Pappa, and Vella (2017) examined the effects of public wage shocks on the macroeconomy for the United States of America (USA) using data for the period 1979 to 2007. The study used the VAR model to estimate the short-run effects of the public wage bill on the private sector. The model suggests government wages/salaries shocks can be expansionary or contractionary at various government levels. In terms of private consumption, the aggregate household consumption bundle with high levels of complimentary for the public good, the model

predicts a positive effect on private activity. However, the results for the wage shock effect with a weaker complementary channel, leads to public-private wage spillovers, which induces labor demand effect that is negative, private employment falls sharply, and unemployment rises, and private activity contracts in the short run.

A study by Eckardt and Mills (2014) investigated the " Cyclical of public sector wage bill spending in Europe and Central Asia (ECA) and assessed the impact of wage bill spending on fiscal discipline". It covered 26 ECA countries using panel data sets for the period between 2000 and 2011, using Ordinary Least Square (OLS), Fixed Effects regression and Difference Generalized Method of Moments (D-GMM) approaches. Their results revealed a negative effect on the fiscal position over time. The analysis submits that, if the wage bill share of GDP increases by 1 percentage point, the fiscal deficit will increase by 0.5 percentage point. Cahuc and Carcillo (2012) examined public wage bills and public deficits in the Organization for Economic Cooperation and Development (OECD) countries using panel data set for the period between 1995 and 2009, using the OLS approach with country fixed effects. The results reveal a positive relationship between budget deficits and increase in government wage bills.

3.4 Synthesis of the literature review

Generally, the literature review points out some form of confluence between the theoretical and empirical findings among the models used by differing authors. The findings for all studies reported a negative relationship between higher wage-bill/increased government spending (wages/salaries) and employment and/or economic growth in developing countries. They all draw conclusions to increased unemployment or loss of employment and fiscal balance distortion and declining GDP for low-income and developing countries. The major disparity in the above literature is the size of the effect obtained due to the differing methods of analysis used, and the

types of indicator variables employed/observed and lastly, the regions analyzed (in terms of the country's level of development, economic health, and other contributing factors). Given the above literature analysis, this paper attempt to establish the effect of an increase in government wages/salaries using the CGE model in Botswana, hence the study is country-specific. This study is bringing overarching objectives to the literature, which is micro and macroeconomic projected but maintaining the distinctive features of both with the specialized simulations on a CGE model platform.

CHAPTER FOUR

CGE MODEL SPECIFICATION FOR BOTSWANA ECONOMY

4.1 Introduction

This chapter presents a standard computable general equilibrium (CGE) model for Botswana. This model is essentially the IFPRI's standard CGE model by Lofgren et al. (2002) that has been calibrated to the database of Botswana. The presentation follows and draws from Tlhalefang (2019). The CGE model specifications and the database are described in this section, which includes the Social Accounting Matrix (SAM) framework (structural data), behavioral data, and other sources of information. The behavioral relationships, transactions relationships, price, quantity, and production price systems are also described together with the model calibration process for the static model.

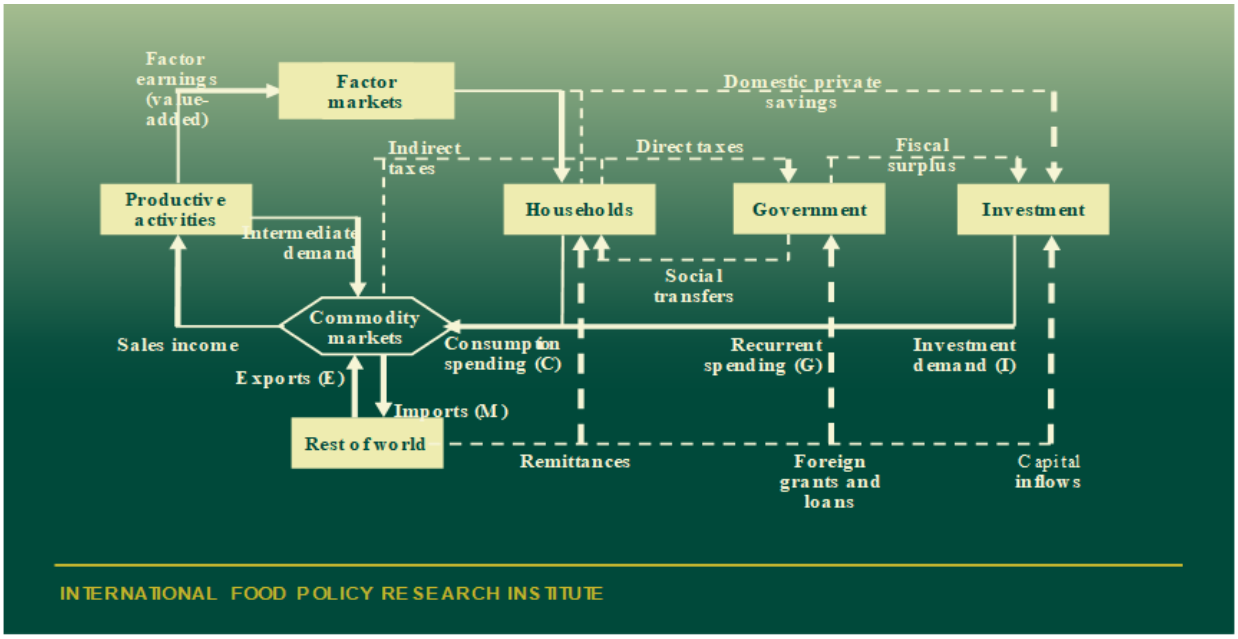
4.2 SAM's conceptual foundations

As explained in chapter three, Breisinger et al. (2009, p. 1) define SAM as "an accounting framework that assigns numbers to the incomes and expenditures in the circular flow diagram". Table 4.1 depicts the SAM that tallies to the circular flow diagram shown in figure 4.1. The figure depicts the flow of activities or transactions in an economy. An account in the SAM is represented by a box in the flow diagram. Cells in the matrix denote the flow of funds from column account to row account. Meaning that, for example, the circular flow diagram indicates private consumption expenditure as a flow of funds to the commodity markets from the households. It is thus captured in the commodity row and the household column. The SAM accounts are described comprehensively in subsection 4.3.1.3.

4.2.1 The circular flow diagram of the economy

The diagram expresses a market economy as a system that is dynamic and creates recurring flows of factor services, money flows, services, and goods, transacting among the economic agents. As discussed earlier in chapter three, the circular flow diagram captures real transactions and transfers between the institutions and sectors in an economy (Breisinger et al., 2009). At the macroeconomic level, the economy comprises of factors and institutions such as Firms, Households, Government, Savings-Investments, ROW (rest of the world), factor markets interactions, and the Commodity market.

Figure 4.1: Circular flow diagram of the economy



The circular flow diagram shows that Firms demand factors of production such as inputs from the Households and reward them by salaries and wages. Firms also demand intermediate inputs provided by the commodity markets to produce goods and services. Firms receive revenues from the sale of goods and services in the commodities market and pay taxes to the government. Households supply their factors (mostly labor) to the factor markets in return for wages and

incomes. They then pay direct tax to the government, consume from the commodities market, and save/invest the rest of their incomes. The government consumes, save-invest through institutions in the commodities market.

The commodities market export to the ROW and imports from the rest of the world. Therefore, for each flow of real resource/income, there must be a corresponding nominal resource/expenditure so that the total income is equal to total expenditure. Savings of Government and Households must equal the flow of S-I because the model requires general equilibrium. Moreover, the inter-institutional transfers, such as savings and taxes are spent so that the incomes circular flow is closed without leakages from the system, by making sure that all incomes are accounted for. In concise, the SAM and CGE frameworks are empirical complements of the circular flow model.

4.3 CGE model database

Data in CGE models are of two basic types - structural and behavioral. Structural data describes the features of the economic system under study. It will generally cover production, consumption, trade, and interventions. The data is being organized in a Social Accounting Matrix (SAM). Behavioral data describes how the system responds to changes. It takes the form of elasticities (of demand, production, trade, etc.) It is usually obtained from the previous econometric work.

4.3.1 Structural data

4.3.1.1 Social accounting matrix

The social accounting matrix (SAM) is a framework within which the regional or national current accounts transactions are quantitatively recorded comprehensively for a given period. It articulates the generation of income by production activities, and the distribution of income

between institutional and social groups (Round, 2003)[8]. By definition, SAM is a square matrix of n x n dimension that conforms to the requirement that each account must have a row and a column (Pyatt, 1988). In this matrix, a pair of row and column defines each account ordered identically. The ith row of the matrix records the transactor i's incomes and the corresponding jth column records its expenditures. Powell and Round (1998) view a SAM as an integrating framework.

Table 4.1: Basic structure of SAM

		Expenditure columns							
		Activities C1	Commod's C2	Factors C3	Households C4	Government C5	Investment C6	Rest of world C7	Total
Income rows	Activities R1		Domestic supply						Activity income
	Commodities R2	Intermediate demand			Consumption spending (C)	Recurrent spending (G)	Investment demand (I)	Export earnings (E)	Total demand
	Factors R3	Value-added							Total factor income
	Households R4			Factor payments to households		Social transfers		Foreign remittances	Total household income
	Government R5		Sales taxes and import tariffs		Direct taxes			Foreign grants and loans	Government income
	Savings R6				Private savings	Fiscal surplus		Current account balance	Total savings
	Rest of world R7		Import payments (M)						Foreign exchange outflow
	Total	Gross output	Total supply	Total factor spending	Total household spending	Government expenditure	Total investment spending	Foreign exchange inflow	

As shown in Table 4.1, entries along the column are expenditures and those along the rows are incomes/earnings. Therefore, cell entries record payments from the column account to the row account. It satisfies the fundamental law of economics. Thus, total income (i.e row total) must equal total expenditure (i.e column total) (Robinson, Yùnez-Naude, Hinojosa-Ojeda, Lewis, &

[8] Its construction reveals various interdependencies in the socio-economic system by comprehensively capturing the actual transactions and transfers between economic agents in the system. According to Round and Pyatt (1985), the SAMs enable the creation of models that "embrace both the traditional concerns of growth economics and the agenda of issues that follow from a focus on income distribution, employment, and poverty alleviation".

Devarajan, 1999). SAM embodies the full circular flow of income[9]. "The SAM represents the whole economic system, it highlights the interlinkages and the circular flow of payments and receipts among the different components of the system such as goods, activities, factors, and institutions"(Bellu, 2012, p. 2).

4.3.1.2 Botswana SAM database

This study uses an officially published 2011 SAM that provides a detailed image of the economy of Botswana. The SAM used is obtained from Dr Tlhalefang as captured by the 2011 Macro SAM for Botswana table, shown in Appendix A, 4.3. The detailed 2011 SAM has 108 accounts; of which 40 are commodities accounts; 37 are activities accounts; 8 are factor accounts; 6 are institutional accounts, with 3 households accounts, 2 government accounts, and 1 enterprise account; 11 tax accounts; 2 social and subsidies accounts; 2 capital and 1 changes in inventory account; 1 rest of the world account.

In this study, the aggregation and the reordering of the SAM accounts were adopted to reduce the number of accounts captured in the 2011 Botswana SAM to match the structure of the IFRPI standard model. In this SAM, to match the structure of the model used, forty commodities accounts are reduced to twenty-three accounts. Activities are reduced from thirty-seven to twenty-three accounts. There were eight factors of production, which were aggregated into two accounts, being labour and capital. The capital account comprises of mixed-income, which has been added to the fixed factor account, as well as the net operating surplus which has been combined with the capital –private account (savings used to purchase or pay for depreciation) to create a gross operating surplus account.

[9] This is not the case with the input-output (I-O) model. The I-O models do not give us the income that consumers use to demand the final good. As a result, SAM extends the I-O model by introducing the factor income.

The six institutions are reduced to five including; firms renamed to (ent) for enterprise and (gov) for aggregated central and local government. Households are classified into cities/towns, urban villages, and rural households. Thirteen lines of taxes are aggregated to five (sales tax, tariffs, export tax, income tax, activity taxes). RoW account, S-I account, and dstk (for stock change replacing changes in inventory) were created. This SAM fits the structure of the IFPRI standard CGE model by (Lofgren. et. Al.,2002). Wider inclusions of most of the sector or accounts make this SAM a useful database to undertake an economy-wide impact assessment (Van Seventer, 2015). The detailed 2011 SAM database in Appendix A is described below.

4.3.1.3 Macro SAM features descriptions

Table 4.3 in Appendix A depicts the schematic macro SAM for Botswana that provides the statistical and conceptual foundations for this CGE model. This section provides a discussion of each of the cell entries made up of row and column valued in millions of Pulas.

i. Value-added

[Labor and Capital, Activities: 82,067]

The earnings received by the factors of production (salaries and wages paid to labor and the profits paid to capital) gives the total value-added, which is also known as GDP at factor cost (Breisinger et al., 2009). The GDP information for various sectors can be obtained from the national accounts. In this SAM, the national capital-labor ratio implies that Botswana is a labour-intensive economy because 77.3 percent of the GDP is generated by labour.

ii. Intermediate demand

[Commodities, Activities: 99,412]

The goods and services used in the production process describe the intermediate demand. Disaggregated commodities and activities reveal production technology differences across sectors in a more detailed SAM. The detailed information is largely useful when establishing the external and/or policy shock effects on the economy (Breisinger et al., 2009). The sectoral information on production technologies is obtained from an input-output (IO) table (Breisinger et al., 2009).

iii. Marketed output

[Activities, Commodities: 194,149]

"Market output represents the conversion of activity output into marketed commodities" (Thurlow, 2004, p. 66). The production activity accounts receive payments for goods and services produced, which is the output from domestic production activities.

iv. Factor income distribution

[Households; Labor and Capital: 63,427]

The aggregate household account receives factor incomes paid to different groups of workers in cities, urban and rural villages in this macro-SAM. With this type of information, the distributional impacts of a policy on different groups can be assessed. Generally, the factor income distribution is a crucial element of the SAM. This is so because policies aimed at increasing production should be disproportionately allocated to benefit the poorer households in a labour-intensive sector, given that the SAM shows that low-income households are largely dependent on labor earnings (Breisinger et al., 2009). "There may also be factors payments to non-household accounts. For example, some of the profits earned by capital may be paid to foreign investors (for instance, mining rents) or the government (such as state-owned enterprises)" (Breisinger et al., 2009, p. 8).

v. Private consumption

[Commodities, Households: 48,629]

"Households use most of their incomes to purchase commodities for consumption. Although the macro-SAM contains a single entry, most SAMs disaggregate private consumption across different commodities and household groups because households' consumption patterns vary, especially across income groups" (Breisinger et al., 2009, p. 8). Such differences in consumption patterns can influence the distributional policy and external shocks' impact on the household income groups. A typical example is a fact that the majority of the poorer households spend a larger portion of their earnings on food than their wealthier counterparts. This implies that that eminent change of food supply will have a larger effect on the poorer households than the wealthier (Breisinger et al., 2009).

vi. Government recurrent spending and investment demand

[Commodities, Government: 19,407] and [Commodities, Investment: 33,640]

In an economy, total absorption consists of public and private consumption and investment demand. Expenditure by the public is the consumption of goods and services acquired to sustain the government function (Breisinger et al., 2009). In terms of investment demand, both the private and public make up the gross capital formation, such as "spending on roads, schools, and residential housing. Investment demand is therefore mainly for commodities like cement and construction services. This information is usually drawn from national accounts, government budgets, and supply-use tables" (Breisinger et al., 2009, p. 8).

vii. Foreign trade

[Commodities, Rest of World: 52,423] and [Rest of world, Commodities: 48,463]

There are three sources of information on import payments and export earnings. The international trade aggregate estimates of goods and services are provided by the balance of payments and the national accounts (Breisinger et al., 2009). “Most SAMs include further detail on specific commodities groups, the information for which is compiled from a country’s customs or trade data” (Breisinger et al., 2009, p. 8).

viii Government taxes

[Government, Commodities: 9,836], [Government, Production subsidies: -548] and [Government, Households: 11,836]

The direct taxes, which include personal pay as you earn, and the indirect taxes that are imposed on domestic institutions as corporate taxes, generate revenue for the government (Breisinger et al., 2009). “Information on tax rates on different commodities and households can usually be obtained from tax authorities, customs data, and household income and expenditure surveys” (Breisinger et al., 2009, p. 8).

ix. Remittances and social transfers

[Households, Government: 8,239] and [Households, Rest of world: zero]

Households receive transfers from the rest of the world and the government besides their factor payments. The transfers from the government include public pensions and social security payments. The remittances are foreign receipts usually from family members working and living abroad. “Conversely, households might also remit incomes to family members living abroad. In the macro-SAM, this could be reflected as a positive entry in the cell [Rest of world, Households] or, as a negative addition to the cell [Households, Rest of world]” (Breisinger et al., 2009, p. 9).

x. Transfers to government

[(GOV, ENT; 704) (GOV, Factors of Production: 17,765)]

The government receives payments for land or buildings ownership from households and enterprises. The payments also include social contributions on labour employment and current transfers to the general government.

xi. Grants, loans, and interest on foreign debt

[Government, Rest of World: 273]

The majority of low-income developing countries are given grants and loans by foreign financial institutions and development partners to augment their capital investment and sometimes to supplement their recurrent expenditures(Breisinger et al., 2009). Such payments are made directly to the government, from the rest of the world. Contrariwise, the rest of the world receives positive interest payments from the government servicing the foreign debt. "Alternatively, interest payments can be treated as a negative receipt from the rest of the world. Information on foreign grant transfers to and from the government is drawn from government budgets and the balance of payments" (Breisinger et al., 2009, p. 9).

xii. Domestic and foreign savings

[Savings, Households: 3,272], [Savings, Government: 860], and [Savings, Rest of World: 548]

The savings are described by the difference between incomes and expenditures. For the rest of the world account, the difference is referred to as the current account balance, and for an account held by the government, it is the fiscal surplus/deficit. "This information is documented in the government budget and balance of payments. However, information on domestic private savings is rarely recorded in developing datasets. Therefore, household savings is often treated as a residual when balancing a macro-SAM" (Breisinger et al., 2009, p. 9).

