A quantitative analysis of industrial policy options for Ghana with a focus on resource allocation

Yamaguchi University

Jorge Tavares Borges

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Abstract

The development and implementation of industrial policy are essential in shaping a country's economic landscape. It promotes industrialization, which, in turn, generates employment opportunities, enhances productivity, and diversifies the economy. the present dissertation studies the subject of industrial policy, with a particular emphasis on resource allocation and computable general equilibrium in Ghana.

Chapter 2 delves into the concept of industrial policy and its implementation in Africa in general, and Ghana, in particular. First, we examine Ghana's past experience with industrial policy implementation and the reasons for its inability to attain the desired outcomes. Subsequently, in response to the call for a return to industrial policy, we argue in favor of a renewed implementation of industrial policy in Ghana. We posit that the likelihood of success is significantly higher with the benefit of better institutions.

Chapter 3 examines the subjects of firm-level productivity, productivity distribution, and resource allocation. In the first instance, we decompose labor productivity in Ghana and draw the conclusion that within-sector resource allocation primarily drives productivity growth, with structural change playing a limited role. Next, we analyze the gross allocative effect, finding evidence that resources are migrating toward sectors of lower productivity. Finally, we also examine productivity distribution through the lens of the power law distribution, establishing that firms involved in international trade exhibit higher levels of aggregation. Thus, allocating resources to such firms leads to greater productivity, thereby minimizing resource misallocation.

Chapter 4 presents a dynamic recursive computable general equilibrium for Ghana, employing a Social Account Matrix (SAM) with 2015 as the benchmark year, and we conclude this chapter with a brief analysis of SAM. Chapter 5 examines several possible simulation scenarios. We build our simulations around two industrial policy strategies: labor-intensive and capital-intensive, furthermore our simulation is informed by Ghana's industrial policy plan. We analyze various policies such as efficiency improvement, trade protection, free trade, and taxation policy. We conclude that capital-intensive industrialization would work better under a free trade policy. Moreover, we discovered that the cost of protecting labor-intensive industries is less than the cost of safeguarding capital-intensive industries.

We conclude the dissertation with a discussion of the implications of our findings. we aim to provide a comprehensive discussion of the implications of our findings, as well as acknowledge the limitations of our study and propose potential avenues for further research. By doing so, we hope to contribute to the existing body of knowledge in our field and inspire future researchers to expand upon our work.

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

Industrial policy is a crucial tool in the promotion of a country's industrial sector, and its effectiveness rests heavily on the efficient allocation of resources. An important challenge in the implementation of industrial policy is ensuring that resources are optimally allocated to achieve desired outcomes (Itoh et al., 1991). The decisions made in this regard can significantly impact the competitiveness and productivity of the industrial sector. Governments typically employ various instruments to allocate resources to different industrial activities. Nonetheless, these decisions must be carefully made to ensure that they are efficient and effective. Suboptimal resource allocation may result in waste, redundancy, and subpar performance in industrial activities. This thesis focuses on the study of Ghana's industrial policy, with a particular emphasis on resource allocation.

Despite Ghana's notable progress in economic growth and welfare enhancement, the country continues to face various constraints regarding economic transformation and structural change[1] (McMillan and Headey, 2014; Ayelazuno, 2014). Scholars have suggested that the implementation of industrial policy is crucial in addressing these limitations (Ayelazuno, 2014). This study aims to enrich the discourse on

[1]Structural change refers to the long-term shifts and transformations that occur within an economy's structure, composition, and patterns of production. It involves changes in the relative importance of different sectors, industries, and technologies, as well as shifts in the allocation of resources, employment patterns, and income distribution

Ghana's industrial policy and resource allocation by providing novel insights into industrial policy strategy through quantitative analysis of labor-intensive versus capital-intensive industrialization. The results of this study have significant implications for policymaking and will advance the ongoing discussion on the appropriate industrial policy framework for Ghana. Our study builds upon and extends the existing literature on industrial policy in Africa, particularly in Ghana, by adopting a quantitative approach to analyzing industrial policy and resource allocation.

We used a unique dataset to study resource allocation, including firm-level manufacturing data for 1991-2002. For industrial-level productivity and resource allocation, we used the allocative efficiency model. We model firm-level productivity distribution using power law distributions and discuss the implications of our results for resource misallocation. To quantitatively analyze industrial policy options in Ghana, we used a recursive dynamic computable general equilibrium model. We build on the model developed by Chang (2021) and create a dynamic model for Ghana's economy. We used Ghana's social account matrix with the year benchmark 2015 as our database.

The subsequent sections provide a concise summary of each chapter in this thesis, detailing the main topics covered and key arguments. The aim is to provide the reader with an overarching view of the thesis and its contents.

Chapter 1 serves as an introductory section that offers an overview of the study, delineates the main objectives of the thesis, and expounds on its methodology. Additionally, this chapter elucidates the originality and novelty of the research, showcasing the potential contributions that this thesis could make to the existing body of knowledge in the field.

Chapter 2 provides a comprehensive review of industrial policy in Ghana, focusing on the concept of economic growth without structural transformation. Ghana, like many other developing countries, has implemented various industrial policies aimed at achieving sustained economic growth and development. However, the effectiveness of these policies in driving structural transformation, characterized by the shift from low-productivity agricultural activities to high-productivity manufacturing and services sectors, has been limited. The chapter proceeds to trace the historical development of industrial policy implementation in Africa, with a specific focus on Ghana. The reasons for the inability of industrial policy to achieve its intended objectives are delved into, with a critical evaluation of the factors that contributed to this outcome. Furthermore, the chapter examines the current state of industries in Ghana and makes a compelling case for the resumption of industrial policy implementation in the country.

