THE UNIVERSITY OF HULL

THE ROLE OF FINANCIAL SECTOR REFORMS IN GHANA: ECONOMETRIC AND CGE ANALYSES

being a Thesis submitted for the Degree of

Doctor of Philosophy in Economics

in the University of Hull

by

Abraham Adu
MRes (University of Hull)
MSc (University of Hull)
BA (Kwame Nkrumah University of Science & Technology, Ghana)

DECLARATION

I declare that the thesis entitled **'THE ROLE OF FINANCIAL SECTOR REFORMS IN GHANA: ECONOMETRIC AND CGE ANALYSES',** submitted by me for the **Degree of Doctor of Philosophy (PhD) in Economics** is the record of work carried out by me during the period October 2011-August 2016, under the guidance and supervision of **Dr. Keshab Bhattarai** and has not formed the basis for the award of any Degree, Diploma, Associate, Fellowship, Titles in this University or any other University or other similar institutions of higher learning.

(Abraham Adu)

ACKNOWLEDGEMENT

I always remember with gratitude, all the persons who have contributed in one way or the other towards the materialization of this scholarly work. First and foremost, I am deeply indebted to **God Almighty** for life abundance, good health and restoration.

Second, I acknowledge my supervisor **Dr. Keshab Bhattarai** under whose guidance, scrutiny and support this work was carried out. It was an honour and privilege working with **Dr. Bhattarai.** His constructive criticisms, mentoring, and persistence encouragement at all stages of my work are admirable. I could not have had a better supervisor and mentor. Likewise, thanks are due to **Prof Andrew Abbot** my second supervisor and **Dr. Raymond Swaray** without whom, I may never have had the opportunity to enrol for this PhD programme.

I immensely benefited from the **Centre for Economic and Social Research** and the **Centre for Economic Policy, University of Hull,** for awarding me the Doctoral Scholarship which has facilitated to complete the work. The award of this scholarship is greatly acknowledged.

Gratitude's to my friends **Dr. Emmanuel Okyere**, **Dr. Roland Yaw Ghetor**, **Dr. Godfrey Nyamuruka** and **Dr. John Kwesi-Buour** for their friendly support.

Lastly, I gratefully dedicate this work to my wife, **Diana** and daughter, **Abbey** for their endless love and moral support. To my wonderful mum, **Ruth,** and the memory of my late father, **Abraham Adu Snr**. who is gone but not forgotten.

(Abraham Adu)

CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AFRC	The Armed Forces Revolutionary Council
BCCI	Bank of Credit and Commerce International
BIS	Bank for International Settlement
BoE	Bank of England
BoG	Bank of Ghana
BRICS	Brazil, India, China and South Africa
CAR	Capital Adequacy Ratio
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	Computerised General Equilibrium
CR	Concentration Ratio
CV	Compensation Variations
ECB	European Central Bank
ESH	Efficient Structure Hypothesis
EV	Equivalent Variations
FAM	Financial Accounting Matrix
FDI	Foreign Direct Investments
FINSAP	Financial Sector Adjustment Programme
GAMS	General Algebraic Modelling System
GCB	Ghana Commercial Bank
GDP	Gross Domestic Product
GSE	Ghana Stock Exchange
GSS	Ghana Statistical Service
HHI	Hirschman-Herfindahl Index
HPAI	Highly Pathogenic Avian Influenza
IFPRI	International Food Policy Research Institute
IFSC	International Financial Services Centre
IMF	International Monetary Fund Development
IO	Input-Output
IPOs	Initial Public Offerings
LDCs	Least Developing Countries
MEBs	Marginal Excess Burden

MC	Marginal Cost
MCPs	Mixed Complementarity Problems
MIC	Middle Income-Country
MPGSE	Mathematical Programming System for General Equilibrium
MR	Marginal Revenue
MS	Market Shares
NBER	National Bureau of Economic Research
NEIO	New Empirical Industrial Organization
NPLs	Non-Performing Loans
OECD	Organisation for Economic Co-operation and
PR	Panzar and Rosse
RoW	Rest of the World
SAM	Social Accounting Matrix
SCP	Structure Conduct Performance
SMEs	Small and Medium Enterprises
SSA	Sub-Saharan Africa
TB	Treasury Bill
VAT	Valued Added Tax
WTO	World Trade Organization

1 CHAPTER:
BACKGROUND AND CONTEXT

1 CHAPTER: BACKGROUND AND CONTEXT

1.1 Context

Financial intermediation is vital for economic development. Existing literature indicate a causal link between the degree of financial intermediation and economic growth. In order to finance both private and public investments, Ghana needs a stable and efficient banking system next to systematic development of its financial system. The cost of financial intermediation has significant ramifications for economic performance (McKinnon and Shaw 1993, Jayaratne and Strahan 1996, Rajan and Zingales 1998, Beck, Levine and Loayza 2000, Hansen (2014)). From the late 1980s through the period of the recent economic downturn, Ghana's financial sector reforms has been characterised with notable component of structural adjustments programs. The financial sector reforms in Ghana typically involved not only decontrolling interest rates and elimination of credits, but also restructuring and privatisation of state-owned banks, implementation of new institutional and legal frameworks along with the adoption of indirect instruments of monetary policy.

Policy expectation from the burgeoning structural adjustment programs can be divided into two categories, some of which has been identified by other authors. First is to increase competition. An improvement in competition and concentration indices in banking systems is often characterised with an increase in participation of foreign and domestic banks which is often explained by a decreasing trend in market concentration. Second is to enhance on efficiency in the banking sector. The effectiveness of the financial system in channelling funds from surplus units to deficit units is often measured by examining the transaction costs (difference between lending and deposit rates) along with an assessment of the degree of competiveness. Interest rate spread as a measure of financial intermediation cost is particularly significant for Ghana where due to continued weaknesses in the financial market, households and firms extensively depend on bank financing as a source of external funding. In addition interest rate spread characterizes how efficiently banks perform their intermediation role of savings mobilisation into capital allocation. Besides, the level of interest rate spreads is an important policy variable since Universal banks are the main source of external finance in the Ghanaian economy.

Nonetheless, high financial intermediation cost may be deemed to be inimical to financial deepening and hence economic growth, as they act as a disincentive to private investment and then constrain it to suboptimal levels. The persistence of high interest rate spread might be symptomatic of structural problems such as the lack of competition in the banking system; scale diseconomies constrained by small market; high operating costs as a consequence of low efficiency; unfavourable institutional environment; existence of varied regulatory constraints distorting financial market activity; perceived market and credit risks and the unsoundness of banks. The deregulation and liberalisation of the Ghanaian banking systems and its associated entry of several private and foreign banks has gradually induced greater competition. Besides this improvement, the intermediation cost of banks in Ghana is still characterised with persistently high interest spreads.

Figure 1 shows the behaviour of bank interest spread, monetary policy rate and annual inflation rate in the formal financial sector in Ghana for the period 2000 to 2014. The monetary policy rate (MPR) is the rate set by the Monetary Policy Committee of the Bank of Ghana and it represents the rate at which the BOG will lend to banks in the banking system. The MPR is also used by the BOG to conduct monetary policy such that, increasing the rate is indicative of a tight monetary stance whereas decreases signal an expansive stance. **Figure 1** indicate that bank interest rate spread-the difference between ex-ante contracted lending and deposit interest rate has not followed the trend in inflation rate and monetary policy rate. Whereas, the inflation rate and monetary policy rate tend to follow similar pattern, bank interest rate spread remained almost the same and peaked in the recent time. The fourteen-year average (2000 to 2014) spread of 11.4 percent shows that transaction cost over the past decade has not changed. It seems that in spite of the efforts of policy makers to induce competition and efficiency in the banking sector and to develop the Ghanaian banking market, it appears that financial sector reform is a slow process in Ghana and has proved far more difficult than previously taught. Hitherto, whereas, relatively high transaction costs are characterised with low degree of efficiency and non-competitive market conditions, this is mainly due to inadequate regulatory banking environment and high degree of information asymmetry in the financial system.

Besides, the prevalence of uncompetitive market conditions, the high transaction costs might also be symptomatic of high risk premia. This implies that an increase in the level of

competition under such market conditions may be contributing to collusive behaviour of participating banks thereby culminating in financial instability in the financial system. Highly concentrated financial systems are less likely to suffer from financial crisis (Beck, Demirguc-Kunt and Levine 2004). Yet Beck, Fuchs, Singer and White (2014) argue that banking systems plays critical function economic growth by intermediating household's savings and allocating them to their best uses. Therefore, at the bear minimum, at least momentarily to sustain bank franchise value and circumvent financial instability in Ghana's financial system, high transaction may be necessary.

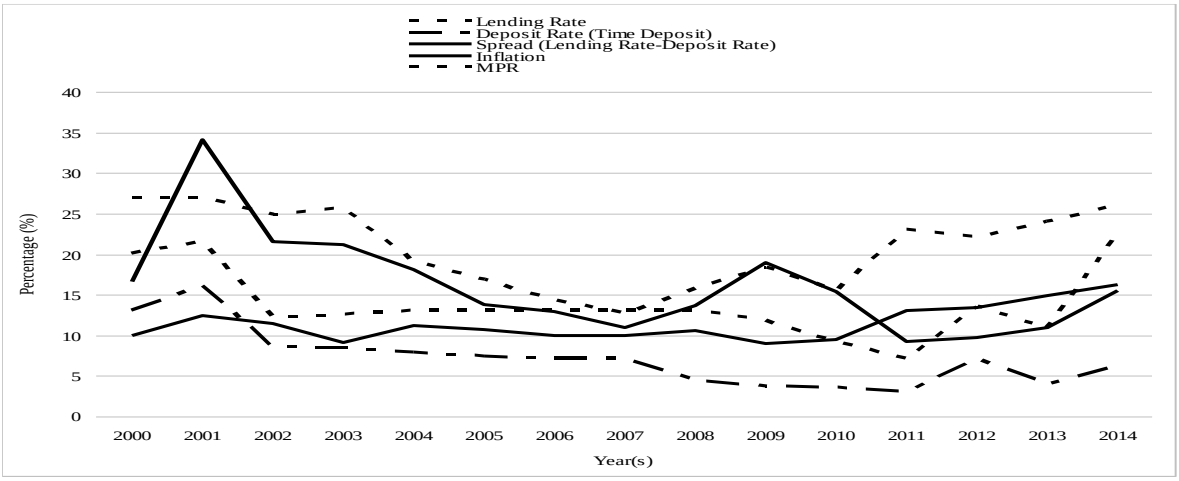


Figure 1: Inflation Monetary Policy Rate and Lending Rates in the Formal Financial System (2000 to 2014)
Source: Bank of Ghana, various years

Related to the combined effect of the behaviour of bank interest rate spread, monetary policy rate and annual inflation rate is that, consumers earn lower rate on deposits yet pay premium rates on loans. This is in contrast to McKinnon and Shaw (1973) hypothesis that the removal of interest rate controls ought to lead to an increase in financial savings, investments and hence economic growth. Therefore, in a developing economy like Ghana a competitive banking environment is critical for an effective and efficient financial intermediation through the transmission mechanism of savings and borrowing for a sustainable economic growth. Accordingly, the regulatory role of the government in the context of financial sector reforms, such as the introduction of appropriate legislation and able to maintain competitive conditions in Ghana became increasing important. The next section discusses the liberalisation and deregulations of the Ghanaian financial system.

1.1.1 Financial Sector Reforms in Ghana-a Historical Background

Ghana's financial sector reforms included various financial reforms on fiscal management, on the financial system, privatisation of state-owned financial intermediaries and on institutional and legal frameworks. The next section discusses events in the pre-financial sector reforms periods and the post-financial sector reforms periods.

1.1.1.1 Pre-Reforms (1961 to 1982)

Between 1961 and 1982 the financial sector of the Ghanaian economy was dominated by state ownership. Successive government's established its own specialized commercial and development banks to provide access to credit facilities to local households. This is because local households including farmers and firms were denied credit facilities by the only two existing foreign banks namely Barclays Bank Ghana Ltd (BBGL) and Standard Chartered Bank (SCB) as they preferred to issue loanable funds to less risky customers. In response, Ghana Commercial Bank (GCB) was established by the government in 1953 to provide credit facilities to local consumers. Thereafter, the National Investment Bank (NIB) was established in 1963 to supply the long-term financial needs of local firms and industries. In 1965, Agriculture Development Bank was also set-up to provide credit facilities to indigenous farmers. Next, Merchant Bank Ghana (MBG) was established in 1971 as a joint venture amongst the Ghanaian government and ANZ Grindlays. Then, the Bank for Housing and Construction was established in 1974 to provide loans for the local housing market, construction and industrial companies who focused in building materials. Likewise in 1975, National Savings and Credit Banks (NSCB) was set-up to provide small loans to consumers.

Later, the government acquired 40 percent ownership in BBGL and SCB in 1975. Similarly, in 1977 the Social Security Bank was established to provide long-term loans facilities for local households. Overall, during the pre-financial liberalisation period, the state owned 90 percent of total bank assets (BoG, 2000). Despite the various establishments of those specialised banks, the behaviour of banks was similar to monopolistic behaviour in the entire banking sector in terms of interest rate spread and banking operations (World Bank, 1995). Furthermore, contrasting to the UK, where the chairman of the Bank of England (BoE) is appointed by the Prime Minister and subsequently vetted and approved by the house of parliament, in Ghana, the general trend is that the President directly appoints the chairman of the Bank of Ghana (BoG). Thus, even though in principle BoG ought to be independent of

the government, in practise, governmental pressures undermined the central bank independence. Commentators viewed the BoG as an extension of the Ministry of Finance in carrying out the economic policies of the government.

Besides, the period witnessed fixed exchange rate policy decisions in an attempt to attaining a low stable inflation as the government significantly intervened in the financial market to keep interest rates low and stable[1]. Accompanied by the exchange rate policies was a series of devaluations in 1967, 1971 and 1978. Direct control of money where the government estimates the public demand to hold money which is determined by the future rate of money and the growth rate of real output became the phenomenon before the financial sector reforms. Such historic monetary indiscipline led to headline inflation hitting double digits in excess of 100 percent as money lost its value completely. With inflation hitting double digits, it culminated in real rate of interest becoming negative during the pre-liberalisation era. As a consequence of wanton governmental regulations and the underdevelopment of the financial sector backed with encroachment on the authority of the 'supposed' regulator led to significant market inefficiencies, inadequate competitive environment and political patronage in the banking system. Consequently, banking laws that existed in the pre-reform period did not provide prudent regulatory guidelines for the banking system.

As a result, savers refrained from saving in the banking sector and this led to excess liquidity stored outside the banking system. The severalty of it was undermining the private sector which in the growth literature is indicative of the engine for growth through the mobilisation of savings and the allocation of funds. These policies exacerbated financial deepening in the Ghanaian economy as economic growth and macro-stability was eroded completely. Similarly, due to the corollary of significant market inefficiencies and substantial losses by the banking sector, most banks were in a state of bankruptcy or technical insolvency. The disarray in the Ghanaian banking system pre-financial liberalisation is summed in the World Bank Report (1988)[2].

[1] See for example (Gockel and Gockel 1995 and 2000)

[2] The World Bank, Ghana Financial Sector Adjustment Program (May 1988) concludes that the banking system of Ghana is typical of inefficiency costumed with high operating costs, huge non-performing loans, in adequate provision for loan losses, insolvency, capital inadequacy and inflated profits.

Subsequently policy recommendation concluded that Ghana has the propensity in attaining faster economic growth if financial sector policies are centred on improving efficiency of savings mobilisation through financial intermediaries backed by efficient allocation of resources to the multi-production sectors of the Ghanaian economy. Particularly, channelling 16 percent of savings held outside the banking sector into the formal banking sector could increase economic growth and reduce poverty levels by a percentage point (Husain and Faruqee (1994). Consequently, the government of Ghana in collaboration with the World Bank and the IMF embarked on landmark financial liberalisation policies in response to the financial crisis in the banking sector dubbed the Financial Institutions Sector Adjustment Program (FINSAP 1 in 1983), (FINSAP 2 in 1990) and the reform for the non-bank financial institutions credit.

1.1.1.2 Post-reforms (1983 to date)

The development of Ghana's financial sector followed well-sequenced financial liberalisation policies including restructuring of distressed banks, increasing savings mobilisation, reducing state-ownership of banks and enactment of banking laws and regulations.

1.1.1.3 FINSAP 1-1983

Next, the launch and implementation of FINSAP 1 in 1983 in collaboration with the World Bank, International Monetary Fund and the Ghanaian Government was part of a comprehensive economic reform program. The aims and objectives of FINSAP 1 were:

i. To restructure distressed banks in the Ghanaian banking system.
ii. To increase the mobilization of savings and efficiency in credit allocation.
iii. To establish Non-Performing Assets Recovery Trust (NPART).

Under the FINSAP 1 program, seven distressed state-owned banks were identified and successively restructured with measures including (a) cleaning up of distressed banks' balance sheet by off-loading non-performing loans to state-owned enterprises, non-performing loans to the private sector and loans guaranteed by the government (b) closure of unprofitable branches of distressed banks (c) cutback in the number of bank staff as a means of reducing operation costs and (d) rebuilding and consolidation of Board of Directors of distressed state-owned banks. This was followed with the issuance of FINSAP 1 interest bearing bonds for the non-performing assets of distressed state-owned banks mandated by

NPART. The FINSAP 1 interest bearing bonds were redeemable in annual instalments within a six-year period. Later, BoG issued guaranteed interest bearing bonds for a decisive portfolio of non-performing bank loans.

1.1.1.4 The Banking Law and Regulations -1989

Furthermore, the Banking Act of 1970 during the pre-reform period did not provide clarity on minimum capital requirements and risk exposures of banks. In order to strengthen the banking system, the government amended the existing banking law. Under the new Banking Act of 1989, it became a requirement for banks to keep 6 percent of their net assets as minimum capital requirement. Nevertheless the regulator (i.e. BoG) had the discretion to increase the minimum capital requirement for any particular bank and the entire banking industry. Following the abolishing of the minimum lending rates in February 1988, commercial banks were given the operational rights to set its own interest rates in 1989. A policy which was expected to enhance the competitiveness in lending and borrowing rates in the banking system.

1.1.1.5 FINSAP 2-1990

Lastly, in 1990 FINSAP 2 was also launched as a modification of FINSAP 1. The aims of FINSAP 2 were to:

i. reduce state shareholding of banks.
ii. continue with the bank restructuring program-launched under FINSAP 1.
iii. increase the intensity in recovering of loans mandated by NPART.
iv. develop money and capital markets or securities.

Owing to the relevance attached by the World Bank, privatisation of state-owned banks in Ghana was the centre piece of Ghana's financial sector reforms, 'to promote the private sector as the engine for a sustainable economic growth' (Berg and Ostry 2011, Lall and Teubal 1998). In response, a total of 50.43 billion cedi's worth of non-performing assets (NPAs) of the seven distressed banks state-owned were identified in the banking system and accordingly replaced with Bank of Ghana Bonds directed by NPART. The NPAs included non-performing loans, letters, letters of credit as well as other investments that yielded no income.

The combined transfer of state-owned non-performing assets accounted for almost 96 percent of industry transfer of assets to NPART (**see Figure 2**). From **Figure 2**, 28.4, 25.5, 24.9, 13.1 percent of non-performing assets were transferred by GBC, SSB, BHC and NIB respectively. The remaining were 13.1, 2.6 and 1.4 from NIB, ADB and NSCB. However, only 4 percent of non-performing assets transferred to NPART were from foreign-owned banks. Thus SCB had the lowest with only 0.9. Similarly Barclays transferred 1.4 percent of non-performing assets whereas MBG transferred 1.7 percent of non-performing assets to NPART. But the high level of non-performing assets from state-owned banks is indicative of extended finance to non-lucrative projects to meet developmental and political pressure before commencing financial liberalisation policies in Ghana. Thus, during pre-reform era, the government had the authority to appoint and dismiss bank's executive and managers.

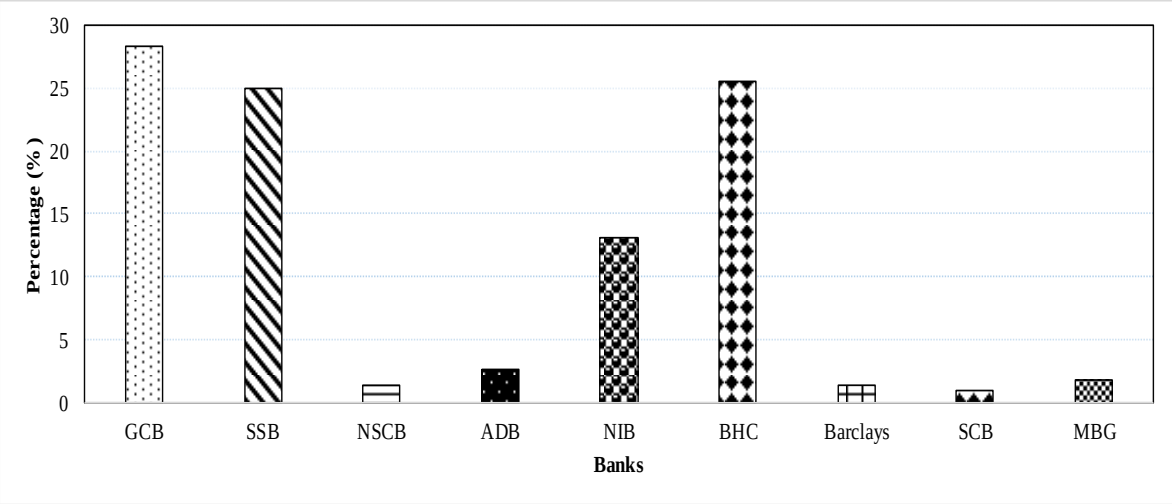


Figure 2: Percentage of Non-Performing Assets Transferred to NPART
Sources: Non-Performing Assets Recovery Trust (NPART) (2000) and Bank of Ghana (2000)

In response to one of the policy objective of FINSAP 2, at the end of 1990 the Ghana Stock Exchange (GSE) was established and it had 12 listed companies and one government bond. This was followed by the enactment of the Non-Bank Financial Institutions Law in 1993 to provide credit facilities for the rural areas who were predominantly indulged in subsistence agriculture. Additionally, the BoG supervisory control was broadened (i.e. Non-Banking Financial Law in 1993) to regulate non-banking financial institutions including Security Discount Company, finance companies, building societies, hire-purchasing companies, savings and loans companies and credit unions.

1.1.1.6 Notable Financial Sector Developments since 2000

1.1.1.7 Central Bank Independence

Next, in 2002 the Central Bank Law was enacted to give the BoG its independence with the core objective of promoting price stability. Markedly, higher central bank independence reduces inflation rate since central bank has the freedom to pursue its objectives and supervisory role effectively. According to Alesina and Summers (1993) and Hayo and Hefeker (2002), central bank independence reduces the level and variability of inflation.

1.1.1.8 Universal Banking

Last but not least the concept of universal banking was introduced in 2003 by BoG. The aim of universal banking was for banks to undertake commercial, development, investment and/or merchandise under without having varied licenses for the respective banking to operate in the country. Also, it was to give customers the flexibility of having all banking services with just one bank.

1.1.2 Concept and Functioning of Financial Deepening in Ghana: Pre and Post Financial Reforms

The stylized facts summarized in **Table 1** shows the ten-year average of stock market capitalization to Gross Domestic Product (GDP) and of bank-provided domestic credit to GDP for Sub-Saharan Africa (developing only[3]), South Africa, Ghana, Middle Income countries and OECD[4] members. The figures reveal that, over the past decade the size of the stock market relative to the Ghanaian economy is, on average, smaller in Ghana than the middle income countries, Sub-Saharan Africa, South Africa and other OECD member countries despite ongoing financial sectors reforms. The ramification is that, unlike developed financial markets, where a wide spectrum of debt and equity instruments is available, in Ghana there are fewer savings options for storing wealth outside the formal financial sector.

Table 1: Ten-Year Average (2001 to 2010) Domestic Credit/GDP and Market Capitalisation/GDP

[3] The term Sub-Saharan Africa developing implies that the dataset does not include high-income economies for example South Africa which is also a Sub-Saharan African economy.

[4] OECD stands for Organisation for Economic Co-operation and Development. In 1960, 20 countries originally signed the convention but only 14 countries including USA, UK, Germany, Australia, Austria, France, Canada, and Chile among others are current Members.

	SSA	South Africa	Ghana	Middle Income	OECD Members
Domestic Credit Provided by Banking Sector/GDP	75.88	178.32	28.77	76.86	187.17
Market Capitalization/GDP	113.18	215.13	14.39	57.02	93.41

Notes: SSA represents Sub-Saharan African Economies developing only
Source: Author's calculation using World Bank Micro Data (2011)

Furthermore, the significance of an appropriate monetary aggregate in Ghana can hardly be over emphasised as it signals the economic position and future course of economic activities in the local economy. But in the pre-reform era, the BOG operated a system of managing the amount of money using direct controls and a fixed exchange rate system. This policy culminated in several inefficiencies associated with the ability to give the right signals for allocating resources efficiently. Policy makers defined money supply (M1) as demand deposits at the banks plus currency in the hands of the general public. The problem associated with M1 is that, it treats money as a medium of exchange. From **Figure 3**, M1 averaged 57.64 percent throughout most of the pre-financial reform era. Though, it can be observed from **Figure 3**, M1 decreased in the post-financial sector reforms period to 36.7 percent. The decrease of only 6 percentage points indicates the magnitude of the average reduction in the nation narrowly defined money supply.

Nevertheless, the case where depositors can withdraw from their savings accounts, without difficulty for transaction purposes indicate that M2, defined as M1 plus time and savings deposits seem to be more appropriate for the local economy than only M1. However, as a result of the increasing unreliability of monetary aggregates, as the reforms began BOG moved to a relatively more market-based system of distributing and managing economic resources. Within this monetary policy framework, greater influence is given for reserve money as an operating target, M2 as the intermediate target with the final aim of targeting inflation as the new framework for monetary policy in Ghana.

Furthermore, the dominance of banking institutions in the Ghana Stock Exchange (GSE) is indicative of subdued lending activity by firms. Also, the domestic-credit provided by the Ghanaian banking sector relative to GDP is less than half the ratio for Sub-Saharan Africa and Middle income countries. Coupled with less domestic credit provided by the Ghanaian sector and lack of debt and equity instruments options is under provision of lending by the financial system. The combined effect is the behaviour of interest margins over the decades

which have remained relatively high and rapidly increasing overtime. This is symptomatic of the Pareto Principle- the law of the vital few or the 80/20 rule where even though banking facilities are most profitable but fewer clients benefit. It is widely accepted that, the structure and efficiency of the financial system account for reasons behind differences in high interest margins across countries.

Typically, economies with weak financial systems tend to be characterised with high interest rate spreads in terms of deposit mobilization and channelling of funds into productive sectors. For example Quaden (2004) suggests that a more efficient banking system benefits the real economy by permeating 'higher expected returns to savers with a financial surplus, and lower borrowing costs for investing in new projects that need external finance'. Therefore, lower deposit interest rates discourage potential savers and thus limits financing for potential borrowers.

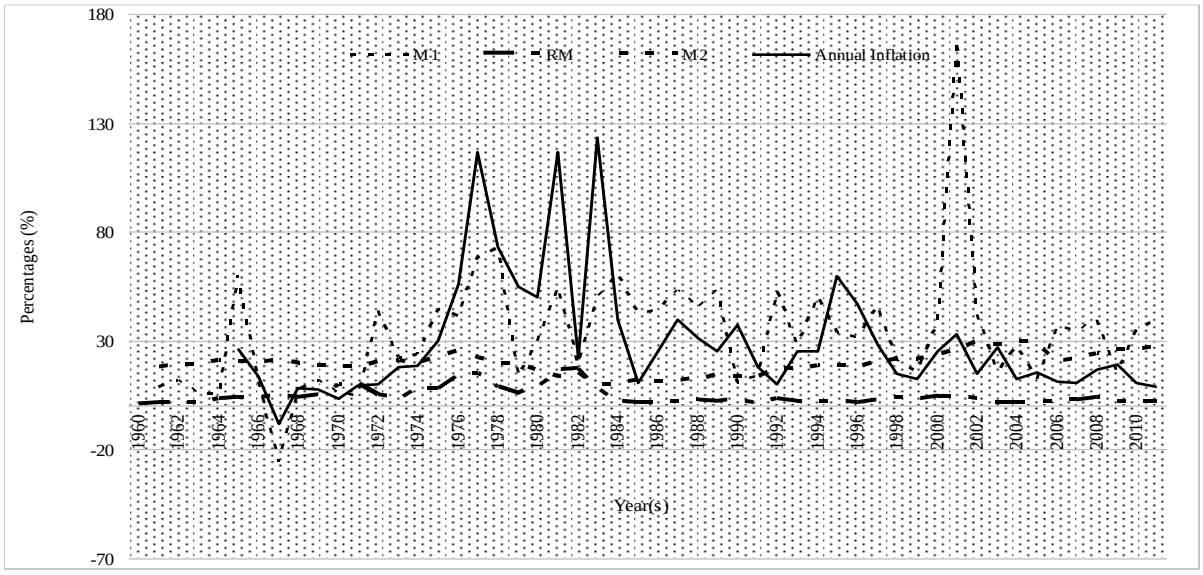


Figure 3: Growth of Money Aggregates and Annual Inflation (1960 to 2011)
Source: Bank of Ghana (1960-2011)

Nevertheless, McKinnon-Shaw (1973) postulates that financial liberalisation should equally lead to an increase in savings and investments, and hence economic growth levels. The average GDP in percentage terms in the pre-financial sector reforms between 1961 and 1989 was 1.9 percent. The pre-financial liberalisation epoch was also characterised with spells of economic contraction. GDP declined to negative 12.4 percent in 1975, increased to 8.5 percent in 1978 but decline yet again to negative 4.6 percent in 1983. However, average GDP in the post-financial reforms epoch increased almost three-fold to 5.7 percent. Since 1993, the

economy of Ghana has been growing by year-year average of 4 percent but peaked at 14.4 percent as a consequence of financial liberalisation policies over the period. However, taking into account domestic savings it is obvious that, the increase in GDP is not the result of domestic savings per se but borrowing from the international organisations and other donor countries which was 33 percent in 2007 (Hausmann, Zahidi, Tyson, Hausmann, Schwab and Tyson 2009).

In comparable with the flow of foreign direct investments (FDI) into the economy, from **Table 2**, it is observed that FDI increased from a shear average of $21.5 pre-financial reforms to an average of $1145.6m during the period of financial liberalisation. The increase in FDI could be attributed to- a reduction in the country's risk premium as an outcome of the relatively macro-economic stability amid the flexible exchange rate regime subsequent to the implementation of FINSAP[5]. Thus as the financial sector reform continue, the credibility of the country at the global stage improved thereby affecting the risk premium leading to an increase in FDI over the period.

Related to this is the increase in the country's reserve accumulation over the period. Prior to the implementation of financial liberalisation, the stock of total reserves (minus gold) was $347.3m in 1989 but increased substantially to $5367.5m in 2012. The substantial increase in the foreign exchange reserves has implications for the balance sheets of the regulator (BoG), the banking system and the private sector of the local economy. Therefore the major shifts in balance sheet variables of the central bank can eventually have substantial macroeconomic effects but overall it depend on how the associated risk exposures in the accumulation of reserves are managed and how the interventionist mechanisms are financed. Potential set of economic consequences include the high costs of intervention, unsustainable increases in credit and asset prices, and an increasingly inefficient banking system in Ghana. The balance sheet effects of the central bank might reduce the effectiveness of sterilisation with potential inflationary consequences that the economy experienced over the period. Such difficulties can lead to increasing reserve requirements which effectively tax the banking system thereby encouraging financial disintermediation, while direct controls compromise the

[5] Financial Institutions Sector Adjustment Programs (FINSAP) 1, 2 and 3 in collaboration with the World Bank and IMF had been launched in Ghana since 1987.

efficiency of resource allocation across the multi-production sectors of the local economy. According to Classical economists', the degree of financial deepening through saving and investment activities promote the level of income and raises the rates of economic growth. Financial deepening measured by ratios of capital stock to GDP before the enactment of financial reforms in 1989 averaged at almost 20 percent but increased by 5 percentage points to 25 percent in the post financial liberalisation era (**see Table 2**).

Table 2: Selected Financial Deepening Indicators for the Ghanaian Economy (1961 to 2012)

	Pre-financial reforms					**Post-financial reforms**					
	(1961 to 1982)					**(1983 to 2012)**					
	GDP	***π***	***FD***	***FDI***	***TBAL***	***GDP***	***π***	***FD***	***MK***	***FDI***	***TBAL***
	(%)	***(%)***	***(%)***	***($'m)***	***($'m)***	***(%)***	***(%)***	***(%)***	***(%)***	***($'m)***	***($'m)***
Average	1.9	37.2	19.6	21.5	**-69.9**	5.7	21.9	25.1	13.7	1145.6	**-1837.4**
Deviation	5.1	36.8	4.4	59.2	**101.5**	2.7	12.7	5.7	8.6	889.6	**1577.3**
Min	-12.4	-8.4	11.3	-15.8	**-331.1**	3.3	8.7	14.1	1.2	2020.1	**-555.0**
Max	9.7	122.9	29.1	20.1	**124.6**	14.4	59.5	34.1	34.3	2651.9	**-399.2**

GDP (%) = annual GDP growth rate; π = annual CPI headline inflation, FD = financial deepening measured by the ratio of financial assets/ % of GDP; FDI = foreign direct investments and TBAL = trade balance (exports less imports in US dollars); MK = market capitalisation

Source: Author's calculation using World Bank's African Development Indicators (2012) and IMF International Financial Statistics (2012)

1.1.3 Prospects and Challenges of Offshore Banking: The Ghanaian Context

The interconnectedness of the global market is increasingly becoming a more important conduit for the transfer of capital across countries. The BoG is committed for the Ghanaian economy to become the premier supermarket for financial activities offering a wide range of offshore financial products specializing in insurance and leasing in the Sub-Saharan African region. Thus, against this backdrop the Parliament of Ghana passed the Banking Amendment Act 2007 (Act 738) an amendment to the banking Act of 2004 (Act 673) paving the way to establishing offshore banking in Ghana, thereby increasing financial depth. Consequently, the International Financial Services Centre (IFSC) is regarded as a critical part of Ghana's financial sector development strategy (BoG, 2008). It is anticipated that, IFSC would link the financial sector to huge volumes of cross border transactions in global financial markets. In June 1999, 50 percent of cross-border assets (US$4,600 billion) were from offshore banking activity, of which US$900 billion is in the Caribbean, US$1,000 billion in Asia and the remaining US$2,700 billion accounted for by other International Financial Centres (IFCs).

Even though International Financial Services Centres have captured a significant proportion of global capital transfers (flows) there is no clear definition of the term 'offshore banking'. However three distinctive characteristics are used to define offshore banking namely the primary orientation of business toward non-residents, the favourable regulatory environmental framework and the low-or-zero local tax schemes Zoromé (2007). Typically, an offshore bank accepts depositor funds from non-residents in the local economy benefiting from low tax jurisdiction.

Notable economic gains that the Ghanaian economy could reap include increase in the depth of the domestic financial sector as a result of direct linkages, employment creation, increase in tax revenue, increase in foreign direct investment and contribution to the development of human capital in terms of accountants, tax consultants among other related jobs. That said, a fundamental benefit in offshore banking is the attraction of foreign deposits in foreign currencies which could be channelled to private sector lending thereby generating employment and wealth creation. However, operations from offshore banking played critical roles in the recent financial crises in Latin America and Asia (Errico and Musalem 1999). Offshore banking activities were used as alternatives to domestic financial institutions that were often subject to strict regulations-due to absence of effectual supervision. The lack of

effective technical capability possesses a huge challenge when regulatory arbitrage is assessed to transfer assets and liabilities between offshore establishments and parent banks onshore. These offshore banking activities are well noted in cases of Bank of Credit and Commerce International (BCCI) in 1991 and Meridian International Bank in 1995. The lack of prudent regulatory framework or thereof posse's scary vulnerabilities to the Ghanaian financial market and the global market at large at least depending on the size and share of offshore banking in Ghana. Lastly, undetected and unaccounted offshore banking activities in Ghana could increase liquidity exposures, foreign exchange and credit risks.

1.1.4 Remaining Challenges in Ghana's Financial System

Since early 1980s, Ghana began to implement financial sector reforms as part of broader market oriented reforms. The key objective of its financial reforms was to build more efficient, robust and deeper financial markets in the local economy. Notwithstanding its recent achievements in central bank independence, improved competition (e.g. increase in the number of foreign banks), stronger balance sheets and capital base as well as ongoing capital account liberalization, there still remain significant challenges in the financial sector reform program.

Firstly, the liberalization of the financial system is still characterized with high intermediation margins and low availability of credit which makes it difficult to support the growth of the private sector which is noted as the engine for growth in the Ghanaian economy. The intermediation margin as measured by the difference between deposit and lending rates provides disincentive for both savings and lending, as it depresses the returns for savers and increases lending rates to borrowers. A high interest margin is also a reflective of inefficiencies in the financial system (Bernanke 1983). Whereas high interest margins can contribute to the strengthening of Ghana's banking system including improving the capital bases of banks (Barajas et al. 1998; Saunders and Schumacher, 2000). However, high intermediation margins discourages potential savers which impacts negatively on credit expansion as a result of higher loan rates.

Second, banks in Ghana tended to be small and fragile. The size of the Ghanaian banking system is smaller than a mid-sized EU bank, with total assets less than US$ 2 billion. Related

to this is the absence of scale economies and the very high risks as a consequence of underdeveloped contractual frameworks and socio-economic volatility driving up banking costs which eventually reduce time horizons equally for investor and borrowers. Related to the small size is low productivity amid skill shortages which mostly prevents banks from exploiting scale economies.

Thirdly, banks in Ghana serve only about 10 percent of the bankable population of 26 million. Also, given that large parts of the Ghanaian population live and work in the informal sector, the high documentation requirements such as passport, pay slip, and utility bill represent significant barriers in opening bank account. These banking costs make outreach to potential savers and borrowers who need small transactions commercially not viable. The daunting challenge is how to narrow the wider spread where most of the bank customers operate to levels that will equally promote savings and enhance the entrepreneurship drive of the local economy. Microfinance institutions in the economy are gradually providing some financial services to rural enchantment areas but microfinance institutions are not well resourced.

Fourthly, the Ghana Stock Market (GSE) is small and illiquid relative to Sub-Saharan African economies (developing only), Middle Income countries and at worse with OECD member countries and South Africa. The actual float of the listed companies on the GSE is low and dominated by financial institutions. The low transaction volume in both primary and secondary markets is self-enforcing and it effectively deters new issuers. Corporate bond issues have also been highly concentrated in the banking sector. This necessitates the need for capital market development but given that the necessary legal and regulatory conditions are not adequate, it would be rather premature. Most importantly, the small open Ghanaian economy has an increasingly difficult time supporting liquid stock market in a global marketplace, independent of its income level-this is because stock markets are subject to scale and network economies. That said, in recent times, there have been large initial public offerings (IPOs) in Ghana stock market but it is unlikely that these advances will make capital markets sustainable. Attempts at establishing Ghana capital market as the premier supermarket for financial activities offering a wide range of offshore financial products such as insurance and leasing have been less successful than expected.

Finally, the government can take an active role in addressing market failures by establishing strong and independent market regulators for example the Financial Conduct Authority in the

UK. It must also pass legislation to protect consumers from predatory practises as well as improving on current pension and insurance systems.

1.1.5 Aims and Research Objectives

This dissertation argues that financial sector reforms are prerequisites for economic development and economic growth in the attainment of an efficient banking system. The main objective of this study is to consider to what extent inappropriate financial sector policies can be a major impediment to the development of an efficient banking system in Ghana in sub-Sahara Africa. Particularly key questions addressed in this dissertation are devised as follows:

a. how have financial sector reforms impacted on the evolution of market concentration and competition in the Ghanaian banking market?
b. how have financial sector policies impacted on the allocation of funds across sectors in Ghana?
c. are there any efficiency and redistribution impacts of liberalization of the financial sector in Ghana?
d. what are the welfare effects of the financial sector reforms in Ghana?

The above stated questions are relevant for economic policy analyses in view of the prominence that financial liberalisation policies have assumed in the economic stabilisation policies of developed and developing economies. In contrast to financial reforms and bank related studies, we use both applied general equilibrium and econometric models to determine nature and extent of financial and economic sector policies of Ghana and here then make recommendations for an efficient banking system in Ghana.

1.1.6 Theoretical Framework

The first objective examine empirically the evolution of market concentration and tests market competitiveness in Ghana's financial system as a consequence of ongoing financial sector reforms. In line with Molyneux and Nguyen-Linh (2008) it examined bank concentration in Ghana. It further tests the degree of competition in the context of the Panzar and Rosse (1987) model using the intermediation approach which considers loans as outputs and interprets bank deposits as key input factor.

As far as the second objective is concerned, the conceptual framework to understand the impact of a change in the final demand of the banking sector on the multi-sectors of the Ghanaian economy is based on flow of goods and services among the wider economy developed by Leontief (1986). A model of the interconnectedness of the various sectors with banking sector in the economy based on complex series of transactions is used to understand the impact of the banking sector on the other multi-sectors of the Ghanaian.

The last two objectives is based on the theoretical foundation of the effect of financial sector reforms on financial intermediation cost as measured by interest rate spread postulated by McKinnon and Shaw (1973). Financial liberalisation and deregulation ought to culminate in lowering transaction costs which has positive effects on savings, investment and growth levels. We model the real side and the financial side of the Ghanaian economy in a standard CGE comparative static framework. The model is an addition to the literature since previous CGE models for the Ghanaian economy did not consider the real and financial side of the economy. We explicitly model the financial sector by incorporating the financial intermediation cost charged by the banking system in a multi-sector comparative static behaviour framework which allows us to study the economic wide impacts of financial sector policies in Ghana. Efficiency and redistribution issues of financial liberalisation policies in Ghana are further highlighted within the financial CGE model.

1.1.7 Methodologies

Methodologies applied in this dissertation rely mostly on quantitative analyses and diagrammatic representation to construct aggregate level models. Such models correspond to reviews of macroeconomic theory that are expressed in text and surveys for example Begg, Dornbusch and Fisher (1991), Taylor and Lucio (2002) among others. But, aggregate macroeconomic models do not have the theoretical microeconomic firmness of the small analytical models, but can all the same provide critical insights into particular economic problems or issues thereof (Fisher and Whitley 2000).

In order to address the first part of the initial objective i.e. to investigate the evolution of market concentration following financial liberalisation and deregulation in Ghana, the study uses two concentration measures namely the Hirschman-Herfindahl indices and the three and

five bank concentration ratios. Following competition literature in banking systems, the evolution of the structure of the Ghanaian banking market is best captured by the aforementioned concentration indices.

The second part of the initial objective, i.e. to tests the competitiveness of the interest based market and the total market, a model on the revenue elasticity to input developed by Panzar-Rosse (1987) model is assessed. It takes account of individual firm data and allow for bank-specific differences in production functions. Besides, the revenue test is cemented on a reduced form revenue equation relating to gross revenues to a vector of input prices and other firm-specific variables. Given that financial intermediation is the core business of universal banks in Ghana, the interest based market model uses the ratio of interest income to total assets of an individual bank as the dependent variable. The independent variables which is symptomatic of the factor input prices are represented with ratio of total interest expenses to total deposits, the ratio of wages expenses to total deposits and loans and the price of physical capital expenditure and other fixed assets relating to expenses. Bank specific control variables is indicative of the ratio of total loans and advances to total assets and the ratio of non-performing loans to total loans outstanding over the period. The inclusion of annual inflation rates is indicative of the macroeconomic risk in the local economy. The total market model is specified with total revenue of banks as the dependent variables with the same aforementioned independent variables. As a consequence of the characteristics of the Ghanaian banking system in terms of supervisory capacity and macroeconomic environment, the set of equations aforementioned are computed with a fixed effect panel regression.

The second objective is to explore the effect of financial sector reforms on the allocation of funds when there is a change in the final demand of the financial intermediation sector. We use applied Leontief (1949) input-output modelling techniques to access the inter-production linkages amidst the banking and the real sector of Ghana's economy. The share of GDP, the value-added shares in terms of capital and labour contribution and the total and final demand for each of the 15 multi-sector is computed. In examining the impact of a change in the final demand of the financial intermediation sector on output, employment, revenue and capital formation, the simultaneous Leontief inverse is used.

The third objective is to assess the economy wide impacts of financial sector policies in Ghana in a computerised general equilibrium (CGE) framework. CGE is a modeling technique that attempt to use the theory of general equilibrium[6] as an operational tool to analyze issues of resource allocation, income distribution and economic policies in market economies. Besides, CGE imbue the probable economic effects of shocks to an economy can be best studied for policy analysis. Moreover, CGE is distinct from partial equilibrium and econometric modeling due to its ability to permeate the examination of the repercussions of shocks on multi-production sectors and not just on single or particular sector or actors. Furthermore, the CGE framework is characterized with more microeconomic behavior, allowing for greater level of disaggregation of the supply side (i.e. production activities and factors of production) and demand side (i.e. different types of households which is separate from their relationships to the factors of production in the given economy).

The CGE technique is therefore applied in this chapter due to: Firstly, its ability to trace the effects of policy and external shocks throughout the Ghanaian economy. Secondly, modeling the real sector with the financial system of the economy will allow the quantitative impacts of the real-financial linkages and transmission mechanisms to be known. This is deemed to be equally significant and appropriate given the effects that the financial sector policies and economic reforms has had on the local Ghanaian economy since the implementation of financial deregulations and liberalization in 1989.

Thirdly, the CGE techniques is the most appropriate technique for analysing impacts of inter-sectoral variation in transaction cost (i.e. the difference between lending and deposit interest rate) and the effects of financial sector reforms in an economy. Finally, even though CGE is the ideal tool for the study of economy wide policies in terms of trade, exchange rate, tax, financial reforms and the analysis of alternative policy measures, there is no literature in Ghana that has explicitly modelled the Ghanaian banking sector with the real side of Ghana's economy to assess the economic wide impacts of financial sector reforms. We explicitly model the Ghanaian banking sector with the real side of Ghana's economy in a standard computerised general equilibrium framework. Econometric models such as endogenous

[6] General equilibrium theory indicates that markets in real world economies are mutually interdependent. Debreu (1959) witnessed that factors and mechanisms determine relative prices and the allocation of resources within as well as between markets.

growth models and neoclassical models are used to examine the association between financial development and economic growth in developed and developing economies. In order to link financial transactions with current transactions, our study is based on Barro and Gordon 1983, Harris and Robinson 2002, Bhattarai 2008) who have brought financial issues in the computerised general equilibrium framework. The last objective is on the welfare effects as a consequence of financial liberalization in Ghana over the period. Hicksian equivalent variations (EV) and compensating variations (CV) are computed to assess the impacts of the financial sector reforms on the economy.

1.1.8 Data Sources

The data required for the study is derived from secondary sources. Firstly, bank level panel data relating to universal banks in Ghana is obtained from individual bank's annual report and Bank of Ghana annual reports for the sampled period of nine years from 2003 to 2012.

Secondly, quantitative data is retrieved from current Ghana Social Accounting Matrix (2005) from the International Food Policy Research Institute (IFPRI). The SAM data is updated to include the banking sector which is salient in the current SAM using Ghana Statistical Services (2012) data. Thirdly, using cross entropy techniques, we develop a Financial Accounting Matrix (FAM) (2012) for Ghana which is indicative of the role of financial intermediaries or banks in the local economy. To develop and compute Ghana FAM (2012), data on financial transactions is obtained from Bank of Ghana (2012), Ghana Statistical Services (2012), International Monetary Fund (2013), and Ministry of Finance and Economic Planning (2013).

1.1.9 Significance of the Study

This study on the impact of the efficiency of the banking sector on output, investment, employment, prices and welfare of the five-households in Ghana differs from earlier studies due to the following:

First, previous studies on the financial sector reforms in Ghana (Asamoah 2011) have discussed about the effect of financial sector reforms on savings, interest rates, investment and GDP in a simple macroeconomic model of savings and investments. But a few studies (Aryeetey 1994, Antwi-Asare and Addison 2000) have briefly looked at the influence of financial liberalisation reforms on the performance of the Ghanaian banking sector. The

enactments of Banking Laws have culminated in more discipline relative to the pre-financial reform era. The post-reform era continue to witness considerable profits from investments in government securities and Bank of Ghana securities.

Yet these studies have not made a thorough analysis on the impact of a change in the final demand of the banking sector on the multi-sectors of the Ghanaian economy in the post-reform era, which would be more appropriate and useful for any policy initiatives. This is because; the deficiency in production of the banking sector could become the limiting factor for the growth of other sectors. Preceding this investigation, the inter-sector linkages between the multi-sectors in Ghana is assessed and analysed in the input-output framework. The sector contribution or share of GDP, the value added shares with regards to capital and labour contribution as well as the total and final demand for each sector of Ghana's economy is computed. Further, the Leontief inverse is used to measure the impact of a change in the final demand of the banking sector on output, employment, and revenue and capital formation accruing from the multi-sectors of the economy.

Most significantly, standard economic theory alone cannot be used to determine: the impact of the banking sector on the other multi-sector of an economy and the magnitude of changes in the volume of savings and investments as a consequence of the on-going financial sector reforms in Ghana. This is because, macroeconomic theory and input-output analysis does not take into account the rational behaviour of economic agents left alone the inter-sector consistency of the economic dynamics of the Ghanaian economy. But, a computable general equilibrium (CGE) anchored in the theoretical foundations of microeconomic theory takes into account greater inter-sector consistency. Also, the behaviour of economic agents is a function of the present and future economic environ in which those agents operates as cemented in macroeconomics analysis principles. The welfare benefits of households after financial sector reforms can be measured quantitatively with CGE modelling.

Additionally, CGE models explicitly take into account the optimizing behaviours of consumers subject to budget constraints and of producers subject to technology constraints. Despite the criticisms levelled on the accurate predictions of applied general equilibrium, 'the performance of CGE models is better than expected' Kim and Kim (2002) albeit comparative static or dynamic. Although CGE technique is becoming commonplace, there are relatively few general equilibrium models on sub-Saharan African (SSA) countries, even though these

are the countries in the greatest need Senbet and Otchere, 2006, Aryeetey 2008, Powell and Round 2000). Notable CGE studies in Ghana by Bhattarai and Okyere (2005) have discussed the general economic policies and the welfare gains of tax. Possible effects of policy on poverty of a range of revenue neutral redistributive polices in Ghana in a SAM-Based CGE model (Diao, Hazell and Thurlow, 2010 and Osei and Quartey, 2005). However, none of the CGE modelling exercise has considered the impact of financial sector reforms on the efficiency of the banking sector and its impacts on the multi-sector of Ghana's economy. Likewise the welfare benefit of the financial sector reforms is yet to be investigated in the Ghanaian economy.

This current study show using an analytical form of CGE model by including the financial sector in the real-side of Ghana's economy is determined using consumer preferences for consumption, constant elasticity of substitution production function, and share of shift parameters. This is extended to a 15 sector with the financial sector in the real-side of Ghana's economy. Existing Ghana SAM (2005) data inherently has the financial sector in the business and services sector. To permeate quantifiable benefits of Ghana financial sectors, though challenging it becomes necessary to update the current SAM with the financial sector in the real side of the economy of Ghana. RAS methods and assumptions are used to update the existing data (Ghana SAM). Supporting data was sourced from variety of sources including Ghana Living Standards, Ghana National Accounts, International Trade Accounts and International Food Policy Research. To link the real side and the financial sector of Ghana economy, we construct a Financial Accounting Matrix (2012) using Ghana Current Account (2012), Capital Account (2012), International Trade Balance (2012) and the updated Ghana SAM (2012). Linking Ghana Sam (2012) and Ghana FAM (2012) provides the financial transactions between households, government, banking and the rest of the world. This provides the benchmark data set for the calibration of parameters on production, consumption, trade, foreign sector and the financial intermediation blocks of the comparative static CGE model for Ghana economy 2012.

Whilst filling such vacuum of the financial sector in the real-side of Ghana's economy in terms of data updates, the vital contribution of this study is that it is a pioneering exercise since this is the first academic exercise that considers the financial sector in the standard real-side CGE modelling in Ghana. The performance of the Ghana's financial sector is relevant

from the point of view of the economic-growth literature which suggests that a better-functioning financial sector strengthens capital formation, savings, safety and soundness as well as sustaining economic growth and development in a given economy, here-in Ghana. That said it will provide a point of departure for further assessment of financial sector reforms in Ghana's financial system based on more complex formulations in a forward-looking computable general equilibrium models in differing time horizons.

Last but not the least, this study contributes to the on-going debate on finance and economic policies spearheaded by the World Bank, Bank for International Settlement (BIS), European Central Bank (ECB) and the International Monetary Fund (IMF) for emerging economies particularly sub-Saharan African economies. Being an academic reference material it will help inform and shape the academic understanding of students' (undergraduate and postgraduate) and researchers. This will add to the existing stock of literature on emerging economies in sub-Sahara Africa particularly Ghana. Ghana is seen by World Bank, BIS, ECB and the IMF as one of the success stories with respect to financial sector reforms.

1.1.10 Organisation of the Thesis

The thesis is schemed into 6 chapters including this introductory chapter.

Chapter 1 introduces the reader to the subject matter of the thesis and its background, especially the significance of intermediation cost of the banking sector for financial deepening and economic development. It suggests that, high intermediation cost is symptomatic of inefficiency in the Ghanaian banking market. A subsequent historical review of the financial sector reforms is also discussed. It further highlights the objectives of the study, the significance of the study, the theoretical framework of the study, methodologies and data sources.

Chapter 2 presents a review of the available literature in the area of financial deepening and economic growth. The review is discussed under three different aspects viz., (a) literature on modelling the financial sector in a one-sector framework (b) literature on modelling the financial sector in multidimensional framework (c) studies on financial intermediation in sub-Saharan Africa with particular focus on Ghana. The general body of literature suggests a link between the financial system and the rest of the economy.

Chapter 3 accesses the performance of the Ghanaian banking sector for the period between 2003 and 2012 which is a period characterised with deregulation, liberalisation and consolidation of the sector. It empirically examines the evolution of market concentration in terms of concentration and Herfindahl-Hirschman indices, to explain the cause for the changing market structure in the Ghanaian banking sector as a consequence of ongoing financial sector reforms. The chapter further analyses market competition across the banking sector and test the observed competition using the Panzar-Rosse (1987) approach to banking competition. The analyses of market concentration and competition uses panel bank level data i.e. secondary sources.

Chapter 4 is on the interrelationships between the financial intermediation sector and the real sector during the process of financial development and growth. It first attempts to appreciate the inter-production linkages accompanied by the banking and the real sector of the local economy in a standard Leontief (1949) input-output framework. Further, share of GDP, the value-added shares with regards to capital and labour contribution and the total and final demand for each of the 15 multi-production sectors is computed. Input-output forward and backward impacts of financial sector policies on aggregate economic activities including output, capital stock and employment is considered. The chapter also shows the process in updating or construction of an input-output table for the Ghanaian economy.

Chapter 5 developed a prototype analytical endogenous growth model with transaction cost as a motivation for the comparative static financial CGE model in Section 5.1.2. Transaction cost is measured by the difference between deposit and lending interest rate. Existing literature indicate that increasing savings rate increases steady-state levels of capital and per capita output, implying that the elimination of financial repression generates additional capital stock. With financial deepening, increase in the proportion of savings is channelled to investments, which in turn increases the marginal productivity of capital by allocating funds to the highest marginal product of capital in the capital market, hence economic growth. How Ghanaian banks adjust to lending rates to changes in market interest rates in lieu with bank mark-up is accessed. The chapter shows that the more uncertain Ghanaian banks are with regards to future developments of markets rates in general, the likelihood of leaving lending rates unchanged for longer spells. Thus, banks may delay their response due to cost of adjustments as they prefer to change their lending rates less frequently.