4.3.1.4 Behavioral relationship

In the SAM, there are four behavioural sectors, namely; government, households, producers, and RoW. Their relationship is founded on behavioural rules that explain the capturing of the recorded transactions in the SAM database. They also reveal how the variables in the model and its parameters are extracted from the SAM database. As displayed in table 4.2, the model's behavioural relationships within which transactions are recorded indicate economic agents' response to shocks.

On the supply side, it is typical of instances where some of the activities in the 2011 SAM happen to produce at least more than a single commodity. Where, i.e., the construction sector produces construction commodities, which is also produced in the manufacturing sector and more other sectors in the economy. In this case, the output produced under this setup is assumed to be fixed when modelled. A CES aggregate of outputs given by dissimilar activities of particular commodity yield the domestic commodity output supply. Hence, it changes the differences to imperfect substitutes among outputs. Given the profit maximization objective, subject to technology transformation, local produce sold in the domestic market and exported to the rest of the world, are differentiated on assumption. Therefore, to acquire product differentiation, constant elasticity of transformation (CET) is specified. The domestic demand receives the entire commodity supply if not exported, or if domestic consumption is low, then the commodity is exported. Hence, domestic exports commodities' relative prices determine export demand and domestic commodity. This justifies the assumption of a small country that, prices are taken as given for export commodities. Whereas domestic commodity prices are endogenously determined.

On the demand side, the consumers rationally distinguish import commodities and commodities produced domestically. Consumers demand composite goods. Composite commodities are the imported and domestic commodities aggregated using the CES function because they are imperfect substitutes. To determine the amount of commodities demanded by consumers, total national spending is minimised subject to domestic imports' relative prices of commodities. This approach permits a two-way trade or cross hauling, where for example, a country imports and exports the same commodity, it also allows the autonomy of the domestic price system from international prices and prevents unrealistic responses by imports and exports from economic shocks or policy change (De Melo, 1988).

Because households are assumed to be rational on their decision, they maximize utility by choosing composite commodities bundles subject to Stone-Geary utility function. The effect is an expenditure demand function that is linear. The linear expenditure system (LES) comes handy because expenditure is divided into luxury and subsistence consumption. Other relationships are thus specified as either as fixed at their base-year values or linear in this study partly because of lack of information and behavioural rules that are definable and clear.

Table 4.2: Behavioural relationship in the CGE model

Receipts	Activities	Commodities	Factors	Households	Enterprises	Government	Savings - Investment	Rest of the World(ROW)	Total
Activities	0	Domestic production (CES)	0	0	0	0	0	0	Activity Income (gross output)
Commodities	Intermediate inputs (CES) others(Leontief)	0	0	Stone-Geary Utility functions Private consumption	Fixed in real terms	Government consumption	Fixed savings shares (Investment)	Exports	Commodity Demand
Factors	Value-added(Factor demands (CES))	0	0	0	0	0	0	Factor Income from ROW	Factor income
Households	0	0	Fixed shares of factor income to households	Fixed(nominal) Inter-household transfers	Fixed (nominal) Surplus to households	Transfers to households	0	Transfers to households from ROW	Household Income
Enterprises	0	0	Fixed shares of factor Income to enterprises	0		Transfers to enterprises	0	Transfers to enterprises from ROW	Enterprise Income
Government	Producer taxes, value-added tax	Revenues(sales taxes, tariffs, export taxes)	Fixed shares of factor income to government factor taxes	Direct taxes on household income	Direct taxes on enterprise income	0	0	Transfer to Government from ROW	Government income
Savings - Investment	0	0	0	Household savings	Enterprise savings	Government savings	0	Foreign savings	Total Savings
Rest of the World(ROW)	0	Imports (Armington CES)	Fixed shares of factor income to ROW	0	Surplus to ROW	Government transfers to ROW	0	0	Foreign exchange outflow
Total	Activity Input	Supply expenditures	Factor expenditures	Household expenditures	Enterprise expenditures	Government expenditures	Total Investment	Foreign exchange inflow	

4.3.1.5 Transactions relationship

This sub-section explains the transaction relationships that exist within the actual transactions presented by the 2011 SAM for the Botswana economy. Table 4.5 in Appendix A presents the transaction relationships that are relevant to expound the behavioural relationships' substance, particularly the inter-institutional relationships.

i. Commodities

The (PQ*c*), which is the composite commodity prices for consumers, reflects the single price assumption, implying the commonality of prices across the rows. Hence, the domestic demands values at purchasers' prices equal (PQ*c**QQ*c*), where (QQ*c*) is the composite commodity quantities. The (QQ*c*) are summed through the domestic final demand and activities, and further distributed across the intermediate demands (QINT*c,a*). The final demand is also distributed across demands by; exports (QE*c*), investment (QINV*c*), household (QH*c*), government (QG*c*), stock changes (qdst*c*), and enterprises (QENT*c*). Commodity export demands are denoted as (QE*c*). The product of world exports prices (pwe*c*) and exchange rate (EXR) plus export duties (te*c*), gives the prices for domestic export commodities (PE*c*), formally, (PE*c* = pwe*c**(1-te*c*)*EXR). Prices of commodities demanded domestically (QD*c*) vary with prices for commodities demanded abroad. This feature indicates that export demands presented in this SAM are inconsistent with Pyatt (1988) supposition that commodities sold at differing prices must be treated as different commodities. Nonetheless, export commodities in this SAM presentation are hence modelled differently.

Domestic producers supply commodity outputs (QX*c*) at the composite commodity output prices (PX*c*), which they receive regardless of the activity that produced the commodity. Hence, the

total domestic supply values of commodities are formally given as (PX*c**QX*c*). Consumption of domestic commodities is subjected to a sales tax rate (tq*c*) which is multiplied by the domestic commodity supply prices (PDS*c*) to obtain (PQ*c*), which is the consumer prices. Therefore total commodity supplied (PQ*c**QQ*c*) must equal the total demand of commodities domestically. The imported commodities (QM*c*) are also supplied and their value is inclusive of all the transportation fares. (PMc) denotes import commodities prices, which is a product of the world prices of imports denoted as (PWM*c*) and the exchange rate (EXR) plus (tm*c*), which is the ad valorem import tariff rate.

ii. Activities and factors

Activities receive average prices (PA*a*) for the quantity output levels (QA*a*) of an activity and are aggregations of the produced multiple commodities. Activities pay production taxes ($t\alpha_{\alpha}$) in proportion to activities' outputs, and other inputs payments that include indirect taxes, given the assumption of zero economic profits. Similarly, the revenues given by (PA*a**QA*a*) are used as payments to primary and intermediate inputs (QF*f,a*). These payments are the average factor prices that are products of (WFDIST*f,a*) and (WF*f*), which are the activity-wage distortion term and the economy-wide wages respectively. The incorporation of (WFDIST*f,a*) accounts for the probable differences in wages across activities that can be brought about by exogenous factors such as health risk, comfort, or market segregation. Hence, despite the common factor price that is economy-wide, activity factor price that is different is accounted for by the activity-specific wage distortion term to capture factor markets inflexibility in the model.

Factors receive incomes from activities traded in the foreign and domestic markets. Total factor income comprises of payments from domestic activities (WFf,a*QFf,a) and foreign factor activities (facrowf), which must be converted to domestic currency. There are factor taxes (tff)

paid from factor income and depreciation (deprec) on capital stock. Factor incomes are also distributed as (YIF) in fixed proportions to factor owners.

iii. Domestic institutions; households, enterprises, and government

Domestic institutions also receive their incomes from other sources. Households receive transfers from; enterprises ($TR\ hldentcons_h$), the ROW ($hhrow_h$), the government ($TR\ hldgovcons_h$) and other households ($TR\ hhldcons_{hp,h}$). The total household income (YH*h*) is deducted direct taxes at the average rate ($tins_h$), and the fixed average savings rate (mps*h*). The average savings rate (MPS*h*) equals the product of average savings rate (mps*h*) and the savings rate adjuster to households (MPSADJ*h*). Lastly, consumption spending is determined by Stone-Geary utility functions. Likewise, the income received by government income (YG) is from differing sources. These are taxes from activities, sale of goods domestically and foreign, households and enterprises, which include; direct taxes (DTAX), indirect taxes (ITAX), import duties (MTAX) factor taxes (FTAX), and exports duties (ETAX).

Others are fixed government ownership factor shares ($shif_{gov,f}$) received from factor income distributions(YIF_f), and grants or aids received as transfers from the rest of the world given as (govrow). Besides government incomes, there are government expenditures, which their differences give the (CAPGOV), which is the government savings. Total expenditure by the government (EG) is the sum of government consumption that comprise of the product of the consumption quantities (QGc) and commodities prices, plus government transfers to domestic non-government institutions.

iv. Capital account and rest of the world (RoW)

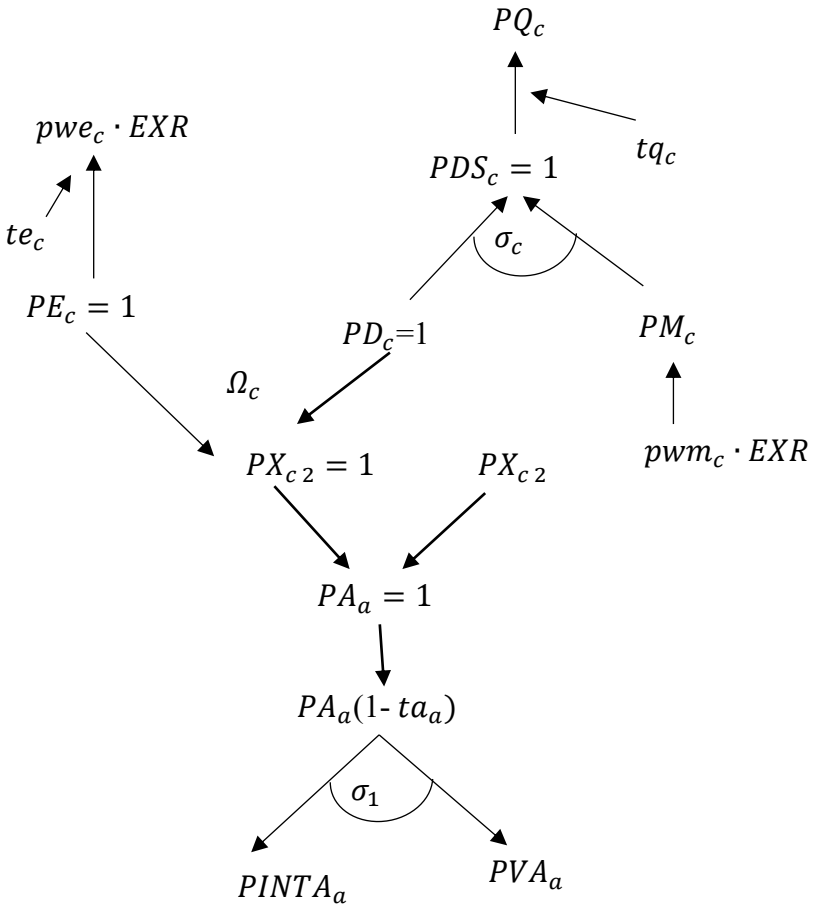
The capital account receives total savings denoted as (TOTSAV), which comprise of all domestic institutions and the rest of world savings denoted as (CAPROW). The volume of investment demand for commodities (QINVc) and the stock change quantity (qdst*c*) gives the domestic investment demand that is financed by (TOTSAV). Total savings and investment expenditure must equate. Lastly, the income earned by RoW is through payments made from the domestic economy to the RoW, such as on factor services and imported commodities. Expenditures made by the RoW, are incomes to the domestic economy from the rest of the world. They comprise of net transfers to institutional accounts in the domestic economy and export commodities payments. The exchange rate (EXR) is used to transform the transaction into the domestic currency.

4.3.1.6 Price systems

This sub-section discusses the price systems and how prices are determined in the market. Figure 4.2 shows that the prices of the domestically imported (PMc) and produced (PDc) commodities' CES functions, determines the supply composite good prices (PDSc). World prices of import commodities (pwm*c*), values the domestic prices of imports generated at border prices. Another consideration is of the ad valorem import fines(tq*c*) which raise the nominal exchange rate (EXR). Often, small countries' domestic commodities prices (PDc) are normally determined by supply and demand while the world imports prices are fixed. A rise in prices of supplied composite (PDSc) goods by the ad valorem sales tax (tq*c)* which is fixed, provides the composite good prices for the consumers (PQc). The world price of exports (pwe*c*) and fixed exchange rate determines the domestic export prices (PEc). The producer prices of composite output (PXc) are equal; the sum of the weighted average of the domestic producer prices of commodity *c* for

activity *a* (PXACc,a) and the average activity price (PAa) per unit of output. The aggregate intermediate composite input (PINTAa) and value-added (PVAa) receive payments from the net activity prices (PAa *(1-ta*a*)). The trade elasticity parameters are denoted by σ and Ω in figure 4.2 for composite good aggregation in the CES and output transformation function in the CET.

Figure 4.2: Model Price System



4.3.1.7 Quantity system

The quantity relationship structure is indicated by figure 4.4 in Appendix A. Domestic production (QDc) and import (QMc) are aggregated by a CES function to obtain the composite goods supplied to the domestic market, denoted by (QQc). The parameter σ captures commodities level of imperfect substitution. Total demands and supplies for composite commodities must balance. Total factor supplies (QFSf) and demands (QFf) must balance. Between the exports (QEc) and domestic markets (QDc), the CET function aggregates the marketed domestic output supplies (QXc). Through the CES aggregating function of commodities outputs (QXACc,a), the domestic output is obtained from various domestic activities. As shown in the diagram, total composite demands for commodity c, comprise of government (QGc), consumption by households (QHc,h), changes in stocks (qdst*c*), trade input use (QTc), investment (QINVc), and the demands for intermediate consumption (QINTc,a). The following sub-section gives the behavioural relationships of the model.

4.3.1.8 Production price system

The production price structure indicated by Figure 4.5 in Appendix A presents the two-nested production function with the corresponding price relationship. The aggregate intermediate composite and value-added are combined by constant elasticity of substitution function (CES) at the top level. The last nest gives; the technology and intermediate inputs that are demanded in fixed proportions for aggregate intermediate demand. The capital and labour are aggregated by the CES technology to obtain the aggregate value-added prices. Given the aggregate intermediate composite and the aggregated value-added for the CES technology specification, it implies that intermediate inputs, skill type of labour and capital are defined from first-order conditions for profit maximization.

4.3.2 Behavioural data

Another important set of additional databases used are the elasticity values to incorporate into our CGE model. This is required because the SAM does not provide the parameter values for the linear expenditure system (LES), Constant Elasticity of Substitution (CES), and Constant Elasticity of Transformation (CET) functions. This section explains how the used elasticity parameter values are obtained for this study. The adopted substitution elasticity values are less than one for aggregate demand and value-added inputs in this model. This is based on the literature surveyed. The Armington elasticities vary widely across studies conducted by researchers. Hence adopting a range between 0.8 and 0.6 for commodities and services. For example, a study by Arndt and Tarp (2001) for Mozambique, had estimate values ranging between 0.6 and 5.5. Unemo (1995) study of Botswana, used elasticities ranging from 0.4 to 0.9. Lofgren et al. (2002) for the Zimbabwe study, used estimates between 0.5 and 3 for varying commodities. A study by Nyamadzabo (2003) for Botswana used a value of 5 for the Armington substitution elasticity for all commodities.

The CET elasticities estimated by different studies also vary. That being the case, the study adopts a combination of different sources to approximate realistic values for this model. For example, In studies by Thurlow and Van Seventer (2002) using a standard CGE model for South Africa, and Lofgren et al. (2002), the IFPRI model for Zimbabwe; the output aggregation elasticities are all set at 4 in the CES specification. The elasticity of market demand (own-price elasticity) is set at 1 in this study, as recommended by the IFPRI for the standard CGE models (Lofgren et al., 2002). This study will adopt the recommended Frisch parameter for the middle-income countries of -2 where Botswana is classified. The labour-capital substitution elasticities used are those estimated econometrically by (Odada & Mogotsi, 2000).

4.4 Model description

To achieve this study's objective, slight changes are made on the IFPRI model used. The changes are made to accommodate the economic features of Botswana. Some of the changes incorporated are the specification and selection of the functional form of model closure rules altogether.

4.4.1 Standard CGE model overview

The static CGE model is fully described in Appendix B. The model is presented as a set of simultaneous equations that are non-linear and linear. The simultaneous equations systems presented are derived from the optimization behavior of the agents (producers and consumers). All the payments and receipts captured in the SAM provide most of the required data for the CGE. This approach gives solutions that are interpreted as equilibria in the market economy.