Chapter 3 focuses on an in-depth analysis of the distribution of productivity and resource allocation in Ghana's manufacturing industries, utilizing a unique set of firm-level longitudinal data. The chapter commences by undertaking a decomposition of aggregate labor productivity growth, revealing that growth in Ghana's manufacturing sector was predominantly driven by labor allocation within the sector rather than reallocation across industries. Moreover, the chapter uncovers that resource allocation was disproportionately directed toward less productive sectors. The analysis proceeds to examine productivity distribution utilizing the power law distribution approach and establishes that firms engaged in international trade exhibited a higher level of aggregation. This finding underscores that resource allocation towards such firms translated into greater productivity and reduced resource misallocation.

Chapter 4 expounds on the model employed in this thesis to investigate industrial policy in Ghana. The chapter outlines the fundamental characteristics of the recursive dynamic computable general equilibrium model and the associated equations that describe the model's behavior. Furthermore, the chapter elucidates the underlying assumptions of the model and the closure rule adopted. Lastly, the chapter provides a succinct overview of the social account matrix for Ghana and the degree of aggregation utilized in the analysis and provides a brief overview of

Ghana's economic structure through the lens of its 2015 SAM.

Chapter 5 presents the policy simulations conducted to explore various industrial policy options available to the government of Ghana, and reports on the subsequent results. To this end, a counterfactual analysis is employed to evaluate the efficacy of different policy interventions. The chapter presents an in-depth discussion of the simulation results, including the sensitivity and robustness analyses of critical parameters.

In concluding chapter 5 we provide a comprehensive summary of the key findings and implications of the study for industrial policy options in Ghana. The chapter also acknowledges the limitations of the study and highlights potential avenues for future research. Overall, this chapter offers a critical reflection on the research conducted and its potential contributions to the existing body of knowledge in the field of industrial policy.

Chapter 2

Economic Growth and Structural Transformation: A Review of Industrial Policy in Ghana

2.1 Introduction

The role of economic transformation in economic development has received increased attention from scholars in recent years. Recently considerable literature has grown up around the topic. Worldbank (2021), McMillan et al. (2017b), McMillan et al. (2017a) all highlight the importance of economic transformation and the lack of it as the explaining factor behind the weak linkage between economic growth and welfare improvement in many African countries. The notion of structural transformation is interconnected with the concept of structural change and sectoral productivity improvement. More specifically, the attainment of economic transformation necessitates the presence of structural change alongside substantial within-sector productivity growth. Economic transformation raises household incomes and living standards, thereby lifting people out of poverty. It can be achieved through the movement of workers and other resources between firms and sectors, or through workers staying within existing firms that benefit from within-firm productivity growth by adopting better technologies and processes (Worldbank, 2021). These dynamics underscore the pivotal role of structural change and productivity growth in driving successful economic transformation.

There is currently an observable trend of structural change characterized by a shift towards a service-led economy, bypassing the traditional manufacturing sector. This phenomenon has been widely documented across developing nations. Likewise, in Ghana, this pattern of structural transformation is clearly following this pattern. The deviation from the conventional industrialization path is known as "structural change without industrialization," which indicates premature deindustrialization (Rodrik, 2013). The negative consequences of premature deindustrialization include a lack of employment opportunity, reduced productivity in alternative sectors such as agriculture or services, and overreliance on these sectors which is less capable of generating high-paying jobs. There is a growing body of literature that prescribe the adoption of industrial policy in many African countries, as an instrument to bring about the development of manufacturing, productivity improvement, and economic transformation.

Industrial development, particularly the growth of manufacturing industries, is widely recognized in the literature as a pivotal factor in the development of societies. Its significance lies in its capacity to generate employment opportunities, foster technological advancements, and stimulate economic growth. The foundation for understanding the role of industries, specifically manufacturing, can be traced back to the work of Nicholas Kaldor and his formulation of Kaldor's three laws. These laws provide a comprehensive framework that elucidates the interplay between industrial development, productivity gains, and overall economic progress (Yülek, 2018).

Rapid industrial development has been the most remarkable in East Asia, positioning the region as a global economic powerhouse (Stiglitz, 1996). The growth experience of East Asia economies has demonstrated the importance and the interlinkage between fast economic growth, economic transformation, structural change, and technological and industrial upgrades. Industrial policy plays a vital role in the technology gap reduction relative to the world technological frontier and generating international competitiveness (Cimoli and Porcile, 2013; Lin and Monga, 2013). The successful economic performance of East Asian economies has been widely attributed to the effective implementation of industrial policies (Stiglitz, 1996; Akkemik, 2008; Cimoli and Porcile, 2013; Yülek, 2018).

In the case of Africa, the push for industrialization started in the 1950s and 1960s, when newly independent countries sought to promote industrial development by implementing industrial policies. Recognizing industrialization as the primary vector of growth, different industrial promotion policies have been tried (Marti and Ssenkubuge, 2009; Grabowski, 2015b). Industrial policy has long been a subject of debate and experimentation in Africa, with policymakers and scholars grappling with the challenges of promoting economic development through industrialization. While numerous policies and strategies have been aimed at improving agricultural and industrial sectors, the efficacy of these efforts remains questionable. However, there has been a recent resurgence of interest in industrial policy as an instrument to stimulate economic growth and development in the continent.

When implementing industrial policies, African countries prioritized import substitute industrialization (Marti and Ssenkubuge, 2009; Grabowski, 2015b). This policy is believed to have shifted resources out of the sectors where the continent had a comparative advantage (mining, primary sectors) toward sectors where it did not have it (final goods). Tools such as tariffs, quotas, and foreign exchange controls were used to protect domestic industries. State ownership was used to 'guarantee supply chain stability' and resource allocation. Agriculture was neglected due to its low productivity. Tools such as tariffs, quotas, and foreign exchange controls were used to protect domestic industries. State ownership was used to 'guarantee supply chain stability' and resource allocation. The state used its monopsony power to push down agriculture prices, effectively shifting resources out of agriculture -one consequence of this policy of neglecting agriculture can be felt even today; agriculture production didn't keep up with population growth. According to Grabowski (2015b), from 1961 until 2009 food production in Africa all but stagnate, however, the protected sectors failed to gain productivity, and countries facing financial constraints dictate the failure of this strategy. The first industrial policy implementation attempt lasted until the end of the 1970s and the beginning of the 1980s when industry policy fell out of fashion (due to substantial financial strain on countries' public finances) and was replaced by the neoliberal agenda (Ansu et al., 2016; Geiger et al., 2019). This period of neoliberalism materialized in the Washington Consensus policy package, which became the dominant ideology in the world and Africa. This period saw a move (under external advice and conditionality) toward the liberalization of the markets, privatization of State-Owned Enterprises (SOE), macroeconomic stabilization, economic opening, and so on. It was a period of declining GDP per capita and a decline in the industrialization process in Africa (Noman and Stiglitz, 2015).