Section 5.1.2 builds on the previous chapters and presents details of a comparative static CGE model of Ghana suitable for analysing financial sector reforms. It relates demand and supplies of financial assets as a consequence of savings of households, investments, government budgets and balance of payments. The real and the financial sector are linked through the flow of funds, banking intermediation cost as measured by interest rate spread and the fiscal policy instrument of the regulator . The model is calibrated to an updated micro consistent data Ghana SAM (2012) and a constructed Ghana FAM (2012) with model parameters, elasticities of production and consumption functions augmented with equilibrium conditions and model closures. The financial CGE model is used to analyse the economic wide impacts of financial liberalisation on the multi-production sectors of the Ghanaian economy under various policy scenarios. The redistribution and welfare impact of financial sector reforms is also analysed.

Chapter 6 presents the summary of the study with main focus on findings and conclusions based on the objectives of the dissertation. Further, the study gives the reader a list of policy suggestions that can improve upon financial intermediation and hence growth rates in Ghana.

2 CHAPTER: FINANCE AND GROWTH: THEORETICAL AND EMPRIRCAL LITERATURE

2 CHAPTER: FINANCE AND GROWTH: THEORETICAL AND EMPRIRCAL LITERATURE

Abstract

This is a literature review chapter on financial deepening and economic growth. It focuses on few models and traces the development of concepts over the years and contrast old theories in terms of partial equilibrium framework and new theories in terms of computerised general equilibrium (CGE) framework and their strengths and remaining challenges. It also reviews developments in econometrics and CGE models in Ghana.

2.1.1 INTRODUCTION

The relationship between financial systems and economic development received considerable attention in the growth literature of the 2008/2009 financial crisis. Albeit the intensity in the transmission of shocks between financial systems and the real sector vary overtime across economies, '…no matter how different the latest financial crisis or crises always appears, there are usually remarkable similarities with past experiences from other economies and from history' (Reinhart and Rogoff 2009 p. 36). Despite the fact that many significant contributions (for example, Goldsmith, Blakelv Bornstein, Campt and Mueller 1969, McKinnon and Shaw 1973) offered prudent arguments augmented with evidence for the role of finance in promoting long-run growth, these models did not establish the direction, timing and relative strength of causal links. Issues on the statistical significance of the effect of the financial system on growth were established by King and Levine (1993).

Besides, the causal inference between finance and growth is restricted to the observation that economies with greater financial depth tends to grow faster than those with relatively lower level of financial activity. Whereas, time series analysis of individual economies finds only bidirectional causality between financial sector reforms and the real economy, a computerised general equilibrium (CGE) analysis finds multidirectional causality. It seems that CGE is the most appropriate technique for analysing impacts of inter-sectoral variation in transaction cost (i.e. the difference between lending and deposit interest rate) and the effects of financial sector reforms in an economy albeit developed and developing economies.

The financial intermediation and economic growth literature is vast, therefore for concentration, this chapter is organized in four sections. Section 2.1.2 distillates on the theoretical developments to financial developments and economic growth in a single-sector framework for policy analysis. *It is centred on the role of finance in growth and financial development and econometric studies of the finance-growth hypothesis.* Section 2.1.3 is on the empirical literature on finance and growth in a single-sector framework. It also includes recent literature on econometric models for the local Ghanaian economy. Section 2.1.4 deliberates on multidimensional CGE models, with particular focus on financial CGE models. Section 2.1.4.1 considers the existing literature on CGE models for the local Ghanaian economy. Lastly, Section 2.1.4.2 discusses the strengths and limitations of the CGE modelling techniques in economic policy analysis.

2.1.2 Modelling the Financial Sector in a Single-Sector Framework

2.1.2.1 Role of Finance in Growth and Development

In the literature there exist disagreement about the role of finance in economic growth and development in terms of supply-leading hypothesis relative to demand-leading hypothesis. According to Bagehot (1873), finance facilitates capital formulation and manage risks that are inherent in particular investment projects during England's industrialisation[7]. This implies that during the industrialisation in England, investors and managers had adequate information about firms together with existing market conditions of the British economy. In the view of Schumpeter (1911), credit supply by financial intermediaries particularly banks was a determinant factor for growth in the periods of industrialisation by facilitating funding for innovative and productive projects. From this theoretical background, the entrepreneur who embodies new innovative techniques requires bank credit provided by the intermediation function of financial systems. Thus financial systems reallocate resources to the most industrious projects in the economy by 'granting credit in this sense operates as an order on the economic system to accommodate itself to the purposes of the entrepreneur, as an order on the goods which he needs: it means entrusting him with productive forces. It is only thus that economic development could arise from the mere circular flow in perfect equilibrium'

[7] The industrialisation in England is usually termed as the 'the industrial revolution'. It is the period characterised with the transition to new manufacturing techniques from manual (hand) production to machinery that changed the face of the British economy evermore.

(Schumpeter 1911). In contrast the conjecture that resources are mysteriously allocated to productive investment projects is not realistic since financial intermediaries has the challenging task of mitigating information and transaction costs. Despite this, economies with advanced financial systems (usually measured by the size of the country's financial system) tend to grow faster than those with underdeveloped financial systems particularly in Sub-Saharan African and emerging Asian economies.

Keynes (1936) model attached partial importance to the role of the financial sector on the premise of an efficient and perfect money market. Related to the equilibrium condition of the money market to the general equilibrium in the entire economy. It could be inferred from Keynes (1936) model that, in the absence of financial intermediaries there would be constraints on savings to investments which may depress the rate of growth in output, income, capital and labour in the economy. This implies that a change in the final demand of the financial sector may affect the multi-production sector of the economy.

Similarly, Patrick (1966) contends that the development of a robust financial sector can foster economic growth. The policy implication is that the creation of financial systems coupled with financial services well in advance of their respective demand will drive the real sector along the growth path through the transfer of scarce resources from surplus saving units to deficit spending units with respect to the highest rates of return on investment. It followed that the role of financial intermediation in the process of economic growth and development is a critical factor (Goldsmith et al 1969, Hicks 1969). Economic growth is enhanced by the accumulation of domestic capital when a proportion of income is reinvested in the local economy. In the interplay of the different channels of transmission process, financial intermediation involving lenders and borrowers, financial superstructure accelerates economic growth and enhances economic performance. Additionally, the creation of financial institutions results in the introduction of financial instruments and a range of financial assets which is a vital input in the production process. The theoretically attributes is that, there is a positive association between financial developments and the level of real per capita GNP as a consequence of encouraging the more efficient use of capital stock. Thus '*irrespective of whether or not the existence and development of a financial superstructure increases the aggregate volume of savings and investments and thus accelerates the rate of economic growth beyond what would have otherwise been, there is no doubt that it results in*

a different allocation of capital expenditures among and within sectors, types of tangible, and regions (Goldsmith et al 1969 p. 398).

McKinnon-Shaw (1973) extended the above finance-led theories by noting that financial deepening does not imply singularly higher productivity of capital but it also results in higher savings rates and hence higher volume of investment. In contrast to Goldsmith (1969) where growth and financial intermediation are mutually thought as endogenous, McKinnon-Shaw (1973) focal point is the effect of economic policies that retard financial deepening. In that regard, the deleterious effect of financial repression on economic growth was developed in a theoretical model with debt intermediation. The authors emphasized that; debt intermediation operates in perfect and competitive financial markets with respect to Walrasian equilibrium conditions. It follows that households firms and other small enterprises in developing economies are faced with significant capital indivisibilities and have less access to domestic credit provided by the banking sector. The consequence of which is that, firms in developing economies are forced to accumulate substantial amount of non-capital assets prior to undertaking productive investments. Typically most of the investment projects are financed in part with own capital and in part with debt. Besides financial intermediaries have the capacity to raise the real returns to savers and equally lower the real cost to investors by way of accommodating liquidity preferences, reducing risk through diversification, increasing operational efficiency and lowering information costs (Fry 1995 p.28).

Furthermore McKinnon-Shaw (1973) advocates that, the imposition of governmental restrictions on the banking system policies for example interest rate ceiling, high reserve requirements as well as directed credit overtime slows down financial sector developments and in so doing declines economic output. Thus, the presence of financial repression distorts the dynamics, the efficiency and competitiveness of the banking system. The consequence of financial repressions is that negative real interest rates reduce the incentive of households to save-and in turn lower savings and decrease the volume of available funds for investments. Besides, the remaining funds might not be efficiently distributed thereby lowering investment and productivity and eventually slowing down economic growth rates. The policy expectation is that interest rate reforms coupled with low inflation can promote capital accumulation and economic growth in developing economies.

In contrast to the supply-led growth theories, demand-following authors asserts that an expanding economy culminate in the demand for financial services including the provision of credits to households. Therefore, as an economy grows further financial institutions, financial products and services emerge in the financial system and respond automatically to the increase in demand for financial services albeit commercial or investment banking services (Robinson 1952 p. 86). He profoundly concludes that '*where enterprise leads' finance follows'*. The implication of Robinson (1952) assertion is that financial and monetary systems per se do not exhibit long-run relationship with economic growth. He concludes that, finance is *'demand following'* relative to leading economic growth. Therefore in an expanding economy, the demand for finance leads to the emergence of new financial institutions, services as well as products and a deepening financial system (Ang 2008 p. 540). From this viewpoint, finance does not foster economic growth but finance responds to the changing demands from the real-side of the economy. At the other extreme, Ireland (1994) and Singh (1997) argues that short-term developments in the financial sector may impede the growth process.

Besides Lucas (1988 p.6) expresses reservations about the significant role of finance in economic development. He emphasized that the capacity of finance is *'badly overstressed'* and that financial systems does not seem to have a sizeable impact on the growth process. He assume that total factor productivity are determined exogenously implying that economic growth is not related to the financial system. This is due to the law of diminishing return to capital implying that financial variable has effect on the level of income but not the growth of income. Other notable development economists including Stern (1991) and Chandavarkar (1992) do not even discuss the existence of the financial sector.

2.1.2.2 Economic Functions of Financial Intermediaries

To enhance market frictions including costs of acquiring information and enforcing contracts, financial intermediaries has influenced the allocation of resources throughout history (Merton and Bodie 1995 p. 12). Concerning the allocation of credit for investors, the emergence of banks tends to improve upon the acquisition of information in terms of firms and managers. Similarly, developments in money and capital markets arise to improve upon the liquidity of markets which increase the mobilisation of savings and efficiency in credit allocation.

In particular, Levine (1997, 1999 and 2005) suggests a functional approach in understanding the economic functions of the financial sector in attaining economic growth. These economic functions include savings mobilisation, allocating capital, monitoring of managers, facilitating the trading of risk, and the easing of trading goods, services as well as enforcing contracts. Financial developments therefore arise to provide quality financial services in reducing the effects of asymmetry information and transaction costs. 'Financial developments involves improvements in the (a) production of ex ante information, (b) monitoring of investments, (c) trading and diversification and management of risks, (d) mobilization and pooling of savings, and (e) exchange of goods and services (Levine 2005 p. 870). From this perspective, reducing the cost of financial intermediation of financial intermediaries tend to result in an increase in the amount of investment as the cost of borrowing is reduced, and hence economic growth. Similarly, savings mobilisation involves: overcoming the transaction costs of collecting savings from bank depositing individuals and overcoming information asymmetries. The implication is that banks play a significant role in making credit available for investments through the mobilisation of funds and allocating of such funds for productive investments. This process culminates in capital accumulation, productivity and hence economic growth (Bencivenga and Smith 1991).

Nevertheless, the negative effect of stock markets on growth rates is higher than banks in developing economies (Boyd and Smith 1998, Huybens and Smith 1999, Rousseau and Wachhtel 2000, Levine 2002, Demirguc-Kunt and Levine 2004, Bekaert, Harvey, Campbell and Lundblad 2005, Masoud and Hardaker 2012). For example Singh (1991) is of the view that, stock market volatility, deterrence of risk-averse savers and the demand of speculative investors for short term gains at the expense of long term growth are likely to be the dominant problem in developing economies and has colossal effect on the overall economic development.

2.1.3 Empirical Literature on Finance and Growth: Single-Sector Framework

Empirically, a plethora of studies have examined the relationship between finance and economic growth albeit having varied results on the impact and direction of bi-causality. I discuss the econometric approaches to examining the finance-growth nexus based on cross-country studies and recent econometric literature in the Ghanaian context.

2.1.3.1 Cross-country Studies

The pioneering cross-country study on finance and growth was spearheaded by Goldsmith (1969). Key ideas lay out in Goldsmith's is that 'one of the most important problems in the field of finance, if not the single most important one…is the effect that financial structures and developments have on growth (1969 p.390). He assess whether finance exerts a causal influence on economic growth. Data comprising 35 countries over the period 1860 to 1963 on the value of financial intermediary assets divided by GNP. The assumption is that, the size of the financial intermediary sector has a positive association with the quality of financial functions provided by the financial system. He found that, overtime the size of financial intermediary compared to the size of the economy increases as countries develop. His graphical illustrations also indicate a positive correlation between financial development and economic development but Goldsmith did not discuss the direction of causality. However, there are three distinctive complications with the work of Goldsmith (1969). Firstly, He does not systematically control for other factors influencing growth. Secondly, close relationship between the structure of the financial system and economic growth does not identify the direction of causality. Finally, in a given economy the measure of financial development may not be an accurate proxy for the financial system.

Building on the ground-breaking work of Goldsmith's (1969), King and Levine (1993) compiled data on 77 countries over the period 1960 to 1989. Unlike Goldsmith (1969), the authors systematically control for other factors affecting long-run economic growth. Three growth indicators namely (a) real per capita GDP growth, (b) growth in capital stock per person and (c) total productivity growth are examined. Accordingly, additional measures of the level of financial development are analysed. Financial depth (proxy as DEPTH) is measured by the size of the financial system. The size of the financial system equates to the liquid liabilities of the financial system divided by GDP. To measure the extent to which the central bank and commercial banks allocate credit to households (proxy as BANK), the ratio of bank credit is divided by bank credit in addition to the domestic assets of central bank. PRIVY is also proxy as credit to private enterprises divided by GDP. Model findings of King and Levine (1993) show a strong positive relationship between each of the financial indicators as well as the three growth indicators. The author concludes that the relationship between the initial level of financial development and economic growth is statistically significant. For example increasing the financial depth of Bolivia in 1960 from 10 percent to

23 percent (mean for developing countries), then this would have resulted in a 0.4 percent growth each year. The effect is that by 1990, the real GDP per capita of Bolivia would have been about 13 percent larger than in 1960. However, financial development predicts growth, but do not formerly address issues of causality. Besides the significance of the work of King and Levine (1993), it is centred on only on banks and not the entire financial system which including capital markets.

In contrast, Atje and Jovanovic (1993), Demirguc-Kunt and Levine (1996), Levine and Zervos (1998) and Arestis, Demetriades and Luintel (2001) construct various measures of stock market development to assess the link between stock market development and economic growth. The works of these authors considers countries between 40 and 50 with the conjecture that stock markets lead to future economic growth rates. But such causal inference from cross-section methods is quite problematic (Quah 1993, Lee, Pesaran and Smith 1997, Arestis and Demetriades 1997). This could be attributed to the speculative nature of markets in least developing economies. Accordingly, the observed prices and movements are not captured by 'market fundamentals' (Shiller and Quinn 2008).

Besides, the McKinsey Global Institute (1999) reported on the association between the performance of the financial sector and economic growth. The McKinsey report examined the productivity of capital in Germany and Japan relative to the United States. Using 1993 United States prices, the report questioned how the growth of per capita wealth in the US could increase by an average of $26,500 over the studied period 1974 to 1993, whereas Germany and Japan lagged behind with $21, 900 and $20, 900 respectively. The outcome of the report was that, differences in the productivity of capital in each country accounted for the differences in wealth accumulation. Additionally, the report indicated that the performance of the financial sector strongly influenced capital productivity in the US. Markedly, financial markets in the US do a better job in terms of funding the most productive investments and also provide management with prudent incentives from start of a project to completion. The McKinsey report concludes that US savers were able to earn a higher financial return between 1974 and 1993 emanating from the higher productivity of capital, the result of which was the advancement in the accumulation of wealth by US households than their Germany and Japan counterparts.

2.1.3.2 Recent Literature on Econometric Model for Ghana

Empirical literature on the finance-growth hypothesis is limited in Ghana. Quartey and Prah (2008) used the growth of broad money to GDP ratio as a measure of financial development to examine the finance-growth nexus. They found some evidence of finance-led hypothesis. But when the authors measure financial development in terms of credit to GDP ratio, private credit to GDP ratio and private credit to domestic credit ratio, they found no evidence of either finance-led growth or growth-led finance.

Esso (2010) investigated the relationship between financial development and economic growth in Burkina Faso, Cape Verde, Cote d'Ivoire, Ghana, Liberia and Sierra Leone and establishes a long run relationship between the two variables. Study findings shows that financial development precedes economic growth in Ghana and Mali. But in Burkina Faso, Cote d'Ivoire and Sierra Leone. Elsewhere finance and growth cause each other in Cape Verde and Liberia.

Adu, Marbuah and Tei Mensah (2013) investigated the long-run growth effects of financial developments in Ghana. Their model is based on the endogenous growth which lies at the core of the AK model. Related is that real aggregate output growth is a function of total factor productivity, real aggregate capital stock, savings and the efficiency of the financial intermediaries. They found that, the growth effect of financial development is sensitive to the choice of proxy. Whereas stock of broad money to GDP ratio is not growth-inducing, credit to the private sector and domestic credit ratios to GDP are conducive for economic growth in Ghana.

Using annual time series data from 1971 to 2010, Adusei (2013) investigated the relationship between economic growth and financial development. The study uses three measures of financial development including domestic credit as a share of GDP, domestic credit to private sector as a share of GDP and broad money supply as a share of GDP. Model findings suggest that financial development undermines economic growth in Ghana.

The theoretical and empirical research outlined above on finance and growth provides the salient aspects of financial institutions including banks and stock markets and their impact on real activity. Particularly, the functions of financial markets in influencing economic growth;

development in the financial markets tends to mobilise and allocates resources to efficient use; financial markets liberalisation may adjust the savings rate and thereby affecting the capital accumulation, which will in-turn increase the productivity of capital in the economy. However, these one-sector models provide only bidirectional relationships between the aforementioned real and financial side indicators. But a financial CGE that considers the real side of the dynamics of an economy is better equipped to investigate the multi-dimensional macroeconomic and sectoral impacts of financial deregulation and liberalisation that, I consider in this thesis. Consequently, a deliberation of CGE models is next.

2.1.4 Modelling the Financial Sector in Multi-Sectoral Framework-CGE

This section reviews recent empirical work that uses computable general equilibrium (CGE) framework for policy analysis. CGE modelling utilizes Walras' competitive economy model structure as an operational tool to examine various policy issues in developed and developing economies including choice of development strategy, income distribution, and structural adjustments to external shocks, tax policy, economic liberalisation policies, long-term growth and structural changes.

The historical origin of the general equilibrium theory is to be found in the marginal utility school of Walras (1954) model of the competitive economy which lies in the analysis of exchange economies. In Walras (1954) economy, the demanders' budget constraint is determined by their respective initial resource endowment and the price vector. Whereas, the function of individual demand is the optimal response of the individual consumer to the given system of price, the market demand function is found by aggregating individual functions, and market equilibrium emerges when one finds the price for which the addition of net demands equal zero in the macro economy. Such classical economy theory where 'supply ought to match demand' had earlier been pointed out by Cournot (1838) in his discussion of international flow of money. However, CGE's expression as a set of mathematical equations is credited to Walras (1954) yet the initial CGE model was the matrix inversion of Johansen (1960) which was to study the dynamics of the Norwegian economy.

However in recent years, due to advancement in theory and analytical techniques and the data processing powers of computers, CGE modelling exercises is increasingly used for quantitative analysis of the effects of policies on economic outcomes. The computer language termed GAMS (General Algebraic Modelling System) was originally developed to assist

World Bank economists' for quantitative analysis of economic policy questions (Meeraus 1983, Brooke, Kendrick, and Meeraus 1987). But, the new features of the GAMS modelling language that accommodates market and game-theoretic equilibrium were not readily available in the optimization context until Rutherford (1995) developed these algorithms for solving mixed complementarity problems (MCPs)[8].

Nonetheless for several years, the CGE technique did not receive much attention until mid-1970 where Shoven and Whalley (1972), Whalley (1975), Piggot and Whalley (1977), Shoven (1976) and Miller and Spencer (1977) used it to analyse varied policy issues. Subsequently, the number of applied CGE models of national economies exploded in response to severe deficits in foreign capital flows in the 1980's. These models incorporated a financial sector in a multi-sector framework to analyse structural adjustment programmes (Feltenstein 1986, Rosensweig and Taylor 1990). The key objectives of stabilisation measures involved achieving macroeconomic stability with respect to government budget, balance of payments, foreign trade and issues on monetary policy, whereas structural adjustment programs seek to achieve shifts of resources amongst sectors and increasing domestic savings in order to maintain adequate level of investment across multi-sectors of the economy.

In concomitant with the conjecture that money is 'neutral' in the long-run in most neoclassical modelling structures, CGE models that appeared in the 1970's placed more emphasis on the real side. According to Dow (1996 pp. 164), the conclusion that money is neutral encouraged general equilibrium theorists in conducting research exclusively with real variables, without particular attention to financial variables. Dow (1996 pp. 167) concludes that 'the inability to integrate money into general equilibrium analysis in a satisfactory way demonstrates the problems of a historic method; the problems stems from the comparative

[8] MCPs permit formulating economic equilibrium models as system of nonlinear equations, complementarity problems or variation inequalities. But in the works of van der Laan and Tallman (1985), MCPs are referred to as generalized complementarity problems. See Rutherford (1995) and van de Laan and Tallman (1985) for more on these.

static approach where analysis starts with a real exchange economy into which money is introduced as a separable variable'. Related to this is that, since, the 1970's it has been one of the key issues on which post-Keynesian economists disapproves neoclassical theory[9]. However, these models were considered as significant improvements over the input-output or linear programming models of economy with fixed prices and fixed technical coefficients (Dervis, de Melo and Robinson 1982). Besides, issues' concerning money matters has also been the precept of structuralist macroeconomics (for example Taylor 1983, 1990, 1991), FitzGerald and Vos 1989, FitzGerald 1993).

Significant reasons that account for including aggregated capital accounts in social accounting matrix (SAM) for example was put forward by Vos (1991). From the onset, appreciating the role of the flow-of-funds bring to fore the description of an economy's financial system and its dynamic structure. Next, the analysis of the portfolio structure of changes in assets and liabilities and its relation to income distribution can be examined. In the end, it would permit analysis of internal and external constraints in the process of financial development, with more sectoral detail than one sector model or partial equilibrium framework. Besides, many of the pertinent issues facing least developing countries (LDCs) in general and Sub-Saharan African economies in particular entail financial variables such as capital flight, volatile capital flows, external debt and higher interest rates. These issues can be examined in a forward and backward linkages input and output models arising from the provision of the purchase of intermediate goods to identify key sectors in LDCs (see for example Bulmer Thomas 1982) but its impact are best quantified in a CGE framework (see for example Dervis, de Melo and Robinson 1982, Adelman and Robinson 1988, Hertel 1997).

Recently, the introduction of financial deregulation and liberalisation policies in most developing economies has seen a growing number of CGE with financial sectors. Key innovation in this area is its specification of the loanable funds market: various assets markets, such as markets for currency, demand deposits, time deposits, government debt, foreign and domestic bonds, equity, real and working capital (Robinson 1991 pp. 1517). In these models, typically the financial sector follows the theoretical groundwork of Tobin (1969) and Tobin

[9] Literature on post-Keynesian monetary theory is vast and varied in its own merit. A comprehensive survey is found in the works of Cottrell (1994), The classical statements of the post-Keynesian monetary theory is well-documented in Davidson (1972), Davidson and Weintraub (1973), Davidson (1994, chapters 6 to 8)

(1982) who explicitly modelled the financial sector. In Tobin (1969 and 1982), equilibrium in the stock markets of assets is conditional upon the assumed values of outputs, incomes and other flows culminating in a consistent equilibrium of financial and real variables. It therefore becomes useful to survey these financial CGE models to get a sense of what can be achieved by modelling the real and financial side of the economy in a CGE framework.

In an attempt to represent the limited financial development that typically characterises least developing countries, (Yeldan 1997) constructed a CGE model with a financial sector for Turkey. The model focus on premium rationing imports, working capital financing by firms, rigidities in the labour, product, credit markets and controlled interest rates (representing a financially repressed economy), monetization of fiscal and balance of payment deficits. However, there is no clarity on the difference between fiscal and monetary policies. That said, four primary actors are paramount in (Yeldan 1997) model, namely the banking sector, the central bank, firms and households. Unlike the neoclassical view, wealth takes only the form of capital stock and savings may not be directly channelled into purchasing investment goods and services through a simple intermediation process. Lewis (1985) argues that, there exist different types of assets with regards to behavioural rules in lieu with the process of portfolio allocation.

The aim is to examine how financial markets and other structural factors affect economic performance. Additionally, the study examined adjustment policy options to external shocks (for example the Turkish experience in the late 1970's). Results from comparative static simulations indicate that 'the existence of structural rigidities and policy-induced distortions in the economy strongly influences the response to external shocks and the efficacy of alternative policy options' (Lewis 1985b, pp. 177). He concludes that, ameliorating import shortages using premium rationing of imports is more inflationary compared to devaluation. Likewise, fiscal policies designed in cutting government deficit, and thereby reducing inflationary pressures are counterproductive even when the government reduces its consumption, investment or transfers. Also, financial liberalisation policies are influenced by the underlying macroeconomic environment. Finally, financial sector reforms is successful in channelling new resources into productive investment when the elasticities of savings are high and the elasticities of investment demand is low. Conversely, liberalisation policies

alternate with quantitative rationing of investment with rationing amid higher financial cost of borrowing, when savings is inelastic.

Feltenstein (1986) considered a disaggregated open economy that exhibits a price-taker for some goods and services and price-setter for others and applied to it Argentina. Public goods are produced and purchased through the collection of tariffs and taxes (for example incomes, sales and imports) by an active government. The government finances the country's budget deficits by issuing government bonds and money. Related to this is that, money supply and public indebtedness are endogenous in Feltenstein (1986) model. Foreign bonds generate endogenous capital flows. Three questions are answered: Firstly, what is the impact on the savings and consumption behaviour of the economy if the government changes its output of public goods? Secondly, how will a change in the government's method of financing its deficit change the overall balance of payments? and lastly, what will be the impact upon the economy of an exogenous change in the world price of an imported good? In the medium to long-term, by adopting an inflationary finance to induce aggregate demand seems to be an irresponsible policy which is susceptible to fail.

Fisher and Easterly (1990) also examined the effects of devaluation via the real channels and the real level of financial shocks in a dollarized Mexican economy in a static CGE model. Three types of financial assets namely: peso assets, mexodollar[10] assets and dollar assets are include in the model. His model shows that severe effects on investment could culminate in an overvalued exchange rate even when financial intermediaries are permitted to accept deposits in foreign currencies. An overvalued local currency leads to a current account deficit and the consequence of it is a capital flight. In contrast, however, the impact of contraction effects of devaluation on investments 'extends to the medium term because of the loss in physical capital formation which will have to be made up later if the economy is to stay on its long-run growth path' (Easterly and Levine 1997). The policy implication is not to postpone devaluation. This is because, a timely devaluation policy induces a portfolio shift from a dollar denominated-assets and thereby reducing dollar external debt. However, the medium

[10] Even though Mexodollar assets are held internally by the Mexican government, they are denominated in dollars to hedge against exchange rate and its associated risks in Mexico

to long-term effect is rather difficult to capture in a static model with no financial assets of the Mexican economy.

Rosensweig and Taylor (1990) constructed a fairly disaggregated financial CGE for Thailand. Five financial assets including currency, bank deposits, shares of private firms, securities from the government, and physical capital are considered. There are eight market participants: households, traded and non-traded sector firms, state enterprises, government, the central bank, commercial banks, and the rest of the world (RoW). Rosensweig and Taylor (1990) extended a standard SAM to take account of a detailed financial bookkeeping anchored by linking the savings of different participants' changes in constructing a financial accounting matrix (FAM). The linkage between the real and financial variables (sectors) is cemented on the flow of funds together with the interest rate on bank loans charged by financial intermediaries. In the end, the model is used to study how the Thailand economy responds to fiscal and monetary initiatives and the devaluation of the country's currency. Given model dimensions of unemployment and fixed exchange rate, it can be said that Rosensweig and Taylor (1990) model is characterised with Keynes (1936).

The model results of Rosensweig and Taylor (1990) show that, a five percent increase in public expenditure culminates in an increase in real GDP, an appreciation of the exchange rate and a fall in exports. Correspondingly, the nominal household net worth increases improved with the flow of savings and capital gains from higher commodity and share prices. Further, model results also indicate that, coupled with higher output and lower interest rates charged on bank loans, the rate of profits increases. Relate to this is that, the increase in government spending as a consequence of central bank results in a crowding effect. The conclusion of Rosensweig and Taylor (1990) is that, inflation does not have any damaging effect on the real side of the economy. Conversely, non-trivial inflation has damaging effect on savings, investment as well as the inflow and outflow of capital (Roubini and Sala-i-Martin 1992, Gomme 1991).

In a special issue of World development on 'adjustment with growth and equity' Bourguignon, Branson, and de Melo (1989, 1991) developed a 'maquette' CGE model that incorporated the financial sector and the real sector as described in Devaragan, Lewis and

Robinson (1991). The authors ascribe to the development of the 'maquette' CGE model with the aim of capturing the quantification of the interaction of two differing frameworks due to: a) its capability in capturing the medium to long-term effects of policy proposals in a multi-dimensional framework and b) to capture the short-run effects of policy proposals in the spirit of a standard IS-LM macro framework of an economy where financial assets are endogenously determined in the financial market.

The microeconomic optimization in Bourguignon, Branson, and de Melo (1989, 1991) model follows the Tobin (1969) tradition. Such that growth and distribution are the consequence of the interplay between expected inflation, the rate of interest, the balance of payment conditions, unemployment, the exchange rate, foreign borrowing and foreign prices of exportable goods. Equally with endogenous micro variables including the relative prices and outputs of sectors, and the respective changes in the assets holdings of firms and households. In the model, micro and macro variables interaction depends on exogenous policy variables such as the stock of money, the monetization ratio of foreign borrowing by the private sector, governmental expenditure, nominal exchange rates, taxes rates, foreign interest rates, prices of import as well as inflation. Despite all these cumbersome complications in Bourguignon, Branson, and de Melo (1989, 1991) CGE model, the core role of the financial system which is the collection and mobilisation of savings into loanable funds is not considered.

However, Bourguignon, Branson, and de Melo (1989, 1991) CGE model 'maquette' CGE model was applied by Bourguignon, de Melo, and Suwa (1991) to six developing economies including Morocco, Malaysia and Indonesia. They explicitly derived a monetary identity from the national income and balance of payment identities with specification of portfolio choice, factor markets and trade conditions. The major outcome of the model indicates that devaluation helps the poor (especially in low income country) due to the fact that they are located in an exporting industry. Also, since premium accrue to capitalists, rationing of imports worsens inequality and cuts in government expenditure have little effect on income distribution in the low income country. Given real wage and price rigidities, cuts in government expenditure culminate in extra increase in inequality and in the number of poor households as a consequence of unemployment and lower growth. This is attributed to the fact that capitalists are in the better position to protect their income since mark-pricing protects profits.

Vos (1998) analysed the mechanisms of aid flows and Dutch disease[11] effect in Pakistan using a financial CGE model. The stimulations is indicative that during the 1980s, the economic growth of the Pakistan's economy was not foreign exchange constrained. In contrast, however, an additional foreign assistance could generate strong Dutch disease effects which would be counter-productive to its structural adjustment policies in pursuit of greater competitiveness and an expansion of traded goods. In fact, in the medium-term, any superfluous exchange rate depreciation would trigger cost-push inflationary tendencies, leading to erosion of real incomes and hence an aggregate demand outfall. Further results of Vos (1998) also suggest that, while fiscal cuts are susceptible to deflationary, a shift from public consumption to public investment tends to generate positive growth effects across board. As a consequence of existing supply constraints, a shift from current spending by the Pakistani government would allow for lower inflation, crowding-in of private investment thereby expanding traded goods production.

The fundamental reason for financial crises was studied in a multi-regional amid an inter-temporal CGE model via Adelman and Yeldan (2000). The model is in the spirit of neoclassical underpinning, with fully functioning, inter-temporal rational savers and investors. It also encompasses a rather smoothly adjusting commodity and factor markets, inter-temporal rational savers and investors' are characterised with perfect foresight. There exists no moral hazards, externalities but with a balanced budget. Financial intermediaries are fully transparent, such that the intermediation function of banks is perfectly administered. However, the model is susceptible to financial crises when capital markets are opened and there is an unexpected rise in the risk premium of the Asia region understudy. Nonetheless, when the Asian capital markets are closed and policy makers retain all policy instruments, the Asian region avoids a crisis when faced with similar external shock, and an increase in growth rates. The conclusion of Adelman and Yeldan (2000) is that, financial liberalisation

[11] The term Dutch disease in originated from the Netherlands during the 1960s. This was the epoch characterised with high revenue generated by Netherlands natural gas discovery that led to a sharp fall in the competitiveness of its other non-booming tradable sector. In spite of the revenue windfall that the new discovery brought, the Dutch economy experienced drastic decline in economic growth during those epoch. Since then, the economic paradox of a Dutch disease is when a booming sector adversely affects the performance of other sectors of an economy.

cause's financial crisis such that the lack of maturity of a country's financial is not adequate to explain the Asian financial crisis but the former.

In recent times the experience with structural adjustment programs has permeate economists to estimate the impacts of trade openness and the liberalisation of trade on growth rates and poverty levels. The conclusion is that openness promotes growth which in turn reduces poverty thereby enhancing on the welfare of households (Nordstrom, Ben David and Winters 2002, Harriss 2002, Berg and Kreuger 2003, Rodrik 2006). However, it is argued that results demonstrating the benefits of trade liberalisation are not robust, and such conclusion is drawn from the misinterpretation of results emanating from such models. Rodriguez and Rodrik (2001) for example postulate that, liberalisation of trade in developing countries has been augmented with sound macroeconomic policy along with other measures that promote economic efficiency including financial sector reforms. Similarly, Berg and Kreuger (2003) argue that, the liberalisation of trade ought to be accompanied with corresponding structural adjustment policies particularly macroeconomic programmes thereby reaping the full benefits of trade liberalisation in developing economies.

Syed, Memon, Halepoto and Shaikh (2012) recently examined the effect of the global financial crisis in South Asia and its impact on the Pakistani small and medium enterprises (SMEs) in the context of a static CGE model. The model results of the authors indicate that, globalization and the recent economic recession have had negative repercussions on the SMEs sector of the Pakistani economy. The growth rate of the economy of Pakistan is negatively affected via increase in inflation rate causing a decrease in the living standards and purchasing power of households. Yet, SMEs is seen as the engine for growth and economic development as a crucial source of job creation (Tambunan 2008). It is also suggested by Kotelnikov (2007) that, poverty levels in developing economies can be reduced through wealth and employment creation. It is well acknowledge that, SMEs are the significant source of job creation, revenue generation, a breeding ground for businessmen. This is line of argument is maintained by Levy, Powell and Yetton (2001) that recent performance of SMEs in least development countries is significant for the growth process.

The preceding discussion of CGE models that consider the real side and financial sector, while brief and schematic, is symptomatic of the significance of including a financial sector

in a CGE model for a better understanding of the real and financial linkages in an economy. In recent times, the most beneficiaries of CGE models are the least developing economies but literature on financial CGE is scanty. The next section reviews relevant theoretical and empirical CGE models for the Ghanaian economy.

2.1.4.1 Recent Literature on CGE Models for Ghana

While the literature on CGE modelling and its application to different economic issues is increasing in least developing economies (LDCs), there are relatively few CGE models of Ghana. Of the existing five CGE models reviewed in this chapter, none of them explicitly model the financial sector by incorporating the transaction cost of financial intermediaries in a multi-sector framework which allows us to study the economy wide impacts of financial sector reforms over the period. From financial CGE in Ghana and sub-Saharan African economies perspective, this dissertation is an addition to the literature. Since none of the earlier models have the specifications of the financial CGE model designed to study the inter-sectoral impacts of reduction in the transaction costs of universal banks in the Ghanaian banking sector.

The paper by Bussolo and Round (2006) deals with poverty reduction strategies in the budget constraint Ghanaian economy for the year 1993. Using Ghana SAM (1993) dataset, the aim is to ascertain the possible effects on poverty of a range of budget-neutral redistribution income transfers. The model fundamentally excludes monetary and the significant role played by the financial system in an economy. In fact, the model is a standard CGE real-side model and it uses aggregated capital and labour. The external sector is specified as domestic and imported commodities combined to produce composite goods (the Armington 1969 specification), and with imperfect substitution between domestically-produced and imported goods and services.

Bussolo and Round (2006) argues that, the fixed foreign savings equals the current account deficit; the balance of payment is always at equilibrium. Related to this requirement is the saving-investment closure in the real sector. To the contrary, this is not true in developing economies, particularly in the case of Ghana which is characterised with financial repression. Earlier discussed, this is because, households save a portion of their real incomes and allocate savings among competing assets based on the returns on such assets. When financial intermediaries collect demand deposits from savers, they are able to transform savings into

loanable funds and rent them to production firms. It follows that the equilibrium in the banking sector is satisfied with the wedge between the lending and deposits interest rates which is symptomatic of the cost of financial intermediation, thus satisfying the zero-profit condition of the banking system which we model in this thesis.

However, the model results of Bussolo and Round (2006) shows that poverty is not eradicated via redistribution income transfers. Poverty levels increases in the short-run after considering secondary effects. In the long-term, however when government transfers are financed by increases in corporate income taxes, poverty is reduced by 32.1% throughout the economy. But, these policies have diverse effects on sectoral poverty as reductions in poverty appear to be unevenly spread across groups. Particularly, urban poverty is reduced sharply when the transfer policy is financed by an increase in corporate taxes relative to rural poverty.

Bhattarai and Okyere (2005) have constructed a CGE for Ghana which deals with tax and welfare gains in a static and dynamic framework. In line with other CGE researchers for Ghana, both models are calibrated to the micro-consistent benchmark Ghana SAM (1993) dataset. The utility function is derived from consumption. The authors build on Bhattarai (1999, 2000, 2003 and 2005) and Bhattarai and Whalley (2000) to evaluate the impacts of tax reforms on reallocation of resources and their impact on the evolution of the Ghanaian economy. In the model GDP, consumption, investment, exports, imports and an Armington supply are specified as activities and a constant elasticity of substitution (CES) specification is employed. The Hicksian equivalent (EV) and the Compensation variations (CV)[12] in terms of prices and quantities are computed to compare welfare gains or losses across different tax scenarios over the period understudy. As a consequence of tax reforms with equal yield, EV and CV is measured around 2.1 and 2.2 percent of GDP for the elasticity substitution of 0.15.

[12] Whereas changes in money metric utility between tax and non-taxes equilibria (equilibriums) is measured by the Hicksian Equivalent Variation (EV), Compensating Variation is a measure of the amount of money required to bring a household back to the same level of utility. A positive EV is indicative of gain relative to the old equilibrium and a negative EV is represents a loss. For example, in Shoven and Whalley (1992), the homothetic preferences, the values of EV and CV amid a benchmark and counterfactual scenarios is computed.

The EV and CV model results of Bhattarai and Okyere (2005) show that, the EV becomes 2.4 percent of GDP (and the corresponding CV is -2.5 percent of GDP for a higher substitution of 0.25). Results from equal yield scenarios maintain a constant level of government size, letting the model to change tax instruments that are most favourable to the structural realities of distortions of taxes existing in the Ghanaian economy by introducing a uniform tax rates across multi-sectors. Welfare gains are the consequence of the improvement due to the removal of taxes existing in the economy by introducing uniform taxes. But tax reforms have diverse effects on sectoral reallocation of resources. Taxes cause reallocation of resources from the public administration, education and health and other community, social, personal and servants sectors to the other sectors in the local economy.

The beneficiaries of tax reforms tends to be wholesale, retail, hotels and restaurants, transport, storage and communication, finance, real estate and business services, manufacturing, electricity and water, construction, cocoa, agriculture and livestock, forestry and logging, fishing, mining and quarrying. Overall, the economy experience higher outputs with huge gains coming from the cocoa sector during the period. However, Bhattarai and Okyere (2005) considered only the real side of the economy implying that money is neutral in the long run having no effect on the real side of the Ghanaian economy. According to Dow (1996, p. 164), concluding that money is neutral in the long run encourages the habit of conducting analysis exclusively in real terms, without reference to money. Dow (1996, p. 167) concludes that 'the inability to integrate money into general equilibrium analysis in a satisfactory way demonstrates the problems of a historic method; the problems stems from the comparative static approach whereby analysis starts with a real exchange economy into which money is introduced as a separable variable'. But, recent global financial crisis is symptomatic that financial sector is an integral part of the real side of an economy. To address this crucial gap in the literature, we develop the first comparative static CGE model for the Ghanaian economy that considers both the financial sector and real sector in assessing the economy wide impacts of financial sector reforms.

Bhasin and Obeng (2006) examined the impact of trade liberalisation where lost tariff revenue is compensated for by budget-neutral increase in foreign aid. Bhasin and Obeng (2006) deal with compensating for loss tariff by resulting to budget-neutral increase in foreign hand-outs. The first Ghana SAM (1993) which is authored by the International Food

Policy Research Institute (IFPRI) is updated using fixed proportion methods into a macro SAM for the year 1999. The model dimensions include forty-eight basic equations which comprises of ten equations for production and trade, sixteen equations for income, taxes, savings and investments, eight equations for demand for commodities, nine price equations, and five equilibrium conditions and model closures. In sum, there are 142 endogenous variables and 34 exogenous variables to be solved and calibrated to the updated 1999 Ghana SAM dataset. Notwithstanding the complexities and the mammoth modelling strategies adopted by Bhasin and Obeng (2006), financial transactions (in financial assets and liabilities) which is indicative of the economic interactions between institutional units (non-financial, financial, government and households) and between, in addition to the rest of the world is not considered. It is imperative to note that financial transactions link the real side of the financial system to real sectors in an economy which is symptomatic of the role of financial intermediaries or banks in the financial system. Vos (1991) argues that, the inclusion of the financial system would permit the analysis of the portfolio structure of changes in assets and liabilities and its relation to income distribution.

However, Bhasin and Obeng (2006) model results shows that the elimination of trade related import and export duties that are accompanied with a budget-neutral increase in foreign aid could reduce the incidence, depth, and severity of poverty in Ghana. Particularly the elimination of import and export duties amid an increase of 4 and 10.84 percent respectively in foreign aid reduces the incidence, depth and severity of poverty across the Ghanaian households. However, the income distributions of agricultural and non-working households tend to improve to larger extent relative to the public and private sector and non-farm self-employed when export duties are relaxed. On the contrary, the income distribution of public and private sector employees and non-farm employees improves immensely when import duties are relaxed.

Breisinger, Diao and Thurlow and Al-Hassan (2008) developed a CGE model to study the possible sources of accelerated growth and their respective contributions to overall economic growth and transformation and applied it to Ghana. The pathways, growth options and structural implications in attaining the middle income-country (MIC) status by 2015 are examined in a dynamic CGE framework. The model includes the demand and production structure for 59 sectors but with greater emphasis on the manufacturing sector which

comprises of five agriculture-related processing sectors and 13 light and heavy manufacturing sectors. In the model, there is free movement of capital across sectors and regions and accumulation of capital is through investment financed by domestic savings and foreign inflows. However, Breisinger et al (2008) does not explicitly model the financial system to endogenise the interest rate charged by financial intermediaries to the 59 production sectors of the economy.

The results show that relative to 2005, the per capita income for 2015 will increase by 70 percent when growth in the labour-intensive manufacturing sector is accelerated. Together with a rapid productivity growth in the manufacturing sectors and accelerated capital accumulation in the economy results in an annual growth rate of 10.3 percent in some manufacturing sectors (i.e. food and wood processing and textiles). The expectation is that, the rapid growth in manufacturing will aid the economy to adjust its export structure and accordingly reduce its dependency on raw materials exports, such as cocoa, gold and forestry products. However, given a highly dependent importation of capital and manufactured consumption goods Ghanaian economy, yet a significant import substitution for these products seems to be in a distant part, even with high manufacturing growth. Besides, the growth potential, export agriculture is not highly linked to the multi-productive sectors of the economy, which will eventually limit impacts on overall economic growth. Thus Breisinger et al (2008) is unlikely to capture significant nonlinear shifts in demand structure in transition from low to middle income status. In addition, the attainment of such ambitious middle income status hinges on encouraging modernization and diversification which require careful coordination between macroeconomic and financial sector reforms. Such financial policies aimed in promoting savings, investments and economic growth will broadly depends on the interest rate elasticity in the Ghanaian economy.

Due to the multiplicity of the CGE techniques, quite recently Diao (2009) analysed the economy wide impacts of HPAI[13] under different scenarios in Ghana. Using the recent Ghana SAM (2005) with a detailed production structure at both national and sub-national levels, the aim is to ascertain the quantitative effects of the agricultural sector as a consequence of avian Flu on the domestic poultry market i.e. chicken which is quite a small sector of the local

[13] HPAI (a highly pathogenic avian influenza). This is a bird flu normally caused by viruses adapted to birds.

economy both as a share of agriculture GDP (1.1 percent) and of the total agricultural production (2.3 percent). The sectoral contribution of the agriculture sector to GDP for the year 2005 at the national level was 35 percent. Following Lofgren (2001), Thurlow (2004) and Diao, Hazell, Resnick and Thurlow (2007) agriculture production requires country specific information on the distribution of land across regions for each individual type of crop or livestock production. A CES technology is specified and a Leontief (1949) inputs such as fertilizer and seeds in crop production, feed in poultry production, and raw materials in the food processing industry augmented with an aggregation of the relationship between intermediaries and primary inputs. In the model, the consumer demand functions' is solved by maximizing a Stone-Geary utility function in which the income elasticity does not need to be degree one (which is different from a Cobb-Douglas specification).

Diao (2009) results show that, while the chicken sector is small sector of the Ghanaian economy, the shock in the demand for chicken is the result of consumer's anxiety which causes the production of chicken to fall. Also, the indirect effect on maize and soybean that are used as chicken feed in chicken production is large. A shock in the demand for chicken results in a fall of 6.4 and 37 percent on maize and soybean production. However, the economy wide impact on both agriculture GDP and the overall GDP is small. Such that, a 70 percent decrease in chicken production, results in only a 0.4 percent fall in agriculture GDP whereas the overall GDP remain unchanged over the period understudy. That said the livelihood impacts of a HPAI outbreak could be significant for sections of the economy albeit directly or indirectly related to the poultry sector of the Ghanaian economy.

2.1.4.2 Strengths and Weaknesses of the CGE Techniques in Economic Policy Analysis

As mentioned earlier, CGE modelling entails numerically estimating the general equilibrium structure of an economy. The equilibrium is concurrently characterised by a set of price and output levels across the multi-sectors of the economy such that market demand equals supply in all markets. That said analysis of economic policy may be examined in the context of a partial equilibrium or computerised general equilibrium (CGE). But, the analysis of economic policy in the framework of a general equilibrium explicitly accounts for all the linkages between the multi-production sectors of economy-household, firms, governments and the RoW. The behaviour of all economic agents are specified using widely accepted economic principles of optimisation and choice, that are operational and consistently remain the most

frequently accessed for empirical and theoretical analysis of economic literature. Thus, CGE modelling is strongly grounded in microeconomic theory and can handle complex economic issues by providing analytical solutions. Further, the multi-sector nature (i.e. sharing the desirable characteristics of Leontief input-output models, where sectors with differing input use and/or output generation can be distinguished) augmented with simultaneous CGE modelling of prices and quantities, supply and demand (these characteristics are not shared by the Leontief input-output and partial equilibrium models).

The parameterisation of CGE models makes it possible to reflect on the structural and behavioural characteristics of a particular economy. This makes it possible to estimate not only the direction, but also the quantum of effects that may result from a particular exogenous shock. The supply side component of the CGE permeates a thorough investigation of supply-side policies, such as efficiency of the banking sector and its effects on the multi-sector, where other models such as input-output are inappropriate. Additionally, the net impacts of a given policy such as mark-up, tax reform or financial deepening is easily evaluated with counter-factual without any changes. Since all changes in output, labour, revenues and intermediation cost are measured relative to this benchmark, the marginal effects of the exogenous shocks in the model stimulations is clear. But, an evaluation of similar policy using time series, panel or cross-sectional data would necessitate counter-factual analysis to be identified by appropriate statistical mechanism, which may be difficult and even risks distorting the divers of adjustments in activity.

Accordingly, CGE imposes further, a set of constraints on the production sectors of the economy, so that expenditures do not exceed income, and the income of these sectors, in turn is determined by what the factors of production earn over the accounting period. However, the focus of the partial equilibrium modelling technique has been on a particular sector albeit one sector of the economy assuming that impact of that sector under discussion on the rest of the economy, and vice versa, is either non-existent or small. Notwithstanding the underlining advantages of partial equilibrium techniques, in terms of economic wide impacts of policy changes and associated economic-wide repercussions are likely to be significant. Particularly, the level of disaggregation in concomitant to specifying the economy in some detail, it becomes possible to inculcate divers' structural aspects of the economy which correspond to

distortions or market failures (imperfections). Related to the inclusion of many structural aspects is the intermediation cost charged by the banking (financial) system.

Intermediation cost measured by the difference between deposit and interest rate (transaction cost) introduce inefficiencies, many of which can only be captured in a fairly disaggregated financial CGE model with significant description of the multi-production sectors of the economy and in terms of financial transactions. The impact of transaction cost on the multi-production sectors is crucial for policy analysis and arguably other non-related sectors. It follows that, inefficiencies and market imperfections (distortions) interact with each other in ways which are not apparent. Given the interconnectedness of the real and financial sector of the economy, removing one source of inefficiency may not inevitably culminate in an overall improvement in the allocation of resources in the economy if other market imperfections exist in other sectors of the economy.

Besides, when an economy is characterised with many sources of inefficiency, the effects of some of the inefficiency will tend to nullify, and eradicating any one of them may worsen the existing situation. For example, Ballard, Shoven and Whalley (1985) examined marginal excess burden (MEBs[14]) of all major taxes in the United States. They used a multi-sector CGE model which allows them to simultaneously calculate the marginal welfare effects of individual income taxes, corporate taxes, payroll taxes, sales and excise duties, with particularly focus on the introduction of a value added tax (VAT). The authors postulate that, relative to income tax, VAT is less distorting and tends to improve the efficiency of resource allocation.

Conversely though, when Ballard, Shoven and Whalley (1985) specify a structure of rates similar to EU economies, they find that all efficiency gains are negated. The distortions caused by different rates for different products outweigh the gains emanating from the incidence of VAT. Their results is symptomatic of the fact that, the multi-faced capability of a CGE model bring to the fore the types of ‘rebound effects’ as a consequence of its ability to trace other essential sources of inefficiencies.

[14] MEBs is a measure of the incremental welfare costs of raising extra revenues from an already existing distorting tax system

However, it is this complexity of CGE models and simulations that critiques of CGE argue that such simulations are often unpredictable. These critiques label the CGE models as a 'black box' which may generate any solutions. But by providing information on key features and assumptions, and explaining the model results with reference to economic theory, transparency may be considerably improved. In view of that, CGE models should not regarded as a black box.

Since, the CGE technique is a practical useful tool as a consequence of it flexibility in solving algorithms amid the development of highly disaggregated models. It is generally accepted that, exogenous shocks will have an overall impact on the economy relative to their effect on the structure of the economy which may be small. Consequently, microeconomic theory indicates that, an increase in the supply of a factor of production for example capital will result in an increase in the total output in the economy. However, the increase in total output tends to be attained by a more than a proportionate increase in the output of capital intensive goods and services along with a decrease in the production of goods and services which are more intensive in other factors of production in the local economy. The policy implication is that, by focussing only on the overall impact on output culminates in neglecting the significant and substantial changes in the structure of the economy. Accordingly, in recent times, a growing body of interest in the structural changes of an economy has culminated in an increasing usage of the CGE technique which is typical of multi-dimension in terms of multi-sectors, multi-households, different types of goods and services and the RoW.

In view of its usefulness in recent literature, CGE modelling is increasingly employed to examine a whole range of policies including questions relating to public finance (Shoven and Whalley 1984), tax reform (Jorgenson and Wilcoxen 1997, Bhattarai 1999), distributive impacts on different household groups in terms of change in policy (Bourguignon, DeMelo and Morrisson 1991 and regional trade agreements (Lloyd and Maclaren 2004). Furthermore, CGE modelling is also used for system-wide analysis concerning energy and environmental issues equally at the national level (, Conrad and Schroder 1991, Beausejour et al 1995, Lee and Roland-Holst 1997, Bohringer and Loschel 2006, Bergman, Markusson, Connor, Middlemiss and Ricci 2010) and regional level (Despotakis and Fisher 1988).

In line with other modelling technique which has some underlying shortcomings, equally the CGE technique is not an exception. Other critiques usually argue that, there is lack of empirical validation of the CGE models and its makes it untraceable to historical facts. This is because CGE models are not econometrically estimated. By and large, the assumption of CGE models is likened to those occasionally observed in all markets simultaneously. The key assumption in general equilibrium is that, all market clears at equilibrium prior to the occurrence of any transactions. In fact, CGE models results 'do not pretend to forecast reality but rather to indicate long-term tendencies, around which the economy will fluctuate' (Borges 1984). Modellers overcome this shortcoming by specifying parameters and functional forms. In this thesis, we specify choices of parameters and use the constant elasticity of substitution (CES) functions while others uses the Cobb-Douglas functions.

Financial intermediation is vital for economic development. Existing literature indicate a causal link between the degree of financial intermediation and economic growth. In order to finance both private and public investments, Ghana needs a stable and efficient banking system next to systematic development of its financial system. The cost of financial intermediation has significant ramifications for economic performance (McKinnon and Shaw 1993, Jayaratne and Strahan 1996, Rajan and Zingales 1998, Beck, Levine and Loayza 2000, Hansen (2014)). From the late 1980s through the period of the recent economic downturn, Ghana's financial sector reforms has been characterised with notable component of structural adjustments programs.

3 CHAPTER:

CONCENTRATION AND COMPETITION

3 CHAPTER: CONCENTRATION AND COMPETITION

Abstract

This chapter empirically investigates the evolution of market concentration and tests market competitiveness in banking systems as a consequence of financial sector reforms in Ghana. In line with empirical banking literature, unbalanced panel data of 24 banks in the period 2003-2012, which is a period characterised with deregulation, liberalisation and consolidation of the banking sector is accessed. The panel data is used to measure market concentration and competition of the Ghanaian banking sector. Market concentration is measured by the Hirschman-Herfindahl indices and the three (CR3)-five (CR5) bank concentration ratios. The CR3 and CR5 measures indicate a decreasing trend and low level of market concentration in the Ghanaian banking industry over the sample period. The degree of competition is assessed based on the revenue elasticity to input approach under Panzar-Rosse framework. The test of market competition using the Panzar-Rosse approach found monopolistic competition in both interest based market and total revenue markets, but with lower competition in the non-interest based market in the Ghanaian banking industry.

3.1.1 INTRODUCTION

The Ghanaian banking industry has changed enormously over the past two decades as a consequence of a continuum financial sector reform, advent of new information technology and increasing integration with the Sub-Saharan African financial system. Liberalization of the financial sector culminated in the entry of new banks in the market; deregulation amplified the scope of activities and delimited banking activities; the advent of new information technology culminated with new ways and tools in performing banking activities somewhat efficiently and the integration with the global market added extra pressure on the competiveness of participating banks.

Even so, in the aftermath of the 2008/20009 global financial crisis, the Bank of Ghana (BoG) introduced a bank capitalization policy which is a form of tax to the banking sector, since additional liquidity ought to be set aside. As a consequence of the bank capitalization policy by the regulator, universal banks operating in Ghana were required to recapitalize from 7 million new Ghana cedis to 60 million new Ghana cedis (equivalent of 23 million US dollars)

by the end of the 2012 fiscal year. While foreign banks that existed prior to the recent capitalization have met their financial obligations, indications are that locally-owned banks were still struggling to the meet the recapitalization target by the end of the 2012 deadline.