In many CGE models, there are key features that influence the choice of a static or standard CGE as a starting point such as the fact that it allows the following;

- The use of a small country assumption together with the Armington intuitions, which enable the cross-hauling process. For example, a country can export and import the same good. The feature has to be accommodated to accord some degree of autonomy to the domestic price system and discourage extreme specialization toward price fluctuations.
- The flexibility to capture various factor market features.
- Trade relationship by provisions that integrates the following; competitive imports, such as the domestically produced and imported commodities; second, the non-traded commodities; third, complimentary import supplied commodities; forth, commodities that are consumed domestically but also exported; fifth, exported commodities not locally sold; lastly, commodities locally produced but only sold in the local market.

- Mining production is largely driven by changes in world prices and demand and other exogenous factors that consider mineral resource depletion, and,
- Lastly, it allows for the new capital allocation scheme that follows the putty clay structure.

The static model set of equations is essentially described in Annexure B.

This following sub-section present the adjusted equations on the IFPRI standard CGE model equations by Lofgren et al. (2002).

4.4.1.1 Production and factors' demands

In the price block, equations (4.7) and (4.8) in Appendix B, have been replaced by three equations defining the price of value-added (*PVAa*), with and without the production tax adjustment and the intermediate aggregate input price (*PINTa*). The price of aggregate value-added (*PVAa*) is derived from Euler's theorem requiring that the value of output must be exhausted. In this case, the value of output is given by;

$$PVA_a = \frac{PA_a \cdot QA_a - PINTA_a \cdot QINTA_a}{QVA_a} \qquad a \in A \qquad (4A)$$

Similarly, if there are production taxes, then Intermediate inputs and value-payments completely exhaust the net of taxes to total revenue for each activity. Given PA and PINTA, the value-added price (PVA) is implicitly defined by the *activity revenue and costs* for *both* equation *4A and 4B.*

$$PVA_a = \frac{PA_a \cdot (1-(TXADJ \cdot QA_a)) \cdot QA_a - PINTA_a \cdot QINTA_a}{QVA_a} \qquad a \in A \qquad (4B)$$

Lastly, determining the price of the intermediate aggregate input is given by the weighted sum times the prices of commodities, where *comactactco* is the Leontief input-output coefficients.

$$PINTA_a = \sum_c comactactco_{c\,a} \cdot PQ_c \qquad (4C)$$

The rest of the equations in the price block are maintained as in their standard model form.

In the production block, equation 4.12 in Appendix B is simplified to make QVAa the subject as displayed by equation (4D). The optimal quantity ratios of value-added to aggregate intermediate input are given by the first-order optimality conditions linked by a CES production technology from equation (4.12) simplified as functions of the relative prices of PINT(aggregate intermediate) and PVA(value-added) as,

$$QVA_a = QINTA_a \cdot \left[\frac{PINTA_a}{PVA_a} \cdot \frac{\delta_a^a}{(1-\delta_a^a)}\right]^{\frac{1}{1+\rho_a^a}} \qquad a \in ACES \qquad (4D)$$

From the production block of equations, equation (4.15) in Appendix B is eliminated and replaced by equation (4E) that defines the quantity of value-added of each activity, as a CES function of the disaggregated factor quantities such as formal and informal sector labour (skilled, unskilled, etc.) and capital i.e.,

$$QVA_a = Alphava_a^{va} \cdot \left[\sum_{f \in F} \delta_{fa}^{va} \cdot [\alpha_{fa}^{vaf} \cdot QF_{fa}]^{-\rho_a^{va}}\right]^{-\frac{1}{\rho_a^{va}}} \qquad a \in A \qquad (4E)$$

Where, α_{fa}^{vaf} and $Alphava_a^{va}$ are factor-specific productivity parameters for activity *a*, and total factor productivity (TFP). To ensure a defined CES function, the ρ_a^{va} , which is the elasticity of substitution term, is restricted to not be equal to one. The IFPRI static CGE model equations (in the price block, production and trade block, institutions, and system constraints blocks) in Appendix B, plus these equations under this section (4.4.1.1), describes this study's model.

4.4.1.2 Model closures

Model closures are the assumptions made regarding the endogenous and exogenous variables when modeling the methodology. These closures differ depending on the purpose of the study. In

the IFPRI model "The CGE model includes three macroeconomic balances: the (current) government balance, the external balance (the current account of the balance of payments, which includes the trade balance), and the Savings-Investment balance" (Lofgren et al., 2002, p. 14). There are four alternative closure rules used for these balances. They are summarized as follows; Neo-Keynesian closure –factors are not paid the value of their marginal product; the Neo-Classical closure – investment is savings-driven; Keynesian closure introduces unemployment and lastly; the Johansen closure rule, which perceives investment-driven for savings and investment.

Lofgren et al. (2002) suggest that imposing a closure that closely mimics the real economy is crucial to capture the likely effects of an exogenous shock in a given setting (present, future, or past), by simultaneously adjusting the three components of absorption that incorporates a balanced closure. Since Botswana is a small country in the international market, the model considers the small country assumption. Hence, in this model, the world prices of the traded commodities are fixed i.e. formally;

$$pwe_c = \overline{pwe}_c$$

However, this small country assumption may be changed such that Botswana may face a downward-sloping demand curve for its exports of minerals. In this model, the investment is savings driven. The model could be investment-driven to reflect the fact that Botswana does not face investment constraints due to its accumulation of foreign reserves. However, because an investment-driven closure means fixed real investment quantities, an adjustment of selected domestic institutions' savings rates has to be made to equal total investment. Implying an assumption that the government must be able to enforce some policies to generate savings from the private sector for the required fixed real quantities of investment, which can be challenging

in the Botswana setting (Olsson & Ohlund, 2004). Instead of dropping one of the macroeconomic constraint alternative options, the model adds the WALRAS variable on the investment savings balance equation. The model is expected to return the zero value for the WALRAS variable during simulations to confirm the correctness of calibration and the simulation designs.

The following specific model closures are expected to determine the behavior of the model based on the conventional wisdom of the structure of the economy of Botswana. Starting with the government accounts[10], the government's savings are allowed to vary while government demands and all tax rates are fixed. For the Botswana setting, the following approaches shall also hold for the model baseline scenarios. The quantities and prices for all commodities in the commodities markets are endogenously determined. In the factor markets, capital is activity-specific and fully employed so that sector-specific wages adjust and the total supply equals demand for capital. In the labor market, since there is a persistently high level of unemployment for the unskilled and semi-skilled labor types and a shortage of highly skilled labor; the wage rate is fixed and employment is allowed to adjust, and similarly, the skilled professionals are fully employed and inter-sectoral mobile.

Since the government has decided to freeze employment, we can also consider a closure condition that imposes an exogenous time path for government employment factors that fixes employment of labor and allow a flexible factor-specific wage distortion variable (WFDIST). The consumer price index (CPI) is fixed at its base level and is the numeraire. So that even when the CPI doubles, all quantities supplied and demanded are unaffected, while nominal variables

[10] Government closures can be many and complex because they are allow for consumption, savings variations and tax instruments policy changes adjustments.

all double. Given the fact that Botswana has since operated a mix of fixed and adjustable peg system for its major trading partner's currencies i.e. the South African Rand and Special Drawing Rights (SDR) in order to maintain real exchange rate stability, a flexible exchange rate regime is presumed for the economy of Botswana. This model will thus allow foreign savings to vary and the exchange rate would then be fixed exogenously.

4.5 CGE model calibration

The section explains the study's model calibration procedure that includes the estimated elasticity values, the variables, and the updating of the exogenous parameters using actual trends. CGE models determine parameters mathematically from a SAM. Thus, it determines the set of parameters and exogenous variables so that the CGE model will replicate the economy presented in the SAM. This is called calibrating the CGE Model. The method of calibration highly depends on the supposition that the economy is in equilibrium. The benchmark data set such as the compiled SAM enables the model to be solved from equilibrium data for its parameter values.

CGE is treated as a collection of non-linear algebraic equations, and linear algebraic equations that solve directly with numerical solution techniques. Within this framework, there are variations, depending on how the system is solved. Part of the theory of a model is the closure – the choice of which variables are endogenous and which are exogenous. The calibration of the model is done such that, the CGE returns a database that is balanced as in the SAM, as its equilibrium solution. The 2011 SAM for the economy of Botswana is parameterized and set for this model as the base year database. Behavioral parameters values are obtained from the benchmark data. The code structure is derived from Lofgren et al. (2002) for the static model. The model is coded and solved using modelling language called the general algebraic modelling

system (GAMS). The steps and method of calibration followed to generate the static general equilibrium model solutions are elaborated in subsection 4.5.1.

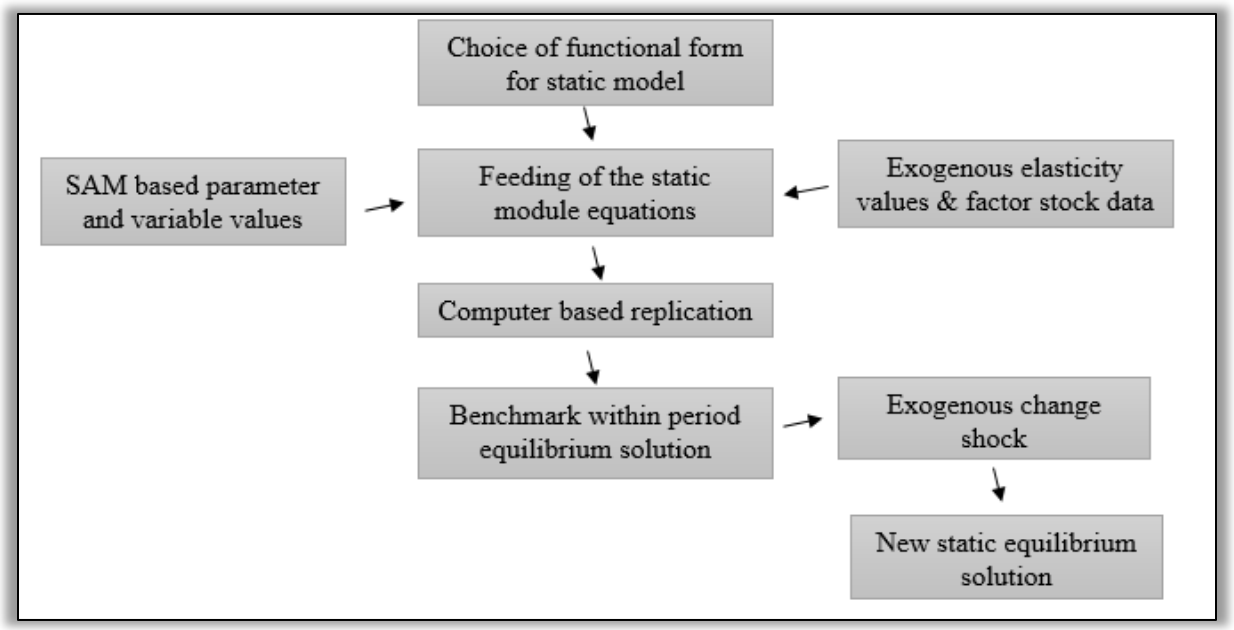
4.5.1 Calibration process in static module

In a CGE, elasticity, and the parameter values that feed the model equations are key to the impact of a shock or policy change (Sánchez, 2004). The calibration method used to calculate the parameter values allows the static module equations to produce a short-run solution or base-year equilibrium observation (Sánchez, 2004). Figure 4.5 outlines the calibration process. In the first stage, the static module functional form is chosen. The second stage involves feeding the static module equations with data. The data is obtained from the SAM (variable and parameter values), and other data such as elasticity values and factor stocks are obtained elsewhere (Sánchez, 2004). According to Shoven and Whalley, (1992:105) cited by Sánchez (2004), to obtain separate observations in terms of quantity and price, units are chosen for goods because the SAM is estimated in value terms.

By following Harberger, (1962) cited by Sánchez (2004), the observations are obtained using the units' conversion criteria by choosing units for goods to ensure the price of unity for the goods in the base year. The exogenous price values are also set at unity in the base year, the expectation is that it will enable the bench-mark output solution that replicates the economic state in real terms. Therefore, on the third stage, the computer-based replication check is conducted by using computer code to test for accuracy. A replication check through an iterative process is expected to fail if there is a programming error. However, the benchmark equilibrium is reached when the replication check does not fail. This implies that the data fed into the model reproduces the corresponding SAM values. From this stage, changes that are made on exogenous variables or parameters are expected to generate a new static equilibrium solution with a new set of data,

which rather means elasticity values should be investigated if that is not the case.In this model, the assumption that no financial implications as a result of the shock and monetary policy changes have inconsequential effects on the real economy is maintained because the model is of the real economy[11].

Figure 4.3: Calibration method flow chart



4.6 Conclusion

This chapter described the study's model specifications, by firstly introducing the SAM as a framework and a database, and its linkage to the Circular flow diagram of the economy. The description of the SAM was provided in this section. Secondly, the model transaction, price, quantity, and behavioral relationships were discussed together with the model description, which

[11] The presumption is maintained because the theoretical basis of CGE models that includes financial modules such as of Zimbabwe, by Rob Davies is not catered for within the Walrasian framework. Subsequently, since this paper analysis is on the long term economic adjustments, the financial module is unnecessary because, theoretically, financial-economic effects are short term and the classical contrast holds in the long run.

included the calibration process in the static model. The following chapter discusses the model simulation process.

CHAPTER FIVE

DESIGN OF SIMULATIONS

5.1 Introduction

This chapter presents how the simulations for this study were designed. Two sets of experiments designed are provided, which are, the central simulations and the sensitivity simulations. The sensitivity results and their analysis are not presented in this paper due to time constraints. The reason being that more time was spent on efforts to implement the dynamic model for this study, which however presented some difficulty in obtaining the results. Hence, the alternative was to run the static model for this study. Nonetheless, the discussion of the experiment is provided in this section for future incorporation.

WITH and WITHOUT APPROACH

This study determined the impact of the large public-sector wages increases on the economy of Botswana using the *WITH* and *WITHOUT* approach. Invariably, this method is used in the CGE modeling analysis to obtain the the effects of a specific exogenous economic shock and, or policy reform on the model economy. This method obtains the effects of a shock as the difference between the the equilibrium solution values *WITH* (counterfactual simulation) the shock and *WITHOUT* the shock (benchmark or baseline simulation). The procedure requires that the model be first used to generate the base equilibrium solution, i.e., the solution without a shock. Then, a shock is introduced to the model by adjusting the value(s) of one (some) of the exogenous variable value (s) of the model, holding other variables (exogenous) and parameters constant. The model is re-run to solve for the new solution values of the endogenous variables.

The effects of a shock on the whole and sectoral economy are obtained by comparison of what happened to the economy with the shock and without that specific shock.

Central Simulation

As it was mentioned earlier on, the model was calibrated and run until the SAM for 2011 used to calibrate the model was returned as the model's equilibrium solution. This run of the model is the base run or the reference scenario against which all counterfactual scenarios are compared. That is, this is the solution produced without any shock imposed.

A central simulation or experiment was then constructed. In this scenario, the shock was imposed by changing the wages paid by the government sector. Specifically, the wages for government employees were increased by 16.5 percent. A shock can be described as an unanticipated permanent change to economic agents. A shock is introduced to the model i.e., a constant to change an exogenous economic variable or any policy tool from its value in the base case scenario. The model was then re-run to obtain a new equilibrium solution. This generated new static equilibrium solution values of the variables. The simulation experiment set up that indicates the base case scenario without a shock and the simulation scenario with a shock is displayed below.

Below is an example of how the base experiment (*SIM0*) and counterfactual experiment (*SIM1*) without and with a 16.5 public-sector wages increases respectively were set-up in GAMS:

*WFDISTSIM (FLAB, 'AGOVT', 'SIM0') = WFDIST0 (FLAB, 'AGOVT')*1;*

*WFDISTSIM (FLAB, 'AGOVT', 'SIM1') = WFDIST0 (FLAB, 'AGOVT')*1.165;*

The parameter (*WFDISTSIM*) was used to carry the value of the simulation, i.e., convey the change on wages, and wage distortion term *WFDIST* was used to introduce the shock. The

parameter, $WFDIST0_{flab}$, denotes the base wage level of each type of labour employed by government. To solve for values of the counterfactual simulations, the model is re-run using the new wage levels, $WFDISTSIM_{flab,}$ in conjunction with the default values of other exogenous variables including of base wages levels paid by non-government sectors.

The simulations provided extensive output of most macroeconomic indicators, in particular real GDP at market prices and at factor costs, absorption, private and government consumption, exports, imports, taxes, total employment, *etc*. Also, a wealth of output on microeconomic indicators was produced including employment by industry and occupation, sectoral value-added, export and import by commodity, *etc*.

Sensitivity Analysis

According to Thurlow and Van Seventer (2002), it is necessary in CGE model analysis to conduct sensitivity analysis. The purpose of it is to test the robustness of the simulation results to changes in key parameter values. These provide some level of confidence in the results to users of the CGE model results. The reason for conducting the sensitivity analysis is that the calibrated CGE models' elasticity values are either guess-estimated or assigned or the basis of estimates for comparable countries.

The sensitivity simulation of the model concerning the CES and CET elasticities is very important for this study. Therefore, to implement the government wage-adjustment shocks for sensitivity analysis, the simulations are conducted through the replacement/changing of behavioral parameter values. Key parameters relevant to the objective of the study and the model features that can significantly affect the results are targeted and analysed.