Against this background, this study proposes to critically review Ghana's current development model and assess its effectiveness in achieving structural change and economic transformation. The study argues for the reintroduction of industrial policy implementation in Ghana as a representative case of failed industrialization in Africa, considering the observed weak linkage between economic growth and structural transformation. The research examines Ghana's previous experiences with industrial policy implementation and analyzes the country's current industrial structure and development plan, which includes provisions for the implementation of industrial policy.

This chapter begins by providing the theoretical foundations of industrial policy, followed by a historical overview of industrial policy implementation in Ghana. Additionally, as evaluated Ghana's present industrial structure is analyzed, and its alignment with the country's development strategy is evaluated.

2.2 Industrial Policy: Theoretical Underpinning

Industrial policy encompasses a set of governmental measures and interventions aimed at fostering and accelerating economic development, particularly in the context of promoting industrialization. This term is often associated with the Japanese government's strategic initiatives and policies implemented to facilitate and expedite the process of economic growth and industrial advancement (Akkemik, 2008). Industrial policies[1] are designed to affect resource allocation, complement market failure, and income distribution. It targets selected industries based on their potential for technological upgrade, productivity growth, and high-income elasticity (Itoh et al., 1991). In a recent study, Lin and Monga (2013) makes a case for comparative advantage as the guideline for sectorial targeting. This definition of industrial policy stresses the "vertical" (picking the winner) approach to industrial policy. A "horizontal" (level playfield) approach also focuses on improving the general macroeconomic and social environment. The industrial policy usually targets manufacturing promotion, as manufacturing more easily checks the boxes of desirable characteristics (technological potential, high-income elasticity, productivity growth) for sectorial promotion. However, if we take a broader view of industrial policy, Rodrik (2004) defines it as any policy designed to affect the structure of an economy; it can be the service sector, for instance. Market failure (information asymmetry, issues of investment coordination, information asymmetry) is among the most compelling arguments favoring government intervention.

The widespread presence of market failures in developing countries presents a compelling argument for the implementation of industrial policies. The historical achievements of economies in East Asia (e.g. Korea, Taiwan) provide empirical evidence that supports the proactive adoption of such policies (Akkemik, 2008; Wade, 2010; Chang and Andreoni, 2020). Nevertheless, doubts persist regarding the fea-

[1] Another approach to industrial policy is to understand it as some deliberate government to affect sectoral composition of output

sibility of effectively implementing industrial policies. These concerns arise from the experiences of various economies, particularly in Latin America and Africa, where the outcomes of industrial policy implementation have failed to replicate the successes witnessed in East Asia. Such instances have engendered skepticism regarding the effectiveness and applicability of industrial policies, particularly within the Sub-Saharan Africa (SSA) region. It was argued that implementing the industrial policy requires certain “first-rate institutions” and a cadre of bureaucrats which is supposedly challenging to be found in these countries (Chang and Andreoni, 2020; Lin and Monga, 2013). In the context of Sub-Saharan Africa (SSA), detractors of industrial policy implementation have highlighted the presence of weak institutional frameworks, politically challenging environments, significant natural resource endowments (which are believed to discourage the pursuit of industrial policy), geographical factors, and other pertinent considerations (Chang, 2013). However, as as the author argues, these same types of arguments were used in the past to argue against industrial policies in East Asia. Hence, these are not credible arguments against the industrial policy in SSA.

Following a period of waning popularity, industrial policy has regained prominence as a result of several influential factors, including the ascendance of China, the global financial crisis of 2008, and the imperative to address climate change. These developments have rekindled interest in government intervention, particularly in the form of industrial policies, and have renewed discussions regarding their applicability and significance (Chang, 2013; Cherif and Hasanov, 2019; Akkemik and Yülek, 2020). The shifting paradigm within the international sphere, combined with the relatively enhanced state of basic institutions and macroeconomic conditions in Sub-Saharan Africa (SSA), creates a conducive environment for a renewed attempt at implementing industrial policies in the region (Chang, 2013). Given the inadequacies observed in the realms of economic growth and transformation in Ghana, there has been a growing demand for the reintroduction of industrial policy as a means to rectify these deficiencies (Chang, 2013). For instance, Ayelazuno (2014) argues that the failure of Ghana to diversify its economy into industrialization (i.e., manufacturing) explains the paradox of growth without development. The author argues for industrialization in Ghana in the modes of East Asia countries, by supporting selective manufacturing firms.