What seems plausible to conjecture is that some of the local banks may well consolidate to stay in the banking sector. Related to this is the ongoing wave of bank mergers which raises the prospect that competition may be diminished through increases in concentration. These structures have changed the structure and market behaviour of the Ghanaian banking industry over the last decades. In view of these structural changes in the dynamics of the banking system, the question arises as to what impact these financial developments have had on the Ghanaian banking market and their conceivably crucial effects for local market conditions. This process of concentration may also affect competition in the banking sector particularly in the loan market. These determinants of bank performance and in terms of concentration and competition have attracted the interest of academic research and regulators. While there is a continuous studies on bank performance in the US and European markets and to a lesser extent in BRICS countries including Brazil and China, relatively less is known about concentration and competition in the Sub-Saharan African context, particularly in the Ghanaian banking market.

The remainder of the chapter is schemed as follows: Section 3.1.2 describes the evolution, structure and soundness of the Ghanaian banking market. The financial performance of the banking industry is deliberated in terms of the capital adequacy ratio and profitability indicators in tandem with macroeconomic indicators in the local economy. Section 3.1.3 presents the theoretical literature on concentration and competition in the banking market. Section 3.1.5 outlines the structural and non-structural methodologies applied to the Ghanaian banking market and data sources. The next sections estimates the market power of banks in terms of market share, concentration index, the Hirschman and Herfindahl (1945, 1950) and the Panzar-Rosse (1987) model to determine the competitive behaviour of Ghanaian banks. The overall results are presented and discussed and Section 3.1.11 summarizes the results and concludes.

3.1.2 The Evolution of the Ghanaian Banking Sector

Modern banking practises in Ghana could be traced back to the establishment of Standard Chartered Bank Ghana Limited as the first commercial bank in 1896. The second foreign bank, Barclays Bank Ghana Limited entered the banking market in 1917. The Bank of the Gold Coast (BCG) which was established by the Government in 1953 was split into two banks namely, the Central Bank of Ghana (BoG) and Ghana Commercial Bank on the 4th of March, 1957. The formation of the BoG as a central bank with regulatory responsibilities under the Bank of Ghana Ordinance (No. 34) gave new dimension to the Ghanaian financial system. The Ghana Commercial Bank was mandated with commercial banking responsibilities to serve local traders and farmers in facilitating the trading of risks and allocation of capital. In 1960s and 1970s, in the backdrop of central planning and the need to extend bank credit to the rural and some urban areas, specialised banks were established by the Government and customised to meet the financial needs of particular sectors in the local economy. Particularly, National Investment Bank, Agricultural Development Bank, Merchant Bank, Ghana Cooperative Bank and the Bank for Housing and Construction were established respectively to strengthen industrialisation, agriculture, commerce and construction.

Prior to the establishment of the aforesaid specialist banks, the two foreign banks, Standard Chartered Bank and Barclays Bank Ghana Ltd were characterised with excessive monopolistic dominance in the deposit and loan market. Therefore, the foreign banks were vastly criticized for lending short to finance foreign trade and mostly providing loan capital to foreign companies (Brownbridge 1998). In view of that the traditional lending policies of the foreign banks were not compatible to rural and urban households in Ghana (Newlyn and Rowan 1954 p. 82). The consequence is that the local business community became discontent with the lending behaviour and policies of the aforementioned foreign banks.

This culminated in the state going on a bank-ownership spree as it acquired 40 percent share in the two foreign banks (i.e. Barclays and Standard Chartered Bank) in 1972. Similarly, preceding to 1988, local banks had a degree of state shareholding, generally wholly owned with the exception of the foreign banks where the state had minority shareholding. With the state commanding 5 state-banks and having minority ownership in Standard Chartered Bank Ghana Limited and Barclays Bank Ghana Limited, the banking system became a controlled financial system with immense political interference in government controlled banks. During

those periods, banks piled-up huge debts with colossal levels of non-performing loans in their respective balance sheets due to lack of due diligence in the approvals of loans and a reticent legal and regulatory framework. Additionally the co-movement between the ratio of the NPLs/total loans and GDP depicted in Figure 3a clearly reflects the sensitivity of impaired loans to the real economy and adverse external shocks. Thus, the dynamics of the local economy and banking system was all but susceptible to economic shocks albeit internal or external.

Consequently in 1976 Ghana's economy experienced an unprecedented economic retrogression that pushed the country to disastrous hyperinflation. The spill-over effect culminated in annual inflation reaching a record high of 116.45 percent in 1977 (**Figure 4**). Differential annual consumer inflation rates became the phenomenon even into the early 1980's as the economy experienced almost a 7 percent negative growth rate in 1981 as productivity increasingly decreased. State-owned banks were systematically refinanced in the expectation of avoiding the socio-economic and political ramifications of a banking collapse. The Ghanaian banking system became a conveyor belt-shifting the losses of the real production sectors to the government budget and onto individual households. The policy decisions of the BoG was subordinated to budget and successive government priorities and constantly covered fiscal and financial losses albeit directly or indirectly by printing money. It seems that during those periods, the BoG did not have the regulatory capacity and the technical know-how to supervise the financial system.

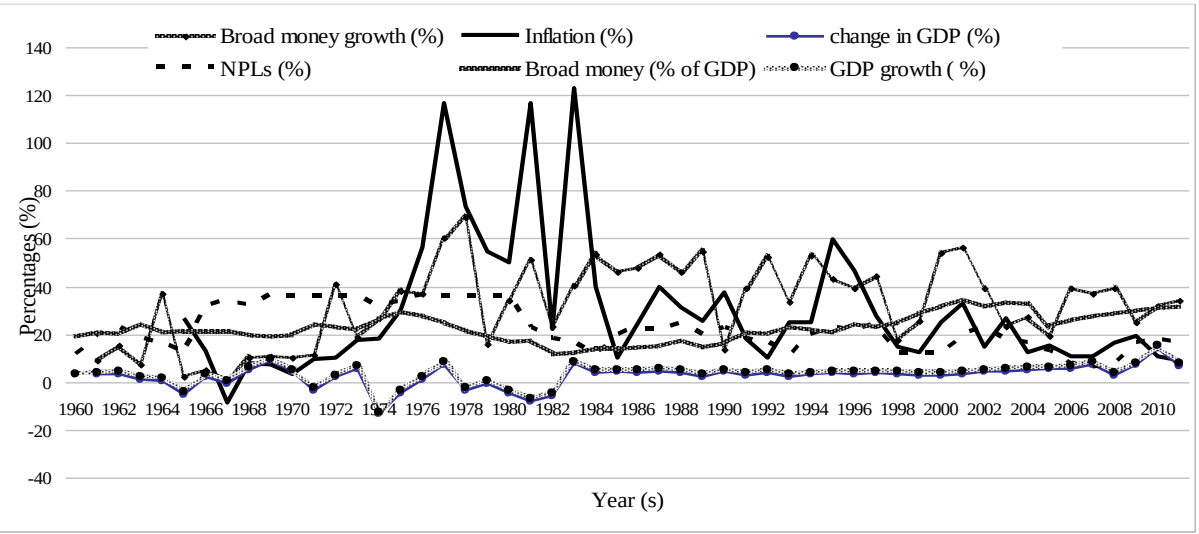


Figure 4: **Trends of Growth in Real Economy's GDP, Inflation and NPL/Total Loans**
Source: World Bank Country Data (1960-2012)

As a consequence of the aforementioned constraints albeit regulatory capacity or otherwise, the BoG lost its control over money supply and the exchange rate as key monetary policy tools ceased to have any meaningful effect equally on the economy and the Ghanaian financial system. These economic policies and practises culminated in the weakening of the critical fundamental role of the banking sector in facilitating, mobilising, as well as the allocation of savings for the business community and households. Hence, the consumption of external financing in terms of credit facility by the business community eroded completely. This equally affected current decisions about the future spending of firms and households in Ghana. This epoch also saw weak and incompetent management, inadequate capital base, obsolete dissemination of accounting information and poor internal banking controls. The economy was characterised with huge external and domestic debt, de-capitalized bank system and bank panic. These entire debacles accounts for the colossal portfolio of non-performing loans in the banking industry. The structure of the Ghanaian banking system post financial sector reforms is discussed next.

3.1.2.1 The Structure of Ghana's Banking Sector

Banks, insurance companies, savings and mutual funds as well as capital markets constitutes the financial system of an economy (Fry 1995, p. 317-352). The structure of the banking system in Ghana is classified into three main categories namely banking, insurance and capital markets. The banking sector further consists of formal and informal financial systems. The classification of formal and informal financial markets extensively depends on the degree of regulations exerted by the monetary authorities in Ghana.

In Ghana the formal financial market is structured into financial institutions and a financial market. The formal financial institutions are regulated under the legal framework of the Bank Act, 2004 (Act 673) as amended in 2007, Act 738. Universal banks (i.e. Commercial, investment, development and merchant), rural and community banks, insurance, leasing and finance companies, mortgage finance companies, finance houses and savings and loans companies operate in the formal financial market (**see Tables 3**). However, the operations and mechanisms of the formal financial markets are clearly distinct with regards to its class of operations. Presently by law, local-owned Class 1 banks' must have capitalization not less than GH¢60.0 million. But for foreign-owned banks Class 1 banks', it is not less than GH¢60.0 million. Universal banks operate with the Class 1 licence and are mostly located in

the urbanely populated cities in Ghana. By the end of the financial year 2013, there were 27 International Finance Centres or 'offshore banks' which ought to demonstrate risk-based capital ratios that are consistent with the minimum international standards in compliance with the Bank for International Settlement (2011). The remaining is the rural and community banks that satisfy the savings and credit needs of rural households.

Obscure understanding of rural credit markets with regards to loan screening, administration and contract enforcement mechanisms have given way to the informal financial system (Hoff and Stiglitz 1990). Black-markets, local money-lenders, neighbours, friends, relatives, farmers, chiefs, land-owners, and extended and nuclear families constitute the informal financial sector in Ghana. They are equally found in rural and urban centres. Even though the activities of the informal financial sector of Ghana are not regulated their activities are legal. The informal financial sector is a critical source of external finance for rural and urban households in Ghana. 56.3 percent of male-headed households access external funds from relative, friends and /or neighbours. The informal financial sector tends to be increasing in contrast with the formal financial sector Aryeetey and Gockel (1990). However cash transactions (Hugon, 1990) are predominant in the banking system.

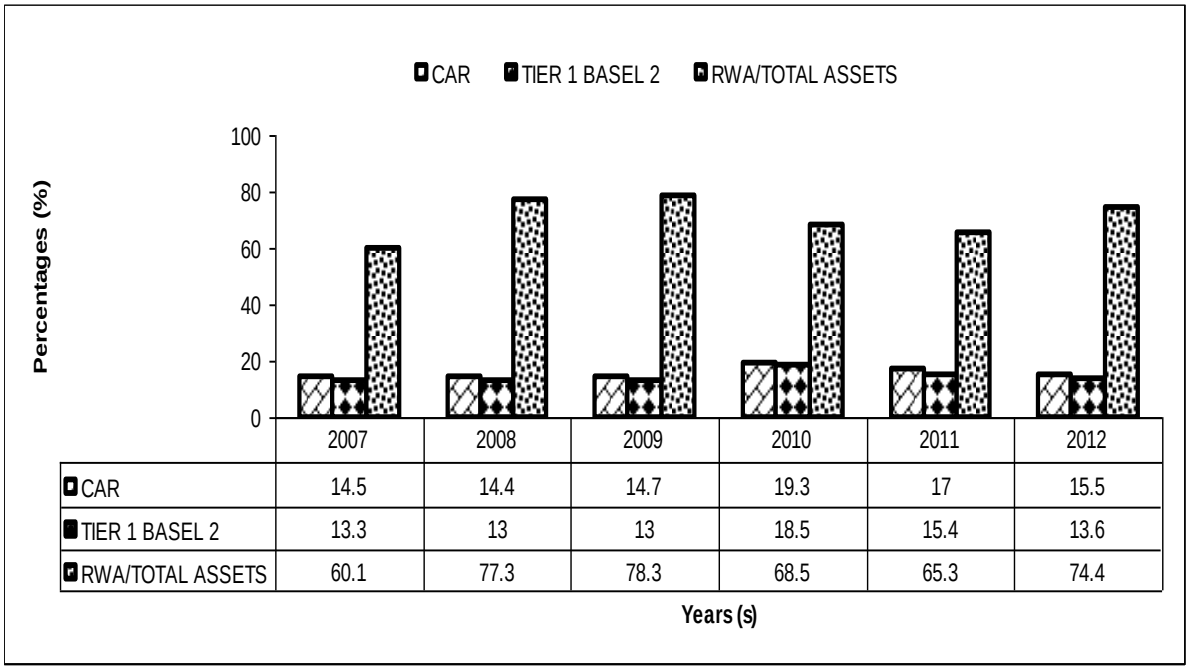
With more than 27 percent of households indebted to persons, institutions or businesses only 6 percent settle their debt in full with-in a twelve month period (Ghana Living Standards Survey 2008). Yet, it is perceived that the level of delinquency and default rates in the informal financial sector is low relative to the formal financial sector in Ghana. This could be attributed to the unconventional rigid enforcement of a zero tolerance policy methods in the collection of loans repayment. That said Ghanaian informal financial markets exhibits differing operating techniques (Aryeetey and Hyuha 1991, Chipeta and Mkandawire 1991, Chipeta 1996, Soyibo 1996a). In many cases book-keeping of records are vastly mute in the informal financial sector. As a consequence of that, revenue, expenditures, financing position of the informal financial sector scantly exist. Few existing book-keeping records are predominantly manipulated by way of understating or overstating invoices to reduce or evade tax payments speculatively valued added tax. Even though, the informal financial sector in Ghana's financial system is relevant in the financing of funerals, marriage ceremonies, consumption loans and other finance for social consumption, it is too fragmented to enjoy economies of scale that formal sector is characterised with.

Tables 3 provide some selected statistics for the structure of the Ghanaian banking industry. Of the 25 universal banks in Ghana, 5 were state-owned and 20 were privately-owned (14 foreign, 5 domestic and 1 foreign-domestic ventures). The banking penetration ratio at one commercial bank branch per 54,000 inhabitants witnessed an increasing trend as deposit account holders surged in recent times. In contrast, however, banking formal banking reaches 10 percent of population and coverage varies widely across the 11 regions in Ghana. This reflects that 40 percent of bank branches are in the greater Accra region even though this region represents less than 20 percent of Ghana's population-thus geographical concentration of banks and lack of wider access to banking services. Even though the rural encashment area is served with a huge 137 rural and community banks, their total asset relative to the universal banks' is scanty. Without doubt, the value for the ratio of total banking sector assets to real GDP is indicative of the significance of the banking system in the Ghanaian economy. The growth of aggregate total-assets to GDP ratio is somewhat attributed to financial deepening between 2003 and 2012 even though after reaching almost 25 percent in 2006, it dropped to 19 percent in 2008. The increase of which in 2012 is indicative of financial deepening in Ghana's financial system. Related to this is the increase in the domestic bank credit provided to the private sectors of the local economy. This buttresses the point that banks are the major lenders to private sectors because the Ghana Stock Exchange (GSE) is still at initial stage of developments yet GSE was established in February in 1989.

Table 3: Structure of the Ghanaian Banking Industry (2003 to 2012)

Indicators/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Percentage Share of Total Assets										
State	0.40	0.39	0.37	0.37	0.36	0.34	0.31	0.33	0.32	0.27
Private-Domestic	0.92	0.77	0.11	0.13	0.14	0.18	0.19	0.16	0.18	0.13
Private-Foreign	0.51	0.53	0.51	0.50	0.50	0.48	0.50	0.50	0.50	0.55
Bank branches per 100,000 people	3.1	3.1	3.2	3.6	4.6	4.8	5.1	5.4	5.4	5.7
Borrowers per 1,000 people	16.2	18.2	27.5	19.2	23.1	23.5	37.5	33.8	35.3	35.5
Depositors per 1,000 people	178.1	198.1	208.6	209	219.8	246.7	271.3	282.9	346.5	456.7
Total bank assets to real GDP (%)	0.23	0.23	0.23	0.25	0.17	0.19	0.21	0.24	0.24	0.23
Banks loan to private sector (% of GDP)	0.27	0.31	0.31	0.21	0.23	0.28	0.29	0.28	0.28	0.32

Sources: World Bank Global Financial Developments and Ghana Banking Survey-various years



	2007	2008	2009	2010	2011	2012
CAR	14.5	14.4	14.7	19.3	17	15.5
TIER 1 BASEL 2	13.3	13	13	18.5	15.4	13.6
RWA/TOTAL ASSETS	60.1	77.3	78.3	68.5	65.3	74.4

Figure 5: **Capital Adequacy Ratios-Ghana Banking Industry (%)**
Footnotes: CAR (capital asset ratio), Tier 1 Basel 2 (is the amount of capital that banks are required to hold against financial and operation risks) and RWA (bank-risk weighted assets)
Source: Ghana Banking Survey (2007-2012)

3.1.3 Review of Related Literature Competition and Concentration in the Banking Sector

The theory of industrial organization indicates that the competitiveness of the banking market cannot be gauged by market structure indicators per se (Baumol, Panzar and Willig 1982). From the standpoint of economic theory, performance measures for example the size of banking margins, interest spreads or profitability is not indicative of the competitiveness of a banking market. This is because, measures of the size of banking margins, mark-ups or profitability are dependent on a country's macroeconomic performance and stability; risk preferences; the form of degree of taxation and financial intermediation and the quality of the judicial systems (Hauner and Peiris 2005). According to Hauner and Peiris (2005), testing for the degree of competitiveness necessitates structural or contestability approach. The authors suggest the actual behaviour of bank conduct to be the key indicators of the degree of competition in the banking system.

In view of that, the literature on the assessment of competitive behaviour in the banking sector is in two folds. The application of the structural method is rooted in the theory of industrial organization. It measures the degree of competiveness by following the structure-conduct-performance (SCP) hypothesis that fewer and larger firms are more likely to engage

in anticompetitive conduct (Mason, 1939; Bain, 1951). The SCP hypothesis point out that, banks offer lower rates on deposits and charge higher rates on loans. Thus the binary stand of banks' results in the attainment of monopoly rent in concentrated markets. Accordingly, the oligopolistic behaviour of banks indicates that relative to non-involvement, collusive arrangements are less expensive to maintain in concentrated markets (Stigler 1964). In that regard, Bain (1951) hypothesizes that greater market concentration lowers the cost of collusion between banks which result in higher than normal profits for all competing banks in a banking industry. Similarly, relative to loan rates, deposit rates are significantly lower in greater concentrated markets (Berger and Hannan 1989). The structural method uses the number of banks or the degree of concentration in the banking market as a proxy for market power. The relationship between concentration and market structure can be measured with Hirschman-Herfindahl index and concentration ratios (Bikker and Haaf 2001). However critiques suggest that market concentration of the banking industry is not a random variable. Particularly the popular works of Demsetz (1973, 1974) and Peltzman (1977) argue that concentration is the consequence of competitive efficiency of the top banks in the banking industry.

Conversely, the efficient structure hypothesis (ESH) challenges the structure-conduct-performance on the grounds that market concentration is not an unsystematic event but an endogenous variable. Thus, the confirmatory observed relationship between concentration and profitability is spurious and a proxy for the link between superior efficiency, market share and concentration. Subsequent extensions of the SCP hypothesis also postulate that, individual banks in their respective markets may have informational advantages as a result of their local dominance. In view of that, market share is used as a proxy for efficiency in the banking industry by later researchers. A positive co-efficient usually supports the ESH (Smirlock 1985). Accordingly Cetorelli (1999) suggests that there is a nonlinear relationship between market power and concentration. This implies that, banks tend to collude and act as monopoly firm thereby setting prices above the competitive price level as markets increasingly become concentrated. The key advantage in the SCP paradigm is the non-requirement of market price, yet it does not permeate the quantification of the market power it finds.

In spite of the substantial literature attempting to model the market structure, efficiency, profitability and behaviour of banking firms in the banking industry, the literature is still unsettled and mixed. That's why regardless of the critique, recent works on the banking market structure and efficiency still uses market share as a proxy for efficiency. This could be attributed to the fact that market share plays a significant role in bank performance (see for example Berger and Hannan 1989, Molyneux and Forbes 1995, Maudos 1998). The recent works by Barajas, et al (1999, 2000) points out that, the performance indicators of banks are positively related to market share. In the same way this is a reflection on the complexity on the microeconomic foundations of the banking industry.

Several studies have tested the structure-conduct-performance hypothesis against the efficient structure hypothesis models and vice versa in the banking industry in both developed and developing countries. In the work of Smirlock (1985) and Evanoff and Fortier (1988), a positive link between market share and profitability was found. However, owing to observational association, the two alternative hypotheses could not be differentiated. The study of the Spanish banking industry by Lloyd-Williams et al (1994) found a positive link between market share and performance between 1986 and 1988, however their study was inconclusive. The examination of the SCP hypothesis in Sweden, Norway, Finland, Austria and Switzerland were examined by Molyneux and Teppet (1993) and found evidence of the SCP hypothesis. Although, Molyneux (1993) model for Portugal, Spain, Sweden, UK and Turkey did not measure efficiency, a positive association between market share and profitability in those banking markets were documented. However, Ruthenberg (1994) found that in banking markets where barriers of entry are high, market concentration tend to result in higher profits. High level of collusion is predominant in the banking industry in Spain, Belgium, Portugal and Ireland (Vander and Vennet 1993). Due to the limitations of the SCP models to define the relationship between market power and concentration, the New Empirical Industrial Organization is proposed by Bresnahan (1982), Lau (1982) and Panzar and Rosse (1987).

The New Empirical Industrial Organization (NEIO) approach is elaborated to test empirically the competitive conditions in banking markets in non-structural applications. NEIO provides empirically related tests based on either aggregate industry data (Bresnahan 1982, Lau 1982) or individual firm data (Panzar and Rosse PR 1987). Bresnahan (1982) and Lau (1982)

estimate demand, supply and price equations simultaneously but PR (1987) allow for bank-specific differences in production functions given that banks are examined under long-run equilibrium. Both empirical techniques identify static models of industry which are accustomed with the actual data. Data availability at the firm level presents an advantage to the PR test in terms of bank competition. This is because revenues are more noticeable than data on output prices and quantities. As a consequence of that, most empirical literature that assess the competitive conditions in the banking market are adapt with the PR method in estimating the reduced form revenue equations of the market participants.

It is imperative to note, application of the NEIO paradigm from classical industry to the banking industry necessitates key assumptions with regards to banks production activity. Freixas and Rochet (1998) suggests that the production approach view the banking firm as an entity producing services amid loans and deposits accounts. Such that interest payments are not inclusive in the cost function amid output measured by the number of deposit account serviced and loans initiated to households albeit individuals or firms in the banking market. Whereas the intermediation approach postulated by Sealey and Lindley (1977) considers the bank as a firm that collects deposits and other respective funds in order to transform the mobilised funds into loans and other financial assets. The transformation of mobilised funds to loanable funds necessitates employing labour and physical capital. These inputs come with their respective costs along with interest payments on deposits and other funds that enter the bank's cost function. Typically, the output is measured by the loans and investments recorded in the balance sheet at the end of the financial year.

The crucial point is that, the production approach and the intermediation approach give different consideration to bank deposits. While the production approach considers banks as an entity producing deposits and loans, labour and fixed assets as inputs, the intermediation approach considers loans as outputs and interprets bank deposits as the key input factor. Consequently, in determining the classification of banks operations into inputs and outputs, a 'user cost methodology' were developed by Hancock (1991 p. 27-32). Accordingly Hancock (1991) estimates the user cost of financial services and classify services with positive user costs as bank inputs and those with negative user costs as outputs of a bank. Her empirical work considers all aggregate loans to have negative user costs and considers them as outputs. But with regards to deposits, there is little clarity. This is due to the fact that, while time

deposits have positive user costs and categorise them as inputs, bank demand deposits are classified as negative user costs and gauged as outputs. However, the empirical works of Hughes and Mester (1993 a, b) classify bank demand deposits as inputs.

In line with previous studies for example Molyneux (1994),Molyneux et al (2008), Bikker and Groeneveld (1998), Claessens and Laeven (2003) and Levy and Micco (2003), we assume that all funds are an input in the bank's production function as a consequence of the intermediation approach. Additionally, this chapter employs both structural and non-structural methodologies to assess market concentration and tests for competition. The results of this chapter have significant policy implications to enhance on the financial health of the Ghanaian banking system.

That said, competition in the banking market and the efficiency of banks are crucial factors that may impact on the performance and the financial health of banks (Bikker and Boss 2005). From the perspective of individual households and firms, high level of competition is prudent because it tend to keep transaction cost of banks low while maintaining higher level of services across the financial system. However, higher level of competition ought to be a systematic process due to the fact; a sudden increase in competition could trigger insolvency. This could threaten the financial system and hence financial stability (Bikker and Boss 2005). Liberalization of the financial sector encourages competition through the entry of new banks, removal of interest rate controls as well as the removal of credit ceilings thereby offering banks greater liberty to compete hostilely for customers.

Accordingly, the seminal works of McKinnon (1973) and Shaw (1973) gave way to a large body of theoretical literature that in support that a well-functioning financial sector nurtured by sound financial sector reforms is a vital condition for accelerating investment, economic growth and financial development (see for example Fry 1995, Jafee and Stiglitz 1990, Greenwald and Stiglitz 1990, Levine 2005). In particular, there is consensus that while financial repression creates uncompetitive intermediary based financial markets (Reinhart and Tokatlidis 2003), prudent market conditions and competition from foreign banks culminate in banking efficiency thereby narrowing transaction costs which stimulates savings and investment and hence increasing economic growth.

3.1.3.1 Empirical Literature: Competition and Concentration in the Banking Sector

Empirical evidence on the degree of competition in the banking market using the PR methodology is varied. Shaffer (1982) reveals monopolistic competition among banks in New York post deregulation of deposit interest rates in the 1980s. Nathan and Neave (1989) reports that part of the Canadian banking market exhibit characteristics of contestability. They found perfect competition for 1982 whereas monopolistic competition for 1983-1984 for Canadian banks. Molyneux et al (1994) tested the Panzar-Rosse H-statistic on a sample of banks in France, Italy, Germany, Spain and the UK for the period 1986-1989. They found monopolistic competition in the market structure of all the EU countries except Italy where the monopoly hypothesis could not be rejected-a result that was later contradicted by Coccorese (1998) and Trivieri (2007). De Bandt and Davis (2000) also assessed the effect of the Economic and Monetary Union on market conditions for banks in the Eurozone over the sampled period 1992-1996. Additionally, they compared the behaviour of large and small banks in the Eurozone vis-à-vis a US banking sample. They concluded that, relative to US banks, the behaviour of large banks are not fully competitive while smaller banks in France, and Germany is characterised with lower level of competition.

Other research by Rime (1999) on banks in Switzerland and Bikker and Groenveld (2000) on 15 EU countries also suggests the presence of monopolistic competition in the EU banking market structure. This finding was later confirmed by Bikker and Haaf (2002). The competitive conditions and market structure for 23 developed countries including Europe, the US, Canada, Japan and Australia for the period 1988-1998 were examined by Bikker and Haaf (2002). They report that the market structure of banks in most of those countries exhibits monopolistic competition. Their estimation also showed that competition is weaker among small banks that operate mainly in local markets and stronger in inter-national markets which is typically operated by large banks.

Further works have extended the standard specification of the PR *H* statistic to account for bank efficiency. Casu and Girardone (2006) examined 15 former EU member countries and concluded that the degree of concentration has no association with the level of competition. Similarly, Staikouras and Koutsomanoli-Fillipaki (2006) find evidence of monopolistic competition for 25 EU member countries for the period 1998-2002. They document that, while larger banks behave more competitive relative to smaller banks, new EU member

countries showed higher levels of competition than earlier EU member countries. Equally, the competitive conditions among major UK banks is characterised by monopolistic competition (Mathews, Murinde and Zhao 2007). Mathews, Murinde and Zhao (2007) conclude that, even though competition appears to have become less intense in off-balance sheet activities, the level of intensity in the core market remained unchanged for the UK banking market.

Contemporary research works on emerging and developing economies on competitive market structure using the PR method is getting momentum. Yuan (2006) examined the Chinese banking industry and documents that; China's financial system was near to perfect competition prior to the entry of foreign banks. The evolution of market structure in emerging banking markets during the 1990s were examined by Gelos and Roldos (2004). They found that while concentration in the emerging banking systems increased during the 1990s, the banking markets in 8 Central European and Latin American countries have not become less competitive. Also, the deregulation of financial systems by way of lowering barrier of entry did not culminate in a fall in competition. However the level of competition in Uganda banks increased significantly due the entry of foreign banks (Hauner and Peiris 2005).

However, research on the Ghanaian banking market is scant. Following Gelos and Roldos (2002), Buchs and Mathisen (2005) examined the degree of competitiveness in Ghana's financial system over the period 1998-2003. Their results indicate monopolistic market conditions in the Ghanaian banking system over the period. They concluded that the structure of the Ghanaian banking system as well as other market characteristics constitutes an indirect barrier to entry. However, Owusu-Antwi and Antwi (2013) investigated the market structure of Ghana's banking industry over the period 1988-2011 using non-structural methods and find perfect condition for Ghanaian banks. Interestingly, according to Owusu-Antwi and Antwi (2013) there is no evidence of a change in the level of competition as a consequence of financial liberalisation in Ghana.

3.1.4 Financial Sector Reforms, Bank Concentration and Competition

Concentration ratios (CR) and the Herfindahl-Hirschman Index (HHI)

In line with preceding empirical studies in banking market competition (Molynuex et al 2008), market concentration indices measured by *'concentration ratios (CR)'* and the Herfindahl-Hirschman Index (*HHI*) are used as indicators to determine the level of market

concentration in Ghanaian banking industry. '*CR*' concentration ratio is the sum of the market shares *(MS)* of the *m* largest banks in the relevant market –calculated by the ratio of the individual bank's total assets to the sum of all banks' total assets in the banking market. Higher *'CR'* concentration ratio is indicative of higher market power of *'CR'* banks of *m*-banks in market and higher degree of concentration and low degree of market competition. This chapter measures the three-bank *(CR3)* and the five-bank *(CR5)* concentration ratios of the banking market on bank's deposits, assets and loans.

Equally, the *HHI* is computed as the sum of the squared market shares of each firm within the respective market under scrutiny or:

$$HHI = \sum_{i=1}^{n} (MSi)^2 \tag{3.1}$$

where, MS_i is the market share of an individual bank, i and n represents an individual bank and the number of banks in the banking industry respectively. As mentioned in the US Merger Guidelines, a HHI index less than 1000 indicates a competitive banking market; HHI between 1000 and 1800 indicates a moderately concentrated market. But HHI index more than 1800 indicates a highly concentrated banking market. It follows that, an increasing HHI is indicative of a decrease in market competition and an increase in the market power of the larger banks, whereas a decreasing HHI implies an increase in market competition. The significance of the HHI is that it captures the number of participating firms in the banking industry which is not considered in the '*CR'* concentration ratios. Additionally, three HHI indices are computed based on total deposits, total assets and total loans.

The Panzar-Rosse (PR, 1987) Analytical Framework

Given the zero profit constraints in equilibrium, the PR estimation consist of estimating the reduced form revenue equation equations (R^*) of the banks derived from marginal revenue and cost functions (Buchs and Mathisen 2005).

$$R_i = (y_i, n_i, z_i) \tag{3.2}$$

$$C_i = (y_i, p_i, x_i) \tag{3.3}$$

where $R =$ total revenue of bank i

$C =$ total revenue of bank i

$y =$ output of bank i

$_z$ = exogenous variables affecting bank i revenue.

$_{n=}$ total number of banks

$_{p=}$ input prices

χ = other exogenous variables

In equilibrium, marginal costs (MC_i) equate marginal revenues (MR_i) due to bank i profit maximization.

$$\text{Thus: } MC_i(y_i, p_{i,j}, x_i) = MR_i(y_i, n, z_i), \tag{3.4}$$

Given the zero profit constraints, profit of bank i is defined by $\pi_i = R_i(y_i, n_i, z_i) - C_i(y_i, p, x_i)$. This implies that, in equilibrium, the zero profit constraints holds at the market level:

$$\frac{\partial R_i}{\partial R_i\ (y_i, n_i, z_i)} - \frac{\partial C_i}{\partial C\ (y_i, p_i, x_i)} = 0 \tag{3.5}$$

The profit maximizing output is given by equation (3.6) with equilibrium values assigned *:

$$y^*_i = y^*_i(z_i, p_i, x_i) \tag{3.6}$$

Substituting equation 3.6 into equation 3.2 with the assumption that n is determined endogenously yields the reduced form revenue equation:

$$R^*_i = R^*_i(y^*_i(z_i, p_i, x_i), n^*, z_i) \equiv R^*(z_i, p_i) \tag{3.7}$$

The sum of these elasticities indicates the *H-statistic* with respect to the input prices allowing inference about the bank's competitive conduct is defined by Panzar-Rosse as:

$$H = \sum_{j=i}^{n} \frac{\partial R_i^*}{\partial p_i} \times \frac{P_{i'j}}{R_i^*} \tag{3.8}$$

Panzar-Rosse postulates that, the sign and the magnitude of the *H-statistic* is a measure of competition, which corresponds to the sum of the elasticities of the reduced form revenue equation with respect to factor prices. Depending on the extent of market structure albeit perfect competition, monopoly or imperfect competition) changes in factor input prices will completely, partly or have an impartial impact on gross interest income.

Therefore market equilibrium is characterized with perfect competition where H is equal to 1 with the assumption that firms' cost functions are linearly homogenous in the factor prices, the production functions are homothetic. Here, the factor prices are exogenous to bank i and the elasticity of the perceived demand of the bank is non-decreasing in the number of rivals

amid free entry and exit of banks' from the banking system. That's why under perfectly competitive equilibrium, discrimination between more or less efficient banks ought to have resulted in entry and /or continuation of the former as well as the exit of the latter. The long-run equilibrium is characterized with banks operating in the minimum level of average costs which is equal to the price. Therefore an increase in input prices could lead to a proportionate increase in price at the firm level to a proportionate increase in revenue, hence H=1. This is indicative of the upward shift of the average cost function without altering the optimal level of output at the minimal of average costs. Nonetheless, at the industrial level, the higher price will lead to lower demand and hence a less than proportionate increase in banking industry revenues culminating in the exit of inefficient banks from the banking market (Panzar-Rosse 1987 p.452).

In contrast, in a monopolistic competition, an increase in input prices p will increase marginal cost, thereby reducing equilibrium output y^* and revenue which is consistent with H statistic values less than or equal to zero. Given differentiated products offered by the banks, the profit maximizing firms are confronted with a falling aggregate demand curve and behave like monopolists, thereby resulting in equalizing marginal costs and marginal revenues at the equilibrium level (Panzar-Rosse 1987 p. 448-451). Owing to the market exit and entry of imperfect substitutes, the demand curve also shifts to correspond with the monopolist earning zero profits. Additionally negative value for H-statistic is associated with monopoly or perfectly collusive oligopoly. Such that an increase in input prices causes marginal costs to rise and –by setting marginal costs to marginal revenues equally reduces the equilibrium output and the banks' revenues. Nonetheless, negative H values ought to be treated with caution, since it is not necessarily caused by monopoly or perfectly collusive conduct (Panzar and Rosse 1987 p.446). In line with literature **Table 4** presents the key discriminatory powers of the H-statistic.

Table 4: Interpretation of Panzar-Rosse H-statistics

Values of H	Market Structure
$H \leq 0$	Monopoly, Colluding oligopoly, conjectural variations of oligopoly
$0 < H < 1$	Monopolistic competition
$H = 1$	Perfect competition, natural monopoly in a perfectly contestable market

Source: Panzar-Rosse (1987)

Following assumptions ought to be considered prior to assessing banks' market conduct and interpreting H-statistic values:

- banks operates in (long-run) equilibrium.
- with the exception of a purely monopolistic market structure, the performance of the banks is influenced by the actions of other participating banks.
- the cost structure is homogenous and the production function is a standard Cobb-Douglas function with constant return to scale.
- price elasticity of demand for bank products is greater than 1.

Given the intuition of the PR model, it is prudent to link the equilibrium as a steady-state reflecting adjustment to shocks. In view of that, the following assumptions are necessary Gelos and Roldos (2002). Firstly, in general banks are assumed to behave as single-product firms using labour, capital as well as intermediate funds as inputs. Lastly, the prices of input are assumed to be associated with higher quality of services, as the contradictory might entail higher revenues thereby preconceiving the value of the *H-statistic.* Notwithstanding the above drawbacks, because revenues are estimated and not output prices, data availability become much less of constraint since data on revenues is more likely to be observable relative output prices and quantities. Reduced-form revenue equation is often possible even though the structural equations cannot be estimated. Related to this is the special importance in the case of structural supply equation due to lack of supply side data. Also, in the case of prices, there is no need for quality corrections (Bresnahan 1989 p. 1035). Finally, the *H-statistic* depend on industry specific characteristics, since the behavior of individual banks themselves gives an indication of their market power-therefore, cross-country comparisons may be misleading.

3.1.5 Application of PR to the Ghanaian Banking System

Following the empirical literature on competition in banking markets (Bikker and Haff 2002, Casu and Girardone 2006, Molynuex et al 2006, Perera et al 2006) this chapter employ the reduce-form revenue equations of the market participants derived from the marginal and cost functions and the zero profit constraint in equilibrium as specified by Panzar-Rosse (1987). Assuming long-run market equilibrium, Panzar-Rosse (1987) approach assesses the impact of changes in factor prices on the revenue under different market conditions (structures). The prices of individual bank differ in response to the change in their respective costs of factor inputs, labour inputs and capital inputs. Related to this is that, the sum of these costs of inputs determining the degree of market competition in the banking market.

A Cobb-Douglas intermediation technology is used to describe the dataset of Ghanaian banks and estimate the sum of the factor elasticities (denoted by $\beta_1, \beta_2 and \beta_3$) with respect to banks' revenues. Assuming that bank *i* faces financial services demand function with constant elasticity and a Cobb-Douglas technology, the magnitude of the H-statistic may be interpreted as a measure of the degree of competition in the Ghanaian banking market. The following fixed effect reduced form panel data regression (PR) model is estimated for the interest based market:

$$\begin{aligned}\log(INC_{it}) &= \alpha + \beta_1(\log IEXP/TDEP_{it}) + \beta_2(\log WA/TDEPLOAN_{it}) + \beta_3(\log DE/FA_{it}) \\ &+ \beta_4(TLA/TA_{it}) + \beta_5(TA_{it}) + \beta_6(NPL/TLO_{it}) + \gamma_1 \log(\pi_{it}) + \gamma_2 \log(GDP_{it}) + \lambda_t + \varsigma_t + \varepsilon_{it}\end{aligned} \quad (3.9)$$

INC in Equation (3.9) is the dependent variable to estimate the *H-statistic*. INC is the log of the ratio of interest income to total assets for bank *i* at time *t*. The choice of INC as the dependent variable is consistent with the approach that financial intermediation is the core business in universal banking. This approach was applied by De Bandt and Davis (1999), Bikker and Haff (2002) and Molynuex et al (2006) since the ratio of interest revenue to total assets of the balance sheet form an equation of prices. However, Shaffer (1982) and Nathan and Neaves (1989) opted for total revenue as dependent variable. $i = 1,..n =$ number of observed banks in the Ghanaian banking market.

Factor input prices for funds are represented with the variables $IEXP/TDEP_{it}$ is the total interest expenses to total deposits, $WA/TDEPLOAN_{it}$ is the ratio of personal (wages) expenses to total deposits and loans which indicates costs of labour inputs, DE/FA_{it} is the price of physical capital expenditure and other expenses related to fixed assets which represents the cost of capital inputs for individual bank. The individual bank specific control variables are TLA/TA_{it} is the ratio of total loans and advances to total assets TA_{it} is total assets and NPL/TLO_{it} is the ratio of non-performing loans to total loans outstanding ratio.

Macroeconomic risk component of the local economy is proxy as π_{it} since the interest rate spread (or the transaction cost) charged by banks is determined by inflationary pressures and GDP_{it} represents the economic growth rates for the period under-study. In addition, λ_t represents time specific constant or time effect accounted for by including time dummy variables, ς_t indicate bank specific constant or individual effect and ε_{it} correspond to error terms with the endogenous variable, INC_{it}. Since the PR model follows the log-linear form, as indicated above the sum of factor, labour and capital elasticities indicate the H-statistic for the banking market. It follows that the value of the H-statistic is associated with the competitive environment and corresponding behaviour of banks. Following Perera et al (2006) an additional specification of the form is developed for total revenue of banks for the total banking market:

$$\begin{aligned}\log(T\,\mathrm{Re}\,v_{it}) &= \alpha + \beta_1(\log IEXP/TDEP_{it}) + \beta_2(\log WA/TDEPLOAN_{it}) + \beta_3(\log DE/FA_{it}) \\ &+ \beta_4(TLA/TA_{it}) + \beta_5(TA_{it}) + \beta_6(NPL/TLO_{it}) + \gamma_1\log(\pi_{it}) + \gamma_2\log(GDP_{it}) + \lambda_t + \varsigma_t + \varepsilon_{it}\end{aligned} \quad (4.0)$$

where the dependent variable $T\,\mathrm{Re}\,v$ is the sum of interest income, fees and commissions and other operating income.

Next it is imperative to note that both interest based market (Equation 3.9) and total market (Equation 4.0) are computed with a fixed effect (within) panel regression. The fixed effect is motivated by country specifics that face banks in terms of supervisory and macroeconomic environ. Also, we intend to capture the effect of model variables that are peculiar to the individual bank data that are constant overtime. Lastly, for consistency the independent

variables in both interest based market (Equation 3.9) and total banking market (Equation 4.0) are the same.

3.1.6 Tests of Equilibrium and Robustness Checks

Tests of Equilibrium: A key fundamental assumption of the PR model is in the long-run, factor, capital and labour inputs are not associated with industry return. This proposition is tested empirically when the sum of elasticities $\beta_1(\log IEXP/TDEP_{it}) + \beta_2(\log WA/TDELOAN_{it}) + \beta_3(\log DE/FA_{it}) = 0$. Following Casu and Girardone (2006) and Perera et al (2006) we test the proposition that with the presence of long-run equilibrium, factor prices are not linked with industry return in the Ghanaian banking system.

$$\begin{aligned}\log(ROA_{it}) &= \alpha + \beta_1(\log IEXP/TDEP_{it}) + \beta_2(\log WA/TDEPLOAN_{it}) + \beta_3(\log DE/FA_{it}) \\ &+ \beta_4(TLA/TA_{it}) + \beta_5(TA_{it}) + \beta_6(NPL/TLO_{it}) \\ &+ \gamma_1 \log(\pi_{it}) + \gamma_2 \log(GDP_{it}) + \lambda_t + \varsigma_t + \varepsilon_{it}\end{aligned} \quad (4.1)$$

where ROA is return on assets with the same independent variables as in the interest based market and total market. The parameters in Equation 4.1 are estimated using fixed effect estimators. The Walt test for null hypothesis of linear combination is not rejected as reported in Appendix 1. The F-statistic is 0.123 with p-value of 0.611. The results indicate that input prices are not related with banking industry return. As reported in Appendix 1, these results validate the empirical results reported in **Tables 10** and **11**.

Robustness checks: To validate PR Model results, the H-statistic is estimated using pooled ordinary least square method as well as random effect method. The estimates from both methods lead to similar conclusion as reported in Appendix 2.

3.1.7 Data and Methodology

Bank-level financial statements and profit and loss accounts were retrieved from individual bank's annual report and the Bank of Ghana annual reports. The sample considers all the Class 1 universal banks operating in Ghana for the sampled period of nine years from 2003 to 2012. There are a minimum of 17 banks (for 2003) and a maximum of 25 universal banks (for 2012) in each year during the period. Two small banks namely Energy Banks (Ghana)

and the Royal Bank Ltd were not included due to data unavailability. While there are other financial institutions (rural & community banks, leasing & finance companies, savings & loans companies, microfinance companies and credit bureaux's) that provide banking and limited banking activities to households and firms, yet the share of universal banks on total financial institutions assets is more than 12 percent over the sampled period (Bank of Ghana Annual Report 2013). Also, the nine year sample period is regarded as satisfactory in capturing the characteristics of Ghanaian banking industry due to the entry of 8 foreign banks and the merger of two banks. In that regard, the sample used in this study may be a reflective of the Ghanaian banking industry.

3.1.8 Empirical Results and Discussions

3.1.8.1 Financial Sector Reforms and Bank Concentration Ratio

The Ghanaian banking industry is generally characterised by the dominant position of the five large banks. The share of these five banks in the overall assets of the banking industry was 74 percent in 2003. As a consequence of the ongoing financial liberalisation reforms, the structure of the banking system in the country has evolved substantially. At the same time, the total number of banks operating in Ghana increased from 17 in 2003 to 27 in 2012, 80 percent of these new banks' is foreign-owned banks with the remaining domestic private banks. The increase in the number of banks and expansion of banking activities helped in reducing concentration in the banking sector as the asset share of the top-five banks in the overall assets of the banks decreased to 46 percent by 2010. Since then, the overall assets of the top five-banks have remained at 46 percent (between 2010 and 2012). **Table 5** depicts the market share of the three and five largest banks in terms of assets, deposits and loans and advances as measured by the CR3 and CR5. In recent times, the three-bank concentration ratio on total assets has decreased from 54 percent in 2003 to 32 percent in 2012, representing a 20 percent decline.

Table 5: Bank Concentration Ratios (%) for Deposits, Loan and Assets (2003 to 2012)

Year	No. of Banks	Deposits		Loans		Assets	
		CR3	CR5	CR3	CR5	CR3	CR5
2003	17	0.55	0.72	0.54	0.72	0.54	0.74
2004	18	0.53	0.60	0.51	0.72	0.47	0.65
2005	20	0.49	0.65	0.47	0.66	0.45	0.65
2006	23	0.46	0.62	0.42	0.56	0.43	0.62
2007	23	0.45	0.62	0.45	0.59	0.42	0.58
2008	23	0.40	0.60	0.42	0.56	0.39	0.53
2009	25	0.35	0.54	0.36	0.49	0.35	0.50
2010	25	0.32	0.49	0.29	0.45	0.31	0.46
2011	25	0.33	0.48	0.26	0.41	0.32	0.46
2012	27	0.33	0.47	0.27	0.40	0.32	0.46

Source: Ghana Banking Survey (2003-2012)

Likewise, the level of and the trend for concentration ratios on deposit is quite similar to the total assets base concentration ratios in the banking sector. In 2003, the share of the CR5 banks in the total deposit of the banking sector was 72 percent which decreased to 47 percent in 2012, representing a 26 percent fall over the period. Notwithstanding that in theory the market for deposits is considered as more concentrated than the other banking segments owing to the important factors determining the depositor's decisions (for example bank size).

The CR5 banks in terms of loans and advanced to households and firms in the Ghanaian economy decreased from 72 percent in 2003 to 40 percent in 2012. In addition, the market shares of the three and five largest banks in the banking sector in terms of total assets, total deposits and total loans and advances have notably decreased over the last ten years (2003 to 2012) particularly since 2010. The increasing interest by foreign investors or foreign banks towards the domestic banking market has caused significant changes in the dynamics of the Ghanaian banking industry. The significant decrease in the concentration is a reflection on the changing market structure of the Ghanaian banking sector. Similarly, Aboagye-Debrah (2007) found a reduction in market concentration for the six large banks from 86% in 2000 to 71% in 2005. Indeed, the Ghanaian banking sector presents a relatively low concentration when compared with other Sub-Saharan African banking industries. **Table 6** indicates that Algeria as an economy having the most concentrated banking sector with 86 percent of assets held by the top-three banks against 50 percent in Morocco and 45 percent in Tunisia.

Table 6: Three-bank Total Asset Concentration Average in Selected Countries

Country	Period	Concentration
Ghana	**2003-2012**	**0.4**
Algeria	2000-2006	0.86
Morocco	2000-2006	0.5
Tunisia	2000-2006	0.45

Source: Author's calculation (Ghana); Turk-Ariss (2009) Table 1

Related to this trend is the impact of the accomplished bank mergers and acquisitions in Ghana. On the other hand, these mergers and acquisitions have been associated with increased profits, business volume expansion and technological developments. Taking these developments into account, the consolidation process would appear to signal positive developments from the perspective of the borrower albeit individual household or firms: gradual efficiency increased and greater market contestability in that regard. The presence of foreign-owned banks on the domestic banking sector contributed to the maintenance of the banking system's stability. In sum, the evidence suggests increasing market competition in the Ghanaian banking industry. The rate of change in CR3 with regards to assets, deposits and loans is more than that of CR5, which also suggests the emergence of new larger players in the banking sector.

Figure 6 and **7** confirm that the concentration of Ghanaian banks on the market for deposits is quite similar to the concentration on the market for loans and advances. CR3 and CR5 has been characterised with a decreasing trend in the deposits and loan markets. Thus CR3 and CR5 values vary around 0.41 and 0.56 during the period 2003-2012.

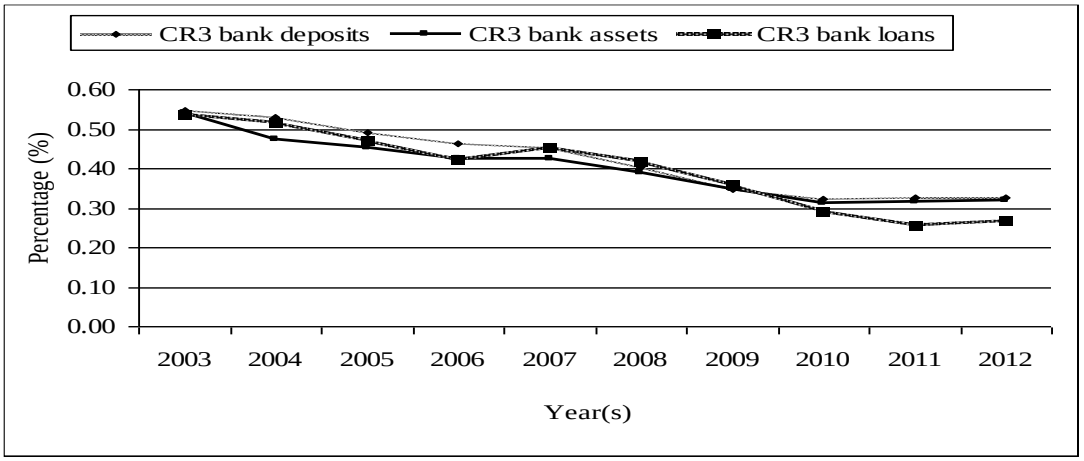


Figure 6: **CR3 based on deposits, assets and loans (2003 to 2012)**
Source: Author's calculations based on Ghana Banking Survey (2003-2012)

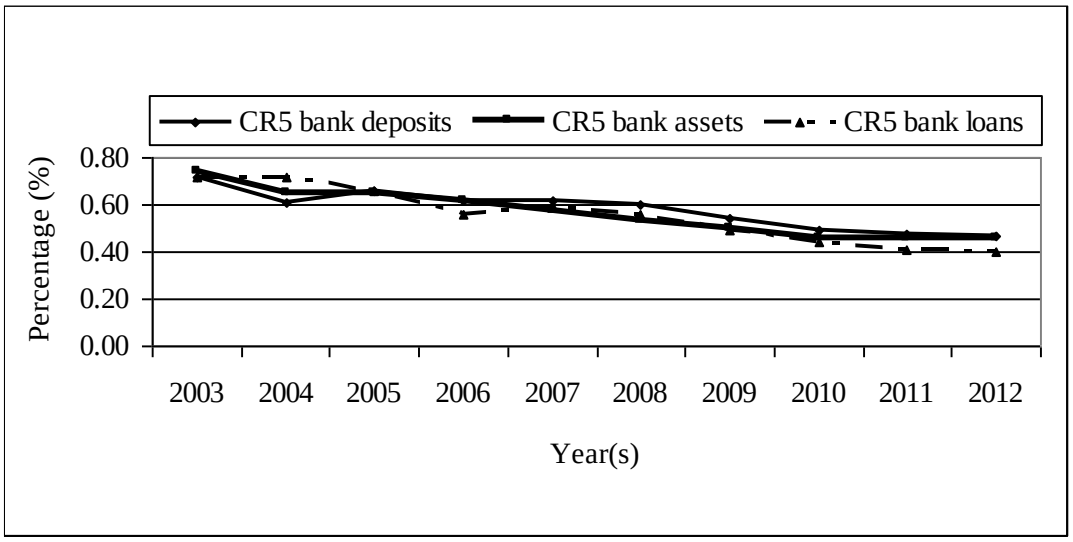


Figure 7: **CR5 based on deposits, assets and loans (2003 to 2012)**
Source: Author's calculations based on Ghana Banking Survey (2003-2012)

3.1.9 Hirschman-Herfindahl Index

Even though the three and five bank concentration ratios provided useful information about the market structure of the Ghanaian banking industry, measures of the concentration ratio do not take into account all the 27 number of universal banks operating in the banking sector. This is because; the number of market participants in the banking sector is directly related to issues of concentration and competition. Since, the US Department of Justice provided numerical guidelines on competition by recognising the importance of the concentration and dispersion index, the Hirschman-Herfindahl Index (HHI) has been widely applied in empirical banking research on competition issues including mergers and acquisition. Evidently, the HHI considers both the relative size and total number of banks in the banking industry.

Table 8 provide the summary results of the HHI on total deposit, total loans and advances in addition to total assets of the Ghanaian universal banks for the period 2003 to 2012. It is observed that, the values of HHI for all the most important indicators of the banking industry decreased over the sample period. The evidence suggests that between 2003 and 2005, the Ghanaian banking industry was moderately concentrated (HHI were above 0.10) in deposits, assets and loans to households and firms.

Over the ten-year period of analysis, the HHI for deposits was 0.1304 in 2003 but decreased by almost half to 0.0625 in 2012. Likewise, assets and loans also witnessed similar reductions

in HHI. The HHI for assets and loans were 0.1305 and 0.1237 in 2003 and decreased to 0.0609 and 0.060 respectively in 2012. Even though, there is significant decline in HHI for deposits, assets and loans from 2003 to 2006, the most significant decline is witnessed in the HHI for loans which decline from 0.1237 to 0.0837, for 4 years period.

Table 7: Herfindahl-Hirschman Index

Year	No. of Banks	Deposits	Assets	Loan
2003	17	0.13037035	0.13046511	0.12374881
2004	18	0.11910909	0.10293223	0.12374181
2005	20	0.10867451	0.10294369	0.10507635
2006	23	0.09937744	0.09453256	0.08370853
2007	23	0.09722355	0.09043894	0.080177
2008	23	0.080177	0.076447	0.09732249
2009	25	0.067508	0.0686	0.089989
2010	25	0.062288	0.060207	0.065579
2011	25	0.064115	0.060938	0.06051
2012	27	0.06246	0.060935	0.060028

Source: Author's calculation based on Ghana Banking Survey (2003-2012)

Relatively, HHI for deposits and assets from 2003 to 2006 were 0.1304 and 0.1305 but decreased to 0.0993 and 0.0945 over the 4 year period respectively. Similarly, the annual figure for HH indices indicate that there is a year lag in terms of deposits and assets market behind the loan market in the Ghanaian banking industry. While the break point for loan market is 2006, for deposits and assets markets is 2007. Evidently, the lower HHI for loan is an indication that the loan market in the banking sector is more competitive relative to deposits and assets markets in 2006. A comparison between the Hirschman-Herfindahl indices for deposits, assets and loans suggest that there is a dominant market leader in the loan market which account for the higher HHI in 2008. By and large, the behaviour of the industrial player with commanding market share dictates the pattern of the HH index. For example, prior to 2010, Ghana Commercial Bank with almost 22 percent (Ghana Banking Survey, 2003) coverage in terms of locations in towns and cities have had higher market shares in deposits, assets and loans which give credence to the old adage that ‘you cannot give what you don’t have’.