5.2 Conclusion

This chapter described how the results of a shock or shocks are obtained in the CGE modelling context and discussed how the simulations that yielded information needed to obtain effects of public-sector wage increases were set-up. The next chapter presents the simulation results. This includes interpretation and explanation of the simulation results of public-sector wage adjustment in Botswana.

CHAPTER SIX

MODEL SIMULATION RESULTS

6.1 Introduction

The purpose of this chapter is to report the results obtained from simulations undertaken with the comparative static standard CGE model parameterised to the Botswana database as indicated in the preceding chapters. The information obtained from the simulations enables the determination of the effects of the public-sector wage increase on the economy.

The rest of the chapter is structured as follows. Section 6.2 presents the central case results. This begins with the presentation and analysis of effects on selected macroeconomic indicators and ends with the presentation of the sectoral effects. Finally, conclusions are drawn in section 6.4.

6.2 Central Results

Wages function as a cost of production and a source of demand in a firm. A wage increase is expected to trigger several effects on demand and supply. In economic theory, it is common practice to distinguish the effects of a shock between the demand side and supply side. The effects of the change in expenditures are observed on the demand side relative to productive capacity and technology, whereas on the supply side, the changes are observed on machinery (capital) and technology. This is linked to growth in the productivity of labour on the supply side. Hence, it is noteworthy, to understand that the wage effects on the demand side may spill-over to the capital growth rate.

A 16.5 percent increase in public-sector wages is expected to cause the aggregate demand components to pull in different directions. From the review of the literature, it is highly that private and public consumption would increase whereas a decline is anticipated for investment

and net exports are anticipated. *A priori*, the net effect cannot be determined. This will depend on which aggregate effect is stronger among the three. Increase in public-sector wages is, also, to increase aggregate household welfare as measured by real aggregate consumption. On the supply side, the effect of wage increase is observed through changes in the productivity growth of the firms. The increase in wages is expected to induce more people to work hard and increase productivity, and output in the long run. In terms of employment, when wages rise, the scale effect encourages the firms to contract, reducing the firm's employment. The substitution effect encourages the firms to be more capital intensive when labor becomes costly, hence reduction in employment. The *a priori* expectation is a negative effect on employment. The key question is; how large are the potential welfare effects of the 16.5 percent increase in public-sector wages likely to be, for the economy of Botswana, and how are the gains/losses likely to be distributed across economic sectors?

Sadoulet and De Janvry (1995) discuss the criteria for evaluation of exogenous economic or policy changes on the economy. This study uses the evaluation measures of efficiency and welfare only. The sustainability issue is not considered because of the difficulty in computing the sustainability indicators. The study uses two aggregate welfare measures that are standard. These are real GDP and real domestic absorption. These are also computed at sectoral level. Real GDP is the most straightforward and standard indicator of overall economic performance, where the increase in this indicator is interpreted as improvement in the health of the economy. Similarly, the increase in real domestic absorption, which is the sum of private consumption, government consumption, and investment, implies improvement in economic welfare. It is argued that these two aggregate welfare measures i.e., real GDP and real domestic absorption, may yield significantly different estimates partly because a country can run a deficit. Following the advice

of Sadoulet and De Janvry (1995), real GDP is regarded as a better aggregate welfare measure of productive capacity whilst real absorption is taken as a better indicator of the actual welfare of the population.

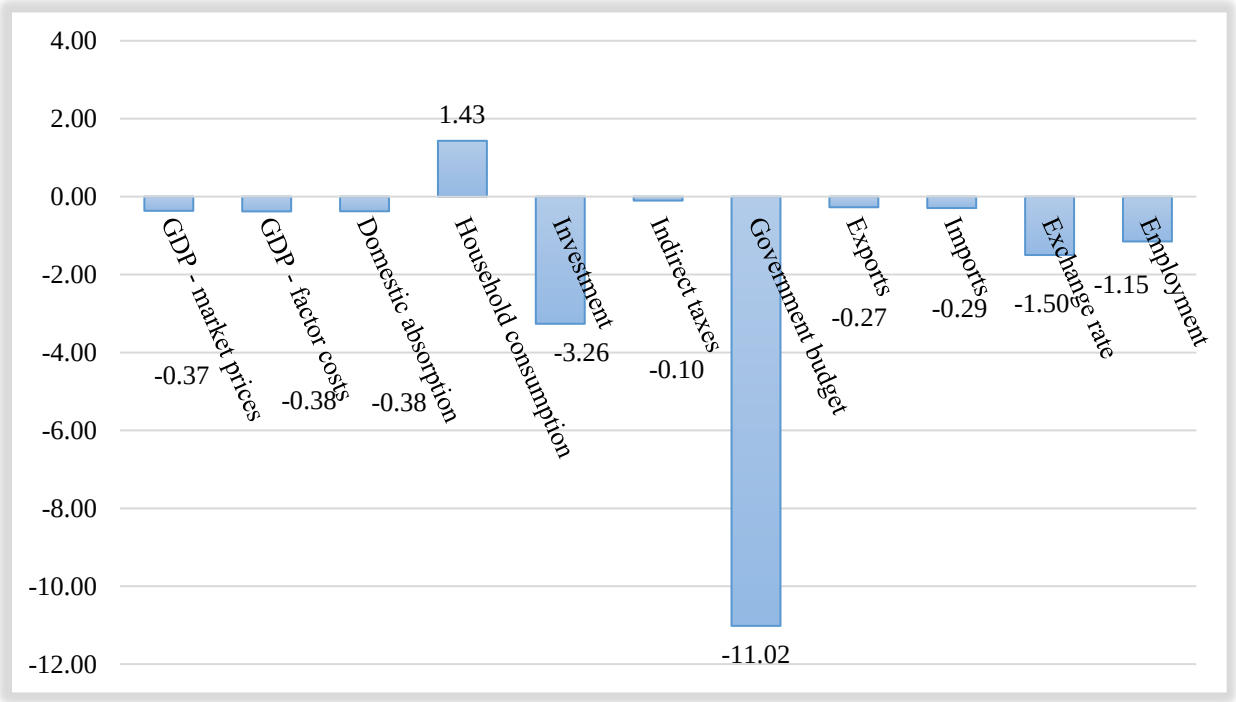
As for the household sector, many monetary measures of change in welfare are used in the literature that is based on the concepts of consumer surplus, compensated and equivalent variation, and real income. The present study uses real aggregate household consumption, and interchangeably real income and the equivalent variation (EV) to measure welfare change on the household sector, and of the distribution of the welfare gain/loss across households respectively. The EV is the amount of money that when is paid to the consumer such a consumer achieves the same utility level as before the economic change. If the economic change increases household welfare, then the EV represents the least amount required by the person to accept foregoing the change. In terms of welfare loss, it is the maximum amount the person is willing to pay to avoid the change in policy. Likewise, a positive-sum of all EV indicates that there is an existing compensating scheme that makes everyone to accept to forgo the change in policy. This attractive features of the EV are neatly encapsulated by (Sadoulet & De Janvry, 1995).

6.2.1 Macroeconomic Impact

The macroeconomic effects of a 16.5 percent increase in public-sector wages are displayed in figure 6.1. The simulation results indicate that the increase in public-sector wages has a detrimental impact on economic development. GDP at market prices decreased by 0.4 percent from P110,014.0 million and, at factor costs, by 0.4 percent from P100,771.0 million in real terms. Real domestic absorption also points to a fall in the welfare of the population by 0.4 percent. The fall in welfare of the population provides evidence that positive aggregate consumption effects are weaker than the negative aggregate investment and net export effects.

With respect to the fiscal balance, the results indicate that the wage rise worsens the government budgetary position. The government budget surplus decreased by 11 percent from P26,490.4 million. The fall in government surplus is caused by a reduction in government revenue largely due to a fall in capital income of 2.2 percent and a rise in the wage bill. A weak budgetary position is also attributed to a fall in net indirect tax revenues, which decreased by 0.1 percent from P9, 243.04 billion.

Figure 6.1: Macroeconomic Effects of a 16.5 Percent Increase in Wages (% changes)



Source: *Model simulations*

Similarly, total investment declined by 3.3 percent from the base value of P33,640.6 million. The fall in investment is explained by the level of expenditure on capital goods. The fall in investment is ascribed to the rise in the price of capital stock. Similar findings were exhibited by MacLeod (2015) who showed that a large increase in wages reduces investment by 3.6 percent.

Economic theory suggests that high prices of capital may create an incentive for firms to switch to labour input to raise productivity. Exports declined by 0.3 percent from a base value of P50,831.4 million. Similar to Erero (2016)'s findings, the fall may be "ascribed to the fact that the increase in domestic demand pushes up domestic prices and producers are then tempted to switch away from exports, according to the Constant Elasticity of Transformation (CET) function". The imports have reduced by 0.3 percent from the base value of P47,371.6 million. The net effect is consistent with the a priori expectation of a decline in net exports.

The exchange rate depreciated by 1.5 percent. At the base values, the country's current account is a surplus; however, the wage rise led to the current account balance decline. The current account deterioration resulted in exchange rate depreciation. The effect essentially encouraged a reduction in the consumption of costly import commodities for their domestic substitutes. Indirect taxes dropped by 0.1 percent from a base value of P9,243.04million. These are taxes received as revenue by the government from sales/value-added tax, excise/duty tax, etc. The 2011 SAM shows that indirect taxes contribute 56.4 percent of the total taxes to the government revenue. Therefore the decline may substantially harm government revenue collection. The evidence is shown by the rise in the government budget deficit from the simulation results. Furthermore, despite the increase in household consumption, a fall in net exports, investment expenditures, and productivity growth in most sectors were sufficient to worsen the firms' profits margin. This in turn contributed to the decline in the accumulation of indirect taxes.

The employment results indicate a fall by 1.2 percent from P32, 022.0 million. The job losses are attributed to the fact that, increased labour costs were not complemented by an increase in productivity, and an increase in firms' profits. For the affected firms to stay in business, they switched factor demands and replaced the now expensive labour with capital technology to

improve production in the long term. Because of the relatively high unemployment rate in the country, Botswana's labour market assumes an infinite supply of workers at a fixed wage rate. This implies that an increase in wages reduces the demand for labour. The results are consistent with findings by Erero (2016) as discussed in the literature chapter (i.e. 35.6 percent fall in employment in the first scenario).

As expected, the households is the only sector that observe a welfare gain. Real private consumption increase by 1.4 percent from P48, 628.3 million. This is ppossible because wage earners typically have a higher propensity to consume than capitalists. This is reflected in the supposition that workers are normally poorer than capitalists.

6.2.2 Microeconomic impact

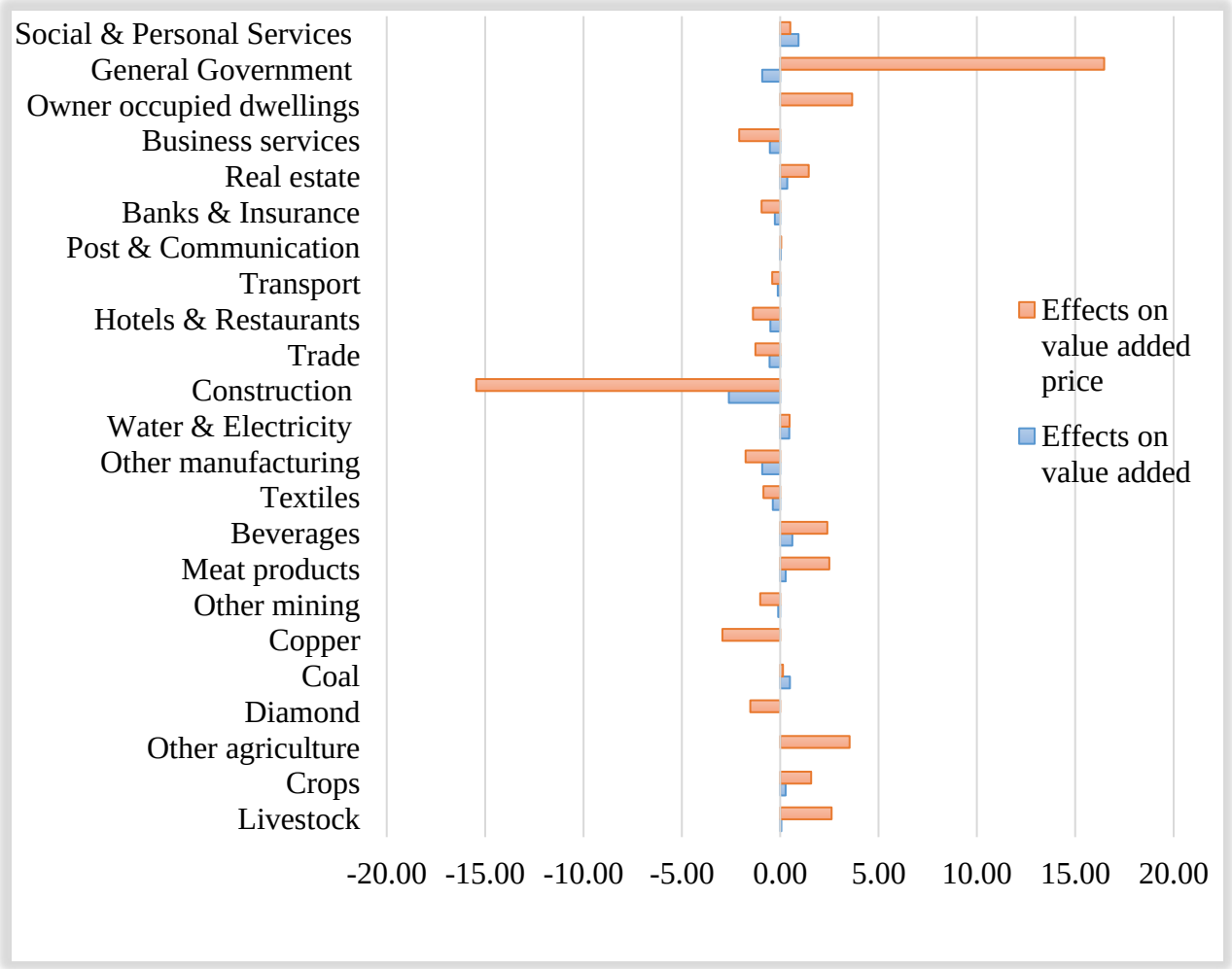
The increase in public sector wages may have substantial disturbance at the micro-economic level. Hence, it is worthy to explore its sectoral effects. This sub-section begins by reporting the impact on production activities and ends with impact on sectoral employment.

6.2.2.1. Impact on Activities

The impact of a 16.5 percent public-sector salaries differs across production sectors. Figure 6.2 reports the results on sectoral value-added and value-added price. As the figure shows, only a few activities benefit from this wage policy. The large beneficiary is the social and personal services, with its value added increasing by 0.9 percent, followed by beverages by 0.6 percent, and meat products by 0.5 percent as well as post and communications by 0.01 percent. Conversely, all the remaining activities observe reductions in value added. The decline invalue added range from a high of 2.6 percent in the construction sector and a low of 0.1 percent in other mining sector. The decline may be attributed to reduced government investment spending

and a fall in capital investment returns for construction since it is highly investment-driven given the 53 percent share on total investment spending.

Figure 6.2: Effects on the quantity and price of value-added



Source: Model simulations

The conclusion that emerge from analysis of the response of value added prices in figure 6.2 is that the loss/gain of activities is generally explained by value added prices. Value added prices increased for sectors whose output increased and fell for activities that lose out. Thus, the increase in value added price was an incentive for poducers in expanding sectors to increase their

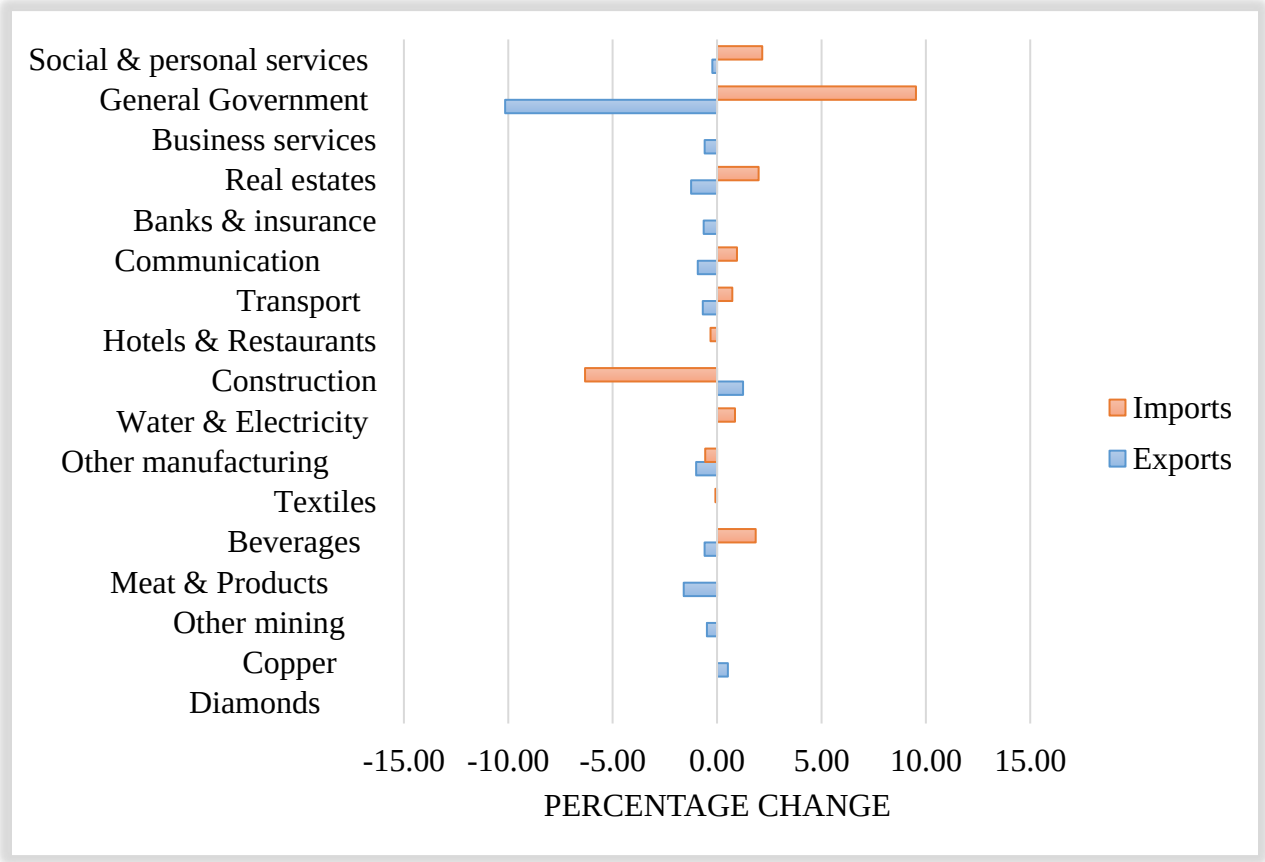
production. The opposite is true. The only exception is surprisingly the general government sector where value added decreased whilst its value added price increased.