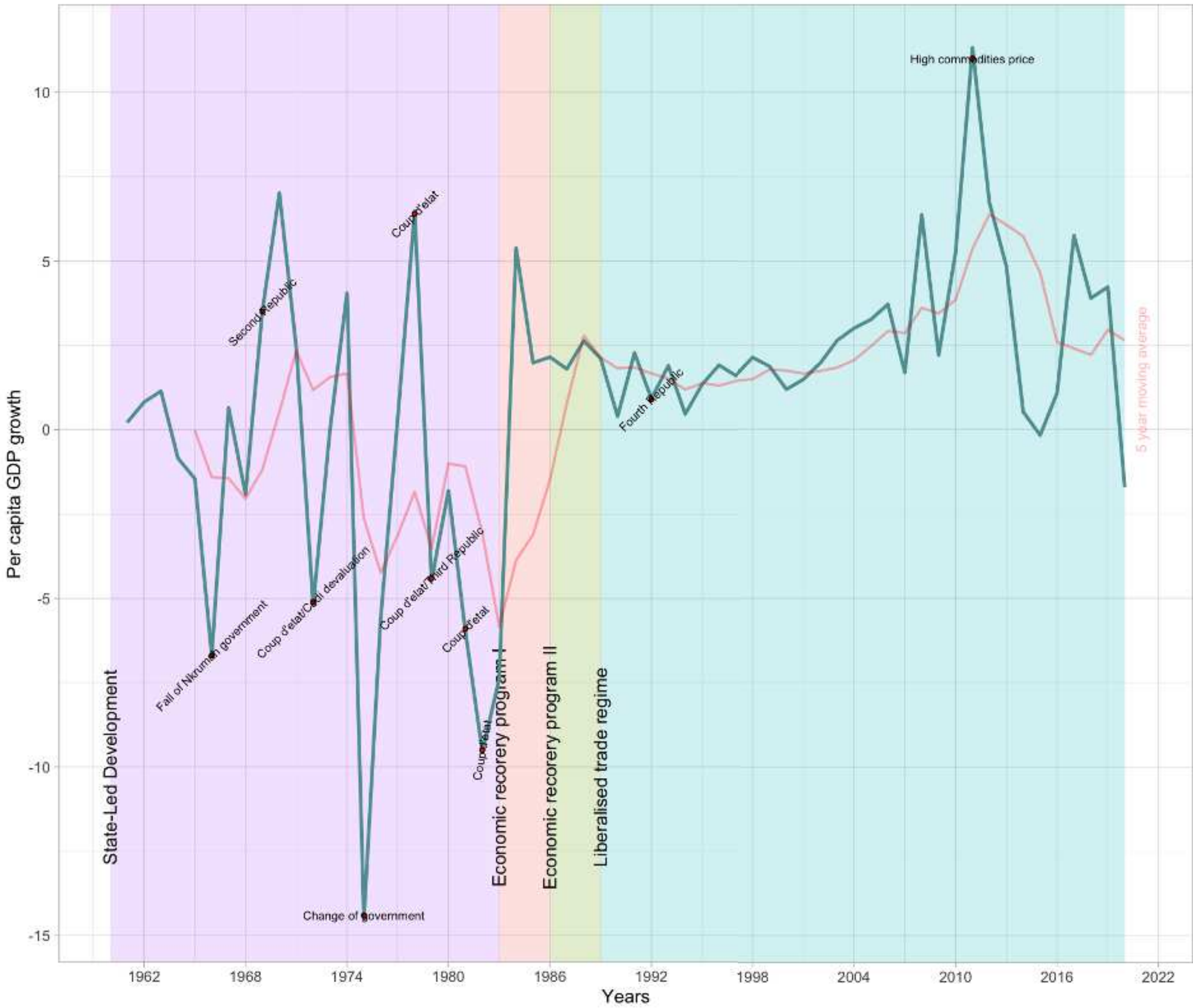
2.3 Industrialization and Industrial Policy in Ghana – A Review

2.3.1 Economic growth performance

Ghana is at the forefront of economic reform in Sub-Sahara Africa. For instance, after independence, the country implemented import substitute industrial policy; later on, when the industrial policy was out of favor, the country was at the vanguard of reforms toward the market economy (Kolavalli et al., 2011). However, the results of these reforms have received mixed evaluations. While some scholars credit it for the high economic growth performance attained ever since. Others argue that the lack of economic transformation and structural change remains the biggest obstacle. Considering the current development level of Ghana and the competitiveness of its industrial base, one can safely argue that there is a need for significant economic transformation and structural changes, which will likely lead the way for further economic and social development. A specific-purpose industrial policy, which aims to nurture specific industries, is arguably a viable way to achieve such a high aim in industrial development. Therefore, before launching industrial policy discussions, it is pertinent to take a brief historical look into industrial policies in Ghana.

Ghana's economic history since gaining independence has been marked by notable fluctuations in GDP growth, mainly due to its overreliance on commodity exports (Gocking, 2005). As shown in figure 2.1 In the initial decades following independence, the country pursued a State-Led Development approach, which involved

Figure 2.1: Ghana GDP per capita growth 1961- 2021



Source: Authors' elaboration based on World Development Indicator.
Note: The GDP per capita growth was determined by dividing the total GDP at a constant local currency by the total population.

Import Substitution Industrialization (ISI). During this period, the government implemented various policy measures such as import tariffs, price controls, import restrictions, foreign exchange rationing, and import licensing to protect domestic industries (Ackah et al., 2016; Aryeetey and Kanbur, 2017; Gocking, 2005; Huq and Tribe, 2018). Figure 2.1 demonstrates that this phase of Ghana's economic history was characterized by significant volatility in GDP growth, with an average growth rate of only 0.46% during the first ten years of independence. This period of economic instability was closely linked to political turmoil and uncertainty. However, due to factors such as high inflation (averaging 40% in the 1970s), fiscal deficits, imbalances in the balance of payments, and depletion of foreign reserves, Ghana sought assistance from the International Monetary Fund (IMF). Consequently, an economic recovery program was implemented, leading to a shift in the economic strategy (Ackah et al., 2016). The new approach embraced a neoliberal agenda, characterized by economic liberalization. This change in strategy yielded positive outcomes, as reflected in the growth of GDP per capita. The long-term growth, represented by the five-year moving average, exhibited an inflection point and turned positive. In the decade prior to the onset of the COVID-19 pandemic, Ghana's economy experienced an average per capita GDP growth rate of 4.5%. This performance positioned Ghana as one of the fastest-growing economies in Sub-Saharan Africa and globally during that period.