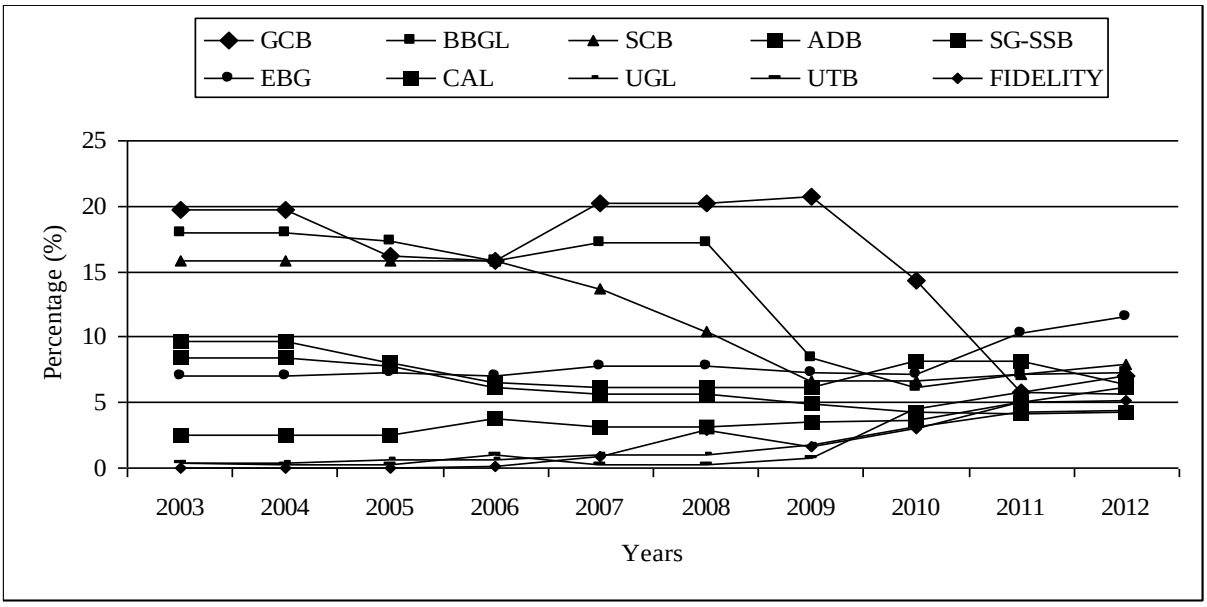


Figure 8: Trends of Market Share in the Loan market of the Top 10 Banks (2003 to 2012)
This figure shows the trend of market shares of banks in the loan market of the top 10 banks from 2003 to 2012. Convergence of loanable market share in 2012 is indicative of intensified market competition in loan market.
Source: Author's calculations based on Ghana Banking Survey (2003-2012)

From **Figure 8** above it is evident that, in 2003, the market share of the GCB has been reduced. This is due to the entry of 10 foreign-owned banks which has intensified competition in the loanable market thereby culminating in the convergence of market shares in the loans market in 2012 with GCB, BBGL and SCB loosing grounds to new entrants in the Ghanaian banking sector.

Similarly, **Figure 9** below captures the trend of HH indices for the 10-year period understudy. The overall results, suggest less concentrated (as suggested by US 1992 Merger Guidelines) banking market in Ghana in Sub-Sahara Africa. The appropriateness of the Hirschman-Herfindahl indices is observed when compared with international banking sectors in terms of total asset concentration. The differences across economies in the HHI asset concentration could be attributed to the differing number of banking institutions.

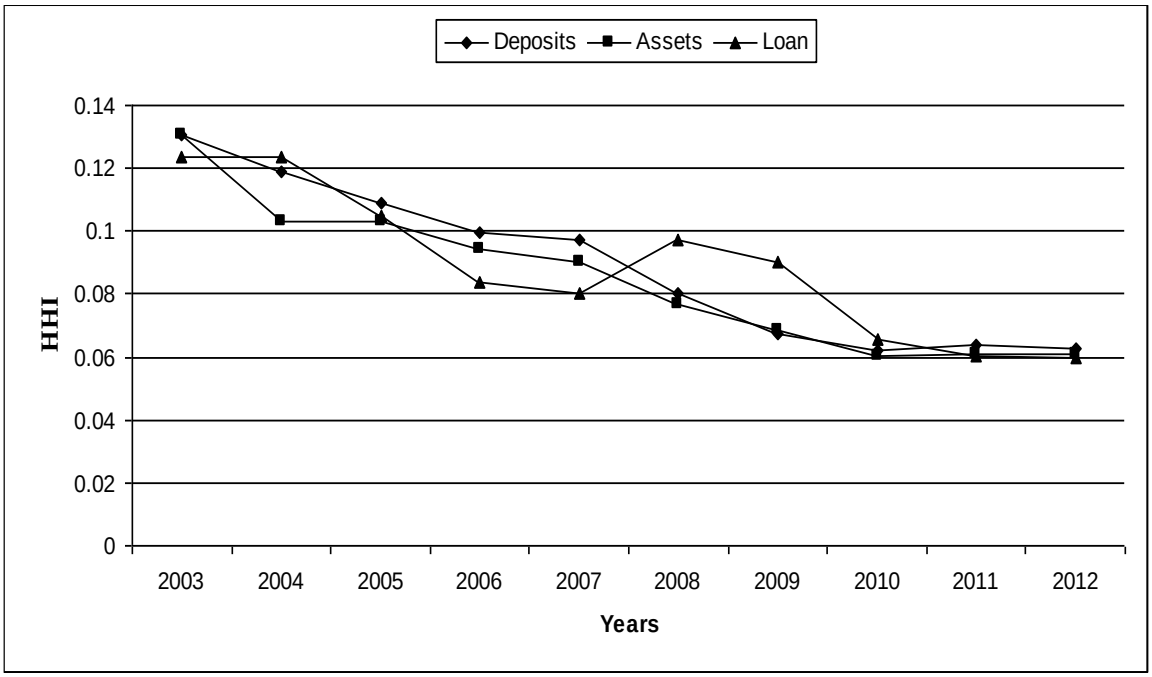


Figure 9: HHI Index for Deposits, Assets and Loans (2003 to 2012)

This figure shows the trend of market shares of banks in terms of deposit (HHID), asset (HHIA) and loan (HHIL) of all universal banks from 2003 to 2012.The decreasing trend in the three leading indicators (HHID, HHIA and HHIL) as measured by Hirschman-Herfindahl Index (HHI) suggests a competitive banking market in the Ghanaian banking industry over the last decade.

Source: Author's calculations based on Ghana Banking Survey (2003-2012)

Table 8: HHI: Total Asset Concentration Average International Comparison

Country	Number of Banks	HHI
Australia	31	0.14
Canada	44	0.14
Denmark	91	0.17
France	336	0.05
Germany	1803	0.03
Ghana	**27**	**0.09**
Italy	331	0.04
Japan	140	0.06
Switzerland	325	0.26
UK	186	0.06
US	717	0.02

Source: Author's calculation (Ghana); Bikker and Haaf (2002), Table 2

In sum, the process of financial sector reforms corresponding with economic sector reforms over the past decade in the Ghanaian economy has culminated in structural changes in the banking sector. Such that, the process of deregulation and reforms resulted in the rapid expansion of the number of banks, and an increase in the total deposits, total assets amid a rise in loans to households and firms. From the standpoint of concentration and HHI measures, there is a remarkable decline in the degree of market concentration in the banking

sector. What's more, the degree of market competition in the Ghanaian banking sector has increased over the last decade.

3.1.10 Financial Sector Reforms and Bank Competition: PR Model

The PR model has been widely applied to study the competitive conditions in the banking market. As indicated above, it accesses the impact of changes in factor prices on the revenue of firms' under different market structure (monopoly, monopolistic competition, perfect competition, and perfect collusive oligopoly). In determining the degree of market competition in the market, the degree of changes is assessed. **Table 9** presents the correlation matrix of the variables used in the PR model. It is observed that there is lower correlation among explanatory variables. Noticeably, low values are reported for LIEXP/TDEP and LDE/FA. These figures suggest the finding of close to zero and non-significant elasticities in the next step of the PR analysis. Also, issues on multi-colinearity may not be the serious problem in concomitant with estimating the parameters.

Table 10 displays the fixed effect estimates for the interest based product market model (Equation 3.9). The model is statistically significant and has reasonably sound explanatory power evident from the R-square value of 0.887. The estimated model explains almost 89 percent in the ratio of interest income equation to total assets equation. This confirms that, the chosen independent variables are highly explanatory. All the coefficients with the exception of the price of physical capital expenditure and other expenses related to fixed assets are statistically significant. The sum of elasticity in terms of factor prices is 0.976 suggesting an imperfect competition market structure in the Ghanaian banking industry.

Similarly, the Wald tests for perfect competition (H=1) and for monopoly (H=0) rejects the null hypothesis and reconfirms the conclusion that interest based income banking market is characterized with monopolistic competition. The higher value of the sum of H-statistic indicates that there is higher competition in interest income based market as a consequence of financial liberalisation. The reported co-efficient LWA/TDELOAN was 0.172 and is positive and significant which suggests that there are higher proportion of qualified personnel in the Ghanaian banking market due to the increasingly entry of foreign-owned private banks. Related to these changes in the composition of banking personnel is the work of Buchs and Mathisen (2005) who found the lack of bank professionals during 1998-2003.

Table 9: **Correlation Matrix**

	LTrev	LINC/TA	LIEXP/TDEP	LWA/TDELONA	LDE/FA	LTLA/TA	LTA	LNPL/TLO	Linfl	LGDPP
LTrev	1.00									
LINC/TA	0.34	1.00								
LIEXP/TDEP	0.04	0.42	1.00							
LWA/TDELOAN	-0.26	-0.28	-0.14	1.00						
LDE/FA	0.13	0.02	0.04	-0.26	1.00					
LTLA/TA	0.28	0.88	0.13	-0.33	-0.01	1.00				
LTA	0.57	-0.46	-0.18	-0.02	0.15	-0.48	1.00			
LNPL/TLO	0.86	0.06	-0.03	-0.23	0.10	0.04	0.60	1.00		
Linfl	0.12	0.09	0.14	0.15	0.06	0.04	-0.01	0.11	1.000	
LGDPP	0.05	-0.099	0.05	0.23	0.14	-0.11	0.12	0.06	0.471	1

Note: LINC/TA is log of the ratio of interest income/total assets which is consistent with Diamond (1983) intermediation function of a bank; LIEXP/TDEP is log of the total interest expenses/total deposits; LWA/TDEPLOAN is log of ratio of wages/total deposits and loans because in Ghana most of bank staff operate in the deposit and loan market; LDE/FA is log of the price of physical capital expenditure and other related expenses related to fixed assets; LTLA/TA is log of the ratio of total loans and advances to total assets; LTA is log of the total assets, LNPL/TLO is log of non-performing loans to total loans outstanding ratio; infl is log of CPI annual growth rate which represents the macroeconomic risk components in the local economy and GDP is the log of economic growth levels over the period.

Source: Author's calculations based on Ghana Banking Survey (2003-2012)

However, the price elasticity of labour appear to confirm that costs of banking personnel has a higher impact on interest revenue during the period 2003 to 2012. Significantly, in the interest based market, the cost of funds has higher influence on income (revenue) with elasticity of 0.731. Other bank-specific variables also shows that lending activities measured by total loans and advances to total assets is positive suggesting an affirmative effect of lending activities on the revenue of participating banks.

Table 11 also shows the results of the total market based model (Equation 4.0). Similarly, the sum of elasticity of factor prices is 0.229 suggesting monopolistic competition in the Ghanaian banking industry both at the interest based product market and the total bank market. However the higher value of PR H-statistic in Equation 4.0 is symptomatic of higher competition among Ghanaian banks in the interest based product market than that of non-interest income market. That said, an analysis of the sign and significance of the regression co-efficient, mostly price of inputs documented in **Table 11** indicate that the price elasticity of funds, labour and capital are positive and statistically significant. However, these model results vary in terms of cost of funds. The cost of funds in the interest based market has a higher influence on income with elasticity of 0.731 relative to 0.165 in the total market.

Table 10: H-statistics of Ghana Banking Systems (2003 t0 2012)

	Interest Based Product Market Model (Equation 3.7)		
	Coefficient	**Standard Error**	**P-value**
LIEXP/TDEP	0.731	0.040	0.000
LWA/TDELOAN	0.172	0.046	0.000
LDE/FA	0.074	0.021	0.001
LTLA/TA	0.808	0.014	0.000
LTA	-0.007	0.017	0.668
LNPL/TLO	0.068	0.013	0.000
Linfl	0.160	0.049	0.002
LGDPP	-0.138	0.037	0.000
Constant	0.039	0.015	0.008
Adjusted R-squared	**0.887**		
No. of observations	229		
PR H-statistic	**0.976**		
Wald test (F-statistic) for H=1	25.59		
p-value of F-statistic	0.000		
Wald test (F-statistic) for H=0	120.5		
p-value of F-statistic	0.000		
Perfect Competition H=1	**Reject****		
Monopoly H=0	**Reject****		

Note: in the interest based product model (equation 3.9), dependent variable is log of total interest income to total assets. All the independent variables are measured in log scale. PR H-statistic (in bold). The Wald test is used to test the hypothesis that at least one of the predictors' regression coefficients is not equal to zero. The Wald test is used to test H=0 and H=1 hypotheses, the null hypothesis is that the regression equation overall is not statistically significant and it follows an F-distribution. The number in the parentheses indicates the degrees of freedom of the distribution. ***, **and* indicate significant at 1%, 5% and 10% level respectively.

Source: Author's calculations based on Ghana Banking Survey (2003-2012)

Table 11: H-statistics of Ghana Banking System (2003 to 2012)

	Total Market Model (Equation 3.8)		
	Coefficient	**Standard Error**	**P-value**
LIEXP/TDEP	0.165	0.021	0.000
LWA/TDELOAN	0.063	0.038	0.097
LDE/FA	0.001	0.015	0.952
LTLA/TA	0.443	0.018	0.000
LTA	0.480	0.016	0.000
LNPL/TLO	0.567	0.018	0.000
Linfl	0.436	0.044	0.000
LGDPP	0.064	0.034	0.061
Constant	0.114	0.015	0.000
Adj. R-squared	**0.885**		
No. of observations	229		
PR H-statistic	**0.229**		
Wald test (F-statistic) for H=1	30.42		
p-value of F-statistic	0.000		
Wald test (F-statistic) for H=0	60.72		
p-value of F-statistic	0.000		
Perfect Competition H=1	**Reject****		
Monopoly H=0	**Reject****		

Note: in the total revenue model (equation 4.0), dependent variable is log of the sum of total interest income, fees and commissions and other operating income. All the independent variables are measured in log scale. PR H-statistic (in bold). The Wald test is used to test the hypothesis that at least one of the predictors' regression coefficients is not equal to zero. The Wald test is used to test H=0 and H=1 hypotheses, the null hypothesis is that the regression equation overall is not statistically significant and it follows an F-distribution. The number in the parentheses indicates the degrees of freedom of the distribution. ***, **and* indicate significant at 1%, 5% and 10% level respectively.

Source: Author's calculations based on Ghana Banking Survey (2003-2012)

3.1.11 Conclusion

This chapter examined the evolution of market competitive structure and revenue behaviour of Ghanaian banking industry over 9 year period (from 2003 to 2012) and investigates factors that can explain differences in the degree of competitiveness in two banking markets namely interest based market and total revenue based market. The chapter explicitly control for bank specific factors such as inflation, GDP, total assets and loans for the period 2003 to 2012. This period corresponds to an era characterised by significant reforms to restructure the banking system and to liberalize as well as deregulate the banking systems thereby improving the process of integrating Ghana's financial system as the financial hub in sub-Saharan African markets.

Results from concentration ratios show the changing structure of the banking sector. The concentration ratios including HHI show a decreasing trend in market concentration in Ghanaian banking industry and decreasing market share of largest banks over the 9 year period. This implies that the banking industry is less concentrated, hence more competitive in recent years. These changes in the dynamism of the domestic banking market are the consequence of foreign banks amid their contribution to the maintenance of stability in the banking system.

By applying the Panzar-Rosse model for the period 2003-2012 to study the revenue behaviour of banking industry for both interest based market and total revenue based market, we find monopolistic competition in Ghanaian banking industry. Equally the rejection of perfect competition and monopoly market competition confirms it. The PR test results indicate that the banking market is in equilibrium. The value PR H-statistic in total revenue based market is lower relative to the interest income based market. This suggests that there is lower competition among banks in non-interest income based market. The policy implementation is that, strategies ought to be developed accordingly. Larger banks are able to generate more revenue and vice versa. The existence of such scale economies is an indication that individual banks can take advantage of their respective economies of scale. Nonetheless, as indicated by the PR H-statistic, there is room for improvement with respect to the competitive behaviour of Ghanaian banks. This implies that the longevity of financial sector liberalization and reformation will improve competitive market behaviour amongst banks in the Ghanaian banking system.

Financial intermediation is vital for economic development. Existing literature indicate a causal link between the degree of financial intermediation and economic growth. In order to finance both private and public investments, Ghana needs a stable and efficient banking system next to systematic development of its financial system. The cost of financial intermediation has significant ramifications for economic performance (McKinnon and Shaw 1993, Jayaratne and Strahan 1996, Rajan and Zingales 1998, Beck, Levine and Loayza 2000, Hansen (2014)). From the late 1980s through the period of the recent economic downturn, Ghana's financial sector reforms has been characterised with notable component of structural adjustments programs.

4 CHAPTER:
LINKAGES BETWEEN BANKING SECTOR AND OTHER SECTORS OF THE GHANAIAN ECONOMY

4 CHAPTER: LINKAGES BETWEEN BANKING SECTOR AND OTHER SECTORS OF THE GHANAIAN ECONOMY

Abstract

This chapter presents an Input-Output analysis of the Ghanaian economy, an important source of the interconnectedness existing among different sectors following financial reform policies. The chapter is focused on the inter-linkages between the banking sector and the other sectors. Model results indicate that, there are lower interconnectedness between the banking sector and other sectors. There is relatively lower linkage between the banking sector and the agriculture sector, implying the lack of transforming the Ghanaian economy from agronomy to a modern economy. Overall, forward linkages of the banking sector to other sectors are stronger than its backward linkages in 2012.

4.1.1 INTRODUCTION

Previously discussed, Ghana is one of the former economic reformers in Africa with a series of structural adjustment programs beginning in the late 80's. These reforms included the elimination of price controls, opening of financial markets, implementation of legal frameworks, restructuring and privatisation of many state-owned enterprises including publicly owned banks. Following the implementation of economic and structural adjustment reforms, the economy of Ghana has shown sustained growth and poverty reduction (Aryeetey and McKay 2007, Sandefur 2010). Presently Ghana is classified by the World Bank as a lower medium income country (World Bank 2012, 2013).

Likewise the interrelationships between the banking sector and the real sector during the process of economic development and growth have been extensively discussed in the literature (see for example Fry 1978, Levine and King 1993). However, proponents of the production approach to banking postulates that the primarily focus of banks is producing services to loans and deposits accounts holders[15]. The divergent view of intermediation approach is that banks intermediates between the transfers of funds from surplus saving units

[15] The production process of the financial firm is a multistage production process involving intermediate outputs, where loanable funds, borrowed from depositors and serviced by the firm with the use of capital, labour, and material inputs, are used in the production of earning assets Sealey and Lindley (1977)

(savers) to deficit spending units (borrowers)[16]. Albeit the approach used in defining the banking sector, in a given economy, banking sector inputs are used in the production of outputs of the other sectors as well as the banking sector itself. Consequently, the deficiency in production of the banking sector becomes the limiting factor for the growth of other sectors thereby affecting the overall growth of Ghana's economy. Thus an in-depth understanding of inter-production dynamics in Ghana becomes vital for policy makers to make effective financial sector policies towards the attainment of broader objective of inclusive development.

Further, it is essential to study the magnitude of production and consumption linkages of sector towards the attainment of a desired rate of growth (see for example Delgado, Hopkins and Kelly 1998, Mureithi and Sharma 1984, Schultz 1998). Similarly, an identification of the key sectors in an economy is a critical analytical task that can have significant and wide policy implications (Temurshoev and Oosterhaven, 2013). This will bring to the fore key sectors generating demand for other segments of the economy and thus acting as leaders of sustainable economic growth. Also, attempts in identifying key sectors are not only important on the general economy but also the interrelationship between sectors. Input-output models are predominantly used to calculate multipliers that can trace the effect of an exogenous increase in the final demand of sector output on other sectors permeating the linkages between multi-sector industries of an economy. Even so, there is no literature in the Ghanaian context that considers the backward and forward linkages of the Ghanaian economy with emphasis on the significance of the banking sector and the impact of final demand shock of the sector on the other sectors.

This chapter contribute to the input-output literature by analysing the inter-production linkages amid the banking and the real sector of Ghana's economy using input-output (I-O) modelling. The production contribution or share to GDP, the value-added shares in terms of capital and labour contribution, and the total and final demand for each sector is computed. Also, various types of production linkages are computed to study the interrelationships between banking and non-banking sectors. In the end, the Leontief inverse is used to measure

[16] Banks transform the credit portfolio demanded by borrowers into a deposit portfolio desired by lenders. Dewatripont and Tirole (1993)

the impact of a change in the final demand of the banking sector on the other sectors of Ghana's economy.

Furthermore, the balanced input-output table for Ghana 2012 is the benchmark data for the comparative static general equilibrium analysis of the quantitative impact of the financial sector reforms in Ghana that follows in Chapter Six. That said, the focal point of this chapter is on examining the inter-linkages between the banking sector and the real sector of Ghana's economy using input-output econometric modelling.

The chapter is schemed as follows: Section 4.1.2 provides a brief theoretical and empirical review of the Leontief (1949) input-output model. The next section which is Section 4.1.3 discusses data and methodology. Section 4.1.4 is centred on the overall structure of the local Ghanaian economy in terms of the sectoral contributions to GDP. This is followed by the application and the steps involved in the construction of the Leontief Input-Output Model to the Ghana's economy. The remaining sections takes care of the interpretation of empirical findings in terms of technical co-efficient, forward and backward linkages between sectors and the counterfactual analysis of model results. Section 4.1.8 concludes the chapter.

4.1.2 A Brief Review of the Leontief (1949) Input-Output

The analytical framework for input-output analysis was developed by Leontief (1949). The fundamental purpose of the input-output technique is to analyse the interdependence of industries in a given economy. Input-output tables are descriptive of the national and regional accounts and provide a general overview of a given economy at a particular time period. The policy implication is that, the quantitative analysis of inter-industry relations by way of allocating resources in an economy is best understood using input-output analysis.

In recent times, one of the significant uses of input-output model is used to assess the short-run impacts of a final demand shock of an industry on one or more industries. Related to this is the short-run impact analysis which is usually accessed from multipliers that are derived from the Leontief inverse matrix. The Leontief inverse matrix quantifies the interdependencies and inter-linkages among sectors in an economy. For recent developments on input-output multipliers see for example Richardson (1985), Sonis, Hewings and Guo

(2000), Oosterahaven and Stelder (2002), Miernyk (2004), Dietzenbacher (2005), Liew (2005) , Oosterahaven (2007) and Gim (2009).

Further, the analysis of economic policies albeit financial liberalisation reforms in a micro-consistent framework necessitates equally theoretical framework and data. A common theoretical basis for economic analysis is the Shoven-Whalley (1992) applied general equilibrium framework which can be applied to varied economic policies such as financial reforms, tax reform and environmental policy. Consequently, in measuring the economic impacts of divisional sectors in an economy, input-output analysis a subset of social accounting models is widely used (Shaffer, Deller and Marcouiller 2004, Hewings 1985). Leontief (1949) input-output models attempt to describe an array of economic transactions between various sectors in a defined economy in a given period of time, say a year. The interdependence of sectors in an economy are thereafter analysed through market based transactions.

Main applications of input-output analysis have been discussed in Leontief (1949), Miller and Blair (1985), Thijs ten Raa (2006). Empirically, input-output analysis has been used in China, Spain, Norway, UK and USA to analyse the economic impacts of sector on other sectors in a general economy. Notable studies include Bhuyan and Leistritz (1996), Coon and Leistritz (2001) and Zeuli and Deller (2007). Researches indicate that such analysis can provide timely and critical information on the interrelationships of the general sectors of an economy as well as the impacts of change on the economy in question. In India, Hansda (2001) analysed the link between the industrial and services sector using I-O techniques. Hansda found strong linkages from the services sector to the industry, implying the significant usage of services input in the industrial sector of the Indian economy. Bekhet and Yazmin (2014) analysed the success or failure development policies for the Malaysian economy. He found that, there remains a high dependency on primary sectors including oil, rubber and wood sectors.

Elsewhere, the variations in backward linkages are examined in numerous papers including Polo and Valle (2008) show that multiplier effects arising from I-O calculations are smaller relative to SAM calculations. By incorporating the income and financial flows into the standard input-output matrix, Leung and Secrieru (2011) analysed the Canadian economy for 2004. The authors also assessed the strength of real-financial linkages of the Canadian

economy by calculating and comparing multipliers from both social and financial accounting matrixes for the period. They found that, financial flows play a key role in determining the aggregate effect of an income shock or the availability of loanable funds.

The efforts by successive governments in altering the structure of the economy of Ghana can be traced back to the commencement of financial sector reforms in the late 80's (see chapter 2 for developments in Ghana's financial sector). Yet, Szereszewski (1965) points out that in 1891, the structural characteristics of the Ghanaian economy were similar to many other pre-colonial economies. This is the era where African economies were engaged in hunting and gathering, agriculture, mining and basic manufacturing. Despite the structural transformation of the Ghanaian economy coupled with developments in the input-output literature, there is no theoretical or empirical work on the Ghanaian context. This chapter fill the vacuum in the literature by analysing the short-run impacts of the backward and forward linkages of the Ghanaian economy. Related to this is that it also assesses the impact of final demand shock of the banking sector on the other sectors of the local economy.

4.1.3 Data and Methodology

This chapter uses quantitative data based on recent Ghana Social Accounting Matrix (SAM) (2005) compiled for the Ghanaian economy. These data files were produced by the International Food Policy Research (IFPRI) (2005) in collaboration with the Ghana Statistical Service (GSS) (2005). Based on International Standard Industrial Classification (ISIC), the original tables consisting of different number of sectors are aggregated into 56 sectors. But the aggregated sector does not explicitly account for the banking sector.

The banking sector can only be traced among the business sector. Using the Ghana National and Capital Accounts (2012), the banking sector is explicitly accounted for based on its sectoral contribution to GDP for the period. Next, for price comparisons, prices are adjusted based on 2012 producer price index. Finally, to assess the inter-linkages of the local economy and most significantly the growth by means of the backward and forward linkages of the banking sector on other sectors of the economy, standard input-output multipliers are applied.

Input-output is a well-established tool as indicators of the importance of particular sectors and the interdependence of multi-sectors of an economy over a time period. The main

advantage of using input-output modelling for impact analysis is that, it provides a simple framework with few assumptions thereby allowing the backward and forward linkages analysis of the banking sector. It also allows us to study the short-run impact of a change in the final demand of the banking sector on one or more sectors.

However, the input-output framework is subject to Luca's (1976) critique. Lucas argues that, as shock shift prices, participating agents cannot adjust to such change. This is because of the continuing changing dynamics of relative prices which do change substantially from one year to the other. In view of that, input and output multipliers ought to be regarded as underlying quantities and technological relationships rather than value and relationships values, since we do not make adjustments for price changes, all proportions and values are in terms of the relative and absolute prices of the 2012 base year. That said input-output is appropriate for short-term impacts analysis of a change in the final demand of a sector as well as the interdependencies and interrelationships of sectors in an economy.

It is imperative to note that, there are four assumptions of the input-output table. First, each sector or industry is characterised by a fixed production function. Such that there is an inflexible association between the level of output of any sector as well as the level (s) of inputs required. This assumption implies that scale economies are not factored into the input-output table. Second, the production of output in each respective sector is characterised by constant return to scale. This also implies that, a 1 percent rise (fall) in the output of a sector requires a 1 percent rise (fall) in all of the outputs. Third, for any input-output table the technology is given. The last assumption is that, each sector produces homogenous products. Taking into account the aforementioned four assumptions, a snap shot of the structure of the input-output is discussed next.

The explanation of the general structure of the input-output table is based upon O'Connor and Henry (1975). **Table 12** below shows that an input-output table is divided into quadrants including intermediate inputs (demand), final demand, total demand, and value added and gross output. An intermediate input is indicative of the flows of products, which are equally produced and consumed in the process of the production of goods and services in the economy. These shows the inter-industry flows in the multi-productive sectors of the economy for example agriculture inputs used by other productive sectors. The final demand

contains data for the output of each respective producing industry for example demand of non-industry consumers in terms of consumption, investments or exports. These are demand for goods and services which are not used in the production of other goods. Total output for a given period equals intermediate demand plus the corresponding final demand. The value added includes wages, capital (investments and savings), taxes (i.e. sales, export or manufacturing, income taxes), wages and salaries emanating from sectoral employment. Sum of intermediate input and value added equals the total input requirement of the representative sector. In brief, the input-output table is indicative of representing an economy in terms of production technology (capability) applied in creating other products (i.e. input coefficients) use of outputs produced locally (which is echoed by the structure of gross capital formation, final consumption and exports) as well as production income (usually illustrated by the structure of wages and salaries as well as the consumption of fixed capital investments and savings).

Table 12: A Snapshot of a Standard Input-Output Table

	Intermediate Input (sectors) 1 2 … n	Final Demand Fd_n	Total Demand X
Intermediate Input (sectors) 1 2 ⋮ n	C_{11} C_{12} … C_{1n} C_{21} C_{22} … C_{2n} ⋮ ⋮ ⋮ C_{n1} C_{n2} … C_n	Fd_1 Fd_2 ⋮ Fd_n	X_1 X_2 ⋮ X_n
Value Added V	V_1 V_2 … V_n		
Gross output X	X_1 X_2 … X_n		

Source: Adapted from O'Connor and Henry (1975)

4.1.4 Overall Structure of the Ghanaian Economy-1983 to 2012

Prior to the enactment of series of economic reforms in Ghana, the agriculture sector dominated the economy in terms of its contribution to GDP and employment. Agriculture contributed 52 percent to national output (**Table 13**) and employed 50 percent of all employment in the early 80's (Aryeetey and Kanbur 2005). But most of the local farmers were involved in low-productivity agriculture; hence agriculture exports were predominantly raw materials (Andrae 1981). While cocoa is the most essential export crop, it accounts for only 10 to 15 percent of the GDP in the agriculture sector. This is largely due to inefficient farming practices including dependence on rain-fed agriculture, poor transport and distributional channels. Similarly, only 19 percent of Ghanaian farmers use inorganic fertilizer and agriculture machinery (Quiñones and Diao 2011). This practises of the lack of usage of modern technologies albeit inputs reduce the competitiveness of the agriculture sector in domestic and international markets. In contrast Malaysia and China have shown that agriculture can play a significant role in the transformation from agronomy to modern economy if the expansion of non-traditional agriculture can provide productivity gains. Equally, the diversification of agriculture exports has accelerated growth in agriculture and wide-ranging economic transformation (Breisinger, Diao and Thurlow 2011, Breisinger, Diao, Thurlow and Hassan 2011).

Table 13: Aggregate Sectors Contributions to GDP (%)

			Average
Sectors	**1983**	**2012**	**1983-2012**
Agriculture	52.0	20.2	38.1
Services	36.0	53.1	33.0
Industry	12.0	26.7	28.9
Total	**100.0**	**100.0**	**100.0**

Source: Author's calculation using Ghana Statistical Services Data, ISSER (2014)

Relative to the sectoral contribution of the agriculture to GDP in 1983, by 2012 its contribution has declined to only 20.2 percent. This shift has culminated in stronger growth in services and industry sector. In 2012, 53.1 percent of national output was from the service sector. The service sector entails many parts of the public sector and a wide range of private activities including transport, retail, finance, community and non-profit services that serve the demands mostly coming from or arising out of resource based extractive industries such as

gold, remittances and international donations. Relative to the agriculture sector (38.1 percent average growth), the services sector grew by only 33 percent.

Further, growth in the financial sector from 1998 to 2012 stalled at only 4 percent. Considering that finance remains small in Ghana's growth, timely financial liberalisation policies could reduce obstacles of competition that hampers the financial intermediation process. Thus a competitive banking market is a prerequisite for effective financial intermediation including channelling savings into investments in Ghana (Buchs and Mathisen 2005). Additionally, increase in service growth is largely drawn from relatively lower-order service sectors including wholesale, retail trade, restaurants and hotels.

Economic growth is associated with the expansion of activities in industry sector (Rodrik 2005). Yet contributions to GDP emanating from industrial subsectors witnessed little change between 1998 and 2004. For the past six years, the share of overall industry contribution to GDP remained constant at 25 percent. The shares of the mining and quarrying decreased by 0.6 percent (from 5.8 to 5.2 percent) over the period. The largest subsector in Ghana's industrial sector is manufacturing. But growth in the manufacturing stalled at 9 percent for the past six years. However contribution to GDP by the construction sector witnessed gradual improvement from 7.7 percent in 1998 to 8 percent in 2004. But growth in the construction sector was primarily driven by an urban housing boom and infrastructure developments in Ghana (Kolavalli, Robinson, Diao, Alpuerto, Folledo, Slavova, Ngeleza and Asante 2012).

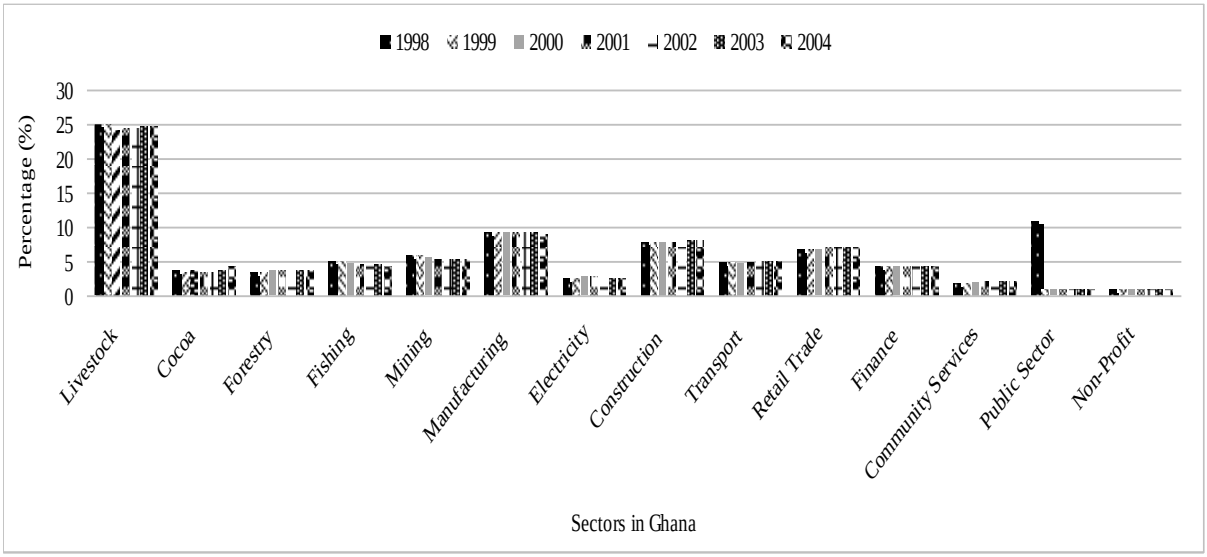


Figure 10: Sectoral Share of GDP in Ghana (1998-2004)
Source: Ghana Statistical Service (1998-2004)

Nonetheless, the construction sector in Ghana is predominantly non-traded and tends to have weaker linkages with the rest of the local economy. However, much of the changed discussed above 'coincided with a poorly documented national accounts rebasing exercise in 1994' (Aryeetey and Kanbur 2005). In fact, much of the shift in sectoral distribution of national output was transformed from the agriculture sector to the industry with only a 3 percent shift in the services sector since reforms began. In sum, economic transformation is usually gauged by the transition from agronomy to a non-agriculture and more diversified economy. From that point of view, available data reveal less about the transformation of the Ghanaian economy and there still exist sectoral weaknesses in diversifying the economy.

4.1.5 Application of I-O model- Ghana's economy

A standard Leontief (1949, 1984) model of the supply side depicts the gross output by sectors, the cost of production by the respective production sectors of the economy of Ghana is divided into intermediate inputs, value added, tax and import components. Each of the multi-production sectors of the Ghanaian economy on the demand side sells its respective products or services for intermediate use either by itself and/or to other 15 sectors as well as for final demand. Theoretical evidence indicates that financial developments foster economic growth. The original 56 x 56 matrix input-output has been aggregated and augmented into a 15 x 15 matrix to include the banking sector of Ghana. The coefficients of production input, gross value of output as well as gross value added figures have been derived from the updated Ghana SAM. An inter temporal input-output modelling exercise of simultaneous equation model with fifteen equations which gives the solution for gross output for all fifteen sectors is derived. Further, consistency in Ghana's national account requires equality between supply side and demand side of the 15 multi-production sectors.

From that backdrop, it is well acknowledged that the real sector of Ghana's economy include households consumption (i.e. urban and rural), investment, trade (i.e. exports and imports) and government expenditure which is usually defined as;

$$Y = C + I + G + (X - M) \tag{4.1}$$

$$Y = C + S + T \tag{4.2}$$

Substituting (4.1) into (4.2), equation (4.3) can be re-written as;

$$(X - M) = (T - G) + (S - I) = 0 \tag{4.3}$$

where X and M represents exports and imports, T correspond to imports, sales and export tax, S stand for savings less investments (I) respectively. As a consequence of the inter-related nature of the government deficit (surplus) and other key economic components of the national income, equation (4.3) is critical. Equation (4.3) implies that, the sum of labour income, capital income as well as taxes from production ought to be equal to final demand of the respective households (rural and urban) for consumption, of producers for investment, of government for public spending and the Rest of the World (RoW) for the net export of Ghana (2012). Thus, increasing the banking sector will have an effect on the real sector of the local economy.

A 15 sector input output model for the local economy can be constructed with a standard Leontief (1949, 1984) model as following:

$$X_1 = X_{1,1} + X_{1,2} + X_{1,3} \ldots + X_{1,15} + Fd_1$$

$$X_2 = X_{2,1} + X_{2,2} + X_{3,3} + \ldots X_{1,15} + Fd_2$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$X_{15} = X_{15,1} + X_{15,2} + X_{15,3} \ldots X_{15,15} + Fd_{15} \qquad (4.4)$$

X_i represents gross output of sector i, each of the respective intermediate inputs is linked by a Leontief technology where the technical co-efficient matrix is divided by each cell in the productive sector quadrant by the total input value for each corresponding column. This is done by transforming the set of simultaneous equations (Equation 4.4) into a technical equation matrix by dividing each cell in the productive sector quadrant as well as the primary input quadrant by the total input value for each corresponding column. Such that $c_{i,j} = X_{i,j} / X_j$, where $c_{i,j}$ shows how much the commodity of sector i is required to produce one unit of sector j commodity with $X_{i'j}$ representing the intermediate input from sector j to sector i or vice versa. Fd represents the final demand of each of the multi-sectors.

Theoretically, the Leontief input-output functional form (LF) chosen for this academic work suitable for the multi-production Ghanaian economy must satisfy Hawkins-Simon (1949)

equilibrium conditions. Hawkins-Simon first conditions indicate that when $n=15$, the principal leading minors of $n \times n$ ought to be evaluated such that; $1-X_{15}>0$ or $X_{15}<1$. This implies that, the required amount of the first banking product used in the production of a cedi worth of the first banking product ought to be less than a cedi. Also, LF is characterised by zero substitutability due to the assumption that inputs used in the multi-production households are fixed in proportion to the level of outputs, at least the assumption of constant return to scale. Substituting the coefficients of $c_{i,j}=X_{i,j}/X_j$ into the system of equations in (4.4) transforms the model as:

$$X_1 = c_{1,1}X_1 + c_{1,2}X_2 + c_{1,3}X_3 ... + c_{1,15}X_{15} + Fd_1$$

$$X_2 = c_{2,1}X_1 + c_{2,2}X_2 + c_{3,3}X_3 ... c_{2,15}X_{15} + Fd_2$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

$$X_{15} = c_{15,1}X_{15} + c_{15,2}X_{15} + c_{15,3}X_{15} ... c_{15,15}X_{15} + Fd_{15} \qquad (4.5)$$

Equation 4.5 is a simultaneous equation model with fifteen equations which gives the respective solutions of gross output of all fifteen sectors $X_1 to X_{15}$ in the economy. This set of equation can be applied to assess the impact of changes in the final demand on gross output, employment and capital as:

$$(1-c_{1,1})X_1 - c_{1,2}X_2 - c_{1,3}X_3 - c_{1,15}X_{15} = Fd_1$$

$$-c_{2,1}X_1 + (1-c_{2,2})X_2 - c_{2,j}X_j - c_{1,15}X_{15} = Fd_2$$

$$-c_{15,1}X_1 - c_{15,2}X_2 - c_{15,j}X_j - (1-c_{15,15})X_{15} = Fd_{15} \qquad (4.6)$$

The second condition of Hawkins-Simon is such that solution to equation 4.6 exists when the determinant matrix in question is non-negative ($(1-C) \neq 0$. This implies that the final demand of the multi-production sectors in the Ghanaian economy must induce a vector of non-negative multi-productions across board. This is best represented in a matrix system of equations below:

$$\begin{pmatrix} X_1 \\ X_2 \\ \vdots \\ X_{15} \end{pmatrix} = \begin{pmatrix} (1-c_{1,1}) & -c_{1,2} & -c_{1,3} & -c_{1,4} & -c_{1,5} & -c_{1,6} & -c_{1,7} & -c_{1,8} & -c_{1,9} & -c_{1,10} & -c_{1,11} & -c_{1,12} & -c_{1,13} & -c_{1,14} & -c_{1,15} \\ -c_{2,1} & (1-c_{2,1}) & . & . & . & . & . & . & . & . & . & . & . & . & . \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ -c_{15,1} & -c_{15,2} & . & . & . & . & . & . & . & . & . & . & . & . & (1-c_{15,15}) \end{pmatrix}^{-1} \begin{pmatrix} Fd_1 \\ Fd_2 \\ \vdots \\ Fd_{15} \end{pmatrix}$$

(4.7)

From above equation (4.7) shows the proportion of inputs that must be purchased by each of the 15 multi-production sectors in order to produce a unit of output. This implies that Hawkins-Simons conditions (1) and (2) are equivalent, hence if the intermediation process is economically practicable and viable, and the fifteen sectors nonnegative output levels. From equation 4.7 the input and output is given by:

$$X = (1-C)^{-1} Fd \,. \tag{4.8}$$

The short run impacts of changes in output, employment and capital in the local economy is captured in a multiplier matrix:

$$\Delta X = (1-C)^{-1} \Delta Fd \,. \tag{4.9}$$

For example, a 5 percent change in the consumption demand of banking sector inputs will impact on gross output, employment and capital information by $\Delta X = (1-C)^{-1} \Delta C_{bank}$. In that regard, a change in the final demand of the banking sector on the remaining 15 multi-sector is analysed as: Increasing the output of the banking sector will lead to an increase in input in the 15 multi-production economy of Ghana which has the propensity in increasing the total output, employment, revenue, output, taxes as well as capital formation which captures the changes in investment induced by the interventions of the financial sector reforms mentioned earlier. A multiplier for the banking sector denotes a ratio between the initial and total impact on gross output, employment, revenue, capital formation, trade margin and imports in the 15 multi-sectors caused by a change in the final demand for the output of the banking sector in 2012.

4.1.5.1 Construction of an Input-Output Table for the Ghanaian Economy (2005)

Input-Output table provides the fundamental yardstick for the assessment of economic policies taking into account the entire structure and dynamics of the economy of Ghana. It

takes account of the respective production plans and activities of the multi-sectors which constitute Ghana's economy. The multi-interdependence arises owing to the fact that each sector employs the output of other sectors as its raw material or by-product. The output in turn is used by other sectors as a productive factor in the economy. As mentioned earlier, the input-output table also provides the benchmark dataset for the application of a computerised general equilibrium (CGE) model with the financial sector in the real-side of the Ghanaian economy in Chapter Five. This section illustrates a procedure to construct such an input-output for the banking sector and the real economy. Following the preceding five steps one can construct a fifteen sector Ghana economy input-output table for a backward and forward linkages analysis as well as counterfactual analysis of change in final demand.

Step 1: The first step is to obtain a social accounting matrix for the local economy. Here I used the social accounting matrix data for Ghana mutually compiled by the IFPR (2008) and the Ghana Statistical Service (2008). The original input and output tables consist of 56×56 matrix. The current data does not explicitly account for the banking sector. The banking sector can only be traced in the business sector. The banking sector is accounted for by splitting the business sector into business and financial sector based on their respective 13.5 and 11.4 percent contribution to GDP (Ghana Statistical Service 2012). The financial sector is categorised into banking and finance (including non-banking financial services and Forex bureau), insurance and financial market. This is aggregated into a 15×15 input-output matrix. Further, the 15×15 input-output matrix is deflated by sector specific producer price index (PPI) with base year set at 2012 to make the data comparable (see Appendix 3 for procedures in adjusting prices for pricing comparisons).

The aggregated sector classification is composed of agriculture and livestock (agri), cocoa production and marketing (cocoa), forestry and logging (forst), fishing (fish), mining and quarrying (mine), manufacturing (manf), electricity and water (elect), construction (const), transport, storage and communication (trans), wholesale and retail trade, restaurants and hotels (trade), insurance and real estate (real), bank, business services (busi), government services (pubad) and community and other services (csrv).

It is imperative to note that, the input-output table is not a model. Input-output tables are a descriptive of the flow of goods and services between all individual sectors of a national

economy over a stated period of time, for example a year (Leontief, Duchin and Szyld 1985 pp. 419-422).

Therefore, the matrix is subsequently transformed into a transaction table (see Appendix 4) in the form of spreadsheet using the pivot table utility function in Excel. This table is indicative of all the productivity in the local economy which entails the demand for all sectors and their value added requirements. The column sectors detailed the amount of purchases that are made from the row sectors. These columns show demanders of factors of production such as intermediate production sectors which uses the respective output sectors as intermediate inputs.

Appendix 4 is used to identify inter-sector dependencies and the extent to which specific sectors in the local economy supply goods and services in the Ghanaian economy for the given period. Appendix 4 reports Ghana's input-output matrix for 2012 (numbers are in millions of new Ghana cedi's). Forestry purchased 115 million of new Ghana cedi's input from banking sector. Likewise, other intermediate demand in terms of purchases of banking sector input include 64, 140 and 303 million of new Ghana cedi's worth of banking sector inputs by fishing, mining and transport respectively. The remaining banking sector purchases of banking sector inputs were from trading, business and the banking sector itself. These purchases amounted to sector 299 (trading), 146 (business) and 123 (banking) new Ghana's cedi's worth of banking sector products correspondingly. The total intermediate demand for banking sector inputs by other sectors of the economy for the period amounted to 1189 million of new Ghana cedi's representing 1.4 percent of total sector intermediate demand of inputs.

However, the banking sector purchased certain inputs from other sectors totalling 632 million worth of new Ghana cedi's. These purchases were from manufacturing (60), electricity (27), construction (90), transport (186) and business (146). Furthermore, Agriculture purchased 3701 million of new Ghana cedi's worth of inputs from other agriculture and 3337 million of new Ghana cedi's inputs from manufacturing. Manufacturing purchased 1585 million of new Ghana cedi's worth of agricultural inputs. Also, the manufacturing sector purchased inputs from cocoa, forestry, fishing, mining, electricity and banking amounting to 1089, 773, 1283, 2166, 4037 and 91 million of new Ghana cedi's respectively.

Step 2: The next step is to copy the transaction table in Appendix 4 and covert the values to a table of multi-production coefficients termed A-matrix or technical coefficients. Such that analyses of inter-sector linkages necessitate input and output coefficients. The input and output coefficients are derived simply by $c_{i,j} = X_{i,j} / X_j$, where the quantity of the output of sector i absorbed by sector j per unit of its total output j is described by the symbol $c_{i,j}$ which is indicative of the input coefficient of product of sector i into sector j. Mentioned earlier $X_{i'j}$ represents the intermediate input from sector j to sector i or vice versa.

Table 14 below presents the cost structure (technical coefficients). It indicates that in 2012, forestry, fishing, mining and transport purchases from the banking sector were 0.0165, 0.0164, 0.0178 and 0.0196 respectively. But there were more purchases in-between banks with inter-bank purchases amounting to 0.061. This shows that the banking sector trade more among themselves which reduce transparency and thereby dipping the effectiveness of market discipline. The next sets of steps involve manipulating the data to arrive at a final input-output model (Leontief inverse) for the Ghanaian economy-2012.

Step 3: Next is to compile an identity matrix (I-matrix) with zeros in all the cells and 1s in the diagonals of the 15 by 15 transaction table. Further, I created I-A transaction table (see Appendix 5) by subtracting the values of cell values in the A-matrix from the I-matrix. This gives positive values on the diagonals but with negative values in all the other remaining cells.

Step 4: Following step 4 is to invert the I-A matrix in creating the Leontief inverse which gives the Input-Output multipliers for backward and forward linkages of the local economy. A dummy table with 15 by 15 matrix is created and this is subsequently marked (blocked) by pressing control, shift and enter key simultaneously. Using the =MINVERSE (,,,) command on the I-A matrix and equally assuming that $I - C$ has an inverse or matrix multiplier, the inverse of the matrix $(I - C)$ is found by hitting the control-shift-enter command. The inverted values represent the input and output multipliers for the Ghanaian economy over the period understudy. Total requirements multiplier for the banking is found by summing all industry values excluding value added multipliers. **Table 15** shows that the total requirements multiplier for the banking industry was 1.489 the input-output multipliers. It

also shows a total value added per 1 new Ghana cedi of output. For example, the total value added requirement from the banking industry was 0.988 including employment, capital and revenue multipliers of 0.482, 0.408 and 0.099 respectively. Further discussions of model results of Leontief inverse (backward and forward multipliers) are discussed.

Step 5: Next, the final demand matrix is found by summing exogenous demand including governments, consumption, investments and net exports (national income identity) equation 4.1. The data values of the final demand are used to create a final demand matrix with zeros in all of the cells and corresponding final demand values in the diagonals. Similar to step 4, a dummy table with 15 by 15 matrix is created and this is subsequently blocked by holding down the control, shift and enter keys at the same time. Following the summation of the final demand for each sectors, the result is multiplied by the 15 by 15 inverse matrix using =MMULT (,,,) command in Excel. Here, the first values to be entered represent the Inverse matrix and the second values are the values of the final demands in the form of (INVERSE MATRIX, FINAL DEMANDS).

For internal consistency and sensitivity of model results, the summation of industrial column amounts should be close to the actual input-output data. **Table 16** shows the exact replication of the micro consistent input and output data and the model results from the input-output estimations. The difference between Ghana (2012) input-output and the Leontief (1949) is zero, implying a near complete replication of phenomenon. The forward contributions to Ghana economic activity flow through to backward economic and social impacts. This backward-forward linkages in the Ghanaian economy occurs through the creation of jobs in the multi-production sectors other than financial intermediaries to support the growth of the banking sector, with related flows of income, wealth creation and accumulation creation in financial and non-financial institutions. Further discussions of model results in terms of technical co-efficient, Leontief inverse (backward and forward linkages) and counterfactual analysis is discussed next.

4.1.6 Interpretation of Empirical Findings

The aim of this chapter is to apply the methods and techniques of input-output as described in the previous sections including Leontief inverse matrix in identifying key sectors, backward and forward linkages and change in final demand of the banking sector on other sectors.

4.1.6.1 Technical Coefficients

Table 14 shows what fraction of total expenditure was used to purchase inputs for respective productive sector (s). These structures of the cost of productive sectors provides policy makers with the part of intermediate consumption of inputs given the direct demand by the banking sector and also intermediate demand in each of the 15 productive sectors of the local economy.

In 2012, 0.0165 new Ghana cedi worth of inputs from banking sector per new Ghana cedi worth of output of forestry sector. Purchases of banking products from the transport sector amounted to 0.0195 worth new Ghana cedi. However, purchases of banking inputs by fishing were the highest relative to all other sectors. These purchases amounted to 0.1647 new Ghana cedi worth of inputs from the banking sector. Trading sector purchases of banking sector input amounted 0.0159, whereas 0.0514 of banking sector inputs were purchased by the business sector.

The banking sector also purchased other sectoral intermediate inputs for the production of banking sector services and products. Such that the cost structure of the banking sector in 2012 indicate that, the usage of transport sector inputs for banking sector outputs dominates. These intermediate inputs by the transport sector amounted to 0.0777 new Ghana cedi worth of inputs from the transport sector. Other intermediate inputs purchased by the banking sector included 0.0248, 0.0111 and 0.0374 of manufacturing, electricity and construction sector respectively. Purchases of banking sector inputs for the production of banking sector output amounted to 0.0514. But business sector intermediate inputs used by the banking sector over the same period amounted to 0.0609.

The cost structure of the manufacturing sector in 2012 indicate that, there were less purchases intermediate inputs from the banking sector for the production of manufacturing sector output. **Table 14** indicate that only 0.0248 new Ghana cedi worth of inputs from banking sector per new Ghana cedi worth of output of manufacturing sector. However, 0.5598 worth of intermediate inputs of electricity were used for the production of manufacturing sector output. Also, 0.0464 of agriculture inputs were used by the manufacturing sector.

Even though the 16 year annual average growth rate in manufacturing has been only 3.2 percent. However, between 1994 and 2010 a number of large industries such as the Volta Aluminium Company (VALCO), various timber processing plants, textile manufacturing operations and vehicle assembly plants were established. That said, only 0.1209 accounted for cocoa inputs used by the manufacturing sector. Whereas 0.3322, 0.2755, 0.2404 and 0.1661 million worth of new Ghana cedi's of manufacturing output were the intermediate inputs of fishing, mining, construction and trading respectively.

4.1.6.2 Forward and Backward Linkages between Sectors

Table 15 shows the Leontief inverse for the Ghanaian economy for the period 2012. It shows that the total requirements multiplier of the banking sector amounted to 1.472 representing 5.38 percent of total sectoral requirements multipliers. The value added requirements of 0.988 per ¢1 of output including 0.482 and 0.408 in terms of employment and capital were from the banking sector over the period (**Table 17**).

Furthermore, the term forward linkage is indicative of the level of interconnectedness of a particular sector to which for example the banking sector sells its respective output. It also shows the level of structural transformation from agronomy including the use of traditional activities to modern industry. But input and output model results for the Ghanaian economy indicate that the forward linkages of banking to other economic sectors are stronger than its backward linkages. In 2012, the forward linkage co-efficient of the banking sector (1.7265) is ranked with the 6th position (**Table 18**). About 7 percent of banking products are employed as intermediate inputs by other economic activities, almost exclusively to business. The lowest interdependence sector to the banking sector is electricity.

However, community and other services (0.119) are more interconnected to the banking sector than the combined interconnectedness of agriculture (0.055). Considering that agriculture is one of the largest production sectors in the local economy and community and other service is small, this is indicative of the lack of financial openness. Lower linkage between agriculture and banking sector is indicative of the lack of transformation from traditional activities in agriculture to modern industry. Unprocessed cocoa and gold accounted for almost 80 percent of Ghana's total export (Yusof 2010) which is mainly driven by rising global market prices.

In terms of forward linkages between other economic sectors, manufacturing (5.340) is the most ranked. But the forward linkage between manufacturing and banking is even low (only 0.0023). Such lower interconnectedness between banking and other sectors is witnessed in electricity (0.001), construction (0.002) and mining (0.022). This suggests that, the economy of Ghana remain relatively diversified coupled with little change in its economic structure (Lejarraga 2010). Thus despite its impressive recent growth rates, the government objective of achieving structural transformation during financial deepening, the progress in modern and non-resource based industrial development, particularly in banking is low.