6.2.2.2 Effects on sectoral exports and imports

The effect of the public-sector wage increase on exports and imports volumes differed. As depicted in figure 6.3, construction and copper/nickel mining exports increased by 1.3 percent from P14.03million and by 0.5 percent from P3,093.50 million respectively. Conversely, exports of the remaining commodities decreased and others remained unaffected. General government registered a relatively large fall in exports of 10.2 percent, followed by meat and meat products with 1.6 percent and real estate with 1.2 percent. Surprisingly, exports of diamonds, which accounts for the largest share of Botswana's total exports at 64.3 percent, and textiles, which account for about 18.9 percent, was not affected by the public-sector wage increase. The reason for this is that the price of their output dropped due to the depreciation of the domestic currency. Exchange rate depreciation allowed a competitive effect in the export market that may have induced these firms to raise productivity to either maintain or improve their export level.

With respect to imports, the increase in government employees wages caused imports of construction, other manufacturing, hotels & restaurants and textiles to contract by 6.3, 0.6, 0.3 and 0.1 percent respectively. The rest of the sectors either increased consumption of imported commodities or did not change in response to the wage rise. The largest increase in imports are for government (9.5), followed by social & personal services (2.2), real estate (2.0) and beverages (1.9).

Figure 6.3: Effects of Public-sector Wage Rise on Exports and Imports



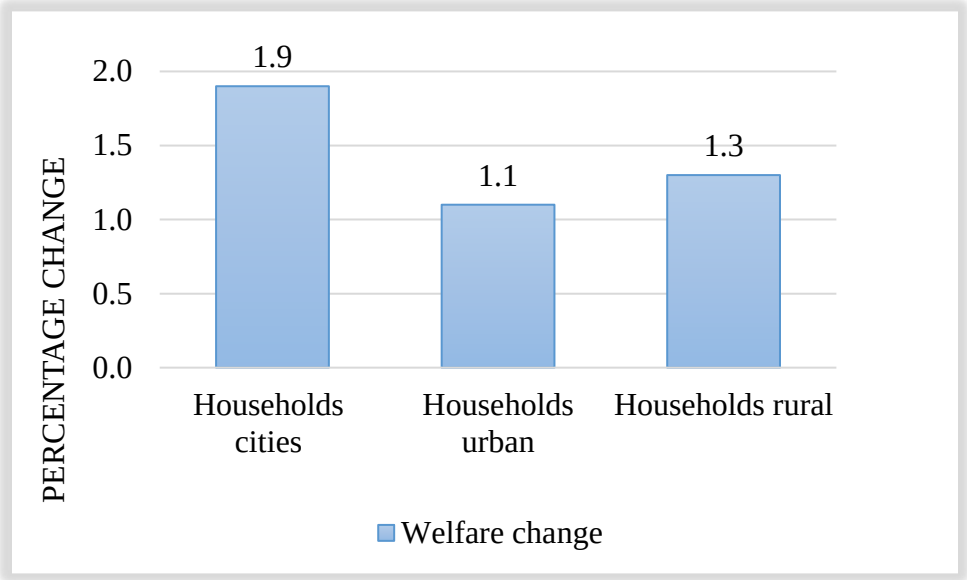
Source: *Model simulations*

6.2.2.3 Household Impact

Both the economic development thinking and empirical evidence suggest that households will benefit from public-sector wage increase. The welfare benefit is disproportionally distributed across households. These results were obtained using a commonly used measure in CGE studies that evaluate the distribution of welfare benefits across households, known as the equivalent variation (EV). The EV estimates are calculated in money metric welfare functions and based on the household utility changes in relation to policy scenarios. They, therefore, measure the incomes needed to make the households as well off as they are in the counter-factual equilibrium

evaluated at benchmark prices, and are positive for welfare gains from the policy scenario and negative for losses.

Figure 6.4: Equivalent variation results



Source: *Model simulations*

From figure 6.4, the EV figures are 1.9 for households in cities/town, 1.3 for rural households, and 1.1 for urban-village households. These denote the minimum amount of money that each of the households in their respective regions requires for them to accept foregoing the wage increment policy. The results show that the largest beneficiary is the cities/towns households and least gainers are urban villages households. The SAM database used for this study indicates that 56.6 percent of incomes of households in cities/towns are wages, followed by urban-villages whilst 10.8 percent of income of rural households is wages. Whereas total household consumption expenditure share for cities is 47.4 percent, followed by urban-villages (33.8 percent) and then rural areas (18.8 percent). Because households in cities have higher shares of

total consumption spending than urban-villages and rural households, they observed a disproportionately higher reduction in their consumption expenditures than others.

As for urban-village households, despite their larger income and consumption rates than rural households, their welfare turned out to be smaller than for rural households. This may be attributed to the decline in total investment since they receive more of their income from capital returns than salary and government transfers, which is the opposite for rural households who receive more government transfers than other sources of revenue.

It is also essential to understand the potential distributional effect of this policy initiative. The evidence shows that an increase in public sector wages has unintended consequences on the distribution of income between cities, urban-villages, and rural area households. Whilst the wage increment increases the total incomes of all households, it increases city households' income at a higher rate (0.23 percent), while other households' income distribution rate is negative, i.e. urban-villages (0.22 percent) and rural areas (0.01 percent). These results suggest that wage increment will heighten inequality in the distribution of income between cities, urban-villages, and rural households. Clearly, this is not the intended outcome of this policy. The explanation for this unexpected outcome lies in the size of value-added price increase (i.e. on beverages, agriculture commodities, etc.) and the initial distribution of assets ownership across households.

The factor incomes' results show that public-sector wage increase also has unintended consequences on the functional distribution of income. Whilst diamond and copper mining workers' incomes fall by 1.5 percent and 2.9 percent respectively, the wage paid to labour by other activities remained the same. These insights point to a shift in the functional distribution of income away from mining workers. This may be explained by the fact that the decline in domestic prices of exports prompted these sectors to implement cost-cutting measures by

reducing factor costs, i.e. through cutting wages paid to labour. This finding is consistent with the theoretical conclusion discussed in the literature review.

Examining the evolution of prices help in understanding the distribution of welfare benefit and income distributional implications of the wage rise. The evidence shows that the consumer price of i.e. owners occupied dwellings increased by 3.7 percent and that of other agriculture produce by 3.5 percent at the top, whilst coal (0.1 percent) and communications (0.05 percent) commodities rise at the lowest rate. Contrary wise, the consumer prices on other commodities decreased, with the fall in prices ranging from 0.4 percent for transport services to 15.5 percent for construction goods and services. In general, the commodity price rise is disproportionately larger for non-traded commodities and services than for traded commodities.

6.2.2.4 Impact on sectoral employment

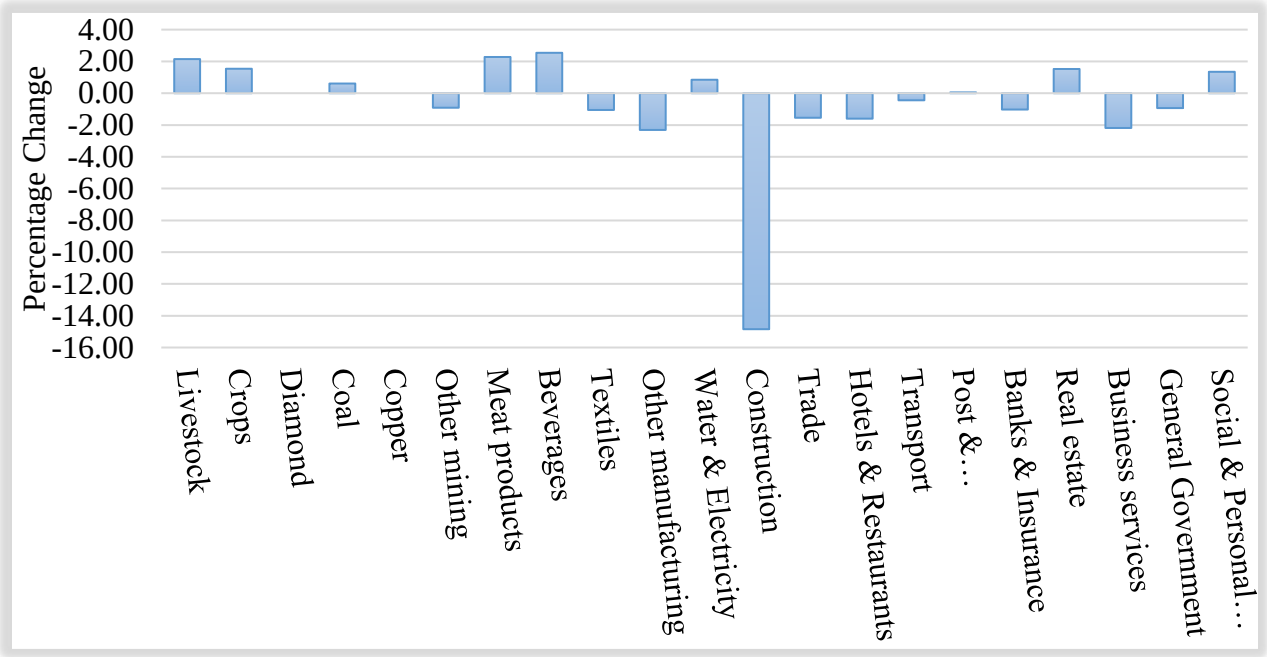
The effect of public sector wage increase on factor demands is depicted in figure 6.5 below. The results indicate that a 16.5 percent increment on wages reduces overall employment. The effect varies across sectors. Factor demand for labour dropped in some sectors of the economy while other sectors increased their demand for labour. The sectors that reduced labour demand include construction (14.9 percent), other manufacturing (2.3 percent), business services (2.2 percent), hotel & restaurant (1.6 percent). These sectors are among the largest employers in the economy. The job losses may be attributed to the fall in productivity and changes in the price of capital. For example, the large fall in rental capital price paid by the government induced a decline in the demand for labour in the government sector. The same applies to other sectors that experienced a decline in the demand for labour.

On the other hand, other sectors were able to enhance productivity. Hence, they demanded more labour as profit rates increased because consumer patterns' flexibility was biased towards their

commodities. Some of these sectors include beverages as the highest by 2.5 percent rise, followed by meat products at 2.3 percent, with the rest of the labour demand increase being marginal especially because these sectors' employment levels are the smallest in the domestic economy. This shows that the demand for goods and services in these sectors increased, which raised their profit margins, productivity growth, and essentially expanded, hence the rise in the demand for labour.

However, the overall effect is negative because most sectors decided to reduce factor costs but substituting labour for capital since labour costs were relatively larger. This attests to the sectoral spillover effect hypothesis.

Figure 6.5: Effects of a wage rise on factor demands results

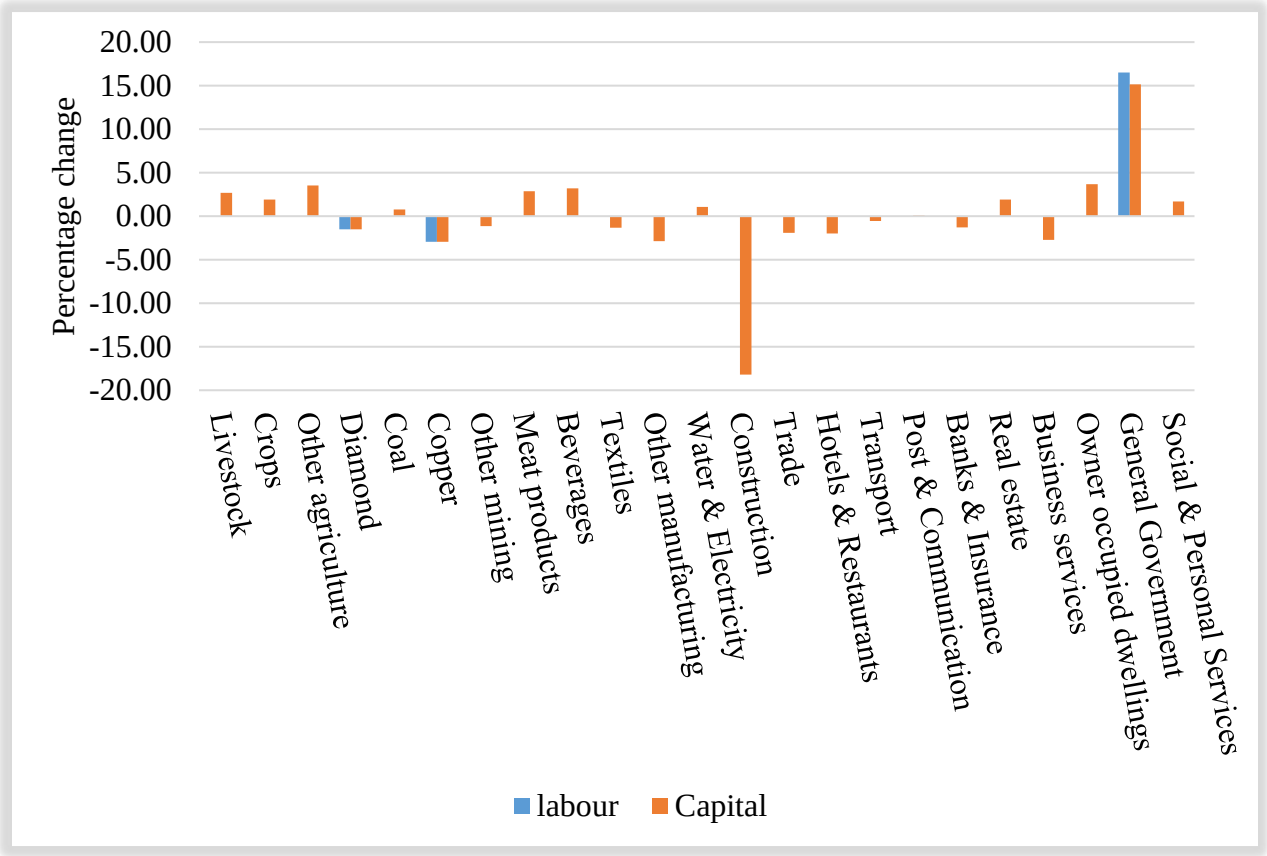


Source: *Model simulations*

6.2.2.5 Effects on sectoral wages

Public-sector wage increase effects on sectoral wages are crucial to discuss in order to understand how the wages paid by activity (i.e., the wage distortion term, given that the economy-wide wage is fixed) respond to changes enacted by their government sector counterpart.

Figure 6.6: Effects of sectoral wages (Percentage change from the base)



Source: *Model simulations*

Wages fall in the copper/nickel and diamond mining activities whilst other activities' wages does not change. Diamond and copper mining account for 64 percent and 6 percent of the country's exports respectively, which rank them in the top three sources of revenue from the export market. The sectors are therefore highly exposed to exchange rate fluctuations. The price of

copper and diamond were thus negatively affected by exchange rate depreciation (1.5 percent). The effect essentially has the potential to lead to profits' deterioration, but the results indicate that value-added output and factor demands remained unchanged, while export volume for copper increased. The subsequent implication neutralized by the reduction in prices paid to labour and capital for diamond and copper, which are both at 1.5 percent and 2.9 percent respectively. The absolute effect is negative on economic development and the actual welfare of the population.

In terms of payments to capital, the results showed two directions. Firstly, as the domestic demand for goods and services upsurges, the subsequent rise in commodity prices improved profit margins, and motivated firms to increase capital investment for some sectoral activities. For example, the General government (15.1 percent) at the top, followed by owner-occupied dwellings (3.7 percent), other agriculture (3.5 percent), as well as post and communications (0.1 percent) at the bottom of the list. On the other hand, in terms of construction, capital investment heavily dropped by 18.2 percent, which is not surprising as shown by the largest drop in value-added output depicted in figure 6.2. Lastly, a conclusion that summarizes the simulation results presented in this chapter is provide.