Despite this positive result, there is mixed feeling in the academic community regarding evaluating the impact of this liberal agenda in Ghana. Some scholars credit it for its stable and steady economic growth. In contrast, others point to the lack of economic transformation, structural change, and persistence of low productivity, joblessness, and poverty (Aryeetey and Kanbur, 2017). What Ayelazuno (2014) characterizes it as the "paradox of growth without development". As opposed to the first development period, it is argued that Ghana achieved transformation without economic growth.

2.4 Industrial Policies in Ghana: A retrospective review

Economic planning in Ghana precedes the country's independence in 1957. In the period leading to the sovereignty, at least three ten-year plan was devised by the then-colonial governorship (Huq and Tribe, 2018). In 1946, the governor of the Golden Coast, as Ghana was denominated then, approved the country's first Ten-Year development plan, which were followed by another plan in 1950, later transformed into a Five-Year plan (Aryeetey and Kanbur, 2017). The plan was intended to promote the development of the industrial development. In fact, the first plan that effectively called for the protection of infant industries in Ghana was developed by the celebrated Nobel laureate economist Arthur Lewis. The plan recommended the use of tariffs and quotas to protect domestic industries, increase agriculture productivity, and the expansion of infrastructures (Gocking, 2005; Huq and Tribe, 2018).

From independence, Ghana aimed to develop an independent economy, which implies being independent of importing consumer goods; hence the country experimented with an industrial policy based on an import substitution strategy. After 1984, Ghana embarked on an open economy under the auspices of the IMF intervention. For the last two decades, the country has been experimenting with a private-led, natural resource processing industrialization strategy (Aryeetey and Kanbur, 2017; Killick, 2010). Ackah et al. (2016) summarize the phases of Ghana's industrialization can be summarized as follows:

1. Import-substitute industrialization (ISI): 1965-1983
2. Outward-oriented liberalization strategy: 1984-2000
3. Private-led natural resource processing-based industrial development: 2000-present

Killick (2010) further categorizes the initial period into two distinct phases: pre- and post-toppling of the Nkrumah government, spanning from 1951 to 1966[2]. Within this framework, the author asserts that this period represents a significant epoch characterized by a heightened pursuit of developmental objectives.

[2] Ghana achieved independence in 1957, however, by 1951 it had already achieved self-governance

2.4.1 Import-Substitute Industrialization (ISI): 1965–1983

During import-substitute industrialization (ISI), Ghana's government adopted a policy of protecting domestic industries from foreign competition. After independence, Ghana was mainly an import-dependent economy based on natural resource extraction (Aryeetey and Kanbur, 2017; Ackah et al., 2016; Gocking, 2005; Killick, 2010). The industrial policy in this phase aimed to break away from the colonial system of over-reliance on imported goods. Ghana's economic structure heavily relied on imports for the acquisition of capital and consumer goods (Killick, 2010).

The government invested significantly in large-scale, capital-intensive manufacturing industries where state-owned enterprises (SOEs) dominated (Gocking, 2005). The main targeted sectors were infrastructure investment, production of previously imported consumer goods, processing and export of primary products, and expansion and development of building materials, electronics, and machinery industries. Industrial policy at this stage primarily targeted increasing manufacturing output. About 90 percent of firms operating in the industrial sector (mining, quarrying, manufacturing, energy, and construction) were manufacturing firms. Light industries such as textiles, garments, soap, wooden products, aluminum, and metal were among the high-priority sectors. The textile industry accounted for 27 percent of the total manufacturing output. The aim was to develop sectoral linkages between the existing sectors and future industries to be developed (Ackah et al., 2016).

The ISI strategy gave special preeminence to SOEs to the detriment of private sector development. The output of the private sector declined during this time. Policy tools such as tariff and non-tariff protection of domestic industries, licensing, price controls, quantitative import restrictions (quotas), and foreign exchange rationing were widely used. However, these did not produce the desired outcome. It resulted in excess capacity and inadequate linkages with other growth-enhancing sectors, the balance of payments problems, inflationary pressure, and currency devaluation (Ackah et al., 2016). Overall, the ISI strategy did not bring about the desired GDP growth. GDP growth remained negative in most years and averaged -1.67% for 1960-1983.

2.4.2 Outward-oriented liberalization: 1984–2000

By 1983, Ghana's production capacity and social infrastructure were in decline. The country went under an Economic Recovery Program (ERP) and Structural Adjustment Program (SAP) by the IMF. These programs generally entail economic liberalization, i.e., the dismantling of industrial policy under implementation. Measures in the SAP include liberalization of the exchange rate, removal of price controls, financial sector liberalization, abolition of the import licensing system, privatization, and the rationalization of the import tariff and taxation system (Ackah et al., 2016; Aryeetey and Kanbur, 2017). The ultimate aim was declared as the development of an internationally competitive economy capable of competing in the domestic market with imported goods and enhancing the capacity to export while developing private-sector-led industrialization as opposed to government-led industrialization previously implemented, which can absorb labors released by the privatization of SOE (Ackah et al., 2016). The liberalization era of the 1980s and the 1990s also witnessed the decline of manufacturing's share in GDP. During the heydays of industrial policy, i.e., the 1960s and the first half of the 1970s, this share was more than 10%. It remained between 10%-15% bad but declined to below 10% during the liberalization era.

Liberalization of the economy emphasized macroeconomic stability through short-run macro policies, and long-run industrial policies were neglected. The macroeconomic results of the liberalization measures, on the other hand, were favorable, as evidenced by the return of positive economic growth. The per capita GDP growth rate improved largely compared to the previous period and averaged 1.96% from 1983-2004 (see figure 2.1). The average growth of the industry was an incredible 11.2% during the first five years of the program. However, this growth was mainly led by the energy sector (water and electricity), not manufacturing growth. In addition, due to the over-exposition of domestic firms to international competition and high production costs resulting from a weak currency, among others, the growth of the industry was short-lived. Soon afterward, there was a return to the sluggish growth rate. The government implemented measures such as setting up business assistance funds, export subsidies, support for small and medium enterprises, and establishing exporting processing zones. However, the impact of these measures was negligible despite being positive (Ackah et al., 2016). As a result of these measures, the share of manufacturing in total industrial output (mining, manufacturing, energy, and construction combined) decreased. The mining sector, which benefited from economic opening thanks to better legislation brought by FDI and better capital equipment, outperformed the manufacturing sector, which still accounted for a large share of industrial output. However, this share was on a declining trend (Ackah et al., 2016).