Table 14: Technical Coefficients of the Ghanaian Economy (2012)

	Agri	Coc	For	Fish	Mine	Manf	Elect	Const	Transp	Trad	Real	Busi	**Bank**	Pubad	Ccsv
Agri	0.1085	0.0000	0.0000	0.0000	0.0000	0.0756	0.0000	0.0000	0.0000	0.0369	0.0000	0.0000	0.0000	0.0000	0.0000
Coc	0.0000	0.0446	0.0000	0.0000	0.0000	0.0211	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
For	0.0003	0.0000	0.0000	0.0000	0.0000	0.0298	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Fish	0.0016	0.0000	0.0000	0.0000	0.0000	0.0071	0.0000	0.0000	0.0000	0.0081	0.0000	0.0000	0.0000	0.0000	0.0000
Mine	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016	0.0000	0.0184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Manf	0.0465	0.1209	0.1112	0.3322	0.2755	0.2210	0.5598	0.2405	0.6235	0.1661	1.0000	0.0248	0.0248	0.0171	0.0351
Elect	0.0028	0.0000	0.0177	0.0000	0.0761	0.0515	0.0354	0.0001	0.0029	0.0139	0.0000	0.0111	0.0111	0.0019	0.0169
Const	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0448	0.0000	0.0052	0.0000	0.0000	0.0374	0.0374	0.0000	0.0000
Transp	0.0485	0.0372	0.0593	0.0337	0.0196	0.0057	0.0000	0.0360	0.0246	0.2559	0.0000	0.0777	0.0777	0.0440	0.0661
Trad	0.1206	0.0574	0.0784	0.1002	0.0257	0.0901	0.0000	0.0000	0.0000	0.1004	0.0000	0.0000	0.0000	0.0000	0.0000
Real	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Busi	0.0000	0.0000	0.0196	0.0195	0.0210	0.0000	0.0000	0.0000	0.0232	0.0189	0.0000	0.0610	0.0610	0.0000	0.0000
Bank	**0.0000**	**0.0000**	**0.0165**	**0.0165**	**0.0178**	**0.0000**	**0.0000**	**0.0000**	**0.0196**	**0.0159**	**0.0000**	**0.0515**	**0.0515**	**0.0000**	**0.0000**
Pubad	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2416	0.0000
Ccsv	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4586

Notes: Agri=agriculture; Coc.=cocoa; For.=forestry; Fish=fishing: Min.=mining; Man.=manufacturing; Con.=construction; Tran.=transport; Trad. =trading; Real=real estate, Busi=business; Pubad=public administration; Ccsrv=community and services

Source: Author's calculations using International Food for Policy Research & Ghana Statistical Service (2005)

Table 15: Leontief Inverse of the Ghanaian Economy (2012)

Sectors	Agri	Coc	For	Fish	Mine	Manf	Elect	Const	Transp	Trad	Real	Busi	**Bank**	Pubad	Ccsv
Agri	1.1467	0.0257	0.0291	0.0565	0.0466	0.1308	0.0775	0.0353	0.0846	0.0975	0.1308	0.0135	0.0135	0.0080	0.0212
Coc	0.0046	1.0524	0.0063	0.0128	0.0112	0.0322	0.0191	0.0087	0.0208	0.0126	0.0322	0.0033	0.0033	0.0020	0.0052
For	0.0066	0.0076	1.0085	0.0173	0.0151	0.0435	0.0258	0.0117	0.0281	0.0170	0.0435	0.0045	0.0045	0.0027	0.0071
Fish	0.0047	0.0026	0.0030	1.0057	0.0044	0.0120	0.0071	0.0032	0.0078	0.0138	0.0120	0.0012	0.0012	0.0007	0.0019
Mine	0.0004	0.0004	0.0005	0.0010	1.0010	0.0025	0.0023	0.0190	0.0017	0.0010	0.0025	0.0011	0.0011	0.0002	0.0004
Manf	0.2086	0.2556	0.2836	0.5788	0.5065	1.4583	0.8646	0.3940	0.9434	0.5707	1.4583	0.1508	0.1508	0.0897	0.2368
Elect	0.0177	0.0156	0.0364	0.0350	0.1084	0.0821	1.0854	0.0239	0.0568	0.0500	0.0821	0.0218	0.0218	0.0079	0.0461
Const	0.0018	0.0013	0.0041	0.0040	0.0070	0.0045	0.0491	1.0016	0.0103	0.0063	0.0045	0.0439	0.0439	0.0008	0.0031
Transp	0.1063	0.0696	0.1007	0.0941	0.0543	0.0653	0.0405	0.0553	1.0717	0.3266	0.0653	0.0985	0.0985	0.0637	0.1364
Trad	0.1761	0.0972	0.1210	0.1799	0.0881	0.1709	0.1013	0.0467	0.1105	1.1858	0.1709	0.0177	0.0177	0.0105	0.0277
Real	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000
Busi	0.0068	0.0041	0.0275	0.0288	0.0274	0.0066	0.0040	0.0032	0.0312	0.0345	0.0066	1.0718	0.0718	0.0020	0.0044
Bank	0.0057	0.0035	0.0233	0.0243	0.0232	0.0056	0.0034	0.0027	0.0263	0.0291	0.0056	0.0606	1.0606	0.0017	0.0037
Pubad	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.3186	0.0000
Ccsv	0.0014	0.0000	0.0000	0.0001	0.0001	0.0002	0.0001	0.0000	0.0001	0.0001	0.0002	0.0000	0.0000	0.0000	1.8471
T. Multipliers	**1.6872**	**1.5358**	**1.6439**	**2.0383**	**1.8933**	**2.0143**	**2.2802**	**1.6054**	**2.3934**	**2.3451**	**3.0143**	**1.4887**	**1.4887**	**1.5084**	**2.3412**

Notes: Agri=agriculture; Coc.=cocoa; For.=forestry; Fish=fishing: Min.=mining; Man.=manufacturing; Con.=construction; Tran.=transport; Trad. =trading; Real=real estate, Busi=business; Pubad=public administration; Ccsrv=community and services; T. Multipliers =Total Multipliers

Source: Author's calculations using International Food for Policy Research & Ghana Statistical Service (2005)

Table 16: Value Added Multipliers of the Ghanaian Economy (2012)

	Agri	Coc	For	Fish	Mine	Manf	Elect	Const	Trans	Trad	Real	Busi	**Ban**	Pubad	Ccsv
Labour	0.5907	0.6270	0.6430	0.5948	0.3285	0.2890	0.3540	0.5501	0.3919	0.4508	0.2890	0.4817	**0.4817**	0.7594	0.5587
Capital	0.2795	0.1361	0.2302	0.1603	0.4656	0.1390	0.2961	0.2929	0.2130	0.1740	0.1390	0.4077	**0.4077**	0.1943	0.3450
Stax	0.0556	0.0555	0.0654	0.1222	0.1010	0.2729	0.1725	0.0762	0.2016	0.2188	0.2729	0.0797	**0.0797**	0.0121	0.0477
Mtax	0.0329	0.0167	0.0185	0.0378	0.0331	0.0954	0.0566	0.0258	0.0617	0.0368	0.0954	0.0099	**0.0099**	0.0037	0.0155
Etax	0.0005	0.1273	0.0007	0.0015	0.0013	0.0038	0.0023	0.0010	0.0025	0.0015	0.0038	0.0004	**0.0004**	0.0001	0.0006
T M	0.0190	0.0150	0.0167	0.0340	0.0298	0.0859	0.0509	0.0232	0.0556	0.0331	0.0859	0.0089	**0.0089**	0.0034	0.0139
Total	**0.9782**	**0.9776**	**0.9745**	**0.9507**	**0.9594**	**0.8860**	**0.9324**	**0.9691**	**0.9262**	**0.9150**	**0.8860**	**0.9882**	**0.9882**	**0.9731**	**0.9815**

Notes: Agri=agriculture; Coc.=cocoa; For.=forestry; Fish=fishing: Min.=mining; Man.=manufacturing; Con.=construction; Tran.=transport; Trad. =trading; Real=real estate, Busi=business; Pubad=public administration; Ccsrv=community and services

Source: Author's calculations using International Food for Policy Research & Ghana Statistical Service (2005)

Table 17: Model Replication of the Ghanaian Economy (2012)

Sectors	Agri	Coc	For	Fish	Mine	Manf	Elect	Const	Trans	Trad	Real	Busi	Bank	Pubad	Ccsv	**Model Results** (output)	**Output (data)**	**Sector Output** %
Agri	30237	197	163	189	352	853	262	452	445	692	40	19	16	127	50	34097.0	34097.0	17.8%
Coc	121	8074	35	43	84	210	65	111	110	89	10	5	4	31	12	9005.0	9005.0	4.7%
For	173	58	5673	58	114	284	87	150	148	121	13	6	5	42	17	6950.0	6950.0	3.6%
Fish	124	20	17	3362	33	78	24	42	41	98	4	2	1	12	5	3862.0	3862.0	2.0%
Mine	10	3	3	3	7551	16	8	244	9	7	1	2	1	3	1	7862.0	7862.0	4.1%
Manf	5499	1961	1595	1935	3821	9515	2927	5042	4968	4049	449	216	182	1420	557	44137.0	44137.0	23.0%
Elect	466	120	205	117	818	536	3674	305	299	355	25	31	26	125	108	7211.0	7211.0	3.8%
Const	48	10	23	14	53	29	166	12819	54	45	1	63	53	13	7	13399.0	13399.0	7.0%
Transp	2802	534	566	314	410	426	137	707	5644	2317	20	141	119	1009	321	15468.0	15468.0	8.1%
Trad	4642	746	680	602	665	1115	343	598	582	8413	53	25	21	166	65	18716.0	18716.0	9.8%
Real	0	0	0	0	0	0	0	0	0	0	308	0	0	0	0	308.0	308.0	0.2%
Busi	179	32	155	96	207	43	14	41	164	245	2	1534	87	31	10	2839.9	2839.9	1.5%
Bank	**151**	**27**	**131**	**81**	**175**	**37**	**11**	**35**	**139**	**207**	**2**	**87**	**1282**	**26**	**9**	**2398.1**	**2398.1**	**1.3%**
Pubad	0	0	0	0	0	0	0	0	0	0	0	0	0	20873	0	20873.0	20873.0	10.9%
Ccsv	36	0	0	0	0	1	0	1	1	1	0	0	0	0	4344	4385	4385	2.3%
Total																		**100.0%**

Notes: Agri=agriculture; Coc.=cocoa; For.=forestry; Fish=fishing: Min.=mining; Man.=manufacturing; Con.=construction; Tran.=transport; Trad. =trading; Real=real estate, Busi=business; Pubad=public administration; Ccsrv=community and services

Source: Author's calculations using International Food for Policy Research & Ghana Statistical Service (2005)

Table 18: Backward and Forward Linkages of the Ghanaian Economy (2012)

	Input (backward) Multipliers		Output (forward) Multipliers	
Sectors	**Co-efficient**	**Rank**	**Co-efficient**	**Rank**
Agri	1.65	10	1.12	11
Coc	1.05	15	1.22	9
For	1.60	11	1.23	8
Fish	1.95	6	1.08	12
Mine	1.82	8	1.03	14
Manf	1.81	9	7.71	1
Elect	2.16	5	1.66	5
Const	1.55	12	1.18	10
Transp	2.26	3	2.29	2
Trad	2.20	4	2.29	3
Real	2.81	1	1.00	15
Busi	1.47	14	1.32	5
Bank	1.47	14	1.27	7
Pubad	1.50	13	1.32	6
Ccsv	2.31	2	1.85	4

Source: Author's calculations using International Food for Policy Research & Ghana Statistical Service (2005

4.1.7 Counterfactual Analysis

Output multipliers measures the effect of an exogenous change in the final demand on the output of the banking sector on other sectors in the local economy. It is defined as total output (total value added) in all sectors necessary to meet one new Ghana cedi worth of final demand for banking sector output. Thus with the final demand of the banking sector, it is possible to estimate the output levels required to meet the specified demand. From the Leontief inverse matrix above,

$$X_i = (I - C)^{-1} \times Fd$$

where X_i is consumption and C is the technical coefficient matrix, the effects of increasing the final demand for banking sector on the consumption of various other sectors is accounted for. Thus for counterfactual analysis we estimate 5 and 10 percent of the final demand in banking intermediate consumption matrix.

The banking sector represents 46 percent of the business sector according to the Ghana Statistical Service (2012). An increase of 5 percent in demand for the banking sector increases banking output by 68.7 million worth of new Ghana cedi's and varied increases in all other economic sectors. The next biggest effect in absolute terms is in the manufacturing sector where output grows from 97105 to 97112.29 million worth of new Ghana cedi's. Construction also expands by 2.64496 million of new Ghana cedi's. The least effect is in community and local services with an increase in output by only 0.00031 million of new Ghana cedi's.

Similar pattern emerges with an increase in demand of 10 percent for banking sector consumption. The expectation was that increasing the final demand for banking sector would accelerate agriculture related sector including agriculture, cocoa and fishing forestry. However, the impact in these sectors is very low, since a 10 percent increase in demand of banking sector only leads to 0.29083, 0.07315, 0.02669 and 0.09872 million of new Ghana cedi's respectively. This indicates a weaker interconnectedness between the banking sector and the agriculture sector, and poor development of the mining sector. However, a change in the final demand of the banking sector tends to benefit the manufacturing, construction and transport sectors than the agriculture sector in the Ghanaian economy.

Table 19: Variation of the final demand 2012 due to 5% and 10% change in Banking Sector Final Demand (46% of banking sector)

-in millions of New Ghana Cedi ₵

	5% counterfactual				*10 % counterfactual*			
	Output	**Employment**	**Capital**	**FD**	**Output**	**Employment**	**Capital**	**FD**
agric	0.29083	0.11384	0.02140	0	0.58167	0.22768	0.10935	0
cocoa	0.07315	0.03830	0.00365	0	0.14630	0.07660	0.01394	0
forst	0.09872	0.05219	0.00880	0	0.19744	0.10439	0.03327	0
fish	0.02669	0.01129	0.00085	0	0.05338	0.02259	0.00399	0
mine	0.05397	0.00993	0.00378	0	0.10794	0.01987	0.04105	0
manf	7.28910	0.42028	0.01232	0	14.57819	0.84057	0.42726	0
elect	0.99435	0.15279	0.02948	0	1.98871	0.30558	0.38375	0
const	2.64496	1.21785	0.29624	0	5.28993	2.43571	1.28675	0
transp	5.69976	1.01223	0.10248	0	11.39952	2.02447	1.15410	0
trad	0.37882	0.07552	0.00387	0	0.75765	0.15104	0.03884	0
busi	68.70801	25.10636	8.22499	60.72	137.41602	50.21273	45.01831	121.44
ccsrv	0.00031	0.00008	0.00001	0	0.00062	0.00016	0.00010	0

Source: Author's calculations based on International Food for Policy Research & Ghana Statistical Service (2005)

4.1.8 Conclusion

Chapter 4 assessed the interconnectedness of the banking sector to the various other sectors of the Ghanaian post financial liberalisation. The theoretical disposition is that financial flows plays a significant role in determining the net-out second round effects of change in the final demand of the banking sector on other sectors of the economy. This is in line with dynamic stochastic general equilibrium models (DSGE). Christensen and Dib (2008) and Bernanke, Gertler and Gilchrist (1999) had shown that financial accelerator propagates the effects of a shock in demand of the banking (investments) on the fluctuations of output.

Model results indicate that financial sector reforms even though there has some progress in manufacturing, construction and transport sectors, it falls short of improving the interconnectedness between the banking sector and the agriculture sector which remain the biggest contributor to Ghana's economic output.

5 CHAPTER:
FINANCE AND GROWTH IN GHANA

5 CHAPTER: FINANCE AND GROWTH IN GHANA

Abstract

Using an endogenous growth model, this chapter analytical include transaction cost as measured by the difference between deposit and lending interest rate this chapter shows that the efficiency of the Ghanaian banking market, ratio of saving and the amount of technical knowledge extensively determines the growth rate of output in the Ghanaian economy. Existing literature indicate that the increase in the savings rate increases the steady-state levels of capital and per capita output. Model results shows the elimination of financial repression augmented with a reduction in transaction cost generate additional capital stock and enhances the productive capacity of the economy. By applying a comparative static CGE model that considers both the real and financial-side of the Ghanaian economy, the economic wide impacts of financial liberalisation policies in terms of the release resources to the most productive sectors is studied. We establish a base case scenario which determines a reference output, domestic consumption, prices and welfare trajectory in the absence of financial sector reforms and serve as benchmark for policy evaluations. The benchmark data set concerns the FAM (2012) and the SAM (2012) for the local economy. It is observed that, the improvement in efficient allocation of resources has improved upon economic growth, the size of the banking system, welfare and income distribution of households. Financial CGE model findings show that output increases in 14 sectors when the banking system is characterised with lower financial intermediation cost. The removal of 7.5 percent spread in the agriculture sector including cocoa and forestry sectors increases output by 1.23, 1.72, and 0.95 percent respectively. Evidently, economic growth in primary rural-labour intensive sectors including agriculture, cocoa, fishing and forestry are greater than some sectors in the service sector. The size of the banking sector increases as the wedge between lending and deposit interest rates narrows when banks become more efficient in the post financial liberalization era. For a 5, 10 and 15 percent reduction transaction cost charged in the banking system, the size of the Ghanaian banking system increases by 2.36238362, 2.36248533 and 2.36259487 respectively. Beyond, the conventional welfare gains, welfare gains of the lowest income groups are higher than the welfare gains of the highest income group. A 5 percent mark-up reduction, it reports 0.0418 and -0.041 for EV and CV respectively for households in the lowest quintile (H01) but for households in the highest quintile it reports 0.0155 and -0.0152 which is relatively smaller compared to welfare gains from the lowest quintile group.

5.1.1 IMPACTS OF TRANSACTION COST IN GHANA

5.1.1.1 Introduction

The monetary policy of the Bank of Ghana plays a critical role in the banking industry as well as the economic stability and financial health in the country. Higher deposit rates will attract domestic households to keep their savings in the banks, rather than keep money at home, or purchase different commodities such as gold, silver or physical assets including property. To the contrary, lower mark-up rate attracts firms to finance investments through banks in the form of bank loans. Loanable funds provided by the banking sector plays a vital role in the economy, even short amount of loan to firms has the propensity to reduce unemployment in the country. According to the Bank of Ghana Report (2014) banking system of Ghana is characterised by high spreads which adversely affects growth prospects and worsen unemployment. However, generally high spreads are generally linked to the efficiency of financial intermediation and competition in the banking sector.

As part of this section a simple AK endogenous growth model with transaction cost is used as basis to measure banking sector efficiency on the steady state level of capital and how savings affects output and economic growth in the local Ghanaian economy. Consequently in Section 5.1.1.2, a simple prototype AK endogenous model is explained and analytically solved as a motivation for the larger comparative static CGE multi-sector model for the economy of Ghana. Whilst acknowledging the main pitfall of the AK-model which is the assumption of the linearity between capital and income (see Jones (2002). This section is also complimented with numerical simulations from a version of the Ramsey (1928) growth model with optimizing consumers and financial intermediaries in Ghana. The simulation is centred on the interaction of parameters in terms of preferences in consumption, productivity and transaction costs in determining the levels of output, consumption, investment and capital stock in the Ghanaian economy. That said, the Ramsey Growth model is the benchmark for sophisticated analyses in terms of consumption and savings (Calallero (1991), Pesendorfer (2004), Meghir (2004), Bhattarai (2005)). Similarly, the Ramsey (1928) model of optimal consumption and saving in a growing economy differs from the Solow model because it explicitly models the consumer side and endogenizes savings.

5.1.1.2 The Theoretical Endogenous Growth Model

In Solow (1956), the long-run growth rate of the Ghanaian economy depends on the policy measures implemented by the government. Hitherto, the investment in human capital,

reforms and technical know-how are significant contributors to economic growth. It follows that the increase in the savings rate increases the steady-state levels of capital and per capita output. What's more the elimination of financial repression augmented with a reduction in transaction cost generates additional capital stock and enhances the productive capacity of the economy. The basic endogenous growth model can be expressed in five equations expressing the production technology, the process of capital accumulation and market clearing conditions.

Let Y represent output or income, A the level of technology being exogenous, K be the capital stock which is at least human and physical capital:

Production technology:

$$Y = AK \tag{5.1}$$

Given that the competing economy exhibits externalities Romer (1989), each sector is faced with technology constraints inherent with constant returns to scale economies, but productivity is an increasing function of K.

Capital accumulation process is given by:

$$K_{t+1} = (1-\delta)K + 1) \tag{5.2}$$

The capital accumulation equation relates investment to the capital stock and the rate of depreciation δ. It follows that the financial market requires that gross savings of households S equals gross investments of households I, indicating that a proportion of δ is lost in the financial intermediation process between the saving unit and the investing unit due to absorption of resources when the economy experience an inefficient banking system. The implication is that the households generate less dollar investment than savings. Banks earns the remaining fraction $1-\delta$ as a consequence of the spread (mark-up) between market lending and borrowing rates in the banking system.

Market clearing condition:

$$Y = C + S \tag{5.3}$$

Indicative in the market clearing equation is that output is either consumed or saved. But how much of the total savings (S) is turned into investment (I) is indicated by the efficiency parameter (ϕ) of the Ghanaian banking market as:

$$I = \phi S \tag{5.4}$$

Saving (S) is a fixed fraction $_{(s)}$ of output as:

$$S = sY \tag{5.5}$$

Boundary (initial) condition:

$K_0 > 0$ $_A$ Exogenous

$\phi = 1$ Perfect Ghanaian banking market

$0 < \phi < 1$ Imperfect Ghanaian banking market

$\phi = 0$ Useless Ghanaian banking market

For simplicity Pagano (1993), Bhattarai (1997 and 2005) assume that $0 < \phi < 1$ .Assume further that there are no taxes therefore national income and output are identical. Given the balance growth condition $K_{t+1} = (1+g)K_t)$ with $\frac{I}{Y} = \frac{S}{Y}$ the solutions of how the efficiency of the Ghanaian banking market determines the growth rate of output can be obtained by substituting the production technology, investment, saving and the market clearing equations into the capital formation process and using the first order difference equation as illustrated below.

$$K_{t+1} - (1-\delta)K = \phi S = \phi sY = \phi sAK = (1+g)K_t - (1-\delta)K \tag{5.6}$$

FODE:

$$K_{t+1} - (1-\delta)K = \phi sAK \tag{5.7}$$

Dropping the time indices, steady state K grows by the growth rate, so does Y, C, I .

Therefore equation 5.7 can be re-written as:

$$g = A\frac{I}{Y} - \delta = A\phi s - \delta \tag{5.8}$$

Despite its relative simplicity, Equation 5.8 conveys useful insights about the efficiency of the Ghanaian banking system (ϕ) along with technical knowledge in determining the dynamics of the growth process in the economy of Ghana. Such that the efficiency can raise the proportion of savings channelled to investment and it may increase the marginal

productivity of capital by allocating funds to the highest marginal product of capital possible. The collection of timely information in evaluating alternative investable projects and promoting risk-adjusted return which are the key functions of the banking market that could improve the productivity of capital, thereby increasing growth.

However, it is worth noting that the liberalisation of the financial sector can affect growth by improving (changing) the saving rates in the banking market. The sign of the relationship between financial development and growth under such scenario is vague, in that financial development may also reduce saving and thereby growth (Pagano, 1993). That said the developments in banking market could result in household gains as they will be in the position to insure against endowment shocks. Such financial developments could also culminate in prudent portfolio management (diversification of rate-of-return risk).

The end result is that, private bank credit to local and foreign investors will be relatively cheaper and readily accessible. The interest rate spread between what firms pay for loanable funds and what households receives for deposits of funds would also be narrowed. Put differently, the wedge between lending interest rate and deposit interest rate will be narrowed in concomitant to the level of banking efficiency exhibiting in the banking market. Even though, the aforementioned factors could have affected the borrowing and saving behaviour of firms and households, the effect in each scenario is not clear. The policy results of financial sector reforms in promoting savings, investments and economic growth will extensively depends on the interest rate elasticity in Ghana. The next section presents a numerical example of the simple endogenous growth model in the spirit of Solow (1956).

5.1.1.3 Stimulations of the theoretical Endogenous Growth Model

Figure 11 shows the mark-up results for the lending and borrowing rates and elasticity of loans in Ghana. Theoretical literature indicates that the function played by banks is mute in the monetary policy transmission via the interest rate channel. Thus given an expansionary monetary policy, interest rate tends to fall, thereby causing a general rise in investment and GDP. From the standpoint of the bank, such expansionary monetary policy increases bank reserves and deposits which cause an increase in investment spending leading to an increase in GDP. This is because; bank credit and borrowing in the financial market are totally

substitutable. The theory implies that, both banks and firms can change the type of financing without bearing any further costs.

However, in practise firms cannot simply raise funds in the financial market as possible alternatives to private credit offered by banks albeit local or foreign owing to the fact that lenders might not have adequate information about the credit worthiness of firms. In the same conduct, banks' cannot raise capital on the same terms in the financial market as possible alternatives to demand deposits. Credit institutions like banks do not have unconstrained liquidity and may partially adjust their assets position subsequent to monetary policy tightening. In sum, the above mentioned factors could affect the credit supply of banks and wittingly affect investment activity.

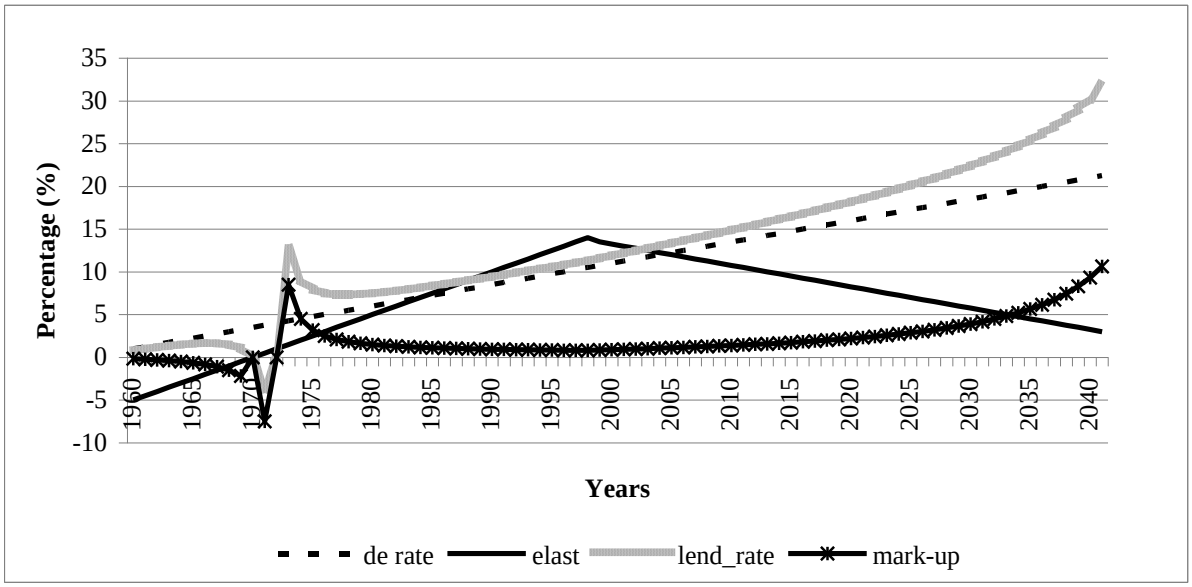


Figure 11: Lending and Borrowing Rates and Elasticity of Loans: Mark-up Analysis
Source: Author's calculations using Bank of Ghana data various years. lend_rate represents lending rate using the formulae $(DepRate/(1-1/e))$, dep rate is the deposit rate in the current year and elast is the price elasticity.

From **Figure 11** Ghanaian banks adjust their lending rates to changes in market interest rates in lieu with bank mark-up. These low levels of financial intermediation appear to be tied in with high borrowing costs and interest rate spreads. Such that the increasing lending rate (cost of borrowing) observed may be caused by several factors. Firstly, the more uncertain Ghanaian banks are with regards to future developments of markets rates in general in the Ghanaian economy, the likelihood of leaving lending rates unchanged for longer time periods. Banks may delay their response due to cost of adjustments as they prefer to change their

lending rates less frequently. However evidently larger lending rates changes over continuously adjusting interest rates. While high interest rate spreads arguably contribute to the strengthening of a country's banking when the profits earned are transferred by banks to their respective capital basis (Barajas, Steiner and Salazar 1999; Saunders and Schumacher, 2000) they are also associated with a number of drawbacks including inefficiencies (Bernanke, 1983) which impedes credit expansion as a result of high loan rates.

Secondly, the degree of competition in the Ghanaian banking market can influence pass-through lending interest rates (**see Chapter 3**). For instance, the presence of weak competition in the banking market may trigger banks to increase their mark-up margin on loans in periods of falling interest rates by reducing their lending rates at a snail pace in concomitant with their borrowing rates as they borrow short and lend long. Similarly in periods of higher lending rates in the local capital market, to remain profitable in a competitive market, the rising cost of refinancing could be passed onto households and firms in the form of higher lending rates by narrowing banks mark-up on loans. The speed at which lending rates adjust to market rates vary overtime, thus interest rates spread do not follow the market rates in a consistently anti-cyclical manner. To a certain extent, lending rates tend to be adjusted less markedly in periods of falling interests and at a faster pace in periods of rising interest rates. The combined effect of the lending rates pass-through is that, investors could be rationed out of the credit market due to the ever increasing high lending rates in the banking market.

The Effect of Banking Efficiency on Loan Rate, Deposit Rate, Spread and Savings Rate

One of the monetary policy measures in curtailing financial repression is reforming the banking sector**.** **Fig 12** shows the loan rate, deposit rate, spread and savings rates post banking sector reforms in Ghana. Evidently deposit rates relative to pre-banking sector reforms are higher. As deposit rate is rising, loan rate is rising and savings rate is rising at a steady rate. Relative to the behaviour of the loan rate and the savings rate, the wedge between the lending interest rate and the savings interest rate is narrowed overtime at a faster rate. The implication of the lower transaction cost in the Ghanaian banking market is what is postulated by the Solow Growth model. It follows that, the increase in the proportion of savings could be channelled to investments and it may increase the marginal productivity of capital by allocating funds to the highest marginal product of capital in the capital market.

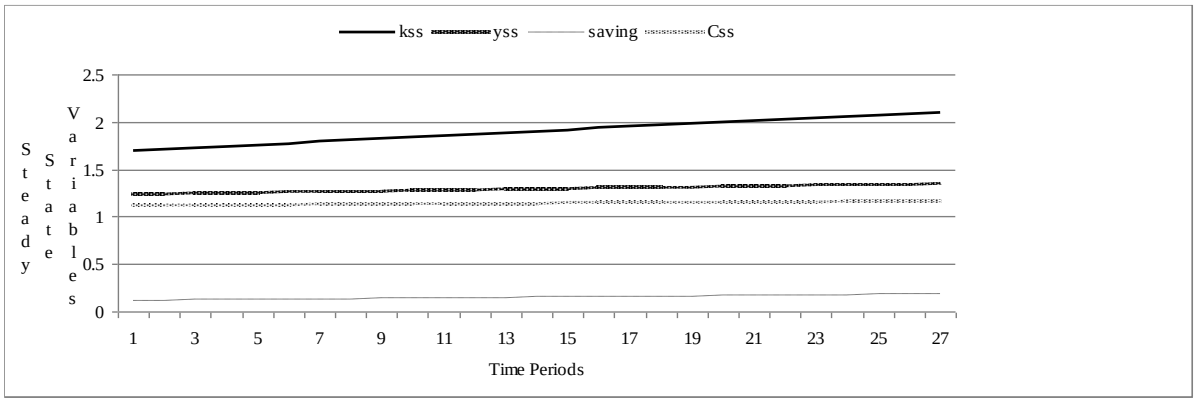


Figure 12: Effect of Banking Efficiency on Capital Stock and Output

$$Formulae: kss = \frac{savingrate}{(DepreciationRate + 0.01)^{1-\alpha}}; yss = kss^{\alpha};$$
$$saving = srate \times yss \;\&\; css = yss - saving$$

Banking efficiency increase saving and the supply of investible resources in the Ghanaian economy. The productivity of investment increases as these resources are channelled to projects that have higher rates of return thereby improving upon the capital stock and hence economic growth. Consequently, the seminar works of McKinnon (1973) and Shaw (1973) had attributed financial repression as the cause of unsatisfactory growth performance of developing economies such as Ghana.

5.1.1.3.1 Optimizing Consumers and Financial Intermediaries- Ramsey Growth Model

The optimizing growth model with optimizing consumers and financial intermediaries chosen for this section is based on the saving investment and economic growth in infinite horizon model by Bhattarai (2005). The AK model presented above show the importance of lower transaction (financial intermediation) cost on the investment decisions of households but does not consider the optimizing behaviour of consumers. The issue of the optimizing consumers and financial intermediaries in a growth model can be further illustrated in a Ramsey (1928), Cass (1965) and Koopman (1965).

In Ramsey (1928), Cass (1965) and Koopman (1965), a representative household with infinite horizon optimises the utility from its life time consumption. Three varied versions of the is presented and explicitly solved for the steady states under diverse assumptions in terms of depreciation rate, growth in technology and the transaction cost in the local Ghanaian

economy. The optimizing problem of the local economy along with 100 percent depreciation can be stated as:

$$\text{Max } U_t = \sum_{t=0}^{\infty} \beta^t \ln(C_t) \qquad 0 < \beta < 1 \tag{5.9}$$

Subject to:

Output and the technology constraint: $Y_t = AK_t^{\alpha} \qquad 0 < \alpha < 1$ (5.10)

Market clearing condition: $C_t + I_t = Y_t$ (5.11)

Capital formation: $K_{t+1} = I_t$ (5.12)

Boundary (initial) condition $K_0 = K_0$ (5.13)

However, overtime there is a reduction in the value of an asset (Hottelling 1925) as a result a less than 100 percent depreciation is much more realistic. In view of that, the law of capital accumulation is given by:

Capital formation: $K_{t+1} = K_t(1-\delta) + I_t$ (5.14)

Even though, the above two scenarios may be efficient for the benevolent social planner, financial markets and the Ghanaian banking market in particular are inefficient. Related to this is that, saving and investment activities are subject to transaction cost. Here, ϕ is indicative of the fraction of savings $0 < \phi < 1$ lost in the financial intermediation process between the saving unit and the investing unit due to absorption of resources when the local economy experiences an inefficient banking system. Mentioned earlier, a higher value of ϕ is indicative of more inefficiency as postulated by Pagano (1993). It follows that the macroeconomic balance under such scenario is distorted as:

$$C_t = Y_t - I_t \;\rightarrow\; C_t = AK_t^{\alpha} - \phi\{K_{t+1} - K_t(1-\delta)\} \tag{5.15}$$

The next section provides analytical solutions to the above scenarios of the local economy.

Analytical Solutions of the Infinite Horizon Problem in the Local Ghanaian Economy

Prior to the analytical solution to the above scenarios to the Ghanaian economy, the following two questions are critical. First, what capital stock, consumption and investment in the steady state maximize' the objective function of the benevolent social planner? Second, how does ϕ affect the saving, investment and capital accumulation process in the Ghanaian economy. By substituting (5.10) and (5.12) in (5.11) and the resulting equation in (5.9),

$$C_t = Y_t - I_t \rightarrow C_t = AK_t^{\alpha} - K_{t+1} \tag{5.15}$$

$$U_t = \sum_{t=0}^{\infty} \beta^t \ln\left(AK_t^{\alpha} - K_{t+1}\right) \tag{5.16}$$

Also, part of this infinite sum actually can be written as:

$$U_t = +\beta^t \ln\left(AK_t^{\alpha} - K_{t+1}\right) + \beta^{t+1} \ln\left(AK_{t+1}^{\alpha} - K_{t+2}\right) + .. +$$

Using the first order conditions or the Euler equations, it is worth mentioning that the consumption is a control variable and capital stock is the state variable.

$$\frac{\partial U_t}{\partial K_{t+1}} = -\frac{\beta^t}{C_t} + \frac{\beta^{t+1}}{C_{t+1}} \alpha A K_{t+1}^{\alpha-1} = 0 \rightarrow \frac{C_{t+1}}{C_t} = \frac{\beta^{t+1}}{\beta^t} \alpha A K_{t+1}^{\alpha-1} \rightarrow \frac{C_{t+1}}{C_t} = \beta \alpha A K_{t+1}^{\alpha-1} \tag{5.17}$$

The implication of Equation 5.18 is that, the ratio of consumptions between two periods sum up to the discounted value of the marginal product of capital in the next period. This shows that for an optimal consumption and savings, the loss in utility by not consuming in the first period ought to equal gain from production or consumption in the next period. Note that capital stock and consumption are constant in a steady state $.. = K_{t-1} = K_t = K_{t+1} = .. = \overline{K}$ and that $.. = C_{t-1} = C_t = C_{t+1} = .. = \overline{C}$. Thus the term in the parenthesis in Equation 5.16 becomes a constant number and can therefore be taken-out of the summation sign.

$$U_t = \ln\left(A\bar{K}^{\alpha} - \bar{K}\right)\sum_{t=0}^{\infty}\beta^t \tag{5.18}$$

The resulting effect of Equation 5.17 is a constant utility in the steady state. It follows that the steady state capital stock $\bar{K}$ in the local economy can be found using steady the respective state values of consumption in Equation (5.17).

$$\frac{C_{t+1}}{C_t} = \frac{\bar{C}}{\bar{C}} = \beta\alpha A\bar{K}^{\alpha-1} \rightarrow \bar{K} = \left(\frac{1}{\beta\alpha A}\right)^{\frac{1}{\alpha-1}} = (\beta\alpha A)^{\frac{1}{1-\alpha}} \tag{5.19}$$

Equation 5.20 equally represents the investment in the steady state when δ =1. Output and consumptions in the steady state are respectively,

$$\bar{Y} = A\bar{K}^{\alpha} \rightarrow \bar{Y} = A(\beta\alpha A)^{\frac{\alpha}{1-\alpha}}$$

and

$$\bar{C} = \bar{Y} - \bar{I} = A\bar{K}^{\alpha} - \bar{K} = A(\beta\alpha A)^{\frac{\alpha}{1-\alpha}} - (\beta\alpha A)^{\frac{1}{1-\alpha}} = A^{\frac{1}{1-\alpha}}(\beta\alpha)^{\frac{1}{1-\alpha}}\left[(\beta\alpha)^{\alpha} - 1\right] \tag{5.20}$$

The benevolent social planner would prefer the steady state outcome in terms of technological factor A augmented with its respective elasticity of output to the capital stock α. Production in the next period $t+1$ is given by investment in period t when depreciation is 100 percent. However, if all output in the Ghanaian economy is consumed, investment is zero since there is nothing left for investment and the capital stock for the next period will also be zero. The end result is that, the local economy collapses due to the non-existence of capital stock. Furthermore, if consumption in period 1 is lower than the steady state, there would be more investment in that period thereby permeating consumption to increase in the next period.

However, with less than a 100 percent depreciation rate, $0 < \delta < 1$, the capital accumulation process changes to $K_{t+1} = K_t(1-\delta) + I_t$ or $K_{t+1} - K_t(1-\delta) = I_t$ where δ is the rate of depreciation. Nevertheless, the analytical solutions to the aforementioned mode are modified as follows:

$$C_t = Y_t - I_t \rightarrow C_t = AK_t^{\alpha} - K_{t+1} - K_t(1-\delta) \tag{5.15}$$

$$U_t = \sum_{t=0}^{\infty} \beta^t \ln\left(AK_t^{\alpha} - K_{t+1} + K_t(1-\delta)\right) \tag{5.16}$$

Consequently, element of this infinite sum can be written as:

$$U_t = +\beta^t \ln\left(AK_t^{\alpha} - K_{t+1} + K_t(1-\delta)\right) + \beta^{t+1} \ln\left(AK_{t+1}^{\alpha} - K_{t+2} + K_{t+1}(1-\delta)\right) + .. +$$

Similarly, first order conditions or Euler equations is used to solve the equations but unlike the previous equations consumption and investments are the control variables and capital stock is still the state variable.

$$\frac{\partial U_t}{\partial C_t}\frac{\partial C_t}{\partial C_{t+1}}\frac{\partial C_{t+1}}{\partial K_{t+1}} = -\frac{\beta^t}{C_t} + \frac{\beta^{t+1}}{C_{t+1}}\left(\alpha A K_{t+1}^{\alpha-1} + (1-\delta)\right) + = 0 \rightarrow \frac{C_{t+1}}{C_t} = \beta\left(\alpha A K_{t+1}^{\alpha-1} + (1-\delta)\right) \tag{5.17}$$

In the same way as above, the implication of this equation is that the ratio of consumption between two periods ought to equal the discounted value of the marginal product of capital in the next period. Related to this is that, in a competitive equilibrium this should equal the gross interest rate in the economy. In a steady state $.. = K_{t-1} = K_t = K_{t+1} = .. = \overline{K}$ and also $.. = C_{t-1} = C_t = C_{t+1} = .. = \overline{C}$ this means the term in the parenthesis in Equation 5.16 becomes a constant number and can be taken out of the summation sign $U_t = \ln\left(A\overline{K}^{\alpha} - \overline{K} + \overline{K}(1-\delta)\right)\sum_{t=0}^{\infty}\beta^t$ resulting in a constant utility in the steady state. The steady state capital stock $\overline{K}$ in the economy is found using steady state values of consumption in Equation 5.17.

$$\frac{C_{t+1}}{C_t} = \frac{\overline{C}}{\overline{C}} = \beta\left(\alpha A\overline{K}^{\alpha-1} + (1-\delta)\right) \rightarrow \left(\alpha A\overline{K}^{\alpha-1} + (1-\delta)\right) = \left(\frac{1}{\beta}\right) \rightarrow \left(\overline{K}^{\alpha-1}\right) = \frac{1}{\alpha A}\left(\frac{1}{\beta} - (1-\delta)\right)$$

$$\left(\overline{K}^{\alpha-1}\right) = \frac{1}{\alpha A}\left(\frac{1-\beta(1-\delta)}{\beta}\right) \rightarrow \overline{K} = \left(\frac{1-\beta(1-\delta)}{\alpha A\beta}\right)^{\frac{1}{\alpha-1}} \rightarrow \quad \overline{K} = \left(\frac{\alpha A\beta}{1-\beta(1-\delta)}\right)^{\frac{1}{1-\alpha}} \tag{5.19}$$

Output in the steady state is given by steady state capital stock:

$$\bar{Y} = A\bar{K}^{\alpha} \rightarrow \bar{Y} = A^{\frac{2-\alpha}{1-\alpha}}\left(\frac{\alpha\beta}{1-\beta(1-\delta)}\right)^{\frac{\alpha}{1-\alpha}}$$

Investment and consumptions in the steady state are:

$$\bar{I} = \bar{K} - (1-\delta)\bar{K} \rightarrow \bar{I} = \delta\bar{K} \rightarrow \bar{I} = \delta\bar{K} = \delta\left(\frac{\alpha A\beta}{1-\beta(1-\delta)}\right)^{\frac{1}{1-\alpha}} \tag{5.20}$$

$$\bar{C} = \bar{Y} - \bar{I} \rightarrow \bar{C} = \left(\frac{\alpha A\beta}{1-\beta(1-\delta)}\right)^{\frac{\alpha}{1-\alpha}} - \delta\left(\frac{\alpha A\beta}{1-\beta(1-\delta)}\right)^{\frac{1}{1-\alpha}} \tag{5.21}$$

From the analysis, the steady state solutions for consumptions, investment and capital stock considerably differ when $0 < \delta < 1$ than in $\delta = 1$. But, consider that the banking system in Ghana deviates from competitive equilibrium of an Arrow-Debreu (1954) economy. This is when only ϕ fraction of saving is channelled to investment. $0 < (1-\phi) < 1$ of saving is indicative of the transaction cost of banks. Consequently investment equals net savings net of transaction cost: $\phi S_t = I_t$. As part of the operations of financial intermediaries in the banking system a fraction of savings is lost while channelling savings to investments. Related to this is that, a lower value ϕ is symptomatic of the more inefficiency in the Ghanaian banking system. In furtherance to the solutions of models with $0 < \delta < 1$ and $0 < \phi < 1$ is modified as:

$$C_t = Y_t - I_t \rightarrow C_t = AK_t^{\alpha} - \phi\{K_{t+1} - K_t(1-\delta)\} \tag{5.15}$$

$$U_t = \sum_{t=0}^{\infty} \beta^t \ln\left[AK_t^{\alpha} - \phi\{K_{t+1} - K_t(1-\delta)\}\right] \tag{5.16}$$

As before portion of this infinite sum can be written as:

$$U_t = +\beta^t \ln\left[AK_t^{\alpha} - \phi\{K_{t+1} - K_t(1-\delta)\}\right] + \beta^{t+1} \ln\left[AK_{t+1}^{\alpha} - \phi\{K_{t+2} - K_{t+1}(1-\delta)\}\right] + .. +$$

Similarly, first order conditions or Euler equations is used to solve the equations with equations consumption and investments being the control variables and capital stock the state variable.

$$\frac{\partial U_t}{\partial C_t} = -\frac{\phi\beta^t}{C_t} + \frac{\beta^{t+1}}{C_{t+1}}\left(\alpha A K_{t+1}^{\alpha-1} + \phi(1-\delta)\right) + = 0 \rightarrow \frac{C_{t+1}}{C_t} = \frac{\beta}{\phi}\left(\alpha A K_{t+1}^{\alpha-1} + \phi(1-\delta)\right) \qquad (5.17)$$

Correspondingly as above, the implication of this equation is that the ratio of consumption between two periods ought to equal the discounted value of the marginal product of capital in the next period. Related to this is that, in a competitive equilibrium this should equal the gross interest rate in the economy. This indicates that for an optimal allocation between consumption and savings, loss in utility by not consuming ought to equal the gain from either production or consumption in the next period.

In a steady state $.. = K_{t-1} = K_t = K_{t+1} = .. = \overline{K}$ and also $.. = C_{t-1} = C_t = C_{t+1} = .. = \overline{C}$. This means the term in the parenthesis in Equation 5.16 turn out to be a constant number and can be dropped from the summation sign $U_t = \ln\left(A\overline{K}^{\alpha} - \phi\overline{K} + \overline{K}\phi(1-\delta)\right)\sum_{t=0}^{\infty}\beta^t$ ➔ resulting in a constant utility in the steady state of the economy. Here, the steady state capital stock $\overline{K}$ is found using steady state values of consumption in equation.

$$\frac{C_{t+1}}{C_t} = \frac{\overline{C}}{\overline{C}} = \frac{\beta}{\phi}\left(\alpha A\overline{K}^{\alpha-1} + \phi(1-\delta)\right) \rightarrow \left(\alpha A\overline{K}^{\alpha-1} + \phi(1-\delta)\right) = \left(\frac{\phi}{\beta}\right) \rightarrow \left(\overline{K}^{\alpha-1}\right) = \frac{1}{\alpha A}\left(\frac{\phi}{\beta} - \phi(1-\delta)\right)$$

$$\left(\overline{K}^{\alpha-1}\right) = \frac{1}{\alpha A}\left(\frac{\phi - \beta\phi(1-\delta)}{\beta}\right) \rightarrow \overline{K} = \left(\frac{\phi - \beta\phi(1-\delta)}{\alpha A\beta}\right)^{\frac{1}{\alpha-1}} \rightarrow \quad \overline{K} = \left(\frac{\alpha A\beta}{\phi - \beta\phi(1-\delta)}\right)^{\frac{1}{1-\alpha}} \qquad (5.19)$$

The output, investment and consumption in the steady state are:

$$\bar{Y} = A\bar{K}^{\alpha} \rightarrow \bar{Y} = \left(\frac{\alpha A \beta}{\phi - \beta\phi(1-\delta)} \right)^{\frac{\alpha}{1-\alpha}};$$

$$\bar{I} = \bar{K} - (1-\delta)\bar{K} \rightarrow \bar{I} = \delta\bar{K} \rightarrow \bar{I} = \delta\bar{K} = \delta\left(\frac{\alpha A \beta}{\phi - \beta\phi(1-\delta)} \right)^{\frac{1}{1-\alpha}}$$

and

$$\bar{C} = \bar{Y} - \bar{I} \rightarrow \bar{C} = \left(\frac{\alpha A \beta}{\phi - \beta\phi(1-\delta)} \right)^{\frac{\alpha}{1-\alpha}} - \delta\left(\frac{\alpha A \beta}{\phi - \beta\phi(1-\delta)} \right)^{\frac{1}{1-\alpha}}$$

The above analytical solutions of growth with optimizing consumers and financial intermediaries that the steady sate of the Ghanaian economy is the preferred outcome of the benevolent social planner, technological factor A, the elasticity of output to the capital stock α, the rate of depreciation and the cost of intermediation ϕ.

Numerical Solutions to the Infinite Horizon Model in the Local Ghanaian Economy

From **Table 20** under scenarios I and II lower level of consumption is notably experienced with 100 percent depreciation relative to when the economy exhibits less than 100 percent depreciation. However, higher share of capital in production or consumption more is the output in the steady state as detailed in scenarios I-IV. Looking at scenarios V-VI, higher transaction cost results in a reduction of growth prospects in the local economy. That said under scenarios VII-IX, higher rate of technological progress culminate in higher levels of income in the steady. The model results indicate that, as the local economy advances the marketisation of real physical assets increases and financial assets reflects the real capital assets.

Table 20: **Capital Stock, Output, Consumption and Investment in the Steady State**

Parameters of the Infinite Horizon Model										
	I	II	II	IV	V	VI	VII	VIII	IX	X
Technology (A)	150.00	44.03	44.03	44.03	44.03	44.03	100.00	100.00	100.00	100.00
Capital share: alpha	0.40	0.40	0.20	0.60	0.60	0.60	0.40	0.40	0.60	0.60
Beta	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.80
Initial Capital K0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Delta	1.00	0.05	0.05	0.05	0.05	0.05	1.00	0.05	0.05	0.05
Transaction Cost	1.00	1.50	2.00	2.50	3.50	4.00	4.00	4.00	4.50	5.25
Infinite Horizon Economy in the Steady State										
Capital Stock	771.48	2498.75	148.60	344201.54	15019.06	10756.30	392.50	9807.48	62306.46	8957.29
Output	2142.99	9750.08	2472.06	420016.93	64145.28	52502.12	1090.27	62607.02	475028.72	148356.32
Consumption	1371.51	7251.33	2323.47	75815.39	49126.23	41745.82	697.77	52799.53	412722.25	139399.02
Investment	771.48	2498.75	148.60	344201.54	15019.06	10756.30	392.50	9807.48	62306.46	8957.29

Source: Model Results using Ramsey Optimization Model with transaction cost

5.1.2 A GENERAL EQUILIBRIUM ANALYSIS OF FINANCIAL SECTOR REFORMS IN GHANA

5.1.2.1 Introduction

Financial sector reforms involving financial liberalisation and institutional reforms had been introduced and implemented in Ghana in the 1980's. The implementation of financial sector reforms in Ghana was crucial due to the repercussions that the pre-reform financial sector policies of government control over the financial system in juxtaposition with prolonged economic crisis had caused. The consequence of the pre-reform era is the colossal damage caused on the financial system which culminated in financial crisis, bank distress and an inefficient Ghanaian economy over the period. The deregulation of the financial sector is generally considered to be a general good for the economy. This is because an efficient financial system promotes savings into investments, permeates inter-temporal optimization by households and firms, spreads risks, promotes efficiency by narrowing the wedge between lending and savings interest rates potentially leading to higher economic growth. In that regard, features of the structural financial sector reforms in Ghana created conducive environment for increased foreign bank entry and enhanced competition in the banking industry (see Chapter 3).

Even though, quantitative impacts of financial sector reforms in the CGE framework is essential for policy analysis it has never been done in the Ghanaian context discussed earlier in **Chapter 2**. This chapter contribute to the literature on the **economic wide impacts of banking sector efficiency in a financial CGE model** in the context of the Ghanaian economy. From this background, since a financial CGE considers the interactions among different markets on the local Ghanaian economy, an analysis of the quantitative impact of the efficiency of the banking sector on output, investment, employment, prices and welfare of households is more effectively carried out. Additionally, this chapter contribute to the literature by developing a **financial accounting matrix (GFAM)** for Ghana which has never been done and also updates the existing social accounting matrix (SAM) (2005) to a current social accounting matrix (2012) which reflects the current structure of the economy of Ghana.

It follows that, in order to appreciate a complete picture of the transactions taking place in the local Ghanaian economy, real accounts from SAM are not sufficient and need to be complemented with financial accounts from FAM. The significance of the SAM and FAM

dataset is that, it becomes the foundation for the construction of the **first financial CGE model** for the Ghanaian economy that considers the real side and explicitly models the banking sector that intermediates between the households sector and the government sector. Lastly, in furtherance of policy analysis, the financial CGE model is used to assess the economy wide impacts of financial policies in Ghana for comparative static analysis.

Theoretical Framework of the CGE Technique

In Robinson (1989 pp. 907-908), a computable general equilibrium is typically epitomized by five distinctive features. Firstly, a CGE model ought to specify the economic sectors or actors in the economy understudy. Secondly, specification of the behavioral rules for the varied sectors ought to be clearly specified. Thirdly, it is imperative for the model dimensions to include a series of signals which trigger economic actors to make their respective economic decisions. Fourthly, the institutional frameworks of the economy with respect to the economic interactions of economic actors need to be indicated.

Fifthly, it is necessary to specify the equilibrium conditions and model closures. This is mainly the system wide constraints that must be satisfied but are not considered in the decision making process of any particular agent's. The point with regards to the model closure is that it establishes how markets will equilibrate by specifying different sets of equations to be solved and by way of establishing endogenous and exogenous variables respectively. The term 'closure' was initially used by Sen (1963) but in the CGE context by Taylor and Lysy (1979). According to Taylor, 'in formal algebra, prescribing closure boils down to stating which variables are endogenous or exogenous in an equation system largely used based upon macroeconomic accounting identities, and figuring out how they influence one another' (Taylor 1990 pp. 15-16). Last but not the least, a micro consistent data in the form of a social accounting matrix (SAM) and/or financial accounting matrix (FAM) is required for model application and simulations.

Nonetheless, similar to economic theory or model, the assumptions in CGE modelling equally have substantial bearing on its conclusions. Besides, a CGE model is best described by the certain specificity of the features that its exhibit. Standard features are cemented in the Walras (1896) Law. In order to satisfy Walras's Law, the utility and profit maximization behaviour is typically assumed and excess demand functions are homogenous of degree zero

in prices. This is mainly when both the supply and demand sides are equalized across all of the interconnected markets in the economy. But the abstractness is formalized by Arrow-Debreu (1954) and Geanakoplos (2004) with realistic micro consistent dataset with specifications to prove the existence of a competitive equilibrium for the levels of supply, demand and price across the specified set of markets. Given the assumptions of a CGE model, its results and policy recommendations should be taken with a grain of salt, keeping in mind the theoretical frameworks.

In the context of CGE application, the first CGE model was applied to the Norwegian economy by Johansen (1989). Nevertheless, the transformation of general equilibrium to a useful policy analysis tool was the catalyst mind of Scarf (1992). 'One of the major themes of economic theory is that the behaviour of a complex economic system can be viewed as an equilibrium arising from the interaction of a number of economic units with different motivations' Scarf (1973). Moreover, owing to the fact that SAM based CGE models are theoretically grounded in Walrasian general equilibrium theory, they ought to satisfy Walras conditions. Walras conditions include (1) every agent's consumption maximizes her utility given the prices and (2) market clears implying that the total demand for each commodity just equals the aggregate endowment. Yet there is a longstanding theoretical conflict between Walrasian modellers and Keynes modellers. The theoretical conflict is centred on the assumptions of market-clearing price adjustment mechanisms in product and factor markets (Walras) vis-à-vis equilibrium levels of employment, income and output levels which in Keynes are taken as given or independent in determining the respective equilibrium position.

A standard CGE model completely account for all the linkages between multi-sectors of an economy. Equally these linkages could be backward and forward or inter-linkages between multi-sectors or linkages between households expenditures and incomes. There is an imposition of constraints on the income and expenditures. Typically, household demands are via utility maximization subject to budget constraints; zero economic profit for firms producing household demands holds; the market forces allocates resources; international trade between the domestic economy and the rest of the world and conditions for model closure. However where the market mechanism behave imperfectly, unemployment may increase and increasing government expenditures are equally met by raising taxes or borrowing which has policy implications for households, firms and the government.