6.3 Conclusion

This chapter presented the macro and microeconomic effects results on the selected economic indicators. The study findings conclude that the increase in public sector wages leads to a decline in economic development. A reduction in aggregate investment and net exports chiefly contributed to the decline in aggregate output, hence the GDP decline in the economy. Overall, the aggregate welfare and actual welfare of the population have deteriorated. The welfare change on households shows that household consumption increased and the EV revealed that the

distribution of the welfare gain was imbalanced among households. The results show that trade to GDP declined because both imports and export decreased, the current account deterioration led to exchange rate depreciation. Employment dropped following public sector wage increase and lower productivity growth across economic sectors.

The public sector wage rises negatively affected the government budget. The results show that as economic output deteriorates, the government ends up with a soaring budget deficit in order to sustain expenditure. The sectoral value-added and value-added prices report unfavorable changes in overall. Although some sectors increased productivity and prices, some reduced productivity and prices, of which as the results stand, the net effect is negative for both the value-added output and price (increase in consumer price inflation on the non-tradables).

The increase in household consumption exists because of a rise in household income, which implies that the cost of attaining a fixed basket of certain commodities is reduced. However, given the increase in sectoral value-added prices, the net effect may reduce the benefit on the consumption of such commodities. Hence the decline seen in absorption (aggregate household consumption effect is not actually strong), and the unproportioned household income distribution that render urban-villages and rural-areas households worse-off. That notwithstanding, the results indicate some changes in consumption patterns in the respective households. Households' consumption increased on commodities that were assumed to be essential such as shelter, food, and utilities (water and electricity).

The aggregate factor demands for labour declined for most sectors in overall, which implies a rise in job losses. This is consistent with the theory which hypothesizes that, if the demand for goods and services is inadequate, unemployment occurs because inadequate demand leads to low

output prices, real wages become high, and the employers will not hire anymore hence the increase in unemployment (Costabile & Rowthorn, 1985). The factor income for labour remained the same for most activities except the decline experienced in copper and diamond mining sectors. Factor income in terms of capital increased for most activities in overall.

The imports and exports volumes changed as shown by both of these indicators plunging in overall. On the exports side, only the construction and copper mining, sectors responded positively to the wage increment while the rest of the sectors responded negatively. On the imports side, four sectors responded negatively to the government wage rise. These are construction, other manufacturing, hotels & restaurants, and textiles. The rest of the sectors had none or positive response to the wage rise. Clearly, the increased domestic consumption induced the production of non-traded commodities and import substitutes in the domestic economy. Finally, a sensitivity analysis was presented.

The following chapter gives a summary of findings and conclusions, as well as policy recommendations.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter presents the summary of findings, conclusions, and recommendations that are drawn from the outcome of the simulations, as well as the study limitations. The first subsection provides the summary and conclusions of the study. The second, third, and fourth give the policy recommendations, study limitations, and further areas of research, respectively.

7.2 Summary and conclusions

This study simulated a rise in government wages/salaries with an objective to investigate the potential effects of such policy shock on the economy of Botswana. The simulations were carried out using a CGE modelling technique, using the 2011 Botswana SAM as the model database. The study used the IFPRI standard CGE model developed by Lofgren et al. (2002), and it was calibrated to the base year values. It was then used to implement simulations by introducing an external shock such as the 16.5 percent government employees' wages/salaries increment. The simulation was expected to provide the economy-wide effects of such an increment on the economy, which include; the aggregate welfare of the economy, actual welfare of the population, household welfare distribution, production structures, fiscal balance, employment, and trade. The study findings were subjected to sensitivity checks through the process of behavioral parameters' alteration.

In conclusion, the simulation findings submit that public sector wage increase has contractionary effects on the domestic economy. This is pointed-out by the fall in both the GDP at market price and factor cost in the short run, which implies that economic welfare deteriorates. The research

findings are consistent with other studies on minimum wage increase, such as for Erero (2016); MacLeod (2015) who examined the impact of minimum wages in the economy of South Africa. Likewise, the effect on domestic absorption is negative, which in essence indicates that the actual welfare of the population is impacted negatively by the public sector wage increase.

The country's features of the model economy indicate that the economic system opposes the government policy initiative to strengthen the household welfare state and improve economic welfare at the same time. A rising budget deficit, unbalanced growth, and stagnation in different sectors, as well as negative productive capacity in the economy, is evidence interpreted from the simulation results. The wage increase as expected encouraged the households to increase consumption. However, the results show that the positive consumption effect was inferior to the plunging investment and net export effects. The outcome shows that wage increase needs to be accompanied by productivity growth, which should also have a positive effect on rising consumption expenditure without the budget deficit rising.

There was a sharp decline in investment due to, for example, a fall in profit share. Intuitively, given the national income level, a tumble in future profits expected from an investment is a sufficient stimulant to plunge firms' profit margins, which typically affect the cycle of investment negatively. The outcome is thus dependent on the economy's financial system in terms of liquidity and structure. As neoclassical economists posit, since economic growth is regularly driven by capital investment, the net effect of a fall in total investment opposes economic growth in the long run. The decline in indirect taxes is not very large but given the key role it serves in the government coffers, it must improve because it contributes the largest share in government revenues. Given the decline in the indirect taxes and the soaring budget deficit,

the government may find it imperative to raise the indirect taxes to minimize the fiscal imbalance.

As the results indicate, the sectoral performance reported mixed outcome. Some sectors increased production while other sectors' production levels deteriorated. Sectors that responded by increasing production are those that consumer demand increased in their favour. These sectors also raised the value-added prices because of the improved demand for their goods and services. In effect, the government wage increment drives both the positive and negative expenditure knock-on effect that is partially beneficial to the sectoral value-added output. One of the factors that is influential to these varying effects is labour productivity on the supply side. The results indicate that the wage rise discouraged productivity improvement because some firms such as mining reduced wages and kept the same level of employment while other firms laid-off some workers. This in turn slowed down labour productivity growth, and essentially led to a fall in profits and potential expansion of the domestic firms.

Therefore, for the domestic firms to maintain or improve their competitiveness, they may need to raise productivity-enhancing investments beside the improvement in the motivation of employees only. Nonetheless, the shift on productivity gain/loss may be attributed to the forces of supply and demand that induce the bridging of economic production (supply) gaps, which must be embraced by diversification exploitation endeavors. In terms of the unaffected sectors, the striking feature among the sectors that i.e., did not respond by changing productivity and those that dropped on production is that, they are a group of quite large sectors that make up a large percentage of contribution to the economy of Botswana.

With regard to price change in some sectors, inherently, the increase in sectoral value-added price is expected to improve the profits margin. Hence, the rise in productivity in these sectors (General government, owner-occupied dwellings, real estate, water & electricity, beverages, meat products agriculture, and crops) could through their interlinkages, potentially enhance economic growth based on their improved strategies on value chain maximization.

Given the negative effect observed in both exports and imports from the simulation results, the trade to GDP lowered as expected. The net effect is negative because productivity in the economy declined. The hampered production in the economy due to a fall in investment, negatively affected the current account balance. Therefore, to improve the trade balance, capital stock accumulation have to increase in the long term. To achieve that, productivity growth and investment expenditures are required to increase.

In terms of households' welfare, the EV analysis indeed underpins the orthodox wisdom that, households that receive most of their income from government wages/salaries in this case, benefits most from the policy change. Overall, the policy change' effect on aggregate households' welfare is positive for all households' groups as indicated in chapter 6. However, the welfare distribution is not proportional because of the earlier discussed reasons, i.e. the fact that investment negatively impacted those households with a larger portion of their incomes from capital investment. This particularly reduced urban-village households' welfare benefits just below the rural area households who consume most of their income and spend very little on investment.

The outcome is driven by the negative effects realized on households' personal income distribution rate in both the urban-village and rural areas households. This fairly attests to the

existence of uneven distribution of income across household groups in Botswana. Clearly, it circumvents the efforts to generally alleviate poverty in the society because households in the cities are better-off while urban-villages and rural areas are worse-off. As a result, strong social security systems are desirable to provide for the marginalized groups, whom most of them are in rural households' bracket.

The effect on employment is indicated to be negative by the simulation results, which is contradictory to the efficiency wage theory. However, there is some exception made on the hypothesis, that efficiency wages are less responsive during a fall in demand; thus, a fall in employment must be expected, which confirms the simulation results. Again, the results are consistent with the labour market competitive models' hypothesis that a negative effect of the wage increase on employment is seen because of two elements; the scale effect and the substitution effect. When wages rise, the scale effect encourages the firms to contract, reducing the firm's employment levels. The substitution effect encourages the firms to be more capital intensive when labor becomes costly, hence reduction in employment. Generally, across economic sectors, the fall in factor demand revealed by the simulation results reflects on the structural unemployment, which is tacitly rife beneath the issues of unemployment and employment creation that render certain jobs in other sectors such as manufacturing obsolete, in the economy of Botswana.

7.3 Policy Implications and Recommendations

The primary objective of this research was to determine the economy-wide effect of government wages/salaries increment in Botswana. According to the simulations' findings, the effect is negative at both the macro and microeconomic level. The findings are important as they are meant to understand and appreciate the likely effect of this type of economic policy decision on

both the aggregate welfare of the economy, and the actual welfare of the populace. Based on the results of the study, the following policy implications and recommendations were drawn:

- At the macroeconomic level, future salary increments should be tied to or be accompanied by an increase in productivity levels for the expenditure to have a positive and larger sustainable ripple effect in the economy. This can be achieved by adopting a performance-oriented reward system backed by a strong monitoring and evaluation framework. It also calls for a change in the role played by the trade unions, which is currently focused on collective bargaining to complimenting the demands for better working conditions with responsibility for performance management.

- Although the wages/salaries increment will stimulate economic activity through increased household consumption, the decline in GDP indicates that it is not sustainable even in the short term. There is a need to reduce the government wage bill in the medium to long term. This should be done by downsizing the public sector through outsourcing some of the government functions and encourage privatisation. This should make the economy more efficient and increase the role of the private sector in the economy. In fact, the responsibility of employment creation should be shared or shifted to the private sector. It will, in the long term relieve pressure on the government and allow for a more dynamic development budget not constrained by larger recurrent budget commitments.

- The response of the sectoral value-added and both the import and export markets echo some weaknesses within the overall economic system. There is a dire need to change the structure of the economy such that an increase in the wage bill has a high impact on the growth of the economy. The largest share of the increment goes to a segment of the

population that will not invest but rather consume. Similarly, the majority of the consumer goods and services are imported, and the retail market is largely occupied by the foreign nationals (which raises remittance outflow while the inflow is substantially low), the economic setup tends to limit the economic benefits of the salary increase. There is therefore an urgent need to adopt and implement policies and programmes that will re-orientate Botswana's economy to be export lead. It is crucial to building an economy that is flexible and resilient to both internal and external shocks.

- Given the pronounced uneven distribution of income in the economy, there is a need for consideration to aim for providing a living wage by targeting specific income earners in the workforce. The current wage increase would seem inclusive but that can be at a cost to those civil servants who are part of the working poor and 10 percent will not make such a difference in their living conditions. A well-targeted wage increase would have had better social outcomes.

- Finally, the simulation results exposes many imbalances in the economy that are suppressed through economic policy decisions that limits economic development in general. For instance, annual inflation that is kept very low without viable measures, and platforms to perform above the steady and minimal growth of the economy. Consequently, the economic policy decision sacrifices employment creation and potential growth in overall. Additionally, opportunities exist in the global economy. The government could intervene by creating secure platforms that allow locals to do business with the rest of the world. It takes investment in technological advancement and setting up relevant institutions to participate in the elevated supply of goods and services in the global community. For example, the government through the Ministry of Investment

Trade and Industry, and Botswana Development Corporation (BDC) could lobby business arrangements with i.e. Alibaba to set up strategic warehouses to promote online buying which is limitless in terms of market access in the global space. This could help domestic producers to sell local products online. This could also make it easier for individuals to buy and sell foreign goods online to the rest of the world without the sellers and buyers coming into contact. Among other benefits, this could reduce unemployment and improve the populace welfare across households segments because the marginalized communities could easily sell their hand made artifacts to the global community.

7.4 Study limitations

Limitations to this study firstly begin with the 2011 SAM, which is compiled, and officially published by Statistics Botswana. Surely, there are drastic changes in the economy post-2011, which may have a significant influence on the disparities in the results of the simulated economy and the actual unfolding of the economy. Another limiting element may be the aggregated labour in our model, which does not allow for the extraction of the exact implication of wage increment by occupation. Therefore, the mentioned limitations impede a detailed analysis of the government wage rise effect.

7.5 Further areas of research

This study was conducted using the standard CGE modelling approach. The author recommends that the same study should be conducted using the dynamic CGE modelling approach, with disaggregated labour for a larger scope of analysis on the subject investigated.

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APPENDIX A – TO CHAPTER 4

A.1 The 2011 macro SAM for Botswana description

Appendix A - Table 4.3: 2011 SAM for Botswana (million pula)

	Commodities	Branches of activity	Factors of production	Households + NPISH	Corporations	Public administrations	Taxes minus subsidies	Capital - private	Capital - public	Changes in inventories	Rest of the World	TOTAL
Commodities		99,412		48,629		19,407		26,436	7,204	6,856	48,463	256,408
Branches of activity	194,149											194,149
Factors of production		82,067										82,067
Households + NPISH			63,427			8,239						71,666
Corporations			736			-31						704
Public administrations			17,765	11,838	704	66	9,287				273	39,934
Taxes minus subsidies	9,836	-548										9,287
Capital - private		10,388		11,170		6,560					3,430	31,548
Capital - public		2,831				5,339					779	8,949
Changes in inventories								5,111	1,745			6,856
Rest of the World	52,423		139	29		355						52,945
TOTAL	256,408	194,149	82,067	71,666	704	39,934	9,287	31,548	8,949	6,856	52,945	

***Source**: Model database*

A.2 Model accounts table

Annexure A - Table 4.4: Model accounts

Commodities Accounts	**Activity Accounts**	**Factor Accounts**
Livestock	Livestock	Labour
Crops	Crops	Gross operating surplus
Other agriculture	Other agriculture	**Households Accounts**
Diamond	Diamond	Households - Cities/Towns
Coal	Coal	Households - Urban Villages
Copper	Copper	Households - Rural Areas
Other mining	Other mining	**Tax accounts**
Meat products	Meat products	Sales taxes
Beverages	Beverages	Export taxes
Textiles	Textiles	Import taxes
Other manufacturing	Other manufacturing	Direct taxes
Water & Electricity	Water & Electricity	Indirect taxes
Construction	Construction	**Other accounts**
Trade	Trade	Enterprises
Hotels & Restaurants	Hotels & Restaurants	General Government

Transport	Transport	Stock changes
Post & Communication	Post & Communication	Capital
Banks & Insurance	Banks & Insurance	Rest of the World
Real estate	Real estate	
Business services	Business services	
Owner-occupied dwellings	Owner-occupied dwellings	
General Government	General Government	
Social & Personal Services	Social & Personal Services	

A.3 Tables

Appendix A - Table 4.5: Transactions relationship in the standard CGE model

Receipts	Activities	Commodities	Factors	Households
Activities	**0**	$(PX_C \cdot QX_C), (PA_a \cdot QA_a)$	**0**	**0**
Commodities	$(PQ_C \cdot QINT_C)$	**0**	**0**	$(PQ_C \cdot QH_C)$
Factors	$(WF_{f,a} \cdot QF_{f,a})$	**0**	**0**	**0**
Households	**0**	**0**	$\left(\sum_f shif_{h,f} \cdot YIF_f\right)$	$\left(\sum_{hp} TR\ hhldcons_{hp,h}\right)$
Enterprises	**0**	**0**	$\left(\sum_f shif_{ent,f} \cdot YIF_f\right)$	**0**
Government	$(ta_a \cdot PA_a \cdot QA_a)$	$(tm_c \cdot PWM_c \cdot QM_c \cdot EXR)$ $(te_c \cdot PWE_c \cdot QE_c \cdot EXR)$ $(tq_c \cdot PQ_c \cdot QQ_c)$	$\left(\sum_f shif_{gov,f} \cdot YIF_f\right)$	$(tf_h \cdot YH_h)$
Savings - Investment	**0**	**0**	$\left(\sum_f tf_f \cdot YIF_f\right), \sum_f deprec_f$	$(YH_h \cdot (1 - TINS_h) \cdot SHH_h)$
Rest of the World(ROW)	**0**	$PWM_c \cdot QM_c \cdot EXR$	$\left(\sum_f trnsfr_{row,f} \cdot YIF_f\right)$	**0**
Total	$(PA_a \cdot QA_a)$	$(PQ_c \cdot QQ_C)$	YF_f	EH_h

Table 4.5 (continues)

Receipts	Enterprises	Government	Savings - Investment	Rest of the World(ROW)	Total
Activities	**0**	**0**	**0**	**0**	$(PA_a \cdot QA_a)$
Commodities	$(PQ_C \cdot QENT_C)$	$(PQ_C \cdot QG_C)$	$(PQ_C \cdot QINV_C)$, $(qdst_c \cdot PQ_C)$	$PWE_c \cdot QE_c \cdot EXR$	$(PQ_C \cdot QQ_C)$
Factors	**0**	**0**	**0**	$facrow_f \cdot EXR$	YF_f
Households	$TR\ hldentcons_h$	$TR\ hldgovcons_h \cdot HGADJ$	**0**	$hhrow_h \cdot EXR$	YH_f
Enterprises	**0**	$TR\ entgovcons \cdot ENTGADJ$	**0**	$entrow_h \cdot EXR$	$YENT$
Government	$(TINSADJ \cdot tins_e \cdot YENT)$	**0**	**0**	$govrow_h \cdot EXR$	YG
Savings - Investment	$YENT - EENT$	$YG - EG$	**0**	$CAPROW \cdot EXR$	$TOTSAV$
Rest of the World(ROW)	**0**	**0**	**0**	**0**	$Total\ Income\ Abroad$
Total	$EENT$	EG	$TOTINV$	$Total\ expenditure\ Abroad$	