2.4.3 Private-led natural resource processing based industrial development: 2000-present

In the 2000s, Ghana witnessed a shift in its development strategy, with the government focusing on enhancing economic welfare through poverty reduction, job creation, and inclusive economic growth (Ackah et al., 2016). During this period, the government identified several key challenges that hindered the country's development. One of the identified obstacles was the high cost of credit, which impeded access to financing for businesses and individuals. To address this issue, the government implemented policies and initiatives to promote financial inclusion, enhance the banking sector, and facilitate easier access to credit for productive activities. Another significant challenge was the unreliable power supply. Ghana faced frequent power outages, which negatively impacted industrial productivity and economic growth. The government undertook various measures to address this issue, including investment in power generation infrastructure, encouraging private sector participation in the energy sector, and promoting renewable energy sources.

Rising fuel costs also posed a challenge to Ghana's development efforts. Fluctuating global oil prices affected the cost of fuel imports, leading to increased transportation costs and inflationary pressures. The government implemented strategies to mitigate the impact of rising fuel costs, such as promoting domestic oil exploration and production, encouraging energy efficiency measures, and diversifying the energy mix. Furthermore, intense competition with domestically imported goods was identified as a hindrance to Ghana's development. To address this, the government implemented trade policies aimed at protecting domestic industries, promoting local production, and reducing the reliance on imported goods.

Overall, during the 2000s, Ghana's development strategy focused on overcoming challenges related to credit availability, power supply, fuel costs, and competition with imported goods. The government aimed to create an enabling environment for sustainable economic growth, poverty reduction, and job creation, fostering inclusive development across various sectors of the economy.

2.5 The current state of Industrial Policy in Ghana

2.5.1 An outlook of manufacturing industries

Ghana's economic growth has been heavily reliant on commodities exports, particularly oil and gold. Mining, in particular, has played a significant role, contributing to approximately 20% of the country's GDP between 2013 and 2019. Mining is a capital-intensive activity that does not generate substantial employment opportunities. This dependence on commodities exports also exposes Ghana to the risks of price fluctuations, leading to macroeconomic instability (Worldbank, 2021). A relatively small proportion of Ghana's labor force, approximately 15%, is employed in the mining, manufacturing, and energy sectors. Within the manufacturing sector, productivity levels are relatively low, with only a 20% productivity difference compared to agriculture. In contrast, China's manufacturing sector demonstrates a much higher productivity level, with a 500% difference compared to the agriculture (Grabowski, 2015b). This disparity indicates a significant productivity gap in Ghana's manufacturing sector. Furthermore, there is a declining trend in productivity as firms employ more workers, suggesting a low absorption capacity in general. This highlights the challenges faced by Ghana in terms of increasing productivity and creating meaningful employment opportunities within the manufacturing sector. These factors collectively underscore the need for Ghana to address its overreliance on commodities exports and enhance productivity within the manufacturing sector. Diversifying the economy, promoting industries with higher value-added activities, and implementing measures to improve productivity are crucial for achieving sustainable economic growth and employment generation in Ghana.

Figuere 2.2 depicts the share of different industries in Ghana's total manufacturing value added during the 1960s (blue) and the 2000s (red). Several notable trends can be observed. First, industries such as wearing apparel and fur, food and beverages, and fabricated metal products have experienced a significant increase in their share of total manufacturing value added over time. This suggests that these industries have grown in importance within the manufacturing sector. However, it is important to note that the observed growth in these industries does not necessarily imply substantial technological deepening. The model of industrial development has established the existence of a pattern of development from light to heavy industries, with a consequent higher level of labor productivity, due to its capital intensity (Timmer and Szirmai, 2000). However, without further evidence, it is challenging to ascertain the extent to which technological advancements have occurred within these sectors. In comparison to East Asian countries like Singapore, where industries with higher value-added and technological content, such as electrical and electronic machines, have increased their share, the Ghanaian manufacturing sector's progress