Various functional forms including the Leontief function, Constant Elasticity of Substitution (CES) function and the Cobb-Douglas function are used in most econometric modelling. Classically, these functional forms are used in modelling the supply/production side or demand/consumption side of microeconomic models. However, the standard approach in applied CGE modelling is to use the single-level value-added type supply structure in a multi-sector supply structure which entails value-added and intermediate inputs in a 'nested' supply or production structure. In the nested supply structure, the Cobb-Douglas, CES and Leontief functions are predominantly used. Typically the function form is based on the proposed research question. Therefore most CGE modellers and commentators choose functional forms that permeate key parameters to be calibrated in order to replicate the benchmark equilibrium Shoven and Whalley (1992). That's why the standard CGE model in an open economy adapts CES and Constant Elasticity of Transformation (CET) functions to model the decision making process of consumers and producers in consumption and production related issues-the consumption of production of imports or exports and domestically produced goods.

That said a standard CGE model for policy analyses is centred on households (rural or urban) who own land and capital. Maximization of household is derived from their lifetime utility drawn from leisure and consumption decisions. Revenues obtained by the government from taxes (direct or indirect) and non-tax (e.g. sovereign wealth funds) are used to finance goods and services as well as government transfer. A government transfer is a distribution function of government (Musgrave, 1959). On the premise of society being un-equal, market-outcomes may lead to a distribution of income through government transfers. However critics argue that, transfer-payments programs adversely affect households' decisions to work and/or retire. This implies that, social security for example contributes to lower saving rates by influencing individual households decisions on earlier retirement. Domestic producers maximises profit and the likelihood of their investment decisions is influenced by prices of respective inputs needed for production. Additionally, goods are imported and/or exported from/to the RoW. In the presence of trade deficit, the RoW is lending to the domestic market or economy. Lastly, three conditions required in a CGE model are zero profit conditions, market clearing conditions and income balances (i.e. income and expenditure account of a given economy).

5.1.2.1.1 The Financial Accounting Matrix (FAM)

The 2008/2009 global financial crisis has highlighted the extent of integration of markets, between financial and real variables. Also, the part that financial markets played in propagating the recent and previous financial shocks is a critical empirical question. Therefore, understanding the nature and quantifying the extent of the integration of economic activities are crucial for understanding for example, the effect of transaction costs as measured by the difference between deposit and lending interest rate charged by financial intermediaries on the multi-sectors in an economy. Besides, policy makers can make use of these macroeconomic tools and models which considers the linkages between financial and real variables.

The financial accounting matrix (FAM) is symptomatic of the flow of funds between institutions in the national economy activities. Unlike a SAM, FAM focuses more on the financial sector and financial transactions of the institutions. Most significantly, FAM brings to the fore, the financial (economic) interrelationships among the different institutions of the local economy and how these interactions, would, in turn, impact the real sector of the economy. Typically, a FAM deals with the financial transactions (in financial assets and liabilities) which take place between institutional units (non-financial, financial, government and rural and urban households) and between them, in addition to the rest of the world (RoW). The FAM shows how the surplus or deficit on the capital account is financed by the transactions in assets and liabilities. It therefore links the real side to the financial system in an economy which is indicative of the role of financial intermediaries or banks. It thus shows how the net lending sectors allocate their surplus by acquiring assets or reducing liabilities in an economy. The FAM is a square table similar to the SAM described below, in which, columns represent the liabilities and rows represent assets. However, relative to the SAM, the properties of a FAM details important dissimilarities. Specifically, the intersection of households (row) and financial intermediation (column) would be an asset of households and the same amount would be the liability of financial intermediation for the base-year.

5.1.2.1.2 The Social Accounting Matrix (SAM)

The micro consistent dataset in part used for a CGE model is termed the social accounting matrix (SAM). The SAM is a representation of the circular flow of resources between economic agents in an economy at a certain period of time. It mainly provides the framework

within which both macroeconomic and multi-production policy variables can be measured. The details of an economy are described in a SAM Fernandez and Gonzalez (2008). SAM thus provides a 'consistent picture of the flow-of-funds accounts of the separate institutions in the economy that one may distinguish' (De Melo 1989).

Typically the features of a SAM are distinguished in two fold. Firstly, the rows and columns are represented in a square matrix. Generally row entries represent resources, incomes, receipts or changes in the value of assets. 'SAM is a single entry accounting system whereby each macroeconomic account is represented by a column for outgoings and a row for incomings' (Round 1981). That's why for each row entry there ought to be a corresponding column entry for that account to be in equilibrium. Typically, column entries include uses, outlays, expenditures or changes in the value of liabilities and the net worth. This demonstrates that the expenditure payment of one sector is the income receipt of another sector and the sector itself- thereby illustrating the interconnections between the various economic agents. Secondly, a SAM display significant features of an economy along with rich and poor households' savings and income, government deficit, trade margin, investment margin, domestic, consumption, accumulation, distribution and production.

That said, a SAM can be represented in the form of a single-entry booking including details of market transactions between economic agents. It can be represented as (Pyatt 1988):

$$T = \lfloor t_{i,j} \rfloor \tag{5.20}$$

where i represents the number of row and j is the number of the column. By definition, the resources are detailed in the rows and expenditures are shown in their respective columns. From this standpoint, $t_{i,j}$ indicates the value of all receipts of i from j during the financial year. It follows that $t_{i,j}$ measures payments from j to i. According to Pyatt and Round (1985), following two basic rules in terms of the double entry bookkeeping accounting principles, the SAM can be standardized. The two basic rules such that (1) every entry is a receipt when read in its row context in the same vein the expenditure in its column context and (2) for every row entry there is a corresponding column and the system is balanced only if the corresponding row and column totals are equal for each respective account.

However, the initial task of constructing a SAM involves compiling secondary data from varied sources. Secondary data is mainly obtained from national accounts; inter industry

surveys, foreign trade statistics, government budgets, balance of payments, data on agriculture production and consumer budget information with respect to the base year under discussion. However, these data sources is often characterised with differences in:

- disaggregation of sectors, production factors, and socio-economic groups of household
- data collection and compilation techniques
- years and/or base-year prices

These partial information or data for subsequent periods for example on the final demand for commodities account for the imbalances between row and column account total. For consistency and accounting identity of the SAM, it requires a parameter estimation technique to determine values for a new input-output matrix using current input-output table as a prior estimated probability. Two techniques usually applied are the RAS[17] (see Appendix 6) and Cross Entropy[18] (see Appendix 7) techniques.

The balanced base-year SAM lays the foundation for later economic analysis since many of the algebraic expressions will become the equations of the CGE model to be modelled. The final stage of a computerised general equilibrium exercise is the process of calibration of the numeric SAM for base year model solution. The process of calibration involves making functions with specified slope or curvature parameters such as elasticities, marginal rates or shares consistent with the base year SAM by adjusting their respective scaling parameters or constant terms (Taylor 1990 p. 54).

5.1.2.2 The Ghanaian Financial General Equilibrium Model

The Basic Structure of Ghana FAM (2012)

The current account of Ghana (2012) details the sources of income and its respective uses among the multi-sectors of Ghana economy. Part of income earned from labour and/or capital

[17] Stone adapted the RAS technique for use in updating IO tables from the work of Deming and Stephan (UN Handbook, 1999)

[18] Kullback-Leibler (1951) developed the measure of distance between new and the prior estimated probabilities called the minimum cross-entropy. Robinson, Cattaneo and El-Said (2001) used the cross entropy techniques in Monte Carlo simulations to obtain a perturbed SAM for International Food Policy Research Institute (IFPRI) research

is consumed based on the preferences and the remaining part is saved either in the formal banking system. Savings entries reflect the flow of funds from current accounts to capital accounts, representing the injections of savings to loanable funds market. **Table (21)** shows that, the remaining part of the aggregated Ghana FAM (2012) describes the transformation of loanable funds that have been accumulated over the years to different types of financial assets (e.g. bonds, securities, and/or short-term/long-term derivatives). Savings to loanable funds market is sensitive to the movement of interest rates (spread) and the time preference of consumers. The savings entries represent the change in assets from current account to capital accounts.

From the standpoint of savings-investment identity, total savings in the formal sector equals the total investments in Ghana economy (2012). The implication is that injections and leakages ought to be equal when Ghana's economy is at its equilibrium of national income. Total savings for the current period is the sum of change in assets of households (rural and urban), government and the rest of the world (foreign sector) reflecting in banks' balance sheet as liabilities for the current period. It follows that, the balance sheets of financial intermediaries (banks) is the consequence of the portfolio allocation decisions of households, firms, government and the foreign sector or the rest of the world thereof.

It is worth noting that, financial information for the rest of the word (foreign sector) entails deposit made overseas, international reserves (emitting from financial accounts of households and the BoG) and current account deficit (from the real of SAM (2012), in the side of the liabilities. Similarly, details of financial assets emitted from external debt balance of payments, for private sector, balance sheet of the banks, for loans to the domestic sector and the fiscal balance for the loans made to the central government. Such that, the net of government bonds (B_t) in lieu of foreign reserves are transmitted as loans by the intermediation function of banks for their respective investments (**Table 22**). The changes in the foreign exchange account affect the capital and the current account concurrently. It follows that deficit in the current account is financed by the net inflow foreign capital owing to balance of payments.

Table 21: Structure of a Financial Accounting Matrix (Ghana FAM)

	Change in Assets	**Assets of Institutions**		**Total Assets**		
	From SAM	***Households***	***Government***	***Foreign Sector (RoW)***	***Banks***	***in period t***
Households	$S_t - \Delta A_t$				FAH_{t-1}	FAH_t
Government	$B_t - S_t$			$\sum_{t=0}^{t} BFR$	DB_{t-1}	DB_t
Foreign Sector (RoW)	ΔFRA_t		$\sum_{t=0}^{t} BFR$		FRA_{t-1}	FRA_t
Banks	$\sum_{t=0}^{t}(S_t + \Delta A_t) + \sum_{t=0}^{t}(B_t + \Delta FR_t)$	$\sum_{t=0}^{t}(S_t - \Delta A_t)$	$\sum_{t=0}^{t} B$	$\sum_{t=0}^{t} \Delta FRA$		**Total Loans**
Total	Savings	Savings	Public Debt	Foreign Reserves	Deposits	

Notes: Financial assets of households are given by their deposits in banks FAH_t Savings for the years is the change in financial assets of households $S_t - \Delta A_t$, Households accumulate financial assets by making deposits over the years $\sum_{t=0}^{t}(S_t - \Delta A_t)$, the effect of leakage of savings ΔA_t, government borrow from the RoW and domestic banks B_t and owes a debt of stock $\sum_{t=0}^{t} BFR$ to RoW and DB_{t-1} to domestic banks. DB_t represents the total debt stock of the government at the end of the year 2012. The banking sector reconciles the financial account. Assets of the banking system are represented by the funds received from the five households, government bonds plus foreign exchange. The savings in the first column is indicative of the flows from current accounts to capital accounts which is injections of savings to the loanable fund market.

Table 22: Aggregated Ghana Financial Accounting Matrix (Ghana FAM 2012) (new Gh Cedis Million)

	Change in Assets	**Assets of Institutions**				**Total Assets**
	From SAM	***Households***	***Government***	***Foreign Sector (RoW)***	***Banks***	***in period t***
Households	13815.3	0	0	0	19986	33801.3
Government	0	0	0	1375.5	1545	2920.5
Foreign Sector (RoW)	1321.7	0	1375.5	0	1031.5	3728.7
Banks	15137	27191.1	2353.2	2353.2	0	22562.5
Total		33801.3	3728.7	3728.7	22562.5	

Source: Author's calculation using Ghana SAM (2012), Ghana National Accounts (2012), Ghana Government Budget (2012) and Ghana Balance of payment (2012)

The Basic Structure of Ghana SAM (2012)

The current Ghana SAM 2005 details the socio-economic circular flows of all the productive sectors of the Ghanaian economy to be modelled. The SAM distinguishes 56 activities, 59 commodities, two group of households (i.e. rural and urban), 6 primary factors of production, 4 sets of tax instruments, and aggregated accounts for trade margin for imported goods, government, national savings as well as the rest of the world (RoW).

The supply system of Ghana's economy is represented by the activities and commodities accounts. The activities accounts entail domestic production by local producers and its outlook between local markets and exports. The value of intermediate inputs is the value of inter-sector flows which are received from the commodity accounts. The value of intermediate inputs from commodity accounts plus value-added, wages and salaries, activity taxes equals the value of output at the market price. The corresponding entry of the value of output is the revenue receipts from domestic sales and exports to the RoW.

The supply of goods and services entails, the marketed outputs sold by domestic industries, transaction costs of domestic industries, sales taxes on domestically sold goods and services plus import tariffs on imported goods from the rest of the world. The total value of imported goods is equivalent to the total absorption in Ghana's economy which entails intermediate inputs (demand), private consumption of households, government consumption, investments, change in the value of stocks plus exports to the RoW.

Table 23: Structure of a Social Accounting Matrix (Ghana SAM) (2012)

	Activities	**Commodities**	**Factors**	**Households**	**Government**	**Taxes**	**Investments**	**Capital Account**	**RoW**
Activities		Marketed Outputs							
Commodities	Intermediate inputs	Transaction Costs		Private Consumption	Public Consumption		Investments in Stocks	Private & Public Investment	Exports
Factors	Value Added								
Households			Factor income to households		Transfers to households				Transfers to the RoW
Taxes	Activity Taxes	Sales & Import Taxes		Direct household taxes					
Government									Transfers to government from RoW
Savings				Household Savings					Foreign Savings
RoW		Imports							
Total	Activity Expenditures	Total supply	Factor Expenditures	Household Expenditures	Government Expenditures	Total Payments	investments	National Investment	Foreign Exchange Inflow

NB: Households represent consumers and firms
Source: International Food for Policy Research & Ghana Statistical Service (2005)

Table 24: Ghana Social Accounting Matrix (2012)

	Agric	Cocoa	Forst	Fish	Mine	Manf	Elect	Const	Transp	trad	fin	busi	pubad	ccsrv	Cons	Gov	Inv	Exp	imports
agric	3701	0	0	0	0	3337	0	0	0	691	0	0	0	0	29023	0	0	1340	3995
cocoa	0	402	0	0	0	931	0	0	0	0	0	0	0	0	0	0	0	7672	0
Forst	11	0	0	0	0	1314	0	0	0	0	0	0	0	0	-1	0	0	5625	0
Fish	53	0	0	0	0	315	0	0	0	151	0	0	0	0	2416	0	0	927	0
Mine	0	0	0	0	0	72	0	246	0	0	0	0	0	0	0	0	0	7544	0
Manf	1585	1089	773	1283	2166	9756	4037	3222	9644	3109	91	347	356	154	39588	0	15408	4497	52968
Elect	96	0	123	0	598	2275	255	1	45	261	40.6	17.4	40	74	3450	0	0	0	65
Const	0	0	0	0	0	0	323	0	81	0	137.2	58.8	0	0	-1	0	12799	0	0
Transp	1652	335	412	130	154	252	0	482	380	4790	284.9	122.1	918	290	5266	0	0	0	0
trad	4113	517	545	387	202	3977	0	0	0	1880	0	0	0	0	2542	0	0	7492	2939
fin	0	0	74.2727	41.1311	90.2517	0	0	0	195.8906	192.932	52.287	122.003	0	1150.55	308	0	0	0	0
busi	0	0	116.032	64.2567	140.995	0	0	0	306.0285	301.406	81.685	190.597	0	1797.45	2640	0	0	0	0
pubad	0	0	0	0	0	0	0	0	0	0	0	0	5043	0	357	15473	0	0	0
ccsrv	22	0	0	0	0	0	0	0	0	0	0	0	0	2011	2352	0	0	0	0
labour	14910	4715	3674	1634	1447	5599	1118	6169	2747	4317	1339.8	574.3	11647	1142					
capital	7161	858	1171	289	2990	2846	1404	3259	1566	1110	1201.2	514.9	2869	714					
stax	0	0	0	0	0	7885	74	19	343	1755	159.6	68.4	0	0					
mtax	588	0	0	0	0	2936	0	0	0	0	0	0	0	0					
etax	0	1089	0	0	0	0	0	0	0	0	0	0	0	0					
trade margin	205	0	0	0	0	2642	0	0	0	0	0	0	0	0					

NB: forst (forestry), manf(manufacturing), transp(transport), trad (trading), fin (financial intermediaries) busi (business), pubad (public administration), ccsrv(community services), cons (consumption), gov (government) inv (investment), exp (export), stax(sales tax) , mtax(manufacturing tax) and etax (export tax).

Source: Updated to include the financial sector (banking sector) using Ghana's sectoral GDP contribution and the International Food Policy Research Institute (IFPRI), 2007

Source: International Food for Policy Research & Ghana Statistical Service (2005)

The factor accounts income represents the payments to rich and poor households by domestic producers and income to the Ghana government for the labour as well as the capital employed in their respective production processes. The income in the factor accounts flow to households after the deduction of taxes to the government, retained earnings which represents the accumulated net income that has been retained for investments by corporations rather than being paid-out in dividends to stockholders of companies and profits repatriation to foreign investors. It is worth mentioning that, households albeit rich or poor receive income from supplying factors of production including for example labour, capital, entrepreneur and land to domestic producers or transfer payments such as social security and welfare from the government. The transfer payments are intended to redistribute income. Consequently, rural and urban households spend their respective incomes in consumption by paying income and taxes (health levy, property tax, petroleum tax, etc) to the government. From the SAM (Table 24) and the FAM (22), there are four sources of funds to banks, namely foreign sector savings, domestic household savings, government savings and savings, thus net earnings plus dividends from domestic corporations.

5.1.3 Data Structure and Model Dimensions

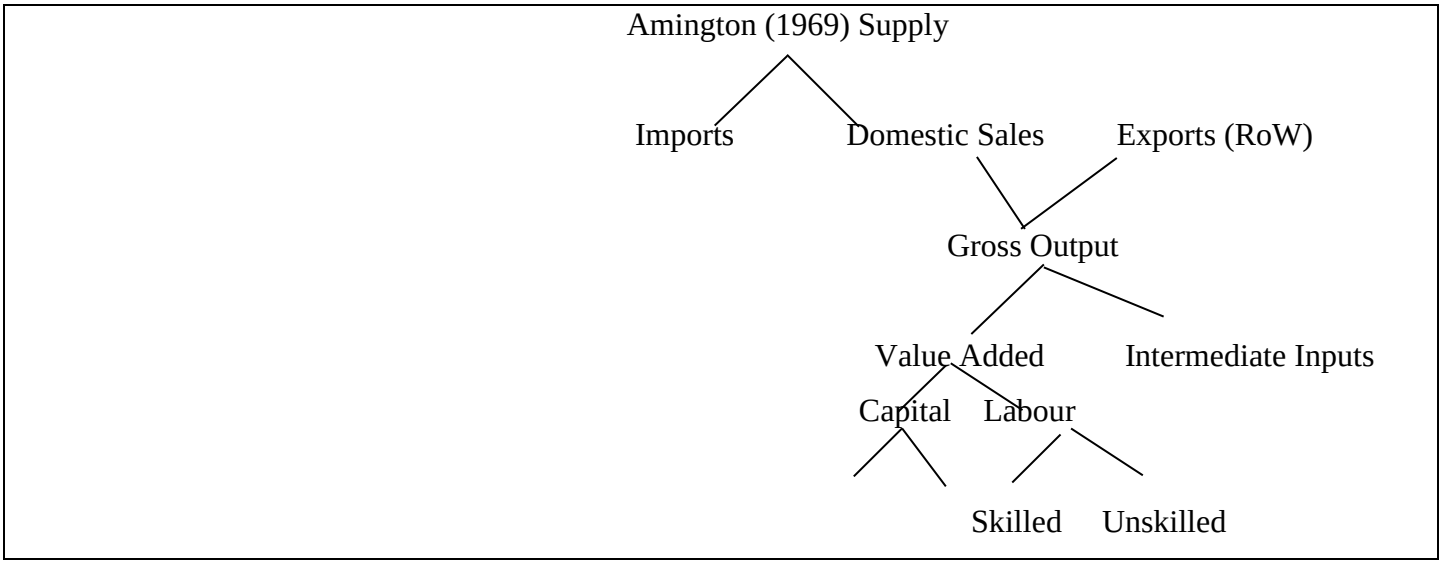
The applied computerised general equilibrium model provides an exhaustive description of the production, trade, consumption, RoW, the public sector and the financial sector of the Ghanaian economy. Following the theoretical specifications of Harberger (1962), Shoven and Whalley (1984, 1992), Ballard, Shoven and Whalley (1985), Bhattarai (1998, 1999, 2000, 2004, 2006, 2008), Whalley and Bhattarai (2000), Varian (1999) Varian and Repcheck (2010), Debreu (1954) and Rutherford (1995, 1999), **this Section** uses the functional form in CES production function. The CES functional form ought to satisfy the equilibrium conditions and/or closure outlined below.

Figure 13 presents the nested structure of production, sales and trade in the Ghanaian economy. The aggregate labour in the modelled economy is a composite of informal/male/unskilled household and skilled/urban/Accra household. Five groups of households are differentiated in the Ghana SAM (2012). The gross income per capita markedly varies across the respective group of households. The aggregate labour in the modelled economy is composite of five households (lowest, second, third, fourth and highest quintile group) according to the Ghana Standard of Living Survey (2008). Similarly,

aggregate capital is grouped into five households from the lowest to the highest quintile group.

The function of the value added comes from the CES function of composite labour and capital stock as specified in Bhattarai (2004, 2008, and 2012). The Armington (1969) CES function is used to aggregate imports from the RoW and domestic sales from the local Ghanaian economy. Elements in the co structure depicted in Figure 6.1 affect substitution in-between commodities and/or activities. That said, the elasticities here-in identified in the model are $(\sigma^1, \sigma^2, \sigma^3, \sigma^4)$. The Leontief input-output coefficients **(see Chapter 4)** represent the degree of inter-linkages among the 15 multi-production sectors of the Ghanaian economy. The implication is that an increase in the input of the financial sector has a direct and/or indirect impact on the other 15 multi-production sectors in the Ghanaian economy. The Leontief function indicate the gross output of a given sector that represents the value added and other amount sold in the local market to other markets in the local economy as inputs. The gross output entails the intermediate transactions that are used in the production process of goods and services in the economy. The gross output from the 15 multi-sectors can be sold to the RoW. It is worth mentioning that, taxes for example sales and import taxes are imposed on the goods and services supplied by the 15 multi-sectors.

Figure 13: Nested Production, Trade and Sales-the Economy of Ghana



Adopted from Bhattarai and Okyere (2005)

The taxes are applied to the consumption of five households, investment and government consumption of goods which are supplied either by the 15 mutli-sector local producers or imported from the RoW and causes distortion in the final demand of goods and services. In concomitant with the nested structure outlined above, the following section presents a detailed discussion of the specific equations and representations comprising the financial sector in the real-side CGE model to analyse the economic-wide impacts of financial sector reforms in Ghana.

5.1.3.1 Model Dimensions

Household (Demand) Functions

A representative household maximizes utility defined by production function CES type over consumption subject to a budget constraint entailing a composite price for the commodity and/or activity derived from sub-composite goods $(i = 1...15)$ based on the model dimensions of the local economy in terms of the nested production, trade and sales (**see Figure 13**). Let Equation 5.21 defines a formal representation of preferences of household's utility function of the form;

$$U_h = (\sum \alpha_i, C_{i,} h^{\rho h})^{\frac{1}{\rho h}} \tag{5.21}$$

where U_h is the utility of representative household h, $C_{i,h}$ is the consumption of the composite good, α is the share of full income of household, ρ is the elasticity parameter in the utility function, ρ is defined by the elasticity of substitution σ, between any two inputs (capital and labour) can be obtained as: $\sigma = \frac{1}{1-\rho}$ (Varian 1992, Rutherford 2001, Bhattarai 2008). Households' receive income from labour and capital endowments, government transfers and pay taxes on disposable income. The disposable income of representative household is given by;

$$I_d = (1-t_r) r K_i + (1-t_l^h) \omega_i L_i + T_p \tag{5.22}$$

where I_d is the disposable income of representative household, r_i is the rental rate of capital, rK_i is the endowment of capital, rL_i is the endowment of labour and T_p is the transfer payments by the Ghana government which is received by the representative household. Also, t_r, t_l taxes on capital and taxes on labour employed in the 15 sectors respectively. The

household uses income I_d for consumption and saves a proportion of their respective income based on individual savings decisions in the formal banking sector. Thus,

$$\sum_h \left\{ \sum_i P_i(1+t_c)C_{i,h} + S_h \right\} = I_d \tag{5.23}$$

However the proportion of household disposable income saved is subject to financial intermediation (transaction) cost in the Ghanaian banking system. The banking firm retain a fraction $(1-\sigma)_{ki}$ of savings plus any unreported profits when such savings is deposited in the banking system of the local economy (see Varian 1996, p. 409). Related to this is that at the firm level, the microeconomic foundations of financial frictions is centred in the capital structure due to information asymmetry, agency frictions and financial intermediation. It follows that, the current price mark-up charged by the representative bank with respect to providing loanable funds to the 15 multi-sector is represented by: $\left(\frac{1}{\frac{1-1}{e}} \right)$

$$i\left(\frac{1}{\frac{e-1}{e}} \right) = P_{I,d} \tag{5.24}$$

where i is indicative of the interest rate, e is the elasticity of demand and $p_{1,d}$ is the price of investment good. Therefore, using the Lagrangian rule the demand functions are ascertained by maximising representative household utility function (Equation 5.21) with respect to disposable income (Equation 5.22) and savings (Equation 5.23) are derived as;

$$C_i = \left(\frac{\alpha_i h}{P_i(1+t_c)^{(1-\sigma)} \sum_i \alpha_i, h(P_i(1+t_c)^{(1-\sigma)}} \right) \tag{5.25}$$

The equilibrium condition require that, labour supplied by the representative household ought to be consistent with the total demand for labour derived from the behaviour of the profit maximization firms.

International Trade

Given the CES Armington function below, the total supply A_i for each of the 15 multi-production sectors is produced with domestic and imported goods and services.

$$A_i = \vartheta\left[\left\{(1-\theta_i^m)L_i^{\sigma^m-1}\right\}^{\frac{1}{\sigma^m}} + \left\{\theta_i^m M_i^{\sigma^m-1}\right\}^{\frac{1}{\sigma^m}}\right]^{\frac{\sigma^m-1}{\sigma^m}} \quad (5.26)$$

where A_i is the CES aggregate of domestic supplies and import supplies of L_i and M_i respectively. θ_i^m is the share of imports in good i, σ^m is the elasticity of substitution in the CES aggregate supply function and the shift parameter of the aggregate function is ϑ.

Production Functions

In this standard comparative static-CGE model both capital and labour are used in the 15 multi-sectors to attain the value added VA_d given the CES function;

$$VA_d = \delta\left[(1-\partial_i)\partial_i L_i^{mi} + \partial K_i^{mi})\right]^{1/mi} \quad (5.27)$$

From Equation 5.27 VA_d measures the contribution of each individual sector in the Ghanaian economy and σ is a shift parameter. m_i, K_i L_i, ∂_i is CES factors substitution parameter, the amount of capital, amount of labour and share parameter of the labour and capital input in CES function respectively. It is worth stating that gross output of each of the 15 multi-sectors inherently contains the value added and the intermediate inputs. Such that given prices, the profit of producers in each of the 15 multi-sectors maximizes profit (π_i) subject to their respective technology constraints.

$$\pi_i = P_i g Y_i - \omega L_i - \sum_i r_i K_i - \sum_i P_i A_i (1+t_i^d) IM_i - \sum_i P_i A_i (1+t_i^a) DIi_i \quad (5.28)$$

Here, P_i includes the price and mark-up for the banks (creditors), gY_i is the gross output for the given period. t_i^d and t_i^a are taxes on the intermediate demands assumed to be zero. The imported intermediate inputs and domestic intermediate inputs are IM_i and DIi_i respectively. The equilibrium condition is such that the marginal product of factors equals factor prices. Hence there exist no positive profits for producers.

Table 25: Dimensions of Ghana's Financial CGE Model

Production Sectors	Primary Factors	Households	Institutions	Rest of the World (RoW)
1. Agriculture	1. Labour	1. Highest	1. Households	1. Foreign Sector
2. Cocoa	2. Capital	2. Fourth	2.Firms	
3. Forestry		3. Third	3.Government	
4. Fishing		4. Second	4. Banks	
5. Mining		5. Lowest		
6. Manufacturing				
7. Electricity				
8. Construction				
9. Transport				
10. Trading				
11. Real Estate				
12. Banking				
13. Business				
14. Government				
15. Community, Social & Personal Service				

Source: Author's formulation based on International Food for Policy Research & Ghana Statistical Service (2005)

Government

The government taxes economic transactions in the Ghanaian economy. Thus both direct and indirect taxes are collected by the government as tax revenue and also influence consumer's disposable income. Taxes are also collected from the production and consumption of goods and services in the local economy. The sum of tax revenues collected are spent on public goods or transferred to household in the form of lump sum:

$$\sum_i G_i P_i + TP = \mathrm{Re}v_t \tag{5.29}$$

where $G_i P_i$ and TP are government purchases from different productive sectors

$$\mathrm{Re}v_t = \sum_h \left\{ \sum_i P_i t_c C_{i,h} \right\} + t_k r K_t + t_w w L_t$$

$\sum_h \left\{ \sum_i P_i t_c C_{i,h} \right\}$ is the tax rate on final consumption of households, $t_w w L_t$ is the tax rate on labour income of households, $t_k r K_t$ is the tax rate on capital income on assets, the value of government consumption is given;

$$G_i = \sum_i \left(GD_c + GM_i \right) \tag{5.30}$$

where GD_c is government consumption of domestically produced goods and services and GM_i is government consumption of imported goods and services.

Investment and Savings

The comparative static CGE model is savings-driven implying that aggregate investment is determined by aggregate savings less total savings from the government, foreign, corporate and household sectors and the level of depreciation.

The Role of Banks

The real and the financial sector are linked through the flow of funds, banking intermediation and the fiscal policy instrument of the Ghana government. The banking sector therefore intermediates between saving units and the deposit units of households (rural and urban). But, how much of households disposable income is saved through banking intermediaries extensively depend on the interest rate spread existing in Ghana banking market. High financial intermediation cost (interest rate spread) at the production level is indicative of

banking efficiency. The cost of capital cost existing in the pre-financial liberalisation era is defined as:

$$(\phi + r + \sigma) = MPK_B = \alpha A K_1^{\alpha-1} L_B \tag{5.31}$$

where ϕ represents the arbitrage condition, r is the interest rate and σ is the rate of depreciation of assets albeit financial assets. This implies that in the financial sector, the base year is symptomatic of a repression of the banking system gauged by spread between lending and borrowing rates in the economy. It follows that, in periods of financial repression lower interest rate are paid on savings. This implies that the local Ghanaian economy is characterised by imperfect information, market imperfections including transaction costs, taxes and regulatory and institutional impediments to the arbitrage process in the banking system. But financial liberalisation policies makes $\phi = 0$, thereby causing the cost of capital to fall to $r + \sigma$ which increases capital stock from K_1 to K_2 as shown in **Figure 14**.

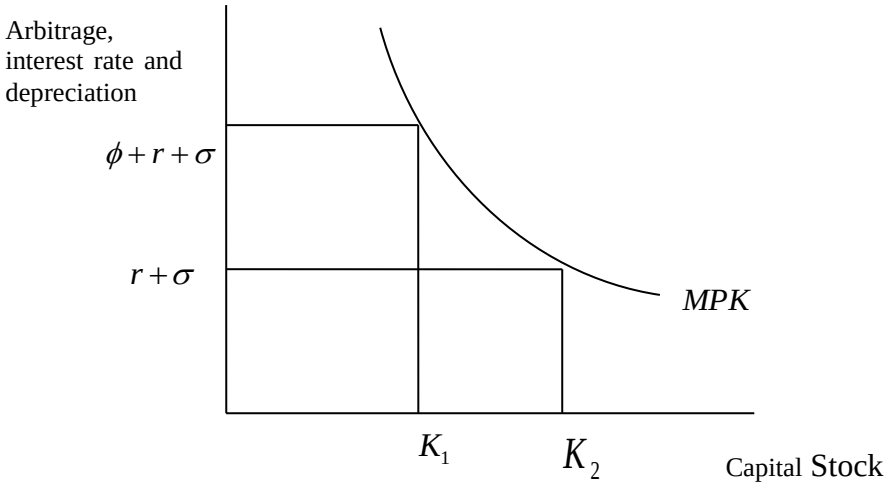


Figure 14: Cost of Capital Pre and Post Financial Reforms

The end result is the change in arbitrage condition after financial reforms.

$$(r + \sigma) = MPK_A = \alpha A K_1^{\alpha-1} L_B \tag{5.32}$$

In addition to corporate tax by the government, firms incur mark-up (financial intermediation) costs on loanable funds. The depth of the financial sector is also measured by the ratio of capital stock to the GDP which ought to be equal to the ratio of financial assets to the GDP in Ghana (2012).

Rest of the World (Foreign Sector)

The rest of the world is aggregated in single foreign accounts which indicate that the level of activity of the foreign sector is fixed. This assumption is in line with the small hypothesis economy that the rest of the world is not affected by any domestic change in the Ghanaian economy.

Equilibrium Conditions and Closure- Financial CGE Model for Ghana

The prices of consumption goods is given by the competitive equilibrium, P_i, the rental rate of capital assets c_a; wage rate for labour, ω; level of gross output, (the gross use of intermediate goods), Y_i; use of capital K_i; production use of labour, L_i; imports M_i; exports X_i intermediate inputs $T_{i,j}$; investment I_{ti}; government consumption G_i; P_c; private consumption ; such that,

a) The markets for goods and services, labour and capital clear; and b) budget constraints of households, the government and investors are satisfied. In a general equilibrium, the prices and quantities in each of the above market clear simultaneously. Such that by Walras' (1954) law only $n-1$ relative prices can be determined endogenously in such a model because the price of n^{th} good is determined in terms of those $n-1$ prices. In reality one of them is defined as a numeraire such as money.

5.1.3.2 Model Calibration and Analytical Framework

Application of the CGE model that considers both the financial and real side of the Ghanaian economy requires data on FAM and SAM and some other sources for calibrating process. Among others, one of the significant tasks of Chapter 6 is the construction of a Ghana FAM (2012) and updating the Ghana SAM (2005) to a current Ghana SAM (2012) which considers the financial intermediation sector. It is imperative to note that, the input and output Table (2005) of Ghana did not explicitly consider the banking sector of the local economy. This a crucial part of the argument advanced in this chapter that the financial sector has a significant role to play in the growth process of the local economy since the level of efficiency and competition of the banking sector tend to have an economic-wide impacts on the multi-production sectors of the economy. Aside data updates the most significant tasks of this

chapter is by filling a gap in the financial CGE literature in Ghana by analysing the economic wide effects of financial repression in a CGE model that considers the real and financial side.

When all the price variables are assumed equal to one, all the parameters in the model are computed so that the current economy is in equilibrium. Calibration for most of the functions in the model is relatively a straightforward exercise. Yet, at present, relevant elasticity estimates for the Ghanaian economy are not available. The CGE model developed in this chapter therefore, used the value of the elasticity of substitution (**see Table 26**) based on Bhattarai and Okyere (2005). The constant elasticity of substitution numbers is indicative of the flexibility of the market structure of the 15 productive sectors of the local economy. These numbers are calibrated to the nested production, trade and sales functions. **Table 26** also illustrates the interest rate spread across the 15 sectors of the Ghanaian economy (2014).

It shows sector average interest rate of 18.4% in the banking market over the period. The remaining other parameters of the model including depreciation rates, government savings rate, distribution coefficients have been completely determined based on Ghana FAM (2012) and Ghana SAM (2012) data.

Table 26: Interest Rate Spread and Elasticities of Substitution and Transformation (Ghana's Economy)-2014

No.	Sector	Deposit Interest Rate	Lending Interest Rate	Interest Rate Spread	Elasticity-CES
1	Agriculture	15	22.25	7.25	8
2	Cocoa	15	22.25	7.25	8
3	Forestry	15	22.25	7.25	8
4	Fish	15	22.25	7.25	8
5	Mining	15	37.5	22.5	5
6	Manufacturing	15	37.5	22.5	5
7	Electricity	15	37.5	22.5	5
8	Construction	15	37.5	22.5	5
9	Transport	15	37.5	22.5	3
10	Trading	15	37.5	22.5	4
11	Real Estate	15	37.5	22.5	4
12	Banking	15	37.5	22.5	3
13	Business	15	37.5	22.5	3
14	Government Services	15	37.5	22.5	4
15	Community Services	15	37.5	22.5	3

CES=constant elasticity of substitution in the production function of respective sectors of the Ghanaian economy

Source: Author's calculation based on Bank of Ghana (2014) and CES from Bhattarai and Okyere (2005) and Bhattarai (2004, 2008, 2012)

5.1.3.3 Modelling System and Solution Procedure

To build a comparative static CGE model of Ghana discussed in Section 5.1.3, I used the General Algebraic Modelling System (GAMS) developed by Brook, Kendrick and Meeraus (1988) in conjunction with the Mathematical Programming System for General Equilibrium Rutherford (1995, 1999). Presently the MPSGE is the most useful, transparent and prudent way in writing and analysing the complexity of the system of non-linear inequalities contained in CGE model. Whereas GAMS can handle a variety of sophisticated problems, MPSGE is best in handling economic equilibrium problems.

Originality of the MPSGE is cemented in the Arrow-Debreu economic equilibrium models which permeate the concise specification of complicated non-linear models in four classes of variables including nested CES or CET functions, sectors, commodities and consumers for relevant preferences and technologies. The MPSGE is implemented using Generalized Algebraic Modelling System (GAMS) by Brook et al (1988) with data handling and report writing facilities of Rutherford (1999). A crucial capability of the MPSGE/GAMS is its ability to use benchmark quantities and prices by which it calibrates automatically function coefficients and generates non-linear equations and Jacobeans. That said, MPSGE provides a shorthand way of presenting the complicated algebraic expressions developed in this chapter. Related to this simplicity inbuilt in MPSGE is an asset that we intend to incorporate in a comparative static behaviour of the five households in the Ghanaian economy. Appendix **8** presents the MPSGE/GAMS program codes for the financial CGE model for the local Ghanaian following financial liberalization policies.

5.1.3.4 Measuring Changes in Welfare across Households

The policy scenarios in terms of changing the transaction cost in the banking system will result in price changes across productive sectors and likely change total utility for households. Standard financial CGE solutions are used to compute both Hicksian Equivalent (EV) and Compensating Variations (CV) in comparing consumer welfare gains and/losses for given changes in policy scenarios. The EV is the amount which the household (consumer) would be indifferent about accepting or paying in lieu of the price change. Households would pay an amount that would be equivalent to the price change with regards to the welfare impact. If the impact of the price makes households worse off, then it is indicative of its EV. However, how

much should be households be compensated for these price changes is satisfied by its respective CV as summed in Table 27.

Table 27: Welfare in Benchmark and Counterfactual Analysis

	Rise	**Fall**
EV	**-**	**+**
CV	**+**	**-**

Source: Author's using financial CGE model results

The measure to welfare impact of policy changes in financial CGE model in this exercise is defined as:

$$UW^h = \sum_t P_t^h U_t^h \tag{5.33}$$

From Equation 5.33, UW^h measure the welfare to households h as result of policy changes, the price of utility is represented by P_t^h and U_t^h is the utility of households. Policy scenarios with a higher value of UW^h is desirable than those with a lower value of UW^h.

5.1.4 Analysis of CGE Model Results

5.1.4.1 Financial Sector Reforms and Economic Wide Impacts

This section reports on the economic wide impacts of financial liberalisation policies in Ghana, applying the comparative static CGE that considers both the real and financial-side of the Ghanaian economy. The main argument advanced in this chapter is on the efficiency of allocation of resources, welfare and distribution impacts on the five households under liberalized financial sector scenarios. The impact of financial deregulation and liberalization in the model Ghanaian economy is realized through its effect on savings and investments. Related to this is that, the volume of savings increases in the post-liberalization era on the premix that the substitution effect from an increase in the real interest rate post-liberalization dominates the income effect.

Given the various channels through which financial reforms affects growth, a growth inducing financial liberalisation policy would result in reductions transaction costs across board. This reduction in transaction costs affects the behaviour of households and firms through substitution, income and reallocation effects. The positive effects of a reduction in

transaction costs on the size of the Ghanaian economy arise due to lower transaction costs raise the incentive to savings and investments. These higher after financial reforms rewards induce more savings and investment as a consequence of substitution effects. This is the intended effect of a reduction of transaction costs on the overall size of the Ghanaian economy. Likewise, other positive effect of wholesome reduction in transaction costs is that they reduce the value of financial distortions and induce an efficiency improving shift in the composition of economic activity away from presently mark-up favoured sectors in the economy. On the other hand, wholesome reductions in financial intermediation costs may also provide income effects which reduce the incentive to save and invest. Similar effects also apply to the impact of reductions financial intermediation costs on savings and other economic activities. This should help increase the size of the economy. Thus, reducing the allocation of resources to sectors benefited from generous financial intermediation costs treatment before financial reforms. But change in arbitrage condition would encourage resources to move-out of currently mark-up preferred sectors into sectors of the local economy. These reallocation effects would increase the size of the Ghanaian economy.

The policy implication of financial reforms is that the volume of investment will increase if the impact of an increase in the cost of financial intermediation is over-compensated by the positive impact of improvement in efficiency of allocation of resources thereby improving upon output of the modelled economy and vice versa. That said there is a continuous debate in the literature as to whether the reallocation effect dominates the interest rate effect in the post-liberalization era. Likewise, when an economy moves from a repressed economy to a free market economy in the discourse for the Ghanaian economy understudy, inherent in the inter-temporal optimization process is mobilization of productive resources.

Related to this is that, unproductive assets that were experienced in the pre-liberalization period are converted into productive assets when households are convinced that the Ghanaian banking system pays positive deposit interest rates on savings. Under such a free market banking sector regime, most of the leakages of funds that goes out of the formal banking system as a consequence of the informal banking sector under the repressed regime goes to the formal banking sector in the post-liberalization era. The ripple effect is evident in increasing economic growth rates under varied lower cost transaction scenarios which improves the distribution of income of households. Households with lower income save more

with improved confidence in the banking system as they increase access to financial products including loanable funds to finance prospective investments under liberalised regime.

The end results is that the size of the banking system increases in commensuration with its level of efficiency due to the effect of changes in savings and investment in the post-liberalization which is reflected in an improvement in the indices of output, domestic consumption, prices (numeraire), accumulation of capital and welfare distribution over the period. In retrospect, an increase in the indices of output, domestic consumption, accumulation of capital and welfare is indicative that the substitution effect dominates the income effect on savings side and the reallocation effect dominates the interest effect on the investment side of the economy.

We establish a base case scenario which determines a reference output, domestic consumption, prices and welfare trajectory in the absence of financial sector reforms and serve as benchmark for policy evaluations. The benchmark data set concerns the FAM (2012) and the SAM (2012) for the local economy. To quantify the impacts of financial liberalization on the 15 multi-productive sectors of the economy, we conducted five sets of policy scenarios on the modified financial CGE model for Ghana. As a starting point for a CGE comparative static analysis, a benchmark analysis is run. Analysis carried out in this section reflects the economic conditions of the Ghanaian economy for the financial and economic period as at 2012. The economic shocks serve as proxies for a varied of policy changes, and which are applied through changing model parameter values that are subsequently introduced. The outcome of these results is then compared to the benchmark (initial equilibrium) outcome conditions using percentage changes[19].

[19] Ratio change (percentage change) is calculated as the new quantity (price) less the old quantity (price) divided by the old quantity (price) multiply by 100%. In notation form, let V_{L1} be new quantity (price) and V_{L0} represent old quantity (price). % change = $\frac{V_{L1} - V_{L0}}{V_{L0}} \times 100\%$

5.1.4.2 Output Impacts of Financial Liberalisation

First, I analysed the impacts of financial liberalisation policies on the economic growth of the Ghanaian economy. The financial CGE model solutions for output indices relative to the benchmark model are presented in **Tables 28, 29 and 30**. These are comparative static exercises, and the results are presented as percent variations from the initial equilibrium of the Ghanaian economy. It can be seen that output increases in all sectors after financial liberalisation when financial system is characterised with lower interest rate spread charged by banks. Output expansion in primary rural-labour intensive sectors including agriculture, cocoa, fishing and forestry are greater than some sectors in the service sector. These sectors include the construction, banking and business sector. Relative to other service sectors, there are significant output expansions in transport, trading and real estate sectors under liberalized regimes.

Table 28 indicate that a complete removal of financial intermediation cost in the banking system increases sector outputs with the exception of the government sector which witness an output decline. But a decline in the size of public services could also be attributed to improvement and efficiency in the government sector, in terms of reduction in recurring government expenditure including wages and salaries. The removal of the 7.5 percent spread in the agriculture sector including cocoa and forestry sectors increases output by 1.23, 1.72, and 0.95 percent respectively (**Table 28**). Accordingly the combined industry GDP share in the agriculture sector which accounts for 20.6 percent improves to 22 percent. There are significant gains in the fishing industry when there is a complete removal of spread.

Subsequently output in the fishing industry improves to 4 percent representing a 1.76 percent increase in the industry's GDP share. Economic growth is sourced from an increase in the volume of investment as a result of improvement in efficiency of allocation in the banking system. The effect is that the complete removal of 22.5 percent spread charged by financial intermediaries culminates in output rises in the mining, electricity, construction, transport and trading by 0.6, 0.74, 0.50, 0.49 and 1.42 correspondingly. In comparison, the real estate sector witnessed 1.45 percent boost in output relative to business and banking sector with only 0.80 percent rise in output. Consequently, a compete abolishing of financial intermediation cost increases community and other services output by 0.97 percent. However, there is a decline in output in government services from 15 to 12 percent due to a fall in

government revenue. Accordingly, such a decline is indicative of a reduction in the size, and the participation of the public sector in economic activity in Ghana (Honu 1988). Elsewhere, the contribution of the manufacturing sector to industry GDP share also improves by only 0.95 percent. Reports by the Ghana Statistical Service (2013) indicate that Ghana's manufacturing sector has not been performing well over the last two decades. Given the start of oil production in Ghana, the slow in growth in the manufacturing sector seem to have been affected by the initial oil production in the local economy.

From **Table 29**, a 25 percent reduction in interest rate spread culminates in substantial structural transformation across the multi-sector production in the economy. As in most sub-Saharan African economies, the public sector is a sizeable employer in Ghana. It account for 51 percent of the country's labour force (Ghana Statistical Service, 2014). The public sector in Ghana pay bill also makes up a large element of public spending, accounting for well over 50 percent of day-to-day spending at the latest count.

Following the implementation of a new pay policy for it public sector, Ghana's wage bill rose by 47 percent in 2013. Such a ballooning wage bill, if untamed has increased the country's debt to levels which pose risk to its transformation agenda (IMF Country Report 2014). However, following financial liberalisation policies, a 25 percent reduction in spread charged by the banking sector significantly reduces the size of the public sector by 22 percent.

Table 28: Impact of Financial Liberalization on Multi-Sector Output

	Financial Liberalization Scenario			
Sector	**Benchmark**	**Spread**	**No Spread**	**% Change**
Agriculture	31542.5	0.075	31931.9	1.2345
Cocoa	1278.0	0.075	1300.0	1.7163
Forestry	1291.9	0.075	1304.2	0.9495
Fish	2807.6	0.075	2856.9	1.7568
Mining	313.0	0.225	314.8	0.5974
Manufacturing	36106.3	0.225	36450.0	0.9519
Electricity	7077.0	0.225	7129.7	0.7439
Construction	13218.6	0.225	13284.1	0.4958
Transport	15075.1	0.225	15230.1	1.0279
Trading	10824.6	0.225	10978.1	1.4179
Real Estate	296.9	0.225	301.2	1.4472
Banking	3591.9	0.225	3620.9	0.8080
Business	1539.4	0.225	1551.8	0.8081
Government Services	23590.2	0.225	22665.6	-3.9195
Community Servi**ces**	4277.1	0.225	4318.8	0.9737
Total Output	**152830.1**		**153238.0**	**11.0095**

Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

Table 29: Impact of Financial Liberalization on Multi-Sector Output

	Financial Liberalization Scenario			
Sector	**Benchmark**	**Spread**	**25% Spread Reduction**	**% Change**
Agriculture	31542.5	0.075	33251.5	5.4183
Cocoa	1278.0	0.075	1368.3	7.0616
Forestry	1291.9	0.075	1346.8	4.2474
Fish	2807.6	0.075	3022.1	7.6375
Mining	313.0	0.225	321.9	2.8442
Manufacturing	36106.3	0.225	37618.4	4.1878
Electricity	7077.0	0.225	7299.1	3.1386
Construction	13218.6	0.225	13541.1	2.4397
Transport	15075.1	0.225	15724.6	4.3085
Trading	10824.6	0.225	11503.1	6.2676
Real Estate	296.9	0.225	315.8	6.3676
Banking	3591.9	0.225	3717.4	3.4938
Business	1539.4	0.225	1593.2	3.4938
Government Services	23590.2	0.225	18380.3	-22.0851
Community Services	4277.1	0.225	4459.6	4.2676
Total Output	**152830.1**		**153463.0**	**43.0890**

Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

Table 29 shows an increased share of trading and the real estate sector and a remarkable increased share of the cocoa and fishing sector. The share of trading and real estate value-added in GDP go up by 3.4 percentage points as a result of a 15 percent fall in spread. With a 25 percent fall in spread, there are 4.5 percent increases in individual sector output from the trading and estate sector. Likewise, the cocoa and fishing sector would account for 5.2 and 5.5 percent of GDP with a 25 percent reduction in financial intermediation cost during the period understudy. The share of the agriculture sector (including cocoa, forestry and fishing combined) would account for nearly 18 percent of GDP. Similar picture emerges from the manufacturing, transport, banking, business and community services. There are two major driving forces for the rapid growth in the 14 sectors of the economy after liberalization.

First, the release of extra resources for investment by convalescing banking efficiency in resource allocation. This implies that as banking systems improves, it offer opportunity to investors to diversify their respective financial assets and for households to diversify their financial sources. Using econometric model similar to King and Levine (1993), Ngugi, Amanja and Maana (2009) studied the impact of capital market deepening on economic growth in Kenya. Ngugi et al (2009) found that, developments in Kenya's capital market have a corresponding effect on the banking sector. In recent times, the Ghana government has secured a GH¢80 million facility from local banks for the procurement of cables and conductors from local manufacturers (Bank of Ghana, 2014). This is part of efforts to promote a non-oil industrial economic growth thereby maximising the benefits of financial sector reforms and consequently impact positively on economic activities. Evidently, efficient financial intermediation is an important factor in economic development process as it has implication for effective mobilisation of investible resources. Therefore a narrow deposit-lending margin is not only symptomatic of banking sector efficiency; it also reflects the level of development of the financial sector and vice versa.

Second, increased in the volume of savings available for investment as transaction cost is reduced significantly. Similarly to the findings of King and Levine (1993), efficient financial markets lower costs of transactions thereby increasing the amount of savings that are put into investments which allows capital to be allocated to investments yielding higher returns, and hence economic growth. Using a simple Portfolio Choice Theory and the Accelerator Model of Investment similar to George and Morisset (1995), Asare (2013) examined the effects of

financial sector reforms on private investment in Ghana. Asare (2013) found that, private investment responded lackadaisical to financial sector policies. He concluded that, unless foreign and unproductive assets including cash and gold are channelled to the banking system, the full benefit of financial liberalisation on private investment in Ghana is far from reach.

Table 30: Impact of Financial Liberalization on Multi-Sector Output

		Financial Liberalization Scenarios				
Sector	**Benchmark**	**Spread**	**15% Spread Reduction**	**% Change**	**20% Spread Reduction**	**% Change**
Agriculture	31542.5	0.075	32469.7	2.9397	32769.4	3.8899
Cocoa	1278.0	0.075	1328.7	3.9671	1344.2	5.1742
Forestry	1291.9	0.075	1321.4	2.2788	1331.0	3.0282
Fish	2807.6	0.075	2924.7	4.1697	2962.2	5.5051
Mining	313.0	0.225	317.6	1.4707	319.2	1.9822
Manufacturing	36106.3	0.225	36925.2	2.2681	37190.5	3.0027
Electricity	7077.0	0.225	7200.4	1.7431	7238.8	2.2859
Construction	13218.6	0.225	13382.2	1.2377	13440.8	1.6807
Transport	15075.1	0.225	15437.0	2.4006	15549.0	3.1433
Trading	10824.6	0.225	11191.3	3.3871	11310.6	4.4891
Real Estate	296.9	0.225	307.1	3.4462	310.4	4.5631
Banking	3591.9	0.225	3660.6	1.9126	3682.5	2.5221
Business	1539.4	0.225	1568.8	1.9125	1578.2	2.5221
Government Services	23590.2	0.225	21133.8	-10.4127	20150.5	-14.5810
Community Services	4277.1	0.225	4376.2	2.3172	4408.2	3.0652
Total Output	**152830.1**		**153544.6**	**25.0383**	**153585.3**	**32.2727**

Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

However, overall, multi-dimensional model results from the various policy scenarios indicate that efficiency in the banking sector culminates in an increase in output across board. Financial liberalisation policies are very broadly consistent with the framework for the contemporary industrial policy of Ghana. Similarly, from **Figure 14** below an efficient banking sector as a consequence of financial liberalization culminates in an increase in output across board. Following previous discourse, there is a decline in public sector output due to the efficient allocation of investment to prudent sectors. According to Arrow-Debreu general equilibrium model for decentralised economy quantities of goods and prices across the 15 sectors falls overall with high financial intermediation cost and vice versa. Relative to the benchmark values output rises even with 5 percent reduction in the interest rate spread charged by the banks (see **Table 30**).

It shows that reducing the cost of borrowing by 5 percent in the base year decreases the cost of capital in agriculture, cocoa, forestry, fishing, mining, manufacturing, electricity, construction, banking, transport, trade and the other sectors due to substitution effect of capital as loanable funds are cheaper to access. In this respect, a consensus seems to be emerging that interest rates in an underdeveloped financial system should not be left fully to market forces due to high chances of market failures resulting from information asymmetries, moral hazards, and high transaction costs, especially for monitoring and transferring information. That said, for the local economy to maximise the benefits of an efficient banking system and promote non-oil industrial growth, it is imperative that all reforms are part of a coherent programme that meet the very high demand of funds are properly sequenced to deliver specific investment outcomes. This implies that, the non-oil industrial sector ought to grow in tandem with the growth of the oil sector.