A.4 Figures

Appendix A: Figure 4.4: Model Quantity System & Figure 4.5: Production Price System

Figure 4.4. Model Quantity System

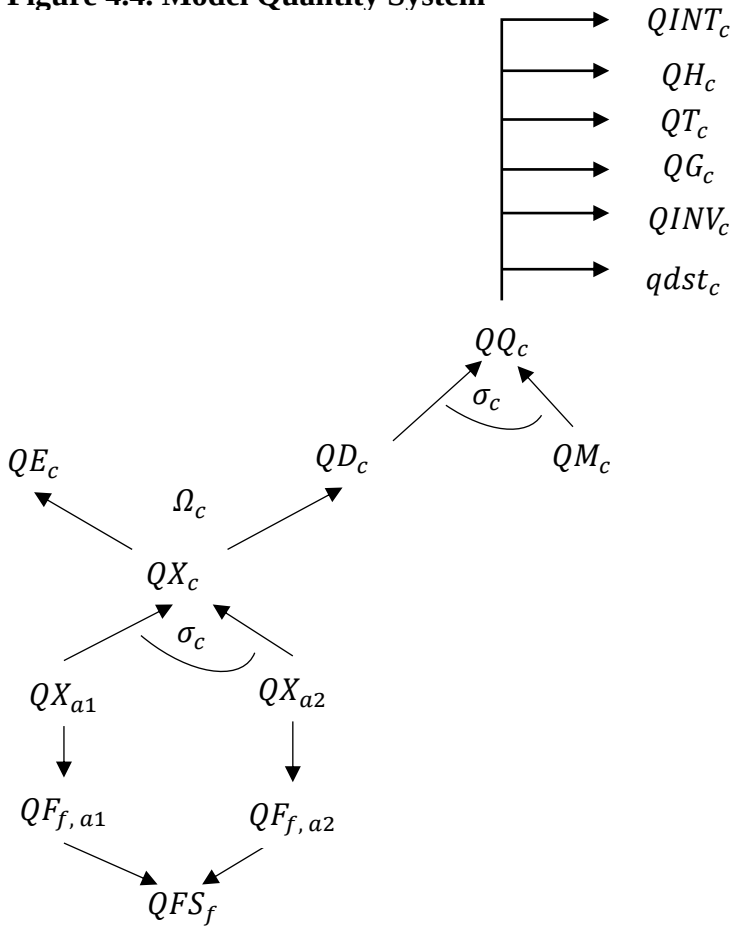
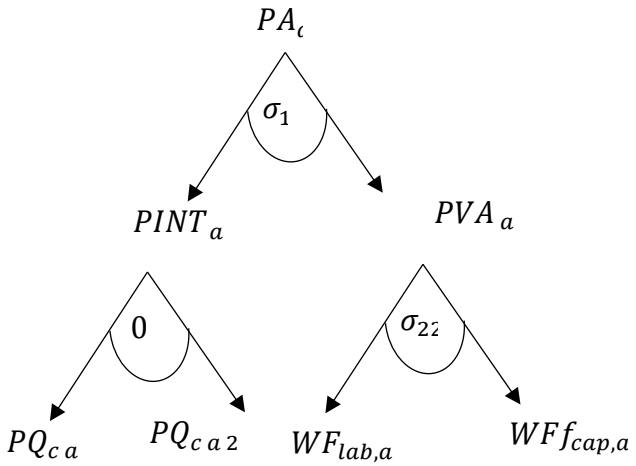


Figure 4.5: Model Production Price System



APPENDIX A: Algebraic Statement of the standard CGE model

The following is a description of the model equations organized as; the price block, production and trade block, institution block, and system constraints as defined by (Lofgren *et al*., 2002). Table A1 below presents the model variables, sets, and parameters.

Table A1 Model parameters, sets, and variables

EXOGENOUS VARIABLES

$\overline{CPI}$	consumer price index
$\overline{FSAV}$	foreign saving (FCU)
$\overline{QFS_f}$	quantity supplied of factor *f*
$\overline{WFDIST}_{f\ a}$	wage distortion factor for factor *f* in activity *a*
$\overline{tins_i}$	exogenous direct tax rate for domestic institution *i*,
$\overline{TINSDAJ}$	direct tax scaling factor (= 0 for base; exogenous variable),
$\overline{DTINS}$	change in domestic institution tax share (= 0 for base; exogenous variable).
$\overline{mps_i}$	base savings rate for domestic institution *i*,
$\overline{MPSDAJ}$	savings rate scaling factor (= 0 for base),

ENDOGENOUS VARIABLES

DPI	producer price index for domestically marketed output
EG	government expenditures
EH	consumption spending of the household
EXR	exchange rate (LCU per unit of FCU)
GSAV	government saving
IADJ	investment adjustment factor
MPS_i	marginal propensity to save for domestic non-government institutions (exogenous variable)
PA_a	activity price (unit gross revenue)
PDD_c	demand price for commodity *c* produced and sold domestically
PDS_c	supply price for commodity *c* produced and sold domestically
PE_c	export price (domestic currency (LCU))
$PINTA_a$	aggregate intermediate input price for activity *a*
PM_c	import price (domestic currency)
PQ_c	composite commodity price
PVA_a	value-added price (factor income per unit of activity)
PW_c	composite commodity price (including sales tax and transaction costs)
PX_c	aggregate producer price for commodity
$PXAC_{a\ c}$	producer price of commodity *c* for activity *a*
QA_a	quantity (level) of activity
QD_c	quantity sold domestically of domestic output

Table A1 (Cont'd)

QE_c	quantity of exports
QF_{fa}	quantity demanded of factor *f* from activity *a*
QG_c	*g*overnment consumption demand for commodity *c*
QH_c	quantity consumed of commodity *c* of the household
$QHA_{a\,c\,h}$	quantity of household home consumption of commodity *c* from activity *a* for household *h*
$QINTA_a$	quantity of aggregate intermediate input
$QINT_{c\,a}$	quantity of commodity *c* as intermediate input to activity *a*
$QINV_c$	quantity of investment demand for commodity *c*
QM_c	quantity of imports of commodity *c*
QQ_c	quantity of goods supplied to domestic market (composite supply)
QT_c	quantity of commodity demanded as transactions service input
QVA_a	quantity of aggregate value-added
QX_c	aggregate marketed quantity of domestic output of commodity *c*
$QXAC_{a\,c}$	quantity of marketed output of commodity *c* from activity *a*
$TINS_i$	rate of direct tax on domestic institutions i,
$TRII_{ii'}$	transfers from institution *i'* to *i*
WF_f	average price of factor *f*
YF_f	income of factor *f*
YG	government revenue
YI_i	income of domestic non-government institution *i*
EH_h	household consumption expenditures
PQ_c	composite commodity price
$QH_{c\,h}$	quantity of consumption of marketed commodity c for household h,
$MPS01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates,
$DMPS$	change in domestic institution savings rates (= 0 for base; exogenous variable)
$TABS$	total nominal absorption
$INVSHR$	investment share in nominal absorption
$GOVSHR$	government consumption share in nominal absorption

COEFFICIENTS

$cwts_c$	weight of commodity *c* in the *CPI*
$dwts_c$	weight of commodity *c* in the producer price index
$ica_{c\,a}$	quantity of *c* as intermediate input per unit of activity *a*
$icd_{c'\,c}$	quantity of commodity *c'* as trade input per unit of *c* produced and sold domestically
$ice_{c'c}$	quantity of commodity c' as trade input per exported unit of c.
$icm_{c'c}$	quantity of commodity c' as trade input per imported unit of c.
$inta_a$	quantity of aggregate intermediate input per activity unit
iva_a	quantity of value added per activity unit
mps_i	base saving rate for domestic institution *i*
pwe_c	export price (foreign currency)
pwm_c	import price (foreign currency)
$qdst_c$	quantity of stock change
qg_c	quantity of government demand
$qinv_c$	quantity of private investment demand

Table A1 (Cont'd)

$shif_{i\,f}$	share for domestic institution *i* in income of factor *f*
$shii_{ii'}$	share of net income of *i'* from *i*
ta_a	tax rate for activity *a*
tf_f	direct tax rate for factor *f*
$tins_i$	direct tax rate for institution *i*
te_c	export tariff rate
tm_c	import tariff rate
tva_a	rate of value-added tax for activity a,
$trnsfr_{i\,f}$	transfer from factor *f* to institution *i*
tq_c	rate of sales tax (as share of composite price inclusive of sales tax).
α_a^{va}	efficiency parameter in the CES value-added function
α_c^{ac}	shift parameter for domestic commodity aggregation function
α_c^{q}	armington function shift parameter
α_c^{t}	CET function shift parameter
α_a^{a}	efficiency parameter in the CES activity function,,
β_c	marginal share of consumption spending on marketed commodity *c* for the household
$\delta_{a\,c}^{ac}$	share parameter for domestic commodity aggregation function
δ_c^{q}	Armington function share parameter
δ_a^{a}	CES activity function share parameter,
δ_c^{t}	CET function share parameter
$\delta_{f\,a}^{va}$	CES value-added function share parameter for factor *f* in activity *a*
γ_{c}	subsistence consumption of commodity *c* for the household
$\theta_{a\,c}$	yield of output *c* per unit of activity *a*
ρ_c^{va}	CES value-added function exponent*ac*
$\rho_c^{a\,c}$	domestic commodity aggregation function exponent
$\rho_a^{v\,a}$	CES value-added function exponent,
ρ_a^{a}	CES activity function exponent.
ρ_c^{q}	Armington function exponent
ρ_c^{t}	CET function exponent
$\gamma_{c\,h}^{m}$	subsistence consumption of marketed commodity c for household h,
$\gamma_{a\,c'h}^{h}$	subsistence consumption of home commodity *c* from activity *a* for household *h*,
$\beta_{c\,h}^{m}$	marginal share of consumption spending on marketed commodity *c* for household *h*.
$\beta_{a\,c\,h}^{h}$	marginal share of consumption spending on home commodity *c* from activity *a* for household *h*.
$tins01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates,

SETS

$c \in C$	= a set of commodities (also referred to as c' and C'),
$c \in CM(\subset C)$	= a set of imported commodities,
$c \in CM(\subset C)$	= a set of domestic trade inputs (distribution commodities),
$c \in CE(\subset C)$	= a set of exported commodities (with domestic production),
$c \in CD(\subset C)$	= a set of commodities with domestic sales of domestic output

Table A1 (Cont'd)

$c \in CX(\subset C)$ = a set of commodities with domestic output.
$a \in A$ = set of activities
$a \in ACES(\subset A)$ = a set of activities with a CES function at the top of the technology nest.
$a \in ALEO(\subset A)$ = a set of activities with a Leontief function at the top of the technology nest,
$f \in F(= F')$ = a set of factors
$c \in CEN(\subset C)$ = non-exported commodities (complement of CE),
$c \in CDN(\subset C)$ = commodities without domestic market sales of domestic output (complement of CD).
$c \in CMN(\subset C)$ = a set of non-imported commodities.
$i \in H(\subset INSDNG)$ = a set of households
$i \in INS$ = a set of institutions (domestic and rest of the world),
$i \in INSD(\subset INS)$ = a set of domestic institutions
$i \in INSDNG(= INSDNG' \subset INSD)$= a set of domestic non-government institutions
h = household

Price Block

Import Price

$$PWM_c = pwm_c \cdot (1 + tm_c) \cdot EXR + \sum_{c' \in CT} PQ_{c'} \cdot icm_{c'c} \qquad c \in CM \tag{4.1}$$

Export Price

$$PE_c = pwe_c \cdot (1 - \text{te}_c) \cdot EXR - \sum_{c' \in CT} PQ_{c'} \cdot ice_{c'c} \qquad c \in CE \tag{4.2}$$

Demand price of domestic non-traded goods

$$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} \cdot icd_{c'c} \qquad c \in CD \tag{4.3}$$

Absorption

$$PQ_c \cdot (1 - tq_c) \cdot QQ_c = PDD_c \cdot QD_c + PM_c \cdot QM_c \qquad \in (CD \cup CM) \tag{4.4}$$

Market output Value

$$PX_c \cdot QX_c = PDS_c \cdot QD_c + PE_c \cdot QE_c \qquad c \in CX \tag{4.5}$$

Activity Price

$$PA_a = \sum_{c \in C} PXAC_{a\,c} \cdot \theta_{a\,c} \qquad a \in A \tag{4.6}$$

Aggregate intermediate Input price

$$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{c\,a} \qquad a \in A \tag{4.7}$$

Activity revenue and costs

$$PA_a \cdot (1 - ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a \qquad a \in A \tag{4.8}$$

Consumer Price Index

$$\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwts_c \tag{4.9}$$

Producer Price Index for non-traded market output

$$DPI = \sum_{c} PDS_c \cdot dwts_c \tag{4.10}$$

The *import price* denoted by PWM_c in *equation 1* is the imported commodity price paid by domestic users in local currency units (LCU). The world price transformation of the imports considers import tariffs, exchange rates, and transaction costs per unit of the import. The composite price PQ is the market price paid for all commodities by domestic commodity demander. It is thus paid only for-trade inputs. For every imported commodity, the model includes a single equation since the domain of the equation is a subset in a commodity set. The equation suggests a fixed world import price, flexible domestic import price, flexible exchange rate, and fixed tariff rate. At the prevailing world prices, a small country share of world trade is assumed to have an infinitely elastic supply curve hence fixed. Output sold in the export market by domestic producers determines the *export price* (PE_c) in LCU received by the domestic producer. This is shown in *equation 2*, the cost of trade inputs and tax reduces the received price by local exports producers.

Domestic production and sale of a commodity at demand price are distinguished between supplier-received prices and demander paid prices. The *demand price for commodity c* PDD_c, is defined by *equation 3* as the sum of trade inputs cost per unit of domestic sale and price of supply. *Absorption* expressed by *equation 4* is defined as the total domestic expenditure at the demanders' domestic price on a commodity. Excluding the sales tax, it is expressed as the sum of expenditure on imports at demand prices (PWM) and domestic output (PDD) and these prices include the trade inputs costs. The equation applies to all imported commodities. Quantity of imported goods (QM) and (PWM) are fixed at zero in the GAMS code for commodities alien to the set CM. Likewise, QD and PDD are fixed at zero for commodities alien to set CD.

Consequently, the model fixes all unwanted variables to zero. Therefore, the transformation of the equation into an explicit absorption at composite or market price definition is derived if divided by (1-tq).QQ or (1-tq).

The summation of values for domestic sales and exports gives the marketed output value for each commodity produced domestically at producer prices. Prices received by suppliers determine the domestic exports and sales values (PE) and (PDS) of the two. The price has thus been reviewed downward so that trade input costs are accounted for. Limitations on domestic produce suggest it has to be stated explicitly since the model does not include domestically produced commodities in the import category. Hence the variables QE and PE are fixed to zero in GAMS since they are not part of set CE, meaning they only part of CD. QX and PX denote aggregate values shown by *equation 5* as the *Marketed output value,* and the equation gives an explicit definition of PX if divided through by QX.

For an activity to produce multiple commodities, expressed by *equation 6* the *activity price* (PA) (which is overall revenue per unit of activity), must be derived from the multiplication of the activity-specific commodity prices by the return per activity unit. Hence the selling of activity output. Disaggregated intermediate costs per unit of aggregate intermediate input are shown by the aggregate intermediate input activity-specific price. It is thus dependent on the intermediate input coefficients and the commodity composite price that gives commodities quantity input *c* per the unit of aggregate intermediate input. Thus, *aggregate intermediate input price* shown by *equation 7* is given by $PINTA_a$. Intermediate inputs and value-added payments completely exhaust the net of taxes to total revenue for each activity. Given PA and PINTA, the value-added price (PVA) is implicitly defined by the *activity revenue and costs equation 8*.

In *equation 9*, the *consumer price index* (CPI) for domestically marketed output is fixed (or fixing the *producer price index* (DPI) in *equation 10*), and it thus serves as a numeraire in the standard model. That is a requirement since the model is homogenous of degree 0, in prices. So that, when doubled all real quantities will not change while all prices double. Income and price changes as they are simulated, are interpreted as changes in relation to the numeraire price index.