Figure 2.2: Share of Industries in Total Manufacturing Value Added

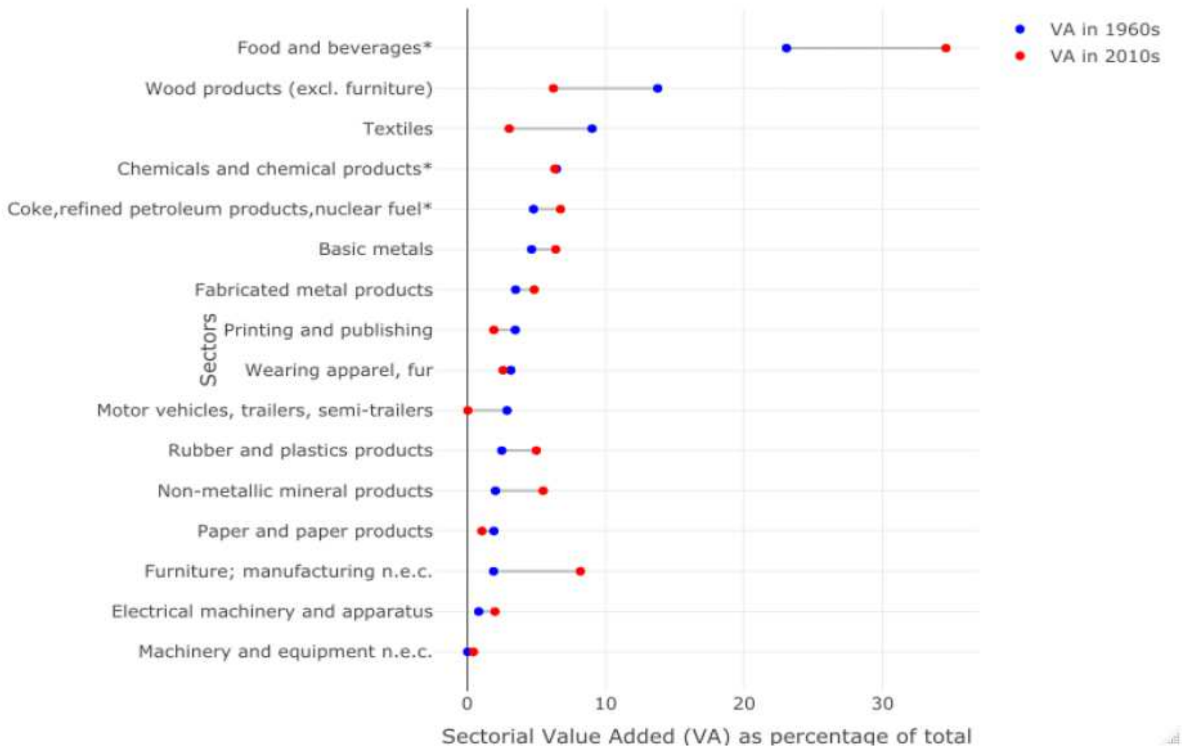


Figure 2.2: Source: Authors' elaboration based on United Nations Industrial Development Organization (UNIDO).
Note: The data source is based on Industrial inquiries conducted annually and quarterly, data were converted from ISIC Revision 2 to Revision 3. In the top right corner of the figure, you'll notice "VA" which stands for "value-added." The data displayed represents the average calculated over a 10-year period, spanning from the 1960s and 2010s respectively.

in technological deepening appears constrained (Akkemik, 2008). Moreover, there are industries, such as wood products and motor vehicles, that have experienced a decrease in their share of total manufacturing value added. This decline could be indicative of challenges in these sectors, potentially including limited technological advancements and competitiveness. To better understand the level of technological deepening in Ghana's manufacturing sector, additional research and analysis are required. Detailed assessments of technological capabilities, research and development investments, and the adoption of advanced manufacturing techniques would provide more insights into the country's progress in this regard.

2.5.2 Recent industrialization strategy in Ghana

Ghana's industrialization strategy is currently centered around promoting privately-led agro-processing industries as a means to bridge the productivity gap, diversify the economy, and foster private sector-led growth. This strategy encompasses various sectors, including agriculture and agro-processing, manufacturing, tourism, and digital services. The government aims to facilitate the development of these sectors by improving the business environment, enhancing access to finance and technology, and encouraging innovation and entrepreneurship.

To achieve these objectives, the Ghanaian government has implemented several policy initiatives. One such initiative is the One District, One Factory (1D1F) program, which aims to establish at least one factory in each district of the country. This program seeks to promote local industrial development and generate employment opportunities. Additionally, the Ghana Automotive Development Policy focuses on promoting the local production of vehicles and auto parts. The government has also established industrial parks and special economic zones to attract foreign investment and stimulate the growth of key industries. Examples include the Ghana Free Zones Authority, the Western Nzema Industrial Park, and the Appolonia Business Park. These initiatives provide dedicated spaces and infrastructure to support industrial activities and facilitate business operations. Overall, the industrialization strategy in Ghana is geared towards creating a more diversified, competitive, and resilient economy that can generate higher levels of economic growth and employment. By prioritizing agro-processing industries, improving the business environment, and implementing targeted policies and initiatives, the government aims to foster industrial development and enhance productivity and skill levels across various sectors.

Ghana's industrial policy plan, developed by the Ministry of Trade and Industry, outlines a comprehensive framework for transforming the country into an industry-driven economy. The plan reflects extensive consultations with stakeholders and aims to achieve sustainable economic growth, job creation, and equitable income distribution. Manufacturing is identified as the key sector to be promoted, with 21 thematic areas grouped into four main components: production and distribution, technology and innovation, incentives and regulatory regimes, and cross-cutting issues. The plan sets multiple goals, including diversifying the economy and creating jobs through industrialization and manufacturing promotion, fostering the growth of small and medium-sized enterprises (SMEs) and entrepreneurship, driving innovation and technology transfer through research and development, encouraging value addition and local processing of raw materials, developing infrastructure and services that support industrial growth, and attracting private sector investment in industrial development. Furthermore, Ghana's industrial development priorities include expanding productive employment in the manufacturing sector, modernizing the economy by promoting high-value-added sectors and enhancing industries' technological capacity. Financial deepening, technological promotion, and macro management are also highlighted as important aspects of industrial policy. Ghana's current industrial policy aligns with the concept of strategic industrial policy, as defined by Chang and Andreoni (2020). It emphasizes correcting market failures in a static sense while promoting innovation to enhance productivity. The policy focuses on creating a level playing field rather than adopting the traditional industrial policy approach of picking winners, as observed in East Asia. Overall, Ghana's industrial policy plan demonstrates a comprehensive and strategic approach to industrial development, emphasizing the promotion of manufacturing, innovation, and private-sector investment. By addressing market failures and facilitating technological advancement, the plan seeks to foster sustainable economic growth, job creation, and a diversified industrial base in Ghana.

2.6 Conclusion

This study presents a thorough and comprehensive analysis of industrial policy and its historical implementation in Ghana. The introduction sets the stage by discussing the current status of industrial development in Ghana and the necessity for revitalizing industrial policy. The theoretical foundations of industrial policy are outlined, highlighting its purpose in addressing market failures and driving economic transformation.

The study proceeds to explore the guidelines for sector targeting in industrial policy, taking into account factors such as technological potential, income elasticity, and comparative advantage. While acknowledging the skepticism surrounding the effectiveness of industrial policy in Africa, the study emphasizes the growing demand for its implementation.