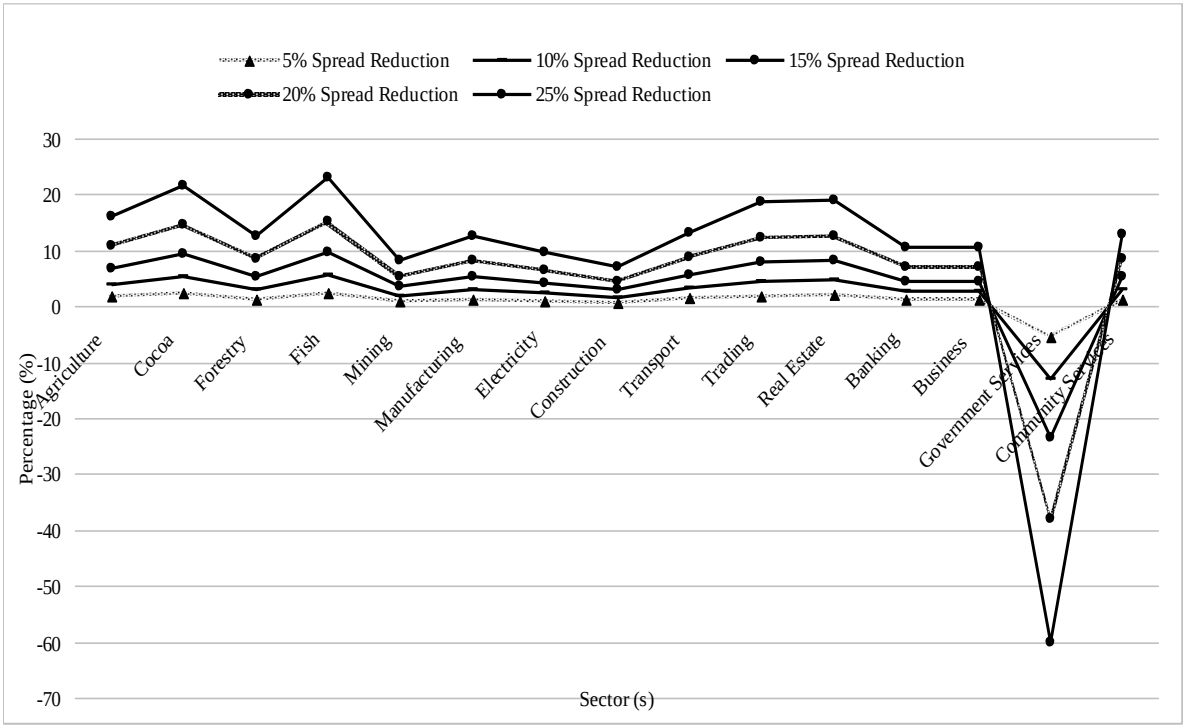


Figure 15: Impact of Financial Liberalisation on Output: Policy Scenarios

Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

5.1.4.3 Cost of Borrowing Impacts of Financial Liberalisation

Next, I consider the effect of financial liberalisation though the reduction of financial intermediation cost. (**Figure 15**). Model results indicate that, there existed inefficiencies in the banking system pre-financial liberalization. It shows relative prices increases in agriculture, cocoa, forestry, fishing, mining, manufacturing, electricity, construction, banking, transport, trade and the other sectors across board. That said the major difference between transaction cost and tax is that the tax revenues goes to the government whereas the mark-up goes to the banking sector. One can argue that the high cost of capital as a consequence of the mark-up charged by the banking sector increases the bank capital thereby enhancing the financial stability of the banking sector in Ghana. However, the mark-up rises increases prices and reduces output across the 15 sectors of the Ghanaian economy leading to inefficiencies in the economy.

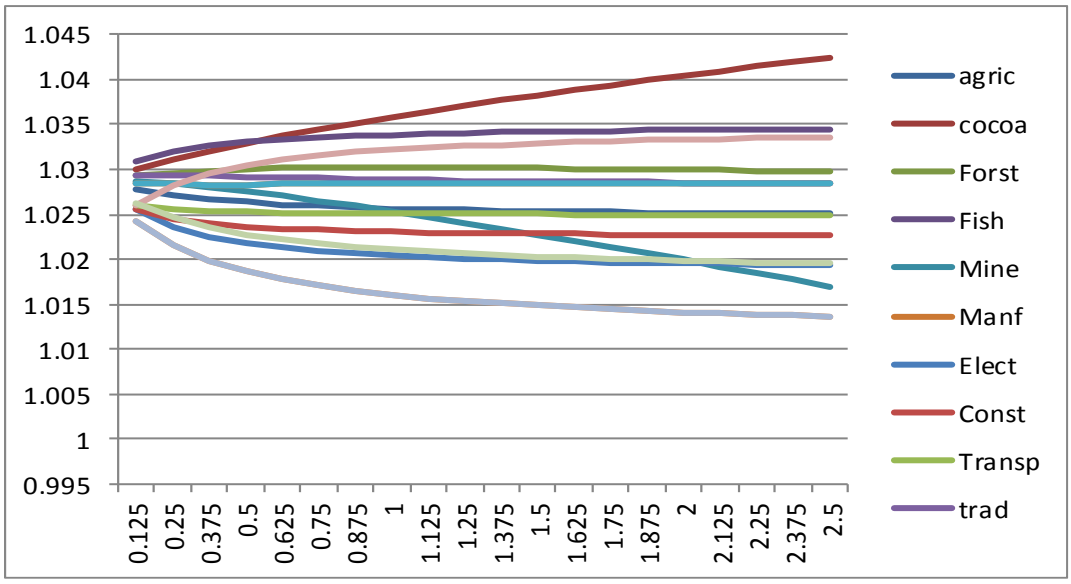


Figure 16: Impact of Transaction of Transaction Cost on Prices

Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

5.1.4.4 Bank Size Impacts of Financial Liberalisation

Further, I consider financial deepening as a consequence of liberalisation policies and its impact on the size of the banking system. Model results indicate that the size of the banking sector increases as the wedge between lending and deposit interest rates narrows when banks become more efficient in the post financial liberalization era. From **Figure 17**, for a 5, 10 and 15 percent reduction transaction cost charged in the banking system, the size of the Ghanaian banking increases by 2.36238362, 2.36248533 and 2.36259487 respectively. There are more increases in bank size with a 20 and 25 percent reduction in financial intermediation cost. This implies that reduction in financial intermediation cost raises demands for loans by entrepreneurs. This in turn motivates banks to mobilise deposits. This liberalisation will cause a large expansion in the banking sector of the local economy as it has been shown empirically in the analysis of trends in the banking system in chapter 3. Accordingly, the increase in the size of banking system is more evident in Figure 17. The benefits of a relatively larger banking system can be classified into three categories.

First, the efficiency of financial intermediation channels linking the size of the banking system and effectively assumes a high quality of financial services. This contributes to a broader allocation of financial and human capital from potentially unproductive uses to more productive uses.

Second, larger banking systems tend to reap the benefits of scale economies. A larger banking system is arguably more effective at allocating capital and monitoring the use of funds as there are significant economies of scale. Factors explaining the gains from scale economies include access to specialised labour cost, access to specialised inputs and services and knowledge spill-over's. Economies of scale is also associated with higher productivity and wages (Crafts and Wolf 2013). Overtime, the local economy would gain a comparative advantage in producing international banking services more efficiently than other sub-Saharan African countries.

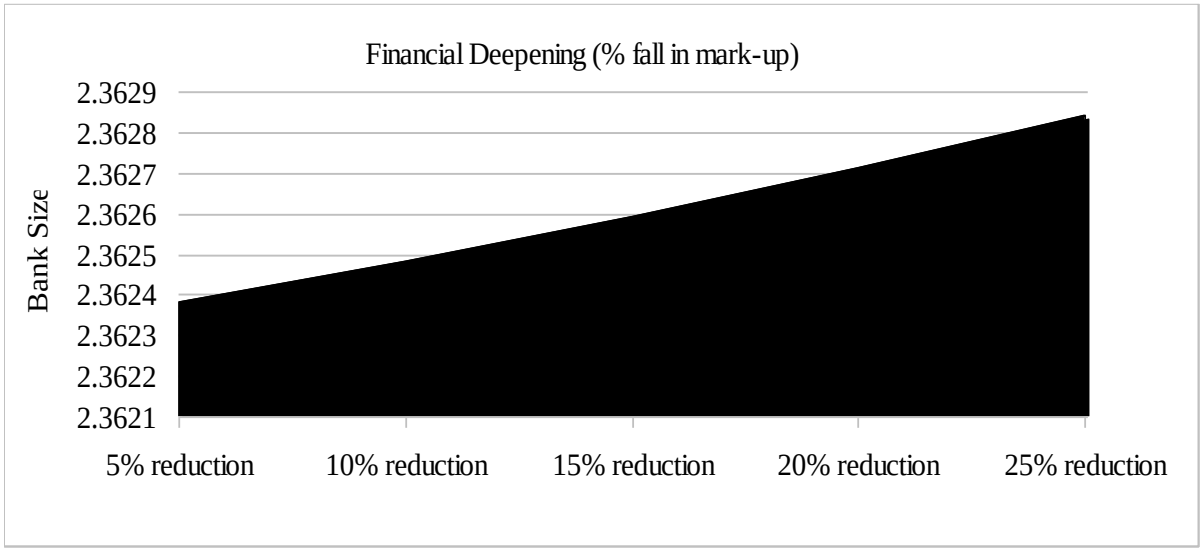


Figure 17: Banking Efficiency and Bank Size

Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

Third, gains of sub-Saharan financial marketplace. The BoG has committed to offering a wide range of offshore financial products specializing in insurance and leasing in the Sub-Saharan African region under the Banking Amendment Act 2007. One factor behind the existence of International Financial Centre including Ghana is the likely gains from clustering, when financial firms locate close to one another in cities (Glaeser 2010). Besides cluster gains, a larger financial system may improve intertemporal risk sharing (Allen and Gale 1997). With the expansion of the banking system to more groups of households, there will be a better allocation of risks, which in turn will boost investment activity in both physical and human capital, leading to higher growth rates. Likewise, an increase in size of financial centre is closely linked to the economic power of the host country (Cassis and Bussière 2005). Lastly, greater availability of financing options also increase the resilience of the local economy to external shocks, thereby smoothing consumption and the pattern of investments.

However, oversized banking systems may inhibit the prospect of economic growth. In that regard, recent empirical studies suggests that there is an n-shaped relationship between the ratio of credit to GDP (as measure of the size of the banking system) and economic growth. Arcand, Berkes and Panizza (2012) found that countries with credit to GDP ratios above 100% exhibit lower growth rates. Ghana currently has a credit to GDP ratio of 34.4%. Also, the efficiency of financial systems cannot be taken for granted, especially as information gathering is one of their key functions. Asymmetric information, externalities in financial markets (Stiglitz and Weiss, 1992) and imperfect competition can lead to sub-optimal levels of financing and investment, an inefficient allocation of capital, or have other undesirable consequences such as bank runs, fraud or illiquidity which are detrimental for economic growth. Some of these market imperfections may be best addressed through appropriate oversight by regulatory bodies such as the BoG. However, the legal and institutional background (including competition policy) may also foster the efficiency of financial markets and hence contribute to economic growth.

5.1.4.5 Welfare Impacts of Financial Liberalisation

Lastly, I consider the level of well-being of five household income groups including the lowest and highest income groups based on current survey of Ghana Living Standards (2008) under post liberalisation regimes. Mentioned earlier, positive change in compensation variation (CV) indices of financial deepening is the maximum that the household is willing to pay in order to reap the full benefit of financial services products. Negative equivalent variation (EV) indices is indicative of the amount that would be taken away from household's in order to lower their respective utility to permeate the full benefits associated with financial deepening. In simple terms, when there is an economic change in financial deepening indices, it is usually associated with change in welfare and redistribution in income. **Table 31** shows the welfare (in EV) and distributional (in CV) impacts of financial policies of households under different scenarios.

The redistribution impacts of financial liberalisation are noticeable under all financial policy scenarios. Beyond, the conventional welfare gains, welfare gains of the lowest income groups are higher than the welfare gains of the highest income group. Further, for the dual cases, the welfare gains and/or losses with the reduction of interest rate spread from 5 to 25 percent across the 15 sectors for a low labour and capital substitution elasticity. Thus, the gains in

economy's welfare are expected to improve on the allocation of capital resources and most significantly lower mark-up to households. However, it is observed by Bawumia, Owusu-Danso and McIntrye (2008) that, only 10 percent of a population of 25 million had access to the banking system. Further, even though less than 13 percent of the country's population resides in the Greater Accra region, almost 35 percent of all bank branches are located in that region (ISSER 2008). But, financial liberalisation plays a critical role in transforming the abundant resources of poor households into relatively more efficient use, hence poverty reduction.

Table 31 shows that reducing mark-up by 5 to 25 percent the EV and CV declines. For a 5 percent mark-up reduction, it reports 0.0418 and -0.041 for EV and CV respectively for households in the lowest quintile (H01). Whereas, for households in the highest quintile it reports 0.0155 and -0.0152 which is relatively smaller compared to welfare gains from the lowest quintile group. With a 15 percent mark-up reduction charged by the banking system, the EV for the lowest, third and highest quintile households are 0.0413, 0.0268 and 0.152 with CV of -0.0396, -0.0261 and -0.0150 respectively. This implies that access to banking services increase the lower quintile income household's ability to accumulate assets and enable them to diversify their economic activity. Equally, the provision of credit to the poor 90 percent will enable them to at least undertake small scale economic ventures thereby sustaining their livelihoods. Without doubt, access to loanable funds can impact on the quality of low-income households Mwanamambo, Salin and Mukumbuta (2007). In particular, access to an efficient banking sector improves the incentives of households to work and save, thereby improving their corresponding standards of living Mawuli Akpandjar, Quartey and Abor (2013). Also using conditional logit model, Mawuli et al (2013), the authors observed that locational characteristics are important in accessing financial services from particular sectors of Ghana's financial market.

Overall model results from the financial CGE developed in this chapter indicate that, at the household level, welfare gains are not evenly distributed. Such that the lower tier in the income distribution group benefit more from efficiency in the Ghanaian banking system. This is consistent with the theoretical growth model of Townsend (2010) that welfare gains are different among households group in Thailand from 1976 to 1996 depending upon their wealth. Also, using a CGE of the Napeles economy with financial intermediation, Bhattarai

(2008) found that welfare gains of rural households are larger relative to urban households. In the general equilibrium model with constrained occupation choice, Gine and Townsend (2004) estimate that eliminating credit constraints culminate in welfare gains 17 to 34 percent of income.

The welfare gains/or loss and income distributional impacts can be summarized into two significant points: First, financial liberalisation permeate more **access to banking services**. Under financial repression regimes, households with the highest income have more access to financial institutions than their lowest household counterpart. For example, access to banking services offer the potential for growth and aids safeguard lower income households against severe vulnerability. In particular, the provision of credit facilities including higher rates and insurance services go a long way to even out income fluctuations and maintaining optimum consumption during lean periods. Second, **mark-up is like a tax charged by banks**. Unlike taxes which go to the government budget of which the government can spend on public goods to compensate for distortional impacts of taxes, mark-up go to banks as part of their profit margin, and are part of the income of the representative household.

Table 31: Welfare and Distributional Impacts of Financial Sector Reforms-varied Policy Scenarios

	5% Reduction	10% Reduction	15% Reduction	20% Reduction	25% Reduction
HO1 (CV)	0.0418	0.0415	0.0413	0.0410	0.0407
HO1 (EV)	-0.0401	-0.0399	-0.0396	-0.0394	-0.0391
HO2 (CV)	0.0325	0.0324	0.0324	0.0323	0.0323
HO2 (EV)	-0.0314	-0.0314	-0.0314	-0.0313	-0.0313
HO3 (CV)	0.0270	0.0269	0.0268	0.0268	0.0267
HO3 (CV)	-0.0263	-0.0262	-0.0261	-0.0261	-0.0260
HO4 (CV)	0.0225	0.0224	0.0224	0.0223	0.0222
HO4 (EV)	-0.0220	-0.0220	-0.0219	-0.0218	-0.0217
HO5 (CV)	0.0155	0.0154	0.0152	0.0151	0.0149
HO5 (EV)	-0.0152	-0.0151	-0.0150	-0.0149	-0.0147

Notes: EV and CV as fraction of income; H05,H04, H03, H02 and H01 represents the highest, fourth, third, second and lowest income group of households.
Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

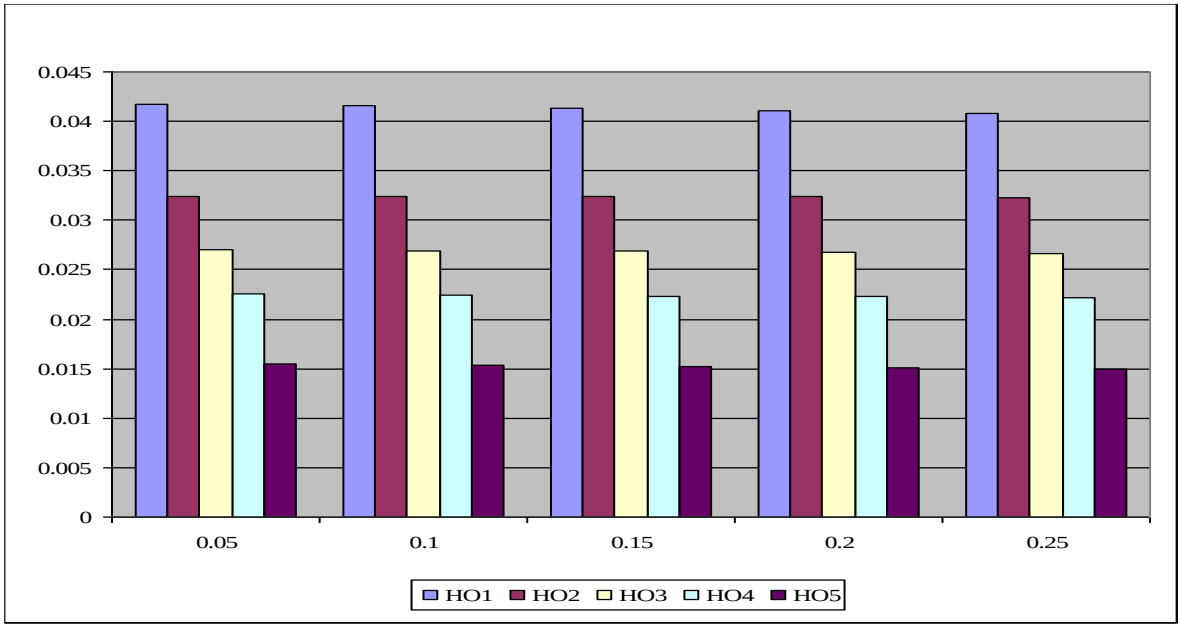


Figure 18: Welfare Impacts of Financial Sector Reforms
Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

5.1.5 Robustness of Model Results

The robustness of the above welfare impacts results is checked through sensitivity analysis of EV, CV and the total output in the economy to twenty different sets of substitution elasticities. For all different set of elasticities (0.125 to 2.5), the welfare impacts of moving to a capital income tax from a set of existing taxes is non-zero- for all set of elasticities between labour and capital inputs (see **Figure 19**). Transaction costs culminate in wide of substitution between capital and labour amongst various sector of the local Ghanaian economy. It shows that substituting among the factors of production yields higher total growth rate as indicated in **Figure 20**.

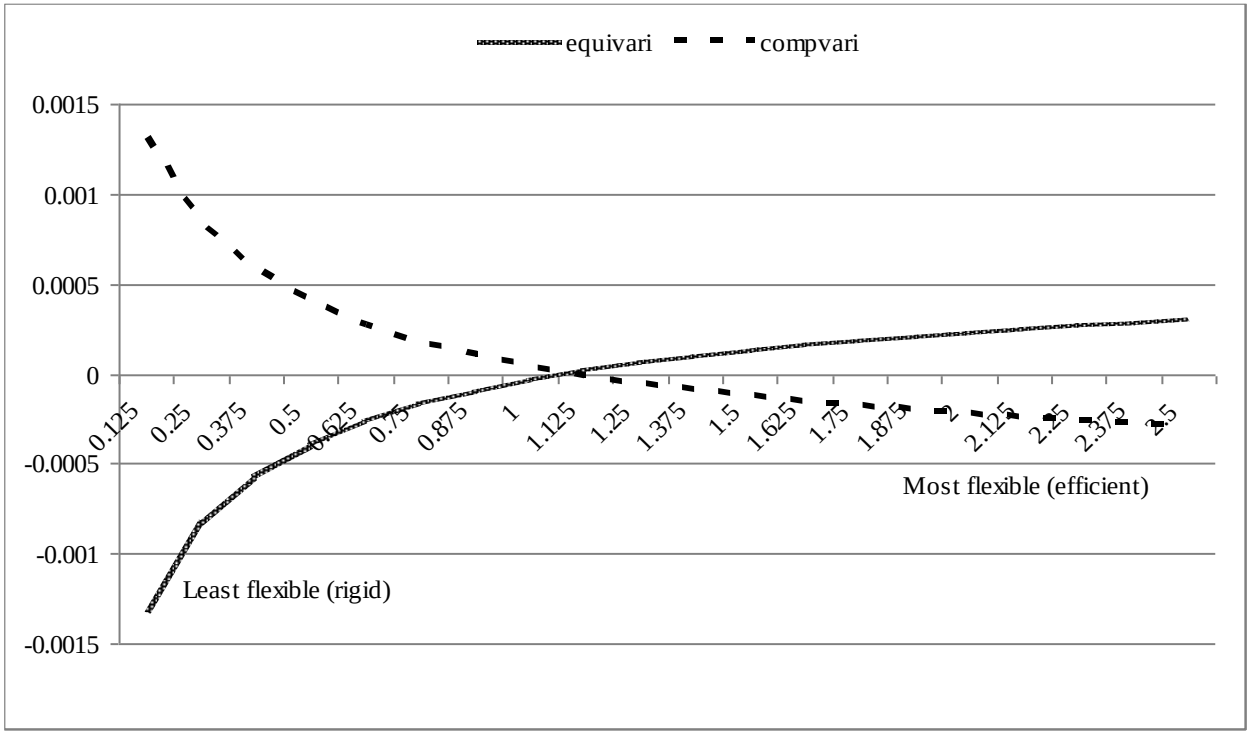


Figure 19: Benchmark and Counterfactual Analysis between Capital and Labour (20 elasticities)
Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

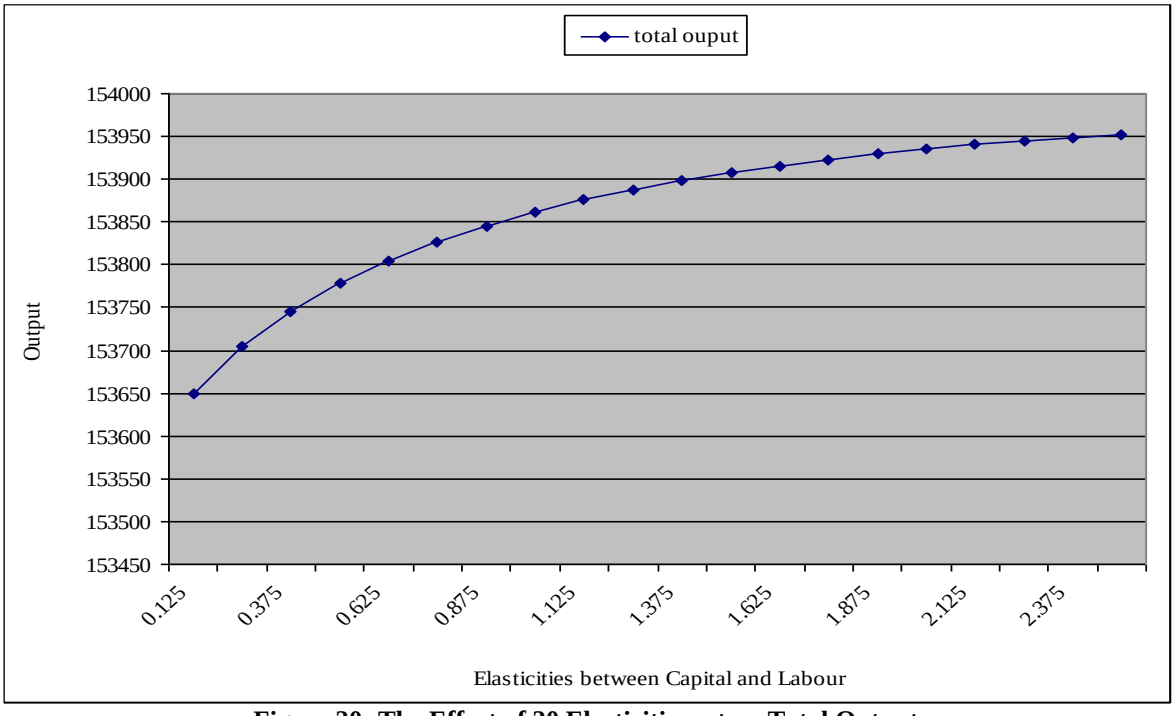


Figure 20: The Effect of 20 Elasticities set on Total Output
Source: Author's calculation based on International Food for Policy Research (2005), Ghana Statistical Service (2005), Ghana Financial Accounting Matrix (2012)

5.1.6 Conclusion

Firstly, this chapter examined a simple AK endogenous model with transaction (financial intermediation) cost. Transaction cost charged by the banking system represented the measure of efficiency in the banking system. Analytical model results indicated that a reduction in transaction costs generates additional capital stock which enhances the productive capacity of the local economy.

Secondly, analytical growth models in the spirit of Ramsey (1928) with optimising consumers and financial intermediaries are further examined as postulated by Bhattarai (2005). Model results show that, higher transaction costs culminates in the reduction of economic growth. Also, higher rate of technological progress leads to higher levels of income in the steady state. The local economy experience lower level of consumption when the economy is characterised with 100 percent depreciation than less than 100 percent depreciation.

Thirdly, a financial CGE model is used to analyse the economic wide impacts of banking efficiency in Ghana as a consequence of financial liberalisation policies. Model results indicate that, financial liberalisation has resulted in the release of unproductive assets to productive assets. The end result is increasing economic growth rates under varied lower cost transaction scenarios which improve the distribution of income of households. Households with lower income save more with improved confidence in the banking system as they increase access to financial products under liberalised regime. This results in increases in output in all sectors after financial liberalisation. But output expansion in primary rural-labour intensive sectors such as agriculture, cocoa, fishing and forestry are greater than construction, banking and business sectors. Also, liberalised regimes exhibits lower financial intermediation cost, thereby increasing economic growth. Furthermore, the level of banking efficiency is associated with the bank size. There are notable welfare gains when the local economy is characterised with lower financial intermediation cost charged by the banking system. But welfare gains by households in the lowest income group are higher than the highest income group. Finally, increases in indices of output, domestic consumption, accumulation of capital and welfare is symptomatic that the substitution effect dominates the income effect on savings side and the reallocation effect dominates the interest effect on the investment side of the economy.

6 CHAPTER:

SUMMARY AND IMPORTANT FINDINGS

6 CHAPTER: SUMMARY AND IMPORTANT FINDINGS

6.1.1 Introduction

A consensus is emerging among researchers that financial sector reforms is a slow process in Ghana despite three decade of implementing financial liberalisation policies. This is mainly attributed to the failure of the formal financial intermediaries in reducing the wedge between deposits and lending interest rates in the banking system. Meanwhile, a large body of evidence provides a sense of feeling that financial sector reforms have done quite impressively during the last decades, in changing the structure of the banking system, increasing competition, releasing extra resources for investments by improving banking efficiency in resource allocation. Further, the financial sector reform process has redistributed resources from highest quintile income group to the lowest quintile income households as lower permeating more access to banking services by lowest quintile income households, and improving upon growth levels.

In relation to this, an attempt has been made in this study to examine the evolution of market concentration and competition in the Ghanaian banking market, to evaluate the allocation of funds across 15 multi-productive sectors, to quantity the efficiency and redistribution impacts as well as the welfare effects of financial sector reforms. Secondary data from various sources were used in this study. The present chapter summarises the findings based on the above mentioned objectives, and discusses the policy implications resulting from the findings of the study. Section 6.1.2 presents the summary and findings of the present study. Policy suggestions and implications based on the findings of the study are given in section 6.1.4 and section 6.1.5 takes care of further research and limitations of the present study.

6.1.2 Summary and Important Findings of the Study

Chapter 1 introduces the reader to the significance of financial intermediation in the economic growth process. It emphasises that the cost of financial intermediation and the level of competition exhibited in the banking system is a crucial input for economic growth of the local economy. Supplementing this, the chapter elaborates on the historical developments in Ghana's financial sector reforms to improve financial deepening but finds that over the years they veered away from improving savings mobilisation in the formal banking sector to

households holding other assets outside the banking system. The relative increasing trend in interest rate spread in the banking system runs contrary to the objective of financial sector developments and is a formidable challenge in increasing the volume of savings and investments and hence economic growth.

Subsequently, the chapter puts forward major problems faced by the banking institutions in extending credit to households and firms at relatively lower transaction cost. Further the chapter judges that the deregulation and liberalisation of the banking systems resulted in the privatisation of state-owned banks, entry of foreign and domestic banks which is intended to induce competition in the banking sector. But, the intermediation cost of banks in Ghana is still characterised with persistently high interest spreads. With this background, the chapter throws some questions that need to be addressed in this study. Based on these questions, Chapter 1 highlights the aims and research objectives of the study, methodologies and data sources.

The major objectives of this study are, to access the evolution of market concentration and competition in the banking market, examine the impact of financial sector reforms on the allocation of funds across multi-productive sectors and to quantify the economic wide impacts of financial liberalisation policies in Ghana. To address the aforementioned objectives, secondary data from varied sources and related standard methodologies in terms of econometrics and general equilibrium techniques have been applied. The detailed description of the secondary data sources and methodology to address each objective discussed in respective chapters where the particular objective is dealt with.

Chapter 2 presents a review of the finance and growth literatures based on four different aspects, relevant to the focus of the thesis, viz., (a) studies on the theoretical developments to financial developments and economic in a single-sector framework (b) studies on financial CGE models (c) existing CGE models in the Ghanaian context and (d) the strengths and limitations of the CGE modelling exercise in economic-wide policy analysis.

The common findings from an overview of studies on the effect of financial developments are that finance plays significant role in the economic growth process. Especially, the presence of financial repression distorts the economic dynamics, banking efficiency and the

competitiveness of the financial system. Also, the deleterious effects of financial repression is that negative interest rate reduce the incentive of households to save and in-turn lower the volume of savings thereby decreasing the volume of loanable funds available for investments and eventually slowing down growth rates.

Nevertheless, the literature finds that there is unevenness in the bi-directional relationship between real and financial side indicators. But, the general consensus is that when the cost of financial intermediation increases, overtime the volume of investment is likely to fall. That said, the net effect of financial developments depend on whether the reallocation of capital in the post reform era can compensate for the effect of an increase in financial intermediation cost. Overall, financial liberalisation policies have their main impacts on finance and economic growth but economic theory alone cannot quantity the impacts of changes in the volume of savings and investments following financial reforms in the post era.

The literature also reveals that multi-dimensional impacts of finance and economic growth relationships are best quantified in financial CGE models. Further, studies on the economic wide impact of the relationship between the real and financial side reveal that many of the economic issues facing most Sub-Saharan African economies in particular entails financial variables including capital flight, inefficient banking systems, volatile capital flows and international debt. Nonetheless despite the advancement in research in financial CGE models in most developed economies, the quantitative impacts of financial developments on economic growth, bank size and reallocation issues are hardly dealt with in earlier studies in the Ghanaian context.

In Chapter 3, we investigated the evolution of market concentration and tests market competitiveness in the banking system, to explain the impacts of financial sector reforms. The chapter begin with the background information about the evolution of the Ghanaian banking sector, the privatisation of state-owned banks and the entry of foreign and domestic banks. The chapter shows evidence of the changing structure of the banking system in Ghana. It shows that the share of the three and five largest banks in terms of assets, deposits and loans decreased in the post-liberalisation era.

Unveiling the importance and significant impacts of competition and concentration in the banking sector, the study further makes effort to test market competition in both interests based and total revenue markets. Using unbalanced panel data sources from Bank of Ghana database, data from varied Ghana Banking Surveys, the evolution of concentration of the Banking Sector are calculated and analysed to understand what can be inferred from it in terms of the level of competitiveness in post financial sector reforms.

The existence and extent of concentration in the banking system is determined using the three and five concentration indices, Herfindahl-Hirschman Index (HHI) and the Panzar Rosse Model. The changes in the structure and performance of the banks have been observed during the post financial liberalization period (2003 to 2012). The major findings in this chapter are outlined below:

i. The total number of banks increased from 2003 to 2012. The number of banks grew by 26% over the entire period but the 80% of these new banks are foreign-owned banks. This is indicative of consolidation taking place in the banking system.

ii. The banking system is dominated by five large banks. The share of these banks in overall assets of the banking system is 74%.

iii. The CR5 banks in terms of loans and advanced to households and firms fell over the period to 40%. The market share of the CR5 and CR3 banks with regards to total assets, total deposits and total loans and advances have notably decreased over the period. Overall, the structure of the banking system has evolved substantially as a result of the entry of new banks albeit foreign or domestically owned banks.

iv. Relative to other banking industries in Sub-Saharan Africa, the Ghanaian banking sector is characterized with relatively low concentration with a concentration ratio of 0.40.

v. HH indices also suggest a year lag in the deposits and assets behind the loan market. Whereas the break point for the loan market is 2006, for deposits and assets markets is 2007.

vi. Relative to the deposits and assets markets, the loan market is more competitive. But there is a dominant banking firm in the loan market which accounted for a higher HHI.

vii. The sum of elasticity in terms of factor prices is 0.976, which is indicative of an imperfect competitive banking industry. There is intense competition in interest based market as a result of financial liberalization.

In Chapter 4 we investigated the success or failure of financial liberalisation policies for the Ghanaian economy in terms of the level of interconnectedness between the banking sector and other sectors using input-output multipliers. The chapter provides theoretical literature and empirical applications of the Leontief (1949) input-output model. It also discusses the sectoral contributions to GDP. It shows that despite series of financial sector reforms, sectoral contributions to GDP indicate that the agriculture sector remain the key contributor to economic output for the past 3 decades. There are sectoral weaknesses in diversifying the economy from agronomy to a modern based economy. Model results from the Leontief inverse indicate that:

i. About 7 percent of banking products are employed as intermediate inputs by other economic activities. The lowest interdependence sector to the banking sector is electricity. However, community and other services (0.119) are more interconnected to the banking sector than the combined interconnectedness of agriculture (0.055).
ii. The relative lower linkage between agriculture and banking sector suggests the lack of transformation from traditional activities in agriculture to modern industry.
iii. Forward linkages of the banking sector to other sectors are stronger than its backward linkages in 2012. Overall, there are lower interconnectedness between the banking sector and other sectors.
iv. Shock in the final demand of the banking sector shows the significant effects of the banking sector on Ghana's economic output. The biggest impact of an increase in demand of the banking sector is witnessed in the intermediate matrix of the manufacturing sector.
v. Financial sectors reforms tend to benefit the construction and transport sectors as well.
vi. However there are weaker interconnectedness between the banking sector and the agriculture sector, and poor development of the mining sector.

Chapter 5 used a prototype endogenous growth model with transaction cost as measured by the difference between deposit and lending interest rate as a motivation for the further financial CGE model. It also considers growth model with optimizing consumers and financial intermediaries in the spirit of Ramsey (1928) growth model. Section 5.1.2 considered the financial CGE model for the local Ghanaian economy.

Results from the prototype analytical models indicate that:

i. Increase in the savings rate increases the steady-state levels of capital and per capita output, implying that the elimination of financial repression generates additional capital stock.
ii. Ghanaian banks adjust their lending rates to changes in market interest rates in lieu with bank mark-up.
iii. The more uncertain Ghanaian banks are with regards to future developments of markets rates in general, the likelihood of leaving lending rates unchanged for longer spells. Thus, banks may delay their response due to cost of adjustments as they prefer to change their lending rates less frequently.
iv. The degree of competition in the Ghanaian banking market can influence pass-through lending interest rates.
v. The increase in the proportion of savings is channelled to investments, which in turn increases the marginal productivity of capital by allocating funds to the highest marginal product of capital in the capital market, hence economic growth**.**

Section 5.1.2 lays emphasis on the analysis of the economic wide impacts of financial liberalisation in terms of the release of resources to the most productive sectors in the Ghanaian economy. It applied a comparative static CGE model that considers both the real and financial-side of the local economy. We establish a base case scenario which determines a reference output, domestic consumption, prices and welfare trajectory in the absence of financial sector reforms and serve as benchmark for policy evaluations. The benchmark data set concerns the FAM (2012) and the SAM (2012) for the economy. It is observed that, the improvement in efficient allocation of resources has improved upon economic growth, the size of the banking system, welfare and income distribution of households. The findings from CGE model results are that:

i. Output increases in 14 sectors when the banking system is characterised with lower financial intermediation cost. The removal of 7.5 percent spread in the agriculture sector including cocoa and forestry sectors increases output by 1.23, 1.72, and 0.95 percent respectively. The combined industry GDP share in the agriculture sector which accounts for 20.6 percent improves to 22 percent. Evidently, economic growth in primary rural-labour intensive sectors including agriculture, cocoa, fishing and forestry are greater than some sectors in the service sector. These sectors include the construction, banking and business sector. Relative to the other service sectors, there are significant output expansions in transport, trading and real estate sectors under liberalized regimes.

ii. Economic growth is sourced from an increase in the volume of investment as result of improvement in efficiency of allocation in the banking system. The effect is that the complete removal of 22.5 percent spread charged by financial intermediaries culminates in output rises in the mining, electricity, construction, transport and trading by 0.6, 0.74, 0.50, 0.49 and 1.42 correspondingly. A 25 percent reduction in interest rate spread culminates in substantial structural transformation across the multi-sector production in the economy.

iii. The size of the banking sector increases as the wedge between lending and deposit interest rates narrows when banks become more efficient in the post financial liberalization era. For a 5, 10 and 15 percent reduction transaction cost charged in the banking system, the size of the Ghanaian banking increases by 2.36238362, 2.36248533 and 2.36259487 respectively. However, there are more increases in bank size with a 20 and 25 percent reduction in financial intermediation cost.

iv. The welfare and income redistribution impacts of financial liberalisation are noticeable under all financial policy scenarios. Beyond, the conventional welfare gains, welfare gains of the lowest income groups are higher than the welfare gains of the highest income group. It is evident that reducing mark-up by 5 to 25 percent the EV and CV declines. For example, a 5 percent mark-up reduction, it reports 0.0418 and -0.041 for EV and CV respectively for households in the lowest quintile (H01). Whereas, for households in the highest quintile it reports 0.0155 and -0.0152 which is relatively smaller compared to welfare gains from the lowest quintile group.

6.1.3 Limitations of the Study and Further Research

The main limitation of this study is the use of a comparative static financial CGE model where impact of economic policy measures were measured on the steady state of the economy, thereby leaving aside issues of transitional dynamics. However, as shown in Markusen, Rutherford and Tarr (2005) those issues can be addressed in CGE static models when conditions are ascertained and attention is given through the analysis of economic-wide policies. Notwithstanding this limitation, the study makes a pioneering attempt in a research area on which there is lack of comprehensive study in the Ghanaian context. It is anticipated that this study would pave way for further research in this area by extending the financial CGE model in a dynamic context. The Leontief input-output exercise could also be extended to cover exercises on the impact of an increase in financial consumption including other sectors such as agriculture, manufacturing, trading and transport.

6.1.4 Policy Suggestions and Implications of the Study

Based on the findings in various chapters of this, and ascertain the fact that financial liberalisation programs in Ghana have improved competition in the banking system, released extra resources for investment by improving efficiency in resource allocation, increased the size of the banking system, improved in growth levels and significant welfare gains from the lowest quintile group, the current section proposes the following:

i. Financial liberalisation policies has significantly changed the structure of the Ghanaian banking system, the number of foreign and domestic banks have increased as competition intensifies. This study finding implies that, increased foreign bank penetration and divestiture of state-ownership in banking can improve competitive pressures in the banking sector. Thus competitive conditions in the banking system could be further enhanced by easing regulatory impediments, and in the long-run allowing more foreign bank participation, especially given the recent regulatory reforms on capital requirements which favour domestic-owned banks. Also, the regulator ought to be more independent coupled with improved regulatory and legal powers.

ii. Forward linkages of banking sector to other economic sectors stronger are stronger than its respective backward linkages. Further, lower linkage between agriculture and

banking sector is indicative of the lack of transformation from traditional activities in agriculture to modern industry. Considering that agriculture is one of the largest contributing sectors to GDP implies the lack of financial openness. This study finding implies that financial flows play significant role in determining the cumulative effect of a shock in its final demand or the availability of investment funds on Ghanaian output. Hence continuous improvement in financial sector reforms is vital in spite of the piece-meal success of connectedness in the Ghanaian economy.

iii. Financial liberalisation policies have released resources to the most productive sectors in the local economy. In addition, improvement in efficient allocation of resources improved upon economic growth and size of the banking system. Correspondingly, welfare gains of the lowest income groups are higher than the welfare gains of the highest quintile group when the banking system is characterised with lower intermediation cost. This implies that wide-deposit rate margin is not only indicative of banking sector inefficiency but also it reflects the level of development of the financial sector. Similarly, financial liberalisation works best when banking markets are efficient but is ineffective when markets are subject to period by period balance of payments constraints. Also, the financial CGE modelling exercise contained in this study can be successfully applied to analyse several other issues including international trade, public finance (accounting), human resource development and regional developments on the Ghanaian economy. Especially, for Ghana where the lack of lengthy time series data often impedes applications of econometric techniques, the possibility of utilizing the real and financial computerised general equilibrium model based on the calibration techniques in this study may be vital in conducting further policy relevant research.

7 BIBLIOGRAPHY

7 BIBLIOGRAPHY

ADELMAN, I. and ROBINSON, S., 1988. Macroeconomic adjustment and income distribution: Alternative models applied to two economies. *Journal of Development Economics,* **29**(1), pp. 23-44.

ADELMAN, I. and YELDAN, E., 2000. The minimal conditions for a financial crisis: A multiregional intertemporal CGE model of the Asian crisis. *World Development,* **28**(6), pp. 1087-1100.

ADU, G., MARBUAH, G. and MENSAH, J.T., 2013. Financial development and economic growth in Ghana: Does the measure of financial development matter? *Review of Development finance,* **3**(4), pp. 192-203.

ADUSEI, M., 2013. Financial development and economic growth: Evidence from Ghana. *The International Journal of Business and Finance Research,* **7**(5), pp. 61-76.

ALESINA, A. and SUMMERS, L.H., 1993. Central bank independence and macroeconomic performance: some comparative evidence. *Journal of Money, Credit and Banking,* , pp. 151-162.

ALEXANDER, W.E., ENOCH, C. and BALIÑO, T.J., 1995. *The adoption of indirect instruments of monetary policy.* International monetary fund.

ALLEN, F. and GALE, D., 1997. Financial markets, intermediaries, and intertemporal smoothing. *Journal of political Economy,* **105**(3), pp. 523-546.

ANDRAE, G., 1981. *Industry in Ghana: production form and spatial structure.* Nordic Africa Institute.

ANG, J.B., 2008. A survey of recent developments in the literature of finance and growth. *Journal of economic Surveys,* **22**(3), pp. 536-576.

ANTWI-ASARE, T. and ADDISON, E., 2000. *Financial sector reforms and bank performance in Ghana.* Overseas Development Institute.

ARCAND, J., BERKES, E. and PANIZZA, U., 2012. Too much finance? .

ARESTIS, P. and DEMETRIADES, P., 1997. Financial development and economic growth: Assessing the evidence*. *The Economic Journal*, **107**(442), pp. 783-799.

ARESTIS, P., DEMETRIADES, P.O. and LUINTEL, K.B., 2001. Financial development and economic growth: the role of stock markets. *Journal of Money, Credit and Banking*, , pp. 16-41.

ARMINGTON, P.S., 1969. A Theory of Demand for Products Distinguished by Place of Production (Une théorie de la demande de produits différenciés d'après leur origine)(Una teoría de la demanda de productos distinguiéndolos según el lugar de producción). *Staff Papers-International Monetary Fund*, , pp. 159-178.

ARMINGTON, P.S., 1969. A Theory of Demand for Products Distinguished by Place of Production (Une théorie de la demande de produits différenciés d'après leur origine)(Una teoría de la demanda de productos distinguiéndolos según el lugar de producción). *Staff Papers-International Monetary Fund*, , pp. 159-178.

ARYEETEY, E., 2008. From informal finance to formal finance in sub $ saharan africa: Lessons from linkage efforts. *AERC/IMF African Finance for the 21st Century Unpublished Manuscript*, .

ARYEETEY, E., 1994. *Supply and demand for finance of small enterprises in Ghana.* World Bank Publications.

ARYEETEY, E. and KANBUR, R., 2005. *Ghana's economy at half century: An overview of stability, growth and poverty.* Cornell University. Department of Applied Economics and Management.

ARYEETEY, E. and MCKAY, A., 2007. Ghana: the challenge of translating sustained growth into poverty reduction. *Delivering on the promise of pro-poor growth: Insights and Lessons from country experiences*, **1**, pp. 147-169.

ASAMOAH, G.N., 2011. The impact of the financial sector reforms on savings, investments and growth of gross domestic product (GDP) in Ghana. *International Business & Economics Research Journal (IBER)*, **7**(10),.

ASARE, E., 2013. The Impact of Financial Liberalization on Private Investment in Ghana. *The International Journal of Business and Finance Research*, **7**(4), pp. 77.

ATJE, R. and JOVANOVIC, B., 1993. Stock markets and development. *European Economic Review*, **37**(2), pp. 632-640.

BAGEHOT, W., 1873. Lombard Street, Homewood, IL: Richard D. *Irwin,(1962 Edition)*, .

BALLARD, C.L., SHOVEN, J.B. and WHALLEY, J., 1985. General equilibrium computations of the marginal welfare costs of taxes in the United States. *The American Economic Review*, , pp. 128-138.

BALLARD, C.L., SHOVEN, J.B. and WHALLEY, J., 1985. General equilibrium computations of the marginal welfare costs of taxes in the United States. *The American Economic Review*, , pp. 128-138.

BARAJAS, A., STEINER, R. and SALAZAR, N., 1999. Interest spreads in banking in Colombia, 1974-96. *IMF Staff Papers*, , pp. 196-224.

BARRO, R.J. and GORDON, D.B., 1983. Rules, discretion and reputation in a model of monetary policy. *Journal of Monetary Economics*, **12**(1), pp. 101-121.

BAWUMIA, M., OWUSU-DANSO, T. and MCINTYRE, A., 2008. Ghana's reforms transform its financial sector. *IMF Survey Magazine: Countries & Region*, , pp. 1-4.

BECK, T., DEMIRGUC-KUNT, A. and LEVINE, R., 2004. *Finance, inequality, and poverty: cross-country evidence*, .

BECK, T., FUCHS, M., SINGER, D. and WITTE, M., 2014. *Making Cross-Border Banking Work for Africa.* Eschborn, Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

BECK, T. and LEVINE, R., 1999. *A new database on financial development and structure.* World Bank Publications.

BEGG, D., FISHER, S. and DORNBUSH, R., 1991. Economics (p. 495). Berkshire.

BEGG, D., FISHER, S. and DORNBUSH, R., 1991. Economics (p. 495). Berkshire.

BEKAERT, G., HARVEY, C.R. and LUNDBLAD, C., 2005. Does financial liberalization spur growth? *Journal of Financial Economics*, **77**(1), pp. 3-55.

BEKHET, H.A. and YASMIN, T., 2014. Assessment of the global financial crisis effects on energy consumption and economic growth in Malaysia: An input–output analysis. *International Economics*, **140**, pp. 49-70.

BENCIVENGA, V.R. and SMITH, B.D., 1991. Financial intermediation and endogenous growth. *The Review of Economic Studies*, **58**(2), pp. 195-209.

BERG, M.A. and KRUEGER, A.O., 2003. *Trade, growth, and poverty: A selective survey.* International Monetary Fund.

BERGER, A.N., DEMIRGÜÇ-KUNT, A., LEVINE, R. and HAUBRICH, J.G., 2004. Bank concentration and competition: An evolution in the making. *Journal of Money, Credit and Banking*, , pp. 433-451.

BERGMAN, N., MARKUSSON, N., CONNOR, P., MIDDLEMISS, L. and RICCI, M., 2010. Bottom-up, social innovation for addressing climate change, *conference on Energy*

*Transitions in an Interdependent World: What and Where Are the Future Social Science Research Agendas*2010.

BERGMAN, N., MARKUSSON, N., CONNOR, P., MIDDLEMISS, L. and RICCI, M., 2010. Bottom-up, social innovation for addressing climate change, *conference on Energy Transitions in an Interdependent World: What and Where Are the Future Social Science Research Agendas*2010.

BERNANKE, B.S., 1983. *Non-monetary effects of the financial crisis in the propagation of the Great Depression,* .

BERNANKE, B.S., GERTLER, M. and GILCHRIST, S., 1999. The financial accelerator in a quantitative business cycle framework. *Handbook of macroeconomics*, **1**, pp. 1341-1393.

BHASIN, V. and OBENG, C.K., 2006. Trade liberalization, foreign borrowing, poverty and income distributions of households in Ghana. *ICFAI Journal of Applied Economics*, **5**(4), pp. 38-53.

BHATTARAI, D.K.R. and OKYERE, E., 2005. Research Memorandum 53• August 2005.

BHATTARAI, K., 2004. Multi-Sectoral Multi-Household General Equilibrium Tax Model: An Application. *Problems and Perspectives in Management*, **3**, pp. 216-241.

BHATTARAI, K., 2008. *On economic model for new Nepal,* .

BHATTARAI, K., 2008. *Economic theory and models: Derivations, computations and applications for policy analyses.* Serials Publications.

BHATTARAI, K., 2008. An empirical study of interest rate determination rules. *Applied Financial Economics*, **18**(4), pp. 327-343.

BHATTARAI, K., 2005. Consumption, investment and financial intermediation in a Ramsey model. *Applied Financial Economics Letters*, **1**(6), pp. 329-333.

BHATTARAI, K., 1999. *Welfare and Distributional Impacts of Financial Liberalization in Nepal*

BHATTARAI, K., HAUGHTON, J. and TUERCK, D., 2015. The Economic Effects of the Fair Tax: Analysis of Results of a Dynamic CGE Model of the US Economy. *International Economics and Economic Policy, forthcoming,* .

BHATTARAI, K., HAUGHTONY, J. and TUERCK, D.G., 2015. Fiscal Policy, Growth and Income Distribution in the UK. *Applied Economics and Finance,* **2**(3), pp. 20-36.

BHATTARAI, K. and OKYERE, E., 2005. *Welfare and growth impacts of taxes: Applied general equilibrium models of Ghana.* University of Hull, Business School.

BHATTARAI, K. and OKYERE, E., 2005. *Welfare and growth impacts of taxes: Applied general equilibrium models of Ghana.* University of Hull, Business School.

BHATTARAI, K. and WHALLEY, J., 2003. Discreteness and the Welfare Cost of Labor Supply Tax Distortions*. *International Economic Review,* **44**(3), pp. 1117-1133.

BHATTARAI, K. and WHALLEY, J., 2000. General equilibrium modelling of UK tax policy. *Econometric modelling: techniques and applications,* , pp. 69-93.

BHATTARAI, K. and WHALLEY, J., 2000. General equilibrium modelling of UK tax policy. *Econometric modelling: techniques and applications,* , pp. 69-93.

BHATTARAI, K. and WHALLEY, J., 1999. The role of labour demand elasticities in tax incidence analysis with heterogeneous labour. *Empirical Economics,* **24**(4), pp. 599-619.

BÖHRINGER, C. and LÖSCHEL, A., 2006. Computable general equilibrium models for sustainability impact assessment: Status quo and prospects. *Ecological Economics,* **60**(1), pp. 49-64.

BORGES, A.M., 1986. Applied general equilibrium models. *OECD Economic Studies,* **7**, pp. 7e43.

BOURGUIGNON, F., BRANSON, W.H. and DE MELO, J., 1989. Macroeconomic Adjustment and Income Distribution.

BOURGUIGNON, F., DE MELO, J. and MORRISSON, C., 1991. Poverty and income distribution during adjustment: issues and evidence from the OECD project. *World Development,* **19**(11), pp. 1485-1508.

BOYD, J.H. and CHAMP, B.A., 2003. Inflation and financial market performance: what have we learned in the last ten years? .

BOYD, J.H. and SMITH, B.D., 1998. The evolution of debt and equity markets in economic development. *Economic Theory,* **12**(3), pp. 519-560.

BREISINGER, C., DIAO, X. and THURLOW, J., 2009. Modeling growth options and structural change to reach middle income country status: The case of Ghana. *Economic Modelling,* **26**(2), pp. 514-525.

BREISINGER, C., DIAO, X., THURLOW, J. and AL-HASSAN, R.M., 2008. *Agriculture for development in Ghana: New opportunities and challenges.* Intl Food Policy Res Inst.

BREISINGER, C., DIAO, X., THURLOW, J. and AL-HASSAN, R.M., 2008. *Agriculture for development in Ghana: New opportunities and challenges.* Intl Food Policy Res Inst.

BREISINGER, C., DIAO, X., THURLOW, J. and HASSAN, R.M.A., 2011. Potential impacts of a green revolution in Africa—the case of Ghana. *Journal of international development,* **23**(1), pp. 82-102.

BREISINGER, C., THURLOW, J. and DUNCAN, M., 2007. A 2005 social accounting matrix (SAM) for Ghana. *International Food Policy Research Institute (IFPRI),* .

BROOK, A., KENDRICK, D. and MEERAUS, A., 1988. GAMS, a user's guide. *ACM Signum Newsletter,* **23**(3-4), pp. 10-11.

BROOKE, T., KENDRICK, D. and MEERAUS, A., 1987. GAMS: A User's Guilds.

BROWNBRIDGE, M. and GOCKEL, A.F., 1996. *The impact of financial sector policies on banking in Ghana.* Institute of Development Studies.

BROWNBRIDGE, M., GOCKEL, A.F. and HARRINGTON, R., 2000. Saving & Investment. *Economic Reforms in Ghana.The Miracle & the Mirage,* , pp. 132-151.

BUCHS, T.D. and MATHISEN, J., 2005. Competition and efficiency in banking: Behavioral evidence from Ghana.

BUCHS, T.D. and MATHISEN, J., 2005. Competition and efficiency in banking: Behavioral evidence from Ghana.

BULMER-THOMAS, V., 1982. *Input-output analysis in developing countries: sources, methods and applications.* Wiley New York.

BUSSOLO, M. and ROUND, J.I., 2006. 6 Poverty and policy in a globalising economy. *Globalisation and Poverty: Channels and Policy Responses,* , pp. 143.

CAPROS, P., KARADELOGLOU, P. and MENTZAS, G., 1990. An empirical assessment of macroeconometric and CGE approaches in policy modeling. *Journal of Policy Modeling,* **12**(3), pp. 557-585.

CASSIS, Y. and BUSSIÈRE, E., 2005. *London and Paris as international financial centres in the twentieth century.* Oxford University Press.

CHANDAVARKAR, A., 1992. Of finance and development: neglected and unsettled questions. *World Development,* **20**(1), pp. 133-142.

CHRISTENSEN, I. and DIB, A., 2008. The financial accelerator in an estimated New Keynesian model. *Review of Economic Dynamics,* **11**(1), pp. 155-178.

CLAESSENS, S. and FORBES, K., 2013. *International financial contagion.* Springer Science & Business Media.

CONRAD, K. and SCHRÖDER, M., 1991. An evaluation of taxes on air pollutant emissions: an applied general equilibrium approach. *Swiss Journal of Economics and Statistics*, **127**(2), pp. 199-224.

COON, R.C. and LEISTRITZ, F.L., 2001. *Economic impact of production and processing of irrigated potatoes in central North Dakota.* Department of Agribusiness and Applied Economics, Agricultural Experiment Station, North Dakota State University.

COTTRELL, A., 1994. Post-Keynesian monetary economics. *Cambridge Journal of Economics*, **18**(6), pp. 587-605.

COURNOT, A., 1838. *Recherches sur les principes mathématiques de la théorie des richesses par Augustin Cournot.* chez L. Hachette.

CRAFTS, N. and WOLF, N., 2013. *The location of the UK cotton textiles industry in 1838: A quantitative analysis.European Historical Economics Society (EHES),* .

DAVIDSON, J., 1994. *Stochastic Limit Theory: An Introduction for Econometricians: An Introduction for Econometricians.* Oxford University Press, UK.

DAVIDSON, P., 1972. Money and the real world. *The Economic Journal,* , pp. 101-115.

DAVIDSON, P. and WEINTRAUB, S., 1973. Money as cause and effect. *The Economic Journal,* , pp. 1117-1132.

DE MELO, J., 1989. Computable general equilibrium models for trade policy analysis in developing countries: A survey. *Journal of Policy Modeling*, **10**(4), pp. 469-503.

DE MELO, J., 1989. Computable general equilibrium models for trade policy analysis in developing countries: A survey. *Journal of Policy Modeling,* **10**(4), pp. 469-503.

DEBREU, G., 1954. Representation of a preference ordering by a numerical function. *Decision processes,* **3**, pp. 159-165.

DECALUWE, B. and MARTENS, A., 1989. CGE modeling and developing economies: A concise empirical survey of 73 applications to 26 countries. *Journal of Policy Modeling,* **10**(4), pp. 529-568.