Production Block

CES technology: activity production function

$$QA_a = \alpha_a^a \cdot \left[\delta_a^a \cdot QVA_a^{-\rho_c^t} + (1-\delta_a^a) \cdot QINTA_a^{-\rho_a^a}\right]^{-\frac{1}{\rho_a^a}} \qquad a \in ACES \tag{4.11}$$

CES technology; value-added intermediate input ratio

$$\frac{QVA_a}{QINTA_a} = \left[\frac{PINTA_a}{PVA_a} \cdot \frac{\delta_a^a}{(1-\delta_a^a)}\right]^{\frac{1}{1+\rho_a^a}} \qquad a \in ACES \tag{4.12}$$

Leontief Technology: Demand for Aggregate value-added

$$QVA_a = iva_a \cdot QA_a \qquad a \in ACES \tag{4.13}$$

Leontief Technology: Demand for Aggregate intermediate input

$$QINTA_a = inta_a \cdot QA_a \qquad a \in ACES \tag{4.14}$$

Value-added and factor demands

$$QVA_a = \alpha_a^{va} \cdot \left[\sum_{f \in F} \delta_{fa}^{va} \cdot QF_{fa}^{-\rho_a^{va}}\right]^{-\frac{1}{\rho_a^{va}}} \qquad a \in A \tag{4.15}$$

Factor demand

$$WF_f \cdot \overline{WDIST}_{fa} = PVA_a(1-tva_a) \cdot QVA_a \cdot \left[\sum_{f \in F'} \delta_{fa}^{va} \cdot QF_{fa}^{-\rho_a^{va}}\right]^{-1} \cdot \delta_a^{va} \cdot QF_{fa}^{-\rho_a^{va}-1} \qquad a \in A\,;\ f \in F \tag{4.16}$$

Disaggregated intermediate input demand

$$QINT_{c\,a} = ica_{ca} \cdot QINTA_a \qquad a \in A\ ;\ \ c \in C \tag{4.17}$$

Commodity production and allocation

$$QXAC_{a\,c} + \sum_{h \in H} QHA_{a\,c\,h} = \theta_{a\,c} \cdot QA_a \qquad a \in A\,;\ c \in CX \tag{4.18}$$

Output aggregation function

$$QX_c = \alpha_c^{ac} \cdot \left[\sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}}\right]^{-\frac{1}{\rho_c^{ac}-1}} \qquad c \in CX \tag{4.19}$$

First-order condition for Output aggregation function

$$PXAC_{a\,c} = PX_c \cdot QX_c \cdot \left[\sum_{a \in A'} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}}\right]^{-1} \cdot \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}-1} \quad a \in A; c \in CX \tag{4.20}$$

This section covers the distribution of domestic output to the domestic market, household consumption and exports; input use and domestic production, supply aggregation to the domestic market; and trade inputs demand generated by the process of distribution. Taking prices as given, production activities are assumed to maximize profits subject to technology. Figure 4.4. Illustrate production flow top to down of three nested functions. Such that, the gross output is given by a Leontief function of value-added composite and aggregate intermediate input. In the technology nest, the top-level, outputs are CES production functions of primary and intermediate inputs or Leontief functions of value-added quantities and the aggregated intermediate input use. So that the optimal quantity ratio of value-added as a function of aggregate intermediate and prices of value-added inputs is obtaining by the first-order condition. The *CES aggregator function of value-added* (QVAa) and quantity of aggregate intermediate input provide the volume of value-added at the second nest, (*see equation 12*).

In *equation 13*, profits are maximized subject to input and output prices, and production technology is used to derive the capital and labor skill type demands. The quantity of value-added of each activity, as stated by *equation 15*, is a CES function of the disaggregated factor quantities. Where, α_{fa}^{vaf} and $Alphava_a^{va}$ are factor-specific productivity parameters for activity *a* and total factor productivity (TFP). Given the factor demand *equation 15a*, the employment levels thus depend on share factor parameters, relative wages, and elasticities for all the varying

labour skill categories. In *equation 16*, *factor demand* of activities is given at the point each factor's marginal cost (LHS; activity-specific factor price) equals the marginal revenue product of that factor (net intermediate input costs). *Equation 16* domain is restricted to factor-activity combinations of the base year SAM in the GAMS code. Equations that are specified by mappings between multiple indices (e.g. *equation 17*) are subjected to similar domain restrictions.

The endogenous variable (average factor price) and the exogenous variable activity-specific (wage-distortion) reflect the handling of factor markets in the standard CGE model (see *equation 39*). Cumulative marketed production of a commodity is specified as a CES function of the total marketed output of various activities involved in producing that commodity (see *equation 19*). There is an inverse relationship between activity-specific price and the optimal quantity of the commodity (as in *equation 20*). QX is the output, priced at PX, inputs QXAC are used and their purchase price is given by PXAC. Choosing between different commodities is an optimization problem. *Equation 19* and *20* give the first-order conditions of profit maximization problem of the sale of the aggregate output (QX) at price PX, and it is subject to the output aggregation function and the disaggregated commodity prices (PXAC). When PXAC of one activity declines relative to others, demand for it will increase and that of the other activities (higher-price) will fall.

Substitutability among various producers is given by the value o (elasticity of substitution). To ensure the isoquants are convex, its values, and that the elasticities are restricted. This is referred to as a diminishing technical rate of substitution in production economics. If there is a sole producer regardless of elasticity value and the exponent, QXAC = QX and PXAC = PX.

Trade Block

Output transformation (CET) function

$$QX_c = \alpha_c^t \cdot \left[\delta_c^t \cdot QE_c^{\rho_c^t} + (1-\delta_c^t) \cdot QD_c^{\rho_c^t}\right]^{\frac{1}{\rho_c^t}} \qquad c \in (CE \cap CD) \qquad (4.21)$$

Export domestic supply ratio

$$\frac{QE_c}{QD_c} = \left[\frac{PE_c}{PDS_c} \cdot \frac{1-\delta_c^t}{\delta_c^t}\right]^{\frac{1}{\rho_c^t - 1}} \qquad c \in (CE \cap CD) \qquad (4.22)$$

Output transformation for domestically sold outputs without exports and for exports without domestic sales

$$QX_c = QD_c + QE_c \qquad c \in (CD \cap CEN) \cup (CE \cap CDN) \qquad (4.23)$$

Composite supply (Armington) function

$$QQ_c = \alpha_c^q \cdot \left[\delta_c^q \cdot QM_c^{-\rho_c^q} + \left(1-\delta_c^q\right) \cdot QD_c^{-\rho_c^q}\right]^{-\frac{1}{\rho_c^q}} \qquad c \in (CM \cap CD) \qquad (4.24)$$

Import domestic demand ratio

$$\frac{QM_c}{QD_c} = \left[\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1-\delta_c^q}\right]^{\frac{1}{1+\rho_c^q}} \qquad c \in (CM \cap CD) \qquad (4.25)$$

Composite Supply for non-imported outputs and non-produced imports

$$QQ_c = QD_c + QM_c \qquad c \in (CD \cap CMN) \cup (CM \cap CDN) \qquad (4.26)$$

Demand for transaction services

$$QT_c = \sum_{c' \in C'} (icm_{c\,c'} \cdot QM_{c'} + ice_{c\,c'} \cdot QE_{c'} + icd_{c\,c'} \cdot QD_{c'}) \qquad c \in CT \qquad (4.27)$$

Neoclassical economic theory suggests that commodities produced in the international markets are perfect substitutes for the same type of commodity produced in the domestic market. The assumption is not suitable for this model because consumers may observe quality variance and in our model, the commodities are aggregated hence, the model has to allow for imperfect substitution between the domestic and imported commodities of the same kind. According to Armington (1969) approach, an assumption is made that both imported and exported commodities, which are domestically produced, are imperfect substitutes.

Botswana communities seem to possess the armington's assumption because they consider the goods of the same kind but different countries as imperfect substitutes. Likewise, they consider exported and imported commodities of the same kind as imperfectly transformable. Owing to that, the closer substitutability is implied by a higher Armington elasticity level. When σ_q approaches infinity, imported and domestically produced commodities become close to perfect substitutes assumed by the neoclassical approach. Essentially, the aggregation of commodities affects export price elasticities. Hence price and quality perception by consumers. Thus, perfect substitutability deviation is handled by a constant elasticity of transformation (CET) function in the model to allow imperfect transformability between exported (QE_c) and the domestically sold (QD_c) commodities, as explained by aggregate marketed domestic output in Annexure A.

This model reflects the economic agents' choices given the import-exports demand functions' relative prices. For a small economy like Botswana, we are considered to be world price takers. As such, the household in Botswana consumes commodities that are CES and CET determined. Thus minimizing the purchasing of the composite commodities is determined by import costs. Furthermore, given that, Botswana is one of the largest diamond producers by value; their exports are however determined by a downward sloping demand function. Hence, the country can only rise mineral exports by reducing the diamond world prices.

B.1.4 Institution equations

Factor income

$$YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{f\,a} \cdot QF_{f\,a} \qquad f \in F \tag{4.28}$$

Institution factor incomes

$$YIF_{if} = shif_{i\,f} \cdot \left[\left(1 - tf_f\right) \cdot YF_f - trnsfr_{row\,f} \cdot EXR\right] \qquad i \in INSD\,;\; f \in F \tag{4.29}$$

Income of domestic, non-government institutions

$$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{i\,gov} \cdot \overline{CPI} + trnsfr_{i\,row} \cdot EXR \quad i \in INSDNG \tag{4.30}$$

Intra-institutional transfers

$$TRII_{ii'} = shii_{ii'} \cdot (1 - MPS_{i'}) \cdot (1 - TINS_{i'}) \cdot YI_{i'} \qquad i \in INSDNG \ ; \ i' \in INSDNG \qquad (4.31)$$

Household consumption expenditures

$$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{i\,h}\right) \cdot (1 - MPS_h) \cdot (1 - TINS_h) \cdot YI_h \qquad h \in H \qquad (4.32)$$

Household consumption spending on marketed commodities

$$PQ_c \cdot QH_{c\,h} = PQ_c \cdot \gamma^m_{c\,h} + \beta^m_{c\,h} \cdot \left[EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^m_{c'h} - \sum_{c' \in A} \sum_{c' \in C} PXAC_{a\,c'} \cdot \gamma^h_{a\,c'h}\right] \qquad (4.33)$$

Household consumption spending on home commodities (4.34)

$$PXAC_{a\,c} \cdot QH_{a\,c\,h} = PXAC_{a\,c} \cdot \gamma^h_{a\,c\,h} + \beta^h_{a\,c\,h} \cdot \left[EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^m_{c'h} - \sum_{c' \in A} \sum_{c' \in C} PXAC_{a\,c'} \cdot \gamma^h_{a\,c'h}\right]$$

Investment demand

$$QINV_c = IADJ \cdot \overline{qinv}_c \qquad (4.35)$$

Government consumption demand

$$QG_c = \overline{qg}_c \qquad (4.36)$$

Government revenue

$$YG = \sum_i TINS_i \cdot YI_i + \sum_f tf_f \cdot YF_f + \sum_a ta_a \cdot PA_a \cdot QA_a + \sum tm_c \cdot pwm_c \cdot QM_c \cdot EXR \qquad (4.37)$$

Government expenditure

$$EG = \sum_c PQ_c \cdot QG_c + \sum_i trnsfr_{i\,gov} \cdot \overline{CPI} \qquad (4.38)$$

Final demand by household assumes utility maximization derived from composite commodities consumption represented by a "Stone-Geary" function. The first-order conditions derived are known as linear expenditure system (LES) function. Given the level of poverty in Botswana as per households, the function is useful for Botswana because it incorporates provisions for subsistence consumption. Household is described by two functions for i) marketed commodities (cost given by market prices) and ii) home production-consumption (cost given by opportunity cost, the activity-specific producer price without marketing costs; see *equation 34*). Demand functions are given by dividing each side with the pertinent price. Since the government is also a composite commodity consumer, the final demand is assumed to be that the government's relative quantity demanded for each commodity is fixed at their base level, the same applies to commodity demanded for investment (see *equations 35* and *36*).

B.1.5 System Constraints equations

Factor markets

$$\sum_a QF_{f\,a} = \overline{QFS_f} \tag{4.39}$$

Composite commodity markets

$$QQ_c = \sum_a QINT_{ca} + \sum_a QH_{c\,h} + QG_c + QINV_c + qdst_c + QT_c \tag{4.40}$$

Current account balance for the rest of the world, in foreign currency

$$\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row\,f} = \sum_{c \in A} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i\,row} + \overline{FSAV} \tag{4.41}$$

Government balance

$$YG = EG + GSAV \tag{4.42}$$

Direct institutional tax rates

$$TINS_i = \overline{tins_i} \cdot (1 + \overline{TINSDAJ} \cdot tins01_i) + \overline{DTINS} \cdot t_i \qquad i \in INSDNG \tag{4.43}$$

Institutional saving rates

$$MPS_i = \overline{mps_i} \cdot (1 + \overline{MPSADJ} \cdot mps01_i) + DMPS \cdot mps01_i \qquad i \in INSDNG \tag{4.44}$$

Savings – investment balance

$$\sum_{i \in INSDNG} MPS_i \cdot (1 - TINS_i) \cdot YI_i + GSAV + EXR \cdot \overline{FSAV} = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \tag{4.45}$$

Total absorption

$$TABS = \sum_{h \in H} \sum_{c \in C} PQ_c \cdot QH_{c\,h} + \sum_{a \in A} \sum_{c \in C} \sum_{h \in H} PXAC_{a\,c} \cdot QHA_{a\,c\,h} + \sum_{c \in C} PQ_c \cdot QG_c + \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \tag{4.46}$$

Ratio of Investment to absorption

$$INVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c \tag{4.47}$$

Ratio of government consumption to absorption

$$GOVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QG_c \tag{4.48}$$

Accordingly, in a CGE model, macroeconomic conditions must simultaneously be satisfied and, simultaneous equilibrium for factors and commodities must occur in all markets. In this model, quantities supplied and demanded are equated for all commodities and factor markets. By defining foreign savings and government, saving as residuals while the model holds a closure rule that investment is savings driven in this economy, then the accounts for the rest of the world

(RoW) and the government is expected to balance. Equality between the total quantity supplied and total quantity demanded for each factor is imposed by *Equation (39).* The demand variables are flexible whereas the supply variable is inflexible. WF_f, factor wage, guarantees the equality is satisfied, WF_f increases the wage each activity pays. There is the mobility of factors across demanding activities. In GAMS two further factor-market closures are programmed. For the case of unemployment at a particular wage for a factor, the supply variable is flexible (QFS_f) and the market-wide wage is inflexible ($\overline{WF_f}$).

Each activity employs the quantity it requires ($QF_{f\,a}$) at a fixed wage ($\overline{WF_f} \cdot \overline{WFDIST_{f\,a}}$). The QFS_f , which is the free supply variable, registers the total employment level. The economy-wide variable and the activity-specific factor-demand variables are set as fixed whereas the supply variable and activity-specific wage-distortion variables are not, such that the model stays square. Variation of the Activity-specific wages, $\overline{WF_f} \cdot WFDIST_{f\,a}$, is allowed so that fixed activity-specific employment level,. $\overline{QF_{f\,a}}$, is line with profit-maximization. The endogenous aggregate factor variable gives the total employment level. In *Equation (40)*, equality between quantities demanded and supplied of the aggregate commodity is imposed. Endogenous terms (as in *equations 17, 27, 33, 35, and 36*) are included on the demand side plus a new exogenous term representing stock change. *QINV and QG* and are fixed. The current account balance (stated in foreign currency) ensures parity between the country's foreign exchange incomes and expenditures. Foreign saving is fixed in the basic model, and real exchange rate (*EXR)* is the equilibrating variable also the trade deficit is fixed. If the trade deficit is to vary, the exchange rate can alternatively be fixed and the foreign savings unfixed.

There is equality between government expenditures (government investment not included) and current government revenue and savings, where savings can be negative. The direct tax rate variable for all institutions is fixed since all RHS variables are fixed. Government balance is cleared by the endogenous variable; government savings. The initial tax rate thus does not affect the rate change. For the second case, *TINSADJ* is a variable whereas *DTINS* is to be fixed. In this closure for institutions with large base-year rates, changes in *TINS* are relatively large (that is if they have a value of 1 for *tins*01). Savings rates of the domestic non-government institutions are defined by *Equation (44).*

In the basic model, *DMPS* is flexible, thus *MPS* is permitted to be changed at a uniform rate for one more of the non-government institutions. Depending on the closure rule *MPASDJ* and *DMPS* are set to be flexible. The equation imposes equality between total savings and total investment. The sum of savings from non-government institutions, government, and the rest of the world (expressed in domestic currency) gives the total savings. The total investment is given by the totality of the fixed investment (gross fixed capital formation) and stock changes. *DMPS* clears the balance. All the other items in the Savings. The investment balance is fixed to ensure there is balance.

Additional Savings-Investment closures have been incorporated in the GAMS code. *DMPS* is inflexible and *MPSADJ* is flexible. Under closure 3, *IADJ* is set flexible while *MPSADJ* and *DMPS* are fixed. The model is not square as the number of equations exceeds the number of variables. However, the model follows the Walras law. Alternatively, it is viable to include one more zero solution variable (if it is not zero the general equilibrium solution has not been identified) to balance the macroeconomic equations. GAMS follow this procedure by adding the WALRAS variable to the Savings-Investment balance. As such, no equation is dropped which

makes the model complete and self-contained. Three more equations and variables are added in the basic model version, as they allow for the construction of the balanced Savings-Investment closures 4 and 5.

Total absorption is determined as the total value of domestic final demands; it equals GDP at market prices plus imports minus exports and is expressed as a new variable, *TABS*. Total investment value is defined by the right-hand side of the equation, (contrast with *equation (45)*). Total absorption is multiplied by *INVSHR* (which measures the ratio between absorption and investment); the final is comparable to *equations (47)* but the government replaces investment. In the right-hand side of the equation, government consumption is defined (contrast with *equation (38)*). Total absorption is multiplied by *GOVSHR* (new variable) on the left-hand side; it gives the ratio between government consumption and absorption.