A chronological approach is employed to examine Ghana's experience in implementing industrial policy, spanning from the period of independence to the present. This section provides valuable insights into the evolution of development policies and the diverse approaches adopted by Ghanaian governments.

Subsequently, the focus narrows down to Ghana's specific implementation of industrial policy. The study delves into the instruments utilized in Ghana's industrial policy and identifies the obstacles that have impeded successful outcomes. Key challenges related to limited technological advancement, low productivity, and employment generation within Ghana's industries are elucidated.

The study concludes by providing an overview of Ghana's industrial strategy and its existing industrial policy plan. The promotion of the private sector, agricultural and agro-industrial development, and the manufacturing sector are emphasized as crucial components of Ghana's industrial policy. The study acknowledges the ongoing need for sustained efforts to address the challenges and gaps in Ghana's industrial development.

Future lines of research on Ghana's industrialization should focus on quantitative analysis and the effectiveness of the recent industrial policy. for this purpose, quantitative techniques such as input-output, computable general equilibrium models (CGE), etc, can be used. It is our interest to further our study by extending it to analysis using up-to-date data using CGE model-based simulation.

Chapter 3

Productivity and resource allocation: An industry-level and firm-level analysis for Ghana

3.1 Introduction

Productivity is central in explaining income differences across countries. Most studies about productivity emphasize that industrialized countries lead in productivity, while recent studies showed evidence for developing countries catching up with the industrialized countries (Maryam and Jehan, 2018). Technology diffusion and allocative efficiency are especially essential in closing the productivity gap.

Productivity improvement is most significant at the firm level. Macro-level productivity differences can also be traced to micro-level components, i.e., firm-level productivity(Souma et al., 2009). Comparative cross-country firm-level productivity studies trace the roots of productivity differences to factors such as pattern organization, managerial motivation, and technology diffusion (Baily and Solow, 2001). In an environment where technological distribution is not uniform, firm-level productivity distributions tend to be more dispersed. The connection between firm-level productivity distribution and a firm's growth and technology diffusion is well established (Heinrich and Dai, 2016).

Recently, a large literature has emerged around the discussion of productivity dispersion at the firm level using firm-level data. The classical microeconomic theory postulates that if the market works properly, there should not be significant productivity dispersion among firms (Aoyama et al., 2010). This idea is based on the theory of perfect competition. According to this theory, businesses are seen as price takers, they use the same production technologies and have equal access to resources. As a result, all firms in the market will converge to a single equilibrium level of productivity. In this ideal scenario, any dispersion in productivity among firms would imply inefficiencies or deviations from perfect competition assumptions.

Empirical findings show evidence for the existence of widespread productivity dispersion (Kehrig, 2011). Syverson (2004) grouped factors behind productivity dispersion into supply-side factors (e.g., technological diffusion, managerial skills, competition and rules, and institutions) and demand-side factors (e.g., product substitutability). However, We acknowledge that factors such as firms' idiosyncrasy, Market imperfection, and regulatory and institutional factors may influence productivity dispersion. Nonetheless, questions such as What factors account for the differences in the level of productivity? What are the options for developing countries to boost productivity to ensure sustained long-run output growth? How is productivity distributed within a country at the firm level, and what are its dynamics like over time? These are important lines of inquiry, and a vast amount of literature has been developed to explain and answer such questions.

Extensive research has shown that the distribution of firm productivity exhibits heavy tail features (Di Matteo et al., 2005). Productivity with such characteristics can be analyzed effectively using appropriate distribution models. Various distribution models are available for this purpose, e.g., power law distribution, Pareto distributions, lognormal distributions, Gaussian normal distribution, asymmetric exponential power distributions, Lévy alpha-stable distributions, and other generating algorithms models (Heinrich and Dai, 2016). The power-law distribution has satisfactorily modeled these heavy tail characteristics, and it was found that inequality in the low productivity range is more significant than in the high productivity range, and the change in inequality in the low productivity range strongly correlates to GDP (Di Matteo et al., 2005; Gaffeo et al., 2003). In addition, Souma et al. (2009) found that non-manufacturing sectors exhibit higher inequality in productivity distribution. Furthermore,Syverson (2004) found that productivity dispersion is extensive for the narrowly defined sectors in the US. There is a ratio of 2-to-1 in value added per labor unit (labor productivity) across the top 25% of high-productivity firms and the bottom 25% of low-productivity firms. Garicano et al. (2016) related size distortion with productivity distributions in France. They argued that increased regulations led to increasing firms' costs which, in turn, tended to create a bias toward small firms, resulting in productivity dispersion. This is a clear case of 'resource misallocation.' Overall, the existing literature argues, in general, that (1) the chances of productivity change are higher the more significant the current level of productivity, and (2) productivity changes are caused not only by technical progress but also by allocative distribution.

The abovementioned literature about productivity differences and resource misallocation usually focuses on advanced countries and a group of developing countries. African countries generally have not been subject to much scrutiny in this literature. Low productivity and misallocating productive resources have been significant problems restricting African economic development and industrialization (Ansu et al., 2016; McMillan and Harttgen, 2014; Van Biesebroeck, 2005). This chapter uses a unique dataset from Ghana and an empirical analysis using productivity distribution building on Aoyama et al. (2010), which links productivity dispersion with aggregated demand and resource allocation. Dispersion in firm-level productivity can be a useful tool for examining resource misallocation. The author argues that when aggregate demand is high, the distribution becomes flat, which means that resources are allocated toward firms or sectors with higher productivity. This study aims to analyze from an empirical perspective the factors behind firm-level labor productivity dispersion and its implications for resource allocation in Ghana. The efficient allocation of production factors crucially depends on the level of aggregation. We use firm-level data to analyze the factors behind firm-level productivity dispersion in Ghana by carefully treating the shape of its distribution and emphasizing its implications for resource allocation and productivity growth. We also categorize the firms into those engaging in international trade and those domestic-oriented. Our findings suggest that firms involved in international trade have a lower Pareto index indicating a