DELGADO, C., HOPKINS, C. and KELLY, V., 1998. *Agricultural Growth Linkages in Sub-Saharan Africa.International Food Policy Research Institute, Washington, .*

DELGADO, C.L., 1998. *Agricultural growth linkages in sub-Saharan Africa.* Intl Food Policy Res Inst.

DEMIRGÜÇ-KUNT, A. and LEVINE, R., 1996. Stock market development and financial intermediaries: stylized facts. *The World Bank Economic Review,* **10**(2), pp. 291-321.

DERVIS, K., DE MELO, J. and ROBINSON, S., 1982. General equilibrium models for developing countries.

DESPOTAKIS, K.A. and FISHER, A.C., 1988. Energy in a regional economy: a computable general equilibrium model for California. *Journal of Environmental Economics and Management,* **15**(3), pp. 313-330.

DEVARAGAN, S., LEWIS, J.D. and ROBINSON, S., 1991. Policy lessons from trade-focused, two-sector models. *Journal of policy modeling,* **12**(4), pp. 625-657.

DEWATRIPONT, M. and TIROLE, J., 1993. Efficient governance structure: Implications for banking regulation. *Capital markets and financial intermediation, ,* pp. 12-35.

DIAO, X., ZENG, S., TAM, C.M. and TAM, V.W., 2009. EKC analysis for studying economic growth and environmental quality: a case study in China. *Journal of Cleaner Production,* **17**(5), pp. 541-548.

DIAO, X., 2009. *Economywide impact of avian flu in Ghana: A dynamic CGE model analysis.* Intl Food Policy Res Inst.

DIAO, X., HAZELL, P.B., RESNICK, D. and THURLOW, J., 2007. *The role of agriculture in development: Implications for Sub-Saharan Africa.* Intl Food Policy Res Inst.

DIAO, X., HAZELL, P. and THURLOW, J., 2010. The role of agriculture in African development. *World Development,* **38**(10), pp. 1375-1383.

DIETZENBACHER, E., 2005. More on multipliers*. *Journal of Regional Science,* **45**(2), pp. 421-426.

DIETZENBACHER, E., LUNA, I.R. and BOSMA, N.S., 2005. Using average propagation lengths to identify production chains in the Andalusian economy. *Estudios de economía aplicada,* **23**(2), pp. 405-422.

DOW, S.C., 1996. The methodology of macroeconomic thought. *Books,*

EASTERLY, W. and LEVINE, R., 1997. Africa's growth tragedy: policies and ethnic divisions. *The Quarterly Journal of Economics,* , pp. 1203-1250.

ERRICO, L. and MUSALEM, A., 1999. Offshore Banking: An Analysis of Micro and Macro Prudential Issues IMF Working Paper.

ESSO, L.J., 2010. Threshold cointegration and causality relationship between energy use and growth in seven African countries. *Energy Economics,* **32**(6), pp. 1383-1391.

FELTENSTEIN, A., 1986. An intertemporal general equilibrium analysis of financial crowding out: A policy model and an application to Australia. *Journal of Public Economics,* **31**(1), pp. 79-104.

FELTENSTEIN, A., 1986. An intertemporal general equilibrium analysis of financial crowding out: A policy model and an application to Australia. *Journal of Public Economics,* **31**(1), pp. 79-104.

FELTENSTEIN, A., 1986. An intertemporal general equilibrium analysis of financial crowding out: A policy model and an application to Australia. *Journal of Public Economics,* **31**(1), pp. 79-104.

FERNÁNDEZ-MACHO, J., GALLASTEGUI, C. and GONZÁLEZ, P., 2008. Economic impacts of TAC regulation: A supply-driven SAM approach. *Fisheries Research,* **90**(1), pp. 225-234.

FISCHER, S. and EASTERLY, W., 1990. The economics of the government budget constraint. *The World Bank Research Observer,* **5**(2), pp. 127-142.

FISHER, P. and WHITLEY, J., 2000. 7 Macroeconomic models at the Bank of England. *Econometric Modelling: Techniques and Applications,* **41**, pp. 158.

FITZGERALD, E. and VOS, R., 1989. Financing economic development: a structural approach to monetary policy.

FITZGERALD, E.V.K., 1993. The macroeconomics of development finance: a Kaleckian analysis of the semi-industrialized economy.

FLEISSNER, P.K., 2010. FROM THE APPEARANCE OF THE ECONOMYTO ITS ESSENCE AND BACK METHODOLOGICAL PRECONDITIONS ON HOW TO ANALYZE CRISES. *World Review of Political Economy,* , pp. 388-406.

FRENKEL, J.A. and JOHNSON, H.G., 2013. *The Monetary Approach to the Balance of Payments (Collected Works of Harry Johnson).* Routledge.

FRY, M.J., 1995. Financial development in Asia: some analytical issues. *Asian-Pacific Economic Literature*, **9**(1), pp. 40-57.

FRY, M.J., 1978. Money and capital or financial deepening in economic development? *Journal of Money, Credit and Banking,* , pp. 464-475.

FRY, M.J., 1978. Money and capital or financial deepening in economic development? *Journal of Money, Credit and Banking,* , pp. 464-475.

FRY, M.J., 1978. Money and capital or financial deepening in economic development? *Journal of Money, Credit and Banking,* , pp. 464-475.

GEANAKOPLOS, J., 2004. *The Arrow-Debreu model of general equilibrium.* Cowles Foundation for Research in Economics.

GEORGE, A. and MORISSET, J., 1995. Does price uncertainly really reduce private investment? A small model applied to Chile. *Applied Economics*, **27**(6), pp. 517-522.

GIM, H.U., 2009. Why Do We Develop a New "Output-Output Model"? **42**(1), pp. 77-94.

GINÉ, X. and TOWNSEND, R.M., 2004. Evaluation of financial liberalization: a general equilibrium model with constrained occupation choice. *Journal of Development Economics*, **74**(2), pp. 269-307.

GLAESER, E.L., 2010. *Agglomeration economics.* University of Chicago Press.

GOLDSMITH, W., BLAKELV, E.J., BORNSTEIN, L., CAMPT, D. and MUELLER, E., 1969. d Development.

GOMME, P., 1993. Money and growth revisited: Measuring the costs of inflation in an endogenous growth model. *Journal of Monetary Economics*, **32**(1), pp. 51-77.

GROSSMAN, G.M. and RICHARDSON, J.D., 1985. *Strategic trade policy: A survey of issues and early analysis*. International Finance Section, Department of Economics, Princeton University.

HAMMAR, H. and LÖFGREN, Å., 2001. The determinants of sulfur emissions from oil consumption in Swedish manufacturing industry, 1976-1995. *The Energy Journal*, , pp. 107-126.

HANSDA, S.K., 2001. Sustainability of Services-led Growth: An Input–Output Analysis of the Indian Economy. *Reserve Bank of India Occasional Papers*, **22**(1), pp. 73-118.

HANSEN, L.P., 2014. *Uncertainty Outside and Inside Economic Models*, .

HARBERGER, A.C., 1962. The incidence of the corporation income tax. *The Journal of Political Economy*, , pp. 215-240.

HARRIS, R. and ROBINSON, C., 2002. The effect of foreign acquisitions on total factor productivity: plant-level evidence from UK manufacturing, 1987–1992. *Review of Economics and Statistics*, **84**(3), pp. 562-568.

HARRISS, J., 2002. *Depoliticizing development: The World Bank and social capital*. Anthem Press.

HAUSMANN, R., ZAHIDI, S., TYSON, L., HAUSMANN, R., SCHWAB, K. and TYSON, L.D., 2009. The global gender gap report 2009, 2009, World Economic Forum.

HAYO, B. and HEFEKER, C., 2002. Reconsidering central bank independence. *European Journal of Political Economy*, **18**(4), pp. 653-674.

HAZEL, T.G., MISRA, R., DAVIS, I.J., GREENBERG, M.E. and LAU, L.F., 1991. Nur77 is differentially modified in PC12 cells upon membrane depolarization and growth factor treatment. *Molecular and cellular biology*, **11**(6), pp. 3239-3246.

HERTEL, T.W. and HERTEL, T.W., 1997. *Global trade analysis: modeling and applications.* Cambridge university press.

HEWINGS, G.J., 1985. Regional input-output analysis.

HICKS, J.R., 1969. A theory of economic history. *OUP Catalogue,* .

HONU, B., 1988. *The Employment and Output Implications of Higher Manufacturing Capacity Utilization in Ghana,* .

HUSAIN, I. and FARUQEE, R., 1994. *Adjustment in Africa: Lessons from country case studies.* World Bank Publications.

HUYBENS, E. and SMITH, B.D., 1999. Inflation, financial markets and long-run real activity. *Journal of Monetary Economics,* **43**(2), pp. 283-315.

IRELAND, P.N., 1994. Supply-side economics and endogenous growth. *Journal of Monetary Economics,* **33**(3), pp. 559-571.

JAFFÉ, W., 1977. The Normative Bias of the Walrasian Model: Walras Versus Gossen*. *The Quarterly Journal of Economics,* , pp. 371-387.

JAYARATNE, J. and STRAHAN, P.E., 1996. The finance-growth nexus: Evidence from bank branch deregulation. *The Quarterly Journal of Economics,* , pp. 639-670.

JOHANSEN, L., 1960. A multisectoral model of economic growth. *Amsterdam: North,* .

JORGENSON, D.W. and WILCOXEN, P.J., 1997. The long-run dynamics of fundamental tax reform. *The American Economic Review,* , pp. 126-132.

KEMAL, D., DE MELO, J. and ROBINSON, S., 1982. General Equilibrium Models for development policy.

KEYNES, J.M., 1936. The general theory of interest, employment and money.

KIM, W. and WEI, S., 2002. Foreign portfolio investors before and during a crisis. *Journal of International Economics,* **56**(1), pp. 77-96.

KING, R.G. and LEVINE, R., 1993. Finance, entrepreneurship and growth. *Journal of Monetary Economics,* **32**(3), pp. 513-542.

KOLAVALLI, S., ROBINSON, E., DIAO, X., ALPUERTO, V., FOLLEDO, R., SLAVOVA, M., NGELEZA, G. and ASANTE, F., 2012. Economic Transformation in Ghana.

KOTELNIKOV, V. and KIM, H., 2007. Small and Medium Enterprises and ICT, Asia-Pacific Development Information Programme e-Primers for the Information Economy. *Society and Polity,(APCICT),* .

KULLBACK, S. and LEIBLER, R.A., 1951. On information and sufficiency. *The annals of mathematical statistics,* , pp. 79-86.

LALL, S. and TEUBAL, M., 1998. "Market-Stimulating" technology policies in developing countries: a framework with examples from East Asia. *World Development,* **26**(8), pp. 1369-1385.

LEE, H. and ROLAND-HOLST, D., 1997. The environment and welfare implications of trade and tax policy. *Journal of Development Economics,* **52**(1), pp. 65-82.

LEE, K., PESARAN, M.H. and SMITH, R.P., 1997. Growth and convergence in a multi-country empirical stochastic Solow model. *Journal of Applied Econometrics,* **12**(4), pp. 357-392.

LEONTIEF, W., 1949. Recent developments in the study of interindustrial relationships. *The American Economic Review,* , pp. 211-225.

LEONTIEF, W. and DUCHIN, F., 1984. The Impacts of Automation on Employment, 1963-2000. Final Report. .

LEONTIEF, W., DUCHIN, F. and SZYLD, D.B., 1985. New approaches in economic analysis. *Science (New York, N.Y.),* **228**(4698), pp. 419-422.

LEUNG, D. and SECRIERU, O., 2012. Real-Financial Linkages in the Canadian Economy: An Input–output Approach. *Economic Systems Research,* **24**(2), pp. 195-223.

LEVINE, R., 2005. Finance and growth: theory and evidence. *Handbook of economic growth,* **1**, pp. 865-934.

LEVINE, R., 2002. Bank-based or market-based financial systems: which is better? *Journal of financial intermediation,* **11**(4), pp. 398-428.

LEVINE, R., 1997. Financial development and economic growth: views and agenda. *Journal of economic literature, ,* pp. 688-726.

LEVINE, R., LOAYZA, N. and BECK, T., 2000. Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics,* **46**(1), pp. 31-77.

LEVINE, R. and ZERVOS, S., 1998. Stock markets, banks, and economic growth. *American economic review, ,* pp. 537-558.

LEVY, M., POWELL, P. and YETTON, P., 2001. SMEs: aligning IS and the strategic context. *Journal of Information Technology,* **16**(3), pp. 133-144.

LEWIS, J.D., 1992. Financial repression and liberalization in a general equilibrium model with financial markets. *Journal of Policy Modeling,* **14**(2), pp. 135-166.

LUCAS, R.E., 1988. On the mechanics of economic development. *Journal of Monetary Economics,* **22**(1), pp. 3-42.

LUCAS, R.E., 1976. Econometric policy evaluation: A critique, *Carnegie-Rochester conference series on public policy* 1976, Elsevier, pp. 19-46.

MASOUD, N. and HARDAKER, G., 2012. The impact of financial development on economic growth: Empirical analysis of emerging market countries. *Studies in Economics and Finance,* **29**(3), pp. 148-173.

MAWULI AKPANDJAR, G., QUARTEY, P. and ABOR, J., 2013. Demand for financial services by households in Ghana. *International Journal of Social Economics,* **40**(5), pp. 439-457.

MCKINNON, R.I., 1993. *The order of economic liberalization: Financial control in the transition to a market economy.* JHU Press.

MCKINNON, R.I., 1973. *Money and capital in economic development.* Brookings Institution Press.

MEERAUS, A., 1983. An algebraic approach to modeling. *Journal of Economic Dynamics and Control,* **5**, pp. 81-108.

MERTON, R.C. and BODIE, Z., 1995. A conceptual framework for analyzing the financial system. *The global financial system: A functional perspective,* , pp. 3-31.

MIERNYK, W.H., 2004. 6 Leontief and dynamic regional models. *Wassily Leontief and Input-Output Economics,* , pp. 90.

MIERNYK, W.H., 2004. 6 Leontief and dynamic regional models. *Wassily Leontief and Input-Output Economics,* , pp. 90.

MILLER, M.H. and SPENCER, J.E., 1977. The static economic effects of the UK joining the EEC: A general equilibrium approach. *The Review of Economic Studies,* , pp. 71-93.

MILLER, R.E. and BLAIR, P.D., 2009. *Input-output analysis: foundations and extensions.* Cambridge University Press.

MILLER, R. and BLAIR, P., 1985. IO analysis: foundations and extensions. *New Jersey,* .

MOLYNEUX, P. and NGUYEN-LINH, H., 2008. Competition and risk in the South East Asian banking. *Bangor Business,* .

MUREITHI, L. and SHARMA, K., 1984. Growth linkages between agriculture and industry in Kenya. *Journal of Eastern African Research and Development,* **14**, pp. 147-161.

MURNANE, R.J., LEVY, F. and AUTOR, D., 1999. Technological change, computers and skill demands: Evidence from the back office operations of a large bank, *Economic Research Labour Workshop, NBER. THE IRISH JOURNAL OF MANAGEMENT* 1999.

MUSGRAVE, R.A., 1959. Theory of public finance; a study in public economy.

MWANAMAMBO, B., SALIN, V. and MUKUMBUTA, L., 2007. Lending to Agribusinesses in Zambia, *Selected paper presented at the Annual Meeting of the American Agricultural Economics Association, Portland, Oregon* 2007.

NGUGI, R., AMANJA, D. and MAANA, I., 2009. Capital market, financial deepening and economic growth in Kenya, *Centre for the study of African economies Conference* 2009, pp. 22-24.

NICKELL, S. and LAYARD, R., 1999. Labour market institutions and economic performance. *Handbook of labour economics,* **3**, pp. 3029-3084.

NORDSTROM, H., BEN-DAVID, D. and WINTERS, L.A., 1999. Trade, income disparity and poverty. *Geneva: World Trade Organization,* .

O'CONNOR, R. and HENRY, E.W., 1975. *Input-output analysis and its applications.* Griffin.

OOSTERHAVEN, J., BOUWMEESTER, M.C. and NOZAKI, M., 2013. *The impact of production and infrastructure shocks: A non-linear input-output programming approach, tested on an hypothetical economy.* University of Groningen, Faculty of Economics and Business.

OOSTERHAVEN, J. and STELDER, D., 2002. On the Economic Impact of the Transport Sector: A Critical Review with Dutch Bi-Regional Input-Output Data. *Trade, Networks and Hierarchies.* Springer, pp. 119-133.

OSEI, R.D. and QUARTEY, P., 2005. *Tax reforms in Ghana.* Research Paper, UNU-WIDER, United Nations University (UNU).

OSTRY, J.D. and BERG, A., 2011. *Inequality and Unsustainable Growth, .*

OWUSU-ANTWI, G. and ANTWI, J., 2013. Do Financial Sector Reforms Improve Competition of Banks? An Application of Panzar and Rosse Model: The Case of Ghanaian Banks. *International Journal of Financial Research,* **4**(3), pp. p43.

PAGANO, M., 1993. Financial markets and growth: an overview. *European Economic Review,* **37**(2), pp. 613-622.

PANZAR, J.C. and ROSSE, J.N., 1987. Testing for" monopoly" equilibrium. *The journal of industrial economics, ,* pp. 443-456.

PARK, I., 2006. East Asian regional trade agreements: Do they promote global free trade? *Pacific Economic Review,* **11**(4), pp. 547-568.

PATRICK, H.T., 1966. Financial development and economic growth in underdeveloped countries. *Economic development and Cultural change, ,* pp. 174-189.

PIGGOTT, J.R. and WHALLEY, J., 1977. General equilibrium investigations of UK tax subsidy policy: a progress report. *Studies in Modern Economic Analysis, Basil Blackwell, Oxford, ,* pp. 378-401.

POLO, C. and VALLE, E., 2008. A general equilibrium assessment of the impact of a fall in tourism under alternative closure rules: the case of the Balearic Islands. *International regional science review,* **31**(1), pp. 3-34.

POWELL, M. and ROUND, J., 2000. Structure and linkage in the economy of Ghana: A SAM approach. *Economic Reforms in Ghana: Miracle or Mirage,* , pp. 68-87.

QUADEN, G., 2004. Efficiency and stability in an evolving financial system, *Speech at the National Bank of Belgium Conference* 2004.

QUAH, D., 1993. Empirical cross-section dynamics in economic growth. *European Economic Review,* **37**(2), pp. 426-434.

QUARTEY, P. and PRAH, F., 2008. Financial development and economic growth in Ghana: is there a causal link? *African Finance Journal,* **10**(1), pp. 28-54.

QUIÑONES, E.J. and DIAO, X., 2011. Assessing Crop Production and Input Use Patterns in Ghana: What Can We Learn from the Ghana Living Standards Survey (GLSS5). *Ghana Strategy Support Program Working Paper,* **24**.

RA, S. and RHEE, C., 2005. *Nepal macro econometric model.* Asian Development Bank, Nepal Resident Mission.

RAJAN, R., SERVAES, H. and ZINGALES, L., 1998. *The cost of diversity: The diversification discount and inefficient investment*

REINHART, C.M. and ROGOFF, K., 2009. *This time is different: eight centuries of financial folly.* Princeton university press.

ROBINSON, J., 1952. The generalisation of the general theory. *The rate of interest and other essays,* **2**, pp. 1-76.

ROBINSON, S., 1991. Macroeconomics, financial variables, and computable general equilibrium models. *World Development,* **19**(11), pp. 1509-1525.

ROBINSON, S., 1991. Macroeconomics, financial variables, and computable general equilibrium models. *World Development,* **19**(11), pp. 1509-1525.

ROBINSON, S., 1989. Multisectoral models. *Handbook of development economics,* **2**, pp. 885-947.

ROBINSON, S., CATTANEO, A. and EL-SAID, M., 2001. Updating and estimating a social accounting matrix using cross entropy methods. *Economic Systems Research,* **13**(1), pp. 47-64.

RODRIGUEZ, F. and RODRIK, D., 2001. Trade policy and economic growth: a skeptic's guide to the cross-national evidence. *NBER Macroeconomics Annual 2000, Volume 15*. MIT Press, pp. 261-338.

RODRIK, D., 2006. Goodbye Washington consensus, hello Washington confusion? A review of the World Bank's economic growth in the 1990s: learning from a decade of reform. *Journal of Economic literature,* **44**(4), pp. 973-987.

RODRIK, D., 2005. Growth strategies. *Handbook of economic growth,* **1**, pp. 967-1014.

ROMER, P., 1989. *Endogenous technological change,* .

ROSE, A., 1995. Input-output economics and computable general equilibrium models. *Structural change and economic dynamics,* **6**(3), pp. 295-304.

ROSE, A. and MIERNYK, W., 1989. Input–output analysis: the first fifty years. *Economic Systems Research,* **1**(2), pp. 229-272.

ROSENSWEIG, J.A. and TAYLOR, L., 1990. Devaluation, capital flows, and crowding-out: a CGE model with portfolio choice for Thailand. *Socially relevant policy analysis: structuralist computable general equilibrium models for the developing world,* , pp. 302-332.

ROSENSWEIG, J.A. and TAYLOR, L., 1990. Devaluation, capital flows, and crowding-out: a CGE model with portfolio choice for Thailand. *Socially relevant policy analysis: structuralist computable general equilibrium models for the developing world,* , pp. 302-332.

ROUBINI, N. and SALA-I-MARTIN, X., 1992. Financial repression and economic growth. *Journal of Development Economics,* **39**(1), pp. 5-30.

ROUND, J., 1981. *Income distribution within a Social Accounting Matrix: A review of some experience in Malaysia and other LDC" s.Development Economics Research Centre-University of Warwick, .*

ROUSSEAU, P.L. and WACHTEL, P., 1998. Financial intermediation and economic performance: historical evidence from five industrialized countries. *Journal of Money, Credit and Banking, ,* pp. 657-678.

RUTHERFORD, T.F., 1999. Applied general equilibrium modelling with MPSGE as a GAMS subsystem: An overview of the modelling framework and syntax. *Computational Economics,* **14**(1-2), pp. 1-46.

RUTHERFORD, T.F., 1995. Extension of GAMS for complementarity problems arising in applied economic analysis. *Journal of Economic Dynamics and Control,* **19**(8), pp. 1299-1324.

SANDEFUR, R.L., 2010. Impact of Counsel: An Analysis of Empirical Evidence, The. *Seattle J.Soc.Just.,* **9**, pp. 51.

SARNO, L. and TAYLOR, M.P., 2002. *The economics of exchange rates.* Cambridge University Press.

SAUNDERS, A. and SCHUMACHER, L., 2000. The determinants of bank interest rate margins: an international study. *Journal of International Money and Finance,* **19**(6), pp. 813-832.

SCARF, H., 1967. The approximation of fixed points of a continuous mapping. *SIAM Journal on Applied Mathematics,* **15**(5), pp. 1328-1343.

SCHAFFER, A. and STAHMER, C., 2006. Women's GDP-a time-based input-output analysis. *Schweizerische Zeitschrift für Volkswirtschaft und Statistik,* **142**(4), pp. 367.

SCHNABL, H., 1994. The evolution of production structures, analysed by a multi-layer procedure. *Economic Systems Research,* **6**(1), pp. 51-68.

SCHUMPETER, J.A., 1911. 1934. *The theory of economic development*, .

SEALEY, C.W. and LINDLEY, J.T., 1977. Inputs, outputs, and a theory of production and cost at depository financial institutions. *The Journal of Finance*, **32**(4), pp. 1251-1266.

SECRIERU, O. and LEUNG, D., 2011. *Real-Financial Linkages in the Canadian Economy: An Input-Output Approach*, .

SEN, A.K., 1963. NEO-CLASSICAL AND NEO-KEYNBSIAN THEORIES OF DISTRIBUTION*. *Economic record*, **39**(85), pp. 53-64.

SENBET, L.W. and OTCHERE, I., 2006. Financial sector reforms in Africa: perspectives on issues and policies, *Annual World Bank Conference on Development Economics 2006: Growth and Integration* 2006, pp. 81-120.

SHAFFER, R., DELLER, S. and MARCOUILLER, D., 2004. *Community economics: linking theory and practice*. Blackwell Publishing.

SHAFFER, S., 2004. Patterns of competition in banking. *Journal of economics and business*, **56**(4), pp. 287-313.

SHAW, E.S., 1973. *Financial deepening in economic development*. Oxford University Press New York.

SHILLER, R. and QUINN, B., 2008. The Subprime Solution: How Today's Financial Crisis Happened, and What To Do About it. *Financial Regulator*, **13**(2), pp. 75.

SHOVEN, J.B., 1992. *Applying general equilibrium*. Cambridge university press.

SHOVEN, J.B., 1976. The incidence and efficiency effects of taxes on income from capital. *The Journal of Political Economy*, , pp. 1261-1283.

SHOVEN, J.B. and WHALLEY, J., 1992. *Applying general equilibrium.* Cambridge university press.

SHOVEN, J.B. and WHALLEY, J., 1984. Applied general-equilibrium models of taxation and international trade: an introduction and survey. *Journal of Economic Literature,* , pp. 1007-1051.

SHOVEN, J.B. and WHALLEY, J., 1972. A general equilibrium calculation of the effects of differential taxation of income from capital in the US. *Journal of public economics,* **1**(3), pp. 281-321.

SINGH, A., 1997. Financial liberalisation, stock markets and economic development*. *The Economic Journal,* **107**(442), pp. 771-782.

SINGH, I., 1991. *China and Central and Eastern Europe: Is there a professional schizophrenia on Socialist Reform?* World Bank, Policy Research Department, Transition and Macro-Adjustment Division.

SINGH, M. and KAUR, H., 2011. Economic growth and inter-sectoral linkages in India.

SONIS, M., HEWINGS, J. and GUO, J., 2000. A new image of classical key sector analysis: minimum information decomposition of the Leontief inverse. *Economic Systems Research,* **12**(3), pp. 401-423.

STERN, N., 1991. Public policy and the economics of development. *European Economic Review,* **35**(2), pp. 241-271.

STIGLITZ, J.E. and WEISS, A., 1992. Asymmetric information in credit markets and its implications for macro-economics. *Oxford Economic Papers,* , pp. 694-724.

SYED, ANWAR ALI SHAH G, MEMON, M.A., HALEPOTO, A.H. and SHAIKH, F.M., 2012. Global Financial Crisis in South Asia and its Impact on Pakistan's SMEs Sector by Using CGE Model. *Journal of Asian Business Strategy,* **2**(4), pp. 84-88.

SZERESZEWSKI, R., 1965. *Structural changes in the economy of Ghana, 1891-1911*. Cambridge University Press.

TAMBUNAN, T., 2008. SME Development in Indonesia: Do Economic Growth and Government Supports Matter? *Available at SSRN 1218922,* .

TAYLOR, L., 1991. Income distribution, inflation and growth: Lectures on structuralist macroeconomics.

TAYLOR, L., 1990. *Socially relevant policy analysis: Structuralist computable general equilibrium models for the developing world.* MIT Press.

TAYLOR, L., 1990. Structuralist CGE models. *Socially relevant policy analysis,* .

TAYLOR, L., 1983. *Structuralist macroeconomics: Applicable models for the third world.* Basic Books New York.

TEMURSHOEV, U. and OOSTERHAVEN, J., 2013. GGDC RESEARCH MEMORANDUM 132.

TEN RAA, T., 2006. *The economics of input-output analysis*. Cambridge University Press.

THURLOW, J., 2004. A dynamic computable general equilibrium (CGE) model for South Africa: Extending the static IFPRI model. *Trade and Industrial Policy Strategies, Johannesburg,* .

TOBIN, J., 1982. *Asset accumulation and economic activity: reflections on contemporary macroeconomic theory.* University of Chicago Press.

TOBIN, J., 1969. A general equilibrium approach to monetary theory. *Journal of Money, Credit and Banking,* **1**(1), pp. 15-29.

TOWNSEND, R., 2010. Financial Structure and Economic Welfare: Applied General Equilibrium Development Economics. *Annual review of economics,* **2**, pp. 507-546.

VAN DER LAAN, G. and TALMAN, A., 1985. *Adjustment processes for finding economic equilibria,* .

VARIAN, H.R., 1999. *Markets for information goods.* Citeseer.

VARIAN, H.R. and REPCHECK, J., 2010. *Intermediate microeconomics: a modern approach.* WW Norton New York.

VOS, R., 1998. Aid flows and "Dutch Disease" in a General Equilibrium framework for Pakistan. *Journal of Policy Modelling,* **20**(1), pp. 77-109.

VOS, R., 1998. Aid flows and "Dutch Disease" in a General Equilibrium framework for Pakistan. *Journal of Policy Modelling,* **20**(1), pp. 77-109.

VOS, R., 1991. A Macroeconomic Social Accounting Framework for the Philippines. *Journal of Philippine Development,* **18**(1), pp. 1-50.

WALRAS, L., 1896. *Études d'économie sociale:(Théorie de la répartition de la richesse sociale.).* F. Rouge.

WALRAS, L., 1874. 1954. *Elements of Pure Economics,* .

WHALLEY, J., 1975. A general equilibrium assessment of the 1973 United Kingdom tax reform. *Economica,* , pp. 139-161.

WORLD BANK GROUP, 2012. *World development indicators 2012.* World Bank Publications.

YELDAN, A.E., 1997. Financial liberalization and fiscal repression in Turkey: Policy analysis in a CGE model with financial markets. *Journal of Policy Modelling,* **19**(1), pp. 79-117.

YUSOF, Z.A., 2010. Economic growth in Malaysia: some possible lessons for Ghana.

ZEULI, K. and DELLER, S., 2007. Measuring the local economic impact of cooperatives. *Journal of Rural Cooperation*, **35**(1), pp. 1.

ZEULI, K. and DELLER, S., 2007. Measuring the local economic impact of cooperatives. *Journal of Rural Cooperation*, **35**(1), pp. 1.

ZOROMÉ, A., 2007. Concept of offshore financial centres: In search of an operational definition. *IMF Working Papers*, , pp. 1-32.

8 APPENDICES

8 APPENDICES

Appendix 1 (Chapter 3)

PR Model Equilibrium Tests of Ghana banking systems (2003 to 2012)

	Coefficient	Std. Error	P-value
LIEXP/TDEP	-0.074	0.357	0.473
LWA/TDELOAN	0.155	0.512	0.233
LDE/FA	0.122	0.526	0.278
LTLA/TA	0.397	0.090	0.567
LTA	0.051	0.871	0.023
LNPL/TLO	-0.005	0.313	0.245
Linfl	0.000	0.095	0.342
LGDPP	0.039	0.047	0.674
Constant	-12.911	2.545	0.000
Wald test (F-statistic) for H=1	3.422		
p-value of F-statistic	0.002		
Wald test (F-statistic) for H=0	0.123		
p-value of F-statistic	0.611		
p-value of F-statistic	0.002		
Wald test (F-statistic) for H=0	0.123		
p-value of F-statistic	0.611		

Appendix 2 (Chapter 3)

Random Effects and OLS Estimates: PR Model

	Random Effects Estimates						OLS Estimates					
	Interest Based Product Market			Total Market			Interest Based Product Market			Total Market		
	Coefficient	Std. Error	P-value	Coefficient	Std.Error	P-value	Coefficient	Std.Error	P-value	Coefficient	Std.Error	P-value
LIEXP/TDEP	0.189	0.027	0.000	0.225	0.036	0.000	0.329	0.036	0.000	0.135	0.040	0.000
LWA/TDELOAN	0.381	0.038	0.000	0.254	0.043	0.000	0.263	0.026	0.000	0.353	0.029	0.000
LDE/FA	0.256	0.051	0.000	0.163	0.048	0.000	0.163	0.042	0.000	0.284	0.039	0.000
LTLA/TA	0.014	0.006	0.000	0.016	0.007	0.153	0.033	0.009	0.002	0.025	0.012	0..002
LTA	0.035	0.015	0.000	0.028	0.016	0.000	0.005	0.022	0.000	0.017	0.024	0.000
LNPL/TLO	(0.l67)	0.023	0.000	0.052	0.022	0.000	-0.162	0.306	0.000	-0.182	0.036	0.045
Linfl	-0.341	0.033	0.000	-0.159	0.328	0.000	0.063	0.32	0.000	0.164	0.057	0.000
LGDPP	0.002	0.016	0.000	0.129	0.024	0.000	0.053	0.002	0.000	-0.153	0.434	0.000
Constant	-1.226	0.277	0.000	-0.724	0.046	0.013	0.053	0.384	0.863	-0.016	0.639	0.968
Adj. R-squared	0.596			0.636			0.714					
Wald Chi-sq	272.67		0.000	**129.43**		**0.000**						
F-statistic							**52.693**		0.000	38.364		0.000
H-statistic	0.826			0.6428			0.755			0.769		
Wald Test for H=1												
Chi-Sq	22.454			28.054		0.000						
F-statistic							9.424		0.003	83.636		0.000
Wald test for H=0												
Chi-sq	178.675		0.000	104.960		0.000						
F-statistic							**149.26**		**0.000**	**19.394**		**0.000**
No. of obs	**229**			**229**			**229**			**229**		

Note: For model description see **Tables 10 and 11**

Appendix 3 (Chapter 4)

Procedures in Adjusting Prices for Pricing Comparison

To express 2012 New Ghana Cedi value in 2005 prices we used the standard formulae:

$$100 * \left(\frac{Index number for 2012}{Index Number for 2005} \right)$$

We used the Consumer Price Index (CPI) which measures changes over time in the general price level of goods and services that households acquire for the purpose of consumption, with reference to the price level in 2012, the base year, which has an index of 100.

Index 2012=100

Sectors	CPI Index (2005)	CPI Index (2012)	2012 New Ghana Cedi Value
Agriculture	272.950	312.544	114.489
Cocoa	282.513	312.591	110.615
Forestry	273.843	312.532	114.134
Fishing	273.823	312.590	114.134
Mining	264.475	297.430	112.462
Manufacturing	305.634	454.468	148.676
Electricity	451.875	520.278	115.121
Construction	276.734	393.746	142.283
Transport	499.756	487.722	97.592
Trading	489.754	739.428	150.974
Real	451.873	665.509	147.276
Business	451.873	610.390	135.060
Bank	289.322	393.809	136.112
Public Administration	243.767	273.358	112.138
Community Services	387.534	499.460	128.867

Source: Author's calculation using Ghana Statistical Service CPI Data (2012)

Appendix 4 (Chapter 4)

Ghana's Input-Output Matrix-2012

Sectors	Agri	Coc	For	Fish	Mine	Manf	Elect	Const	Trans	Trad	Real	Busi	Ban	Pubad	Ccsv
Agri	30237	197	163	189	352	853	262	452	445	692	40	19	16	127	50
Coc	121	8074	35	43	84	210	65	111	110	89	10	5	4	31	12
For	173	58	5673	58	114	284	87	150	148	121	13	6	5	42	17
Fish	124	20	17	3362	33	78	24	42	41	98	4	2	1	12	5
Mine	10	3	3	3	7551	16	8	244	9	7	1	2	1	3	1
Manf	5499	1961	1595	1935	3821	9515	2927	5042	4968	4049	449	216	182	1420	557
Elect	466	120	205	117	818	536	3674	305	299	355	25	31	26	125	108
Const	48	10	23	14	53	29	166	12819	54	45	1	63	53	13	7
Transp	2802	534	566	314	410	426	137	707	5644	2317	20	141	119	1009	321
Trad	4642	746	680	602	665	1115	343	598	582	8413	53	25	21	166	65
Real	0	0	0	0	0	0	0	0	0	0	308	0	0	0	0
Busi	179	32	155	96	207	4**3**	**14**	**41**	**164**	**245**	**2**	**1534**	**87**	**31**	**10**
Bank	**151**	**27**	**131**	**81**	**175**	37	11	35	139	207	2	87	1282	26	9
Pubad	0	0	0	0	0	0	0	0	0	0	0	0	0	20873	0
Ccsv	36	0	0	0	0	1	0	1	1	1	0	0	0	0	4344

Source: Author's calculation using International Food and Policy Research (2012)

Appendix 5 (Chapter 4)

I-A Transaction Table

Sectors	Agri	Coc	For	Fish	Mine	Manf	Elect	Const	Transp	Trad	Real	Busi	Bank	Pubad	Ccsv
Agri	0.903	0.000	0.000	0.000	0.000	-0.034	0.000	0.000	0.000	-0.032	0.000	0.000	0.000	0.000	-0.001
Coc	0.000	0.955	0.000	0.000	0.000	-0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
For	0.000	0.000	1.000	0.000	0.000	-0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fish	-0.001	0.000	0.000	1.000	0.000	-0.003	0.000	0.000	0.000	-0.007	0.000	0.000	0.000	0.000	0.000
Mine	0.000	0.000	0.000	0.000	1.000	-0.001	0.000	-0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manf	-0.042	-0.121	-0.111	-0.332	-0.276	0.900	-0.555	-0.240	-0.623	-0.144	-1.000	-0.025	-0.017	-0.035	0.000
Elect	-0.003	0.000	-0.018	0.000	-0.076	-0.023	0.965	0.000	-0.003	-0.012	0.000	-0.011	-0.002	-0.017	0.000
Const	0.000	0.000	0.000	0.000	0.000	0.000	-0.044	1.000	-0.005	0.000	0.000	-0.037	0.000	0.000	0.000
Transp	-0.043	-0.037	-0.059	-0.034	-0.020	-0.003	0.000	-0.036	0.975	-0.221	0.000	-0.078	-0.044	-0.066	0.000
Trad	-0.108	-0.057	-0.078	-0.100	-0.026	-0.041	0.000	0.000	0.000	0.913	0.000	0.000	0.000	0.000	0.000
Real	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
Busi	0.000	0.000	-0.036	-0.036	-0.039	0.000	0.000	0.000	-0.043	-0.030	0.000	0.888	0.000	0.000	0.000
Bank	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.758	0.000	0.000
Pubad	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.541	0.541
Ccsv	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.541	0.155

Source: Author's calculation using International Food and Policy Research (2012)

Appendix 6 (Chapter 1)

Steps in Balancing Input-Output Tables using the RAS Method

Table a to f presents the iteration process in balancing the Input-Output tables using RAS adjustment. Table a shows a simple matrix of domestic production with three sectors and three products. Margins totals are accurate whereas internal entries have been estimated from varied sources. The task at issue is to revise the less reliable internal entries to balance with the correct margin entries.

Table A: Matrix of Domestic Production of Goods and Services

Sector/Products	**Agric**	**Man**	**Bank**	**ROW Totals**	**Correct ROW Totals**
Agric	20	30	15	65	70
Man	10	60	20	90	80
Bank	40	55	5	100	120
Column Totals	70	145	40		
Correct Column Totals	**80**	140	50		

Table A shows that both the column totals and margin totals are not balanced. To balance this, each row entry is multiplied by the ratio of the correct row total to the actual row total. In this example, first row (agric) is multiplied by 1.0769 (70÷65), the second row is also (man) is also multiplied by 0.8888 (80 ÷ 90), and the third row by 1.2 (120 ÷100). These adjustments results in Table B.

Table B: 1st Iteration -Recalculating the Row Totals (1st Round)

Sector/Products	Agric	Man	Bank	ROW Totals	Correct ROW Totals
Agric	21.54	32.31	16.15	70.04	70.00
Man	8.88	53.28	17.76	80.05	80.00
Bank	48.00	66.00	6.00	120.34	120.00
Column Totals	78.44	151.63	40.00		
Correct Column Totals	**80.44**	140.00	50.00		

Even though the summation of the row totals is accurate, yet the column totals are inaccurate. Using a similar procedure to the first iteration, the column totals are accurate but the recalculated rows are incorrect. Repeating the adjustment process repetitively we get the 3rd iteration as seen in Table C.

Table C: 2nd Iteration-Recalculating the Column Totals (1st Round)

Sector/Products	Agric	Man	Bank	ROW Totals	Correct ROW Totals
Agric	22.43	29.85	20.32	72.03	70.00
Man	9.10	49.23	22.34	80.63	80.00
Bank	49.00	60.09	7.60	117.40	120.00
Column Totals	80.00	151.63	50.00		
Correct Column Totals	**80.00**	140.00	50.00		

Table D: 3rd Iteration-Recalculating the Column Totals (2nd Round)

Sector/Products	Agric	Man	Bank	ROW Totals	Correct ROW Totals
Agric	21.43	29.05	19.73	70.03	70.00
Man	9.02	48.93	22.14	80.03	80.00
Bank	50.00	62.39	7.70	120.40	120.00
Column Totals	80.00	140.23	49.00		
Correct Column Totals	**80.00**	140.00	50.00		

But by the end of the 4th iteration, the new rows are still inaccurate but very close to the correct figures. Table E as seen in the 4th iteration

Table E: 4th Iteration-Recalculating the Column Totals (2nd Round**)**

Sector/Products	Agric	Man	Bank	ROW Totals	Correct ROW Totals
Agric	21.23	29.05	19.94	70.13	70.00
Man	9.02	48.83	22.44	80.14	80.00
Bank	49.80	62.23	7.80	119.83	120.00
Column Totals	80.00	140.23	50.00		
Correct Column Totals	**80.00**	140.00	50.00		

The 5th iteration as displayed in Table F below shows a complete balance between the column totals and row totals.

Table F: 5th Iteration-Recalculating the Column Totals (2nd Round)

Sector/Products	**Agric**	**Man**	**Bank**	**ROW Totals**	**Correct ROW Totals**
Agric	21.2	29.0	19.9	70.0	70.00
Man	9.0	48.7	22.3	80.0	80.00
Bank	49.8	62.3	7.8	120.0	120.00
Column Totals	80.0	140.0	50.0		
Correct Column Totals	**80.0**	140.0	50.0		

Appendix 7 (Chapter 1)

Balancing the SAM Using Cross Entropy Techniques

The initial disaggregated SAM is not balanced owing to issues of data availability and constructed using a variety of data sources. To obtain a balanced SAM, we applied the Robinson, Cattaneo and El-Said (2001) cross-entropy techniques. A concise explanation of the cross-entropy approach is described below:

The SAM is a matrix T_{ij} of economic flows from expenditure (row) account i to receipt (column) account j. Therefore, total expenditures and total receipts of an agent i must be equal.

$$y_i = \sum_j T_{ij} = \sum_j T_{ji}$$

By dividing each cell entry of the matrix T by its respective column total, a preliminary matrix A is obtained:

$$A_{ij} = \frac{T_{ij}}{y_i}$$

$$\text{where } \sum_j A_{ij} = 1, (\forall)_i$$

But information in the form of the new A_{ij} represents inconsistent and unbalanced data as well as exact information on totals Robinson et al (2001). The problem entails finding a new A_{ij} which minimizes the cross entropy distance between the preliminary $\bar{A}_{ij}$ and the newly estimated coefficient matrix.

$$\min \sum_i \sum_j A_{ij} \times In \frac{A_{ij}}{A_{ij}} = \min \left(\sum_i \sum_j A_{ij} \times InA_{ij} - \sum_i \sum_j A_{ij} \times In \bar{A}_{ij} \right)$$

Equation is subject to:

$$\sum_i A_{ij} \times y_i = y_i$$
$$\sum_j A_{ij} = 1$$

Where $A_{ij} \in [0,1]$

Appendix 8

MPSGE/GAMS Program Codes for the comparative static financial CGE Model for Ghana

Production Sectors/Industries (shorter notations are in parenthesis)

1. Agriculture and Livestock (***agric***)
2. Cocoa production and marketing (***cocoa***)
3. Forestry and Logging (***Forst***)
4. Fishing (***Fish***)
5. Mining and Quarrying (***Mine***)
6. Manufacturing (***Manf***)
7. Electricity and Power (***Elect***)
8. Construction (***Const***)
9. Transport, Storage and Communication (***Transp***)
10. Wholesale and Retail Trade, Restaurants and Hotels (***trad***)
11. Real Estate (***real***)
12. Banking (***bank***)
13. Business (***busi***)
14. Government Services (***pubad***)
15. Community and other services (***csrv***)

SET I SECTORS/

AGRIC
COCOA
FORST
FISH
MINE
MANF
ELECT
CONST
TRANSP
TRAD
REAL

BANK
BUSI
PUBAD
CSRV
/

HO HOUSEHOLDS AND LABOUR CATEGORIES /

HO1 HOUSEHOLD 1
HO2 HOUSEHOLD 2
HO3 HOUSEHOLD 3
HO4 HOUSEHOLD 4
HO5 HOUSEHOLD 5
/
;

ALIAS (I, J), (H, HO);

PARAMETERS AND VARIABLES

IOT	INPUT OUTPUT
L0	LABOUR INCOME
K0	CAPITAL INCOME
Y0	SECTORAL OUTPUT AT FACTOR COST
YY0	SECTORAL OUTPUT AT MARKET PRICES
SD0	TOTAL SECTORAL DEMAND
SSD0	TOTAL SECTORAL DEMAND
TRDMAG	TRADE MARGINS
ITX	INDIRECT TAXES ON PRODUCTION
ITX0	
STAX0	SALES TAXES
STAX01	
STAX02	
DEP	CAPITAL CONSUMPTION
TAX	TOTAL TAX (INDIRECT AND SALES TAXES)
LABTAX	LABOUR TAX RATE
CAPTAX	CAPITAL TAX RATE

SUPTAX	TAX ON GOODS SUPPLIED
DTAX	DIRECT TAXES ON PRODUCTION
EXP	EXPORTS
EXPNET	EXPORTS LESS EXPORT TAXES
EXTAX	EXPORT TAXES
EXPTAX	EXPORT TAX RATE PER SECTOR
C0	CONSUMPTION DEMAND
INV0	INVESTMENT DEMAND
TINV	TOTAL INVESTMENT
GOV	GOVERNMENT CONSUMPTION
IMPO	IMPORTS
IMPNET	IMPORTS LESS IMPORT TAXES
IMTAX	IMPORT TAXES
IMPTAX	IMPORT TAX RATE PER SECTOR
FD0	FINAL DEMAND
INDEX	PRICE INDEX OF MARGINAL CALCULATIONS
P0	
PL0	LABOUR
TM	TAXES ON IMPORTS
I0	
PX0	EXPORT PRICE
BAL	BALANCE BETWEEN SECTORAL DEMAND AND SUPPLY
ENDOWL	LABOUR ENDOWNMENT
GK0	GROSS OF TAX CAPITAL INCOME
INCBAL	INCOME BALANCE FOR HOUSEHOLDS
SAVING	SAVINGS OF HOUSEHOLDS
NINCBAL	NET OF TAX INCOME
REVBAL	REVENUE BALANCE FOR THE GOVERNMENT
GOVREV	GOVERNMENT REVENUE
SIBAL	SAVING INVESTMENT BALANCE
IMEXBAL	TRADE BALANCE OR BOP
RESBAL1	RESORUCE BALANCE (SIBAL+REVBAL)

```
ZEPROF          ZERO PROFIT CONDITION AMONGST
                PRODUCTION SECTORS
HINCOME         HOUSEHOLD INCOME;


PARAMETER SIOT    SUM OF IOT (J);
IOT(I,J) =IO(I,J);
L0(I) = VA("LABOUR",I);
K0(I) = VA("CAPITAL",I);
TRDMAG(I) = VA("TRADEMARGIN",I);
ITX(I) = VA("STAX",I);
C0(I) =VA("CONS",I);
INV0(I)=VA("INV",I);
GOV(I)=VA("GOVT",I);
EXP(I)=VA("EXPO",I);
IMPO(I)=VA("IMPORTS",I);
TINV = SUM (I, INV0 (I));
```

***SUPPLY AT FACTOR COST/SUPPLY SIDE**

```
y0(i) = sum(j,io(j,i)) + L0(i) + k0(i);
siot(i)=sum(j,io(j,i));
yy0(i)= sum(j,io(j,i)) + L0(i) + k0(i) + itx(i) + imtax(i) +extax(I);
```

***SALES TAXES**

```
stax0(i)=va("stax",i);
```

***EXPORT TAXES**

```
extax(i) =va("etax",i);
exptax(i)$exp(i)=extax(i)/exp(I);
expnet(i)=(1-exptax(i))*exp(I);
```

*IMPORT TAXES

imtax(i) =va("mtax",i);
imptax(i)$impo(i)=imtax(i)/impo(I);
impnet(i)=(1-imptax(i))*impo(I);
stax01(i) = extax(i) + imtax(i);

*DEMAND SIDE

sd0(i) = sum(j,io(i,j)) + c0(i) + gov(i) + inv0(i) + exp(i) -impo(i) - trdmag(i);
ssd0(i)= sum(j,io(i,j)) + c0(i) + gov(i) + inv0(i) + exp(i) -impo(I) - trdmag(I);
fd0(i) = sd0(i) - sum(j,io(i,j));

display yy0, sd0;

*LABOUR ENDOWNMENT

endowL = sum(i,L0(i));

*BALANCE

bal(i) =yy0(i) -sd0(i);

*TAX RATES

tax(i) = itx(i)+stax01(i);
itx0(i)=tax(i)/yy0(i);

*lnet;

labtax(i)$L0(i) = 0.1/0.9;
*labtax(i)$L0(i) = 0/L0(i);
lnet(i) = 0.9*L0(i);

*sales taxes

stax02(i)=0/ssd0(i);

*capital income tax rates

*captax(i)=0.175;
*captax(i) = tax(i)/k0(i);
captax(i)$k0(i) = 0/k0(i);
gk0(i)= k0(i)*(1+captax(i));

*INCOME BALANCE

saving= sum(i,L0(i)*(1+labtax(i)) + k0(i)*(1+captax(i))- c0(i));
hincome= sum(i,L0(i)+k0(i));

*investment saving balance

sibal=saving - tinv;

*revenue balance

govrev=sum(i, k0(i)*captax(i)+Lnet(i)*labtax(i)+yy0(i)*itx0(i)+sd0(I)*stax02(i));

revbal=sum(i,k0(i)*captax(i)+L0(i)*labtax(i)+exp(i)*exptax(I)+yy0(i)*itx0(i)+sd0(I)*stax02(i)-gov(i));

*+impo(I)*tm(I));

*trade balance/BOP

imexbal = SUM(I,exp(I)-impo(I)-trdmag(i));

*zero profit

zeprof(i)= yy0(i)- sum(j,io(j,i))-L0(i)-k0(i) - itx(i)-stax01(i);

resbal1= sibal + revbal;

display bal, sd0, yy0,trdmag, tax, stax02, captax, labtax, itx0, imexbal, hincome, revbal, tinv, sibal, zeprof,resbal1,govrev;

*ARMINGTON AND OTHER ELASTICITIES

PARAMETER ETRNDX(I)/cocoa 8, agric 8, Forst 8, Fish 8, Mine 5, Manf 5,
Elect 5, Const 5, trad 3, Transp 3, busi 3, pubad 3, csrv 3/,
ETRNXX(I)/cocoa 10, agric 10, Forst 10, Fish 10, Mine 7.5, Manf 7.5,
Elect 7.5, Const 7.5, trad 4, Transp 4, busi 4, pubad 4, csrv 4/;
parameter elas,

elast;
elas=1;
elast=0.15;
parameter pk0 capital rent

```
ps0 supply price
trdmg margins;
trdmg(I)=trdmag(I)/(sd0(I)-exp(i)+impo(i));
pL0(i) = (1+labtax(i));
pk0(i) = (1+captax(i));
ps0(i) = (1-stax02(i));
px0(i) = (1+exptax(I));
tm(i) =0;
p0(i)=(1-itx0(i));
display siot, iot, l0, k0, itx, stax02, c0,inv0,gov, exp, impo, pl0, pk0;


SCALAR    W0, TRANS;
          W0 = SUM(I,c0(I));
DISPLAY W0;
          Trans=govrev-sum(i,gov(i));
*HOUSEHOLDS ASSIGNMENT
PARAMETERS c01, c0h, incadj, tho, tho1, hoL, hoK;
          c01(i,h)=Conhouse (i,h);
          c0h(h)=sum(i,c01(i,h));
          tho(ho)=(houdist("ltotal",ho)+houdist("ktotal",ho));
          tho1=sum(ho,(houdist("ltotal",ho)+houdist("ktotal",ho)));
          hoL(ho)=houdist("ltotal",ho);
          hoK(ho)=houdist("ktotal",ho);
          Parameters diff, diff1, diff2;
          diff1=sum(ho,hoL(ho));
          diff2=sum(i,lnet(i));
          diff=diff1-diff2;
          display diff;
          incadj(ho)= c0h(ho)-(((tho(ho)/tho1)*(-imexbal))+hoL(ho)
          +sum(i,(hoK(ho)/(sum(h,hoK(H)))*K0(I)))+((tho(ho)/tho1)*(-tinv))
          +((tho(ho)/tho1)*Trans)+((hoL(ho)/(sum(i,L0(I))))*(-diff)));
```

$ONTEXT

$MODEL:gstatic14
*$ECHOp: TRUE
*$FUNLOG:TRUE
*$WALCHK:TRUE
*$DATECH:TRUE

Appendix 9(Chapter 5)

Table Conhouse (i,h) Distribution of Consumption Amongst Households

	HO1	HO2	HO3	HO4	HO5
agric	2089.656	3134.484	4266.381	6094.83	13437.649
cocoa	0	0	0	0	0
Forst	-0.072	-0.108	-0.147	-0.21	-0.463
Fish	173.952	260.928	355.152	507.36	1118.608
Mine	0	0	0	0	0
Manf	2850.336	4275.504	5819.436	8313.48	18329.244
Elect	248.4	372.6	507.15	724.5	1597.35
Const	-0.072	-0.108	-0.147	-0.21	-0.463
Transp	379.152	568.728	774.102	1105.86	2438.158
trad	183.024	274.536	373.674	533.82	1176.946
real	22.176	33.264	45.276	64.68	142.604
bank	133.056	199.584	271.656	388.08	855.624
busi	57.024	85.536	116.424	166.32	366.696
pubad	25.704	38.556	52.479	74.97	165.291
csrv	169.344	254.016	345.744	493.92	1088.976

Source: Ghana Living Standards (2008)

Appendix 10 (Chapter 5)

Tabel housdistwag (I,h) household distribution (wages

	HO1	HO2	HO3	HO4	HO5
agric	1904.652	2792.096	2963.459	3378.952	3870.842
cocoa	602.309	882.946	937.137	1068.528	1224.079
Forst	469.329	688.005	730.231	832.614	953.821
Fish	208.732	305.988	324.768	370.302	424.209
Mine	184.844	270.970	287.601	327.924	375.661
Manf	715.234	1048.487	1112.838	1268.863	1453.578
Elect	142.817	209.360	222.210	253.365	290.248
Const	788.048	1155.227	1226.129	1398.038	1601.558
Transp	350.911	514.412	545.984	622.534	713.159
trad	551.468	808.416	858.032	978.332	1120.753
real	0.000	0.000	0.000	0.000	0.000
bank	171.150	250.895	266.294	303.630	347.831
busi	73.350	107.527	114.126	130.127	149.070
pubad	1487.825	2181.056	2314.917	2639.480	3023.722
csrv	145.883	213.855	226.980	258.804	296.479

Source: Ghana Living Standards (2008)

Appendix 11(Chapter 5)

Tabletint(I,h) household income distribution

	HO1	HO2	HO3	HO4	HO5
agric	978.689	885.845	1110.340	1412.427	2773.698
cocoa	117.262	106.138	133.036	169.231	332.332
Forst	160.040	144.858	181.568	230.967	453.568
Fish	39.497	35.750	44.811	57.002	111.939
Mine	408.641	369.875	463.611	589.744	1158.128
Manf	388.961	352.062	441.283	561.342	1102.352
Elect	191.884	173.681	217.696	276.923	543.817
Const	445.405	403.152	505.320	642.801	1262.321
Transp	214.024	193.721	242.814	308.876	606.565
trad	151.703	137.312	172.110	218.935	429.941
real	0.000	0.000	0.000	0.000	0.000
bank	164.167	148.593	186.251	236.923	465.265
busi	70.357	63.683	79.822	101.539	199.399
pubad	392.104	354.907	444.849	565.878	1111.261
csrv	97.582	88.325	110.708	140.829	276.556

Source: Ghana Living Standards (2008)

Appendix 12 (Chapter 5)

Table houdist (*,h) total household income

	HO1	HO2	HO3	HO4	HO5
lTotal	7796.552	11429.241	12130.705	13831.493	15845.009
ktotal	3820.318	3457.902	4334.220	5513.417	10827.144

Source: Ghana Living Standards 2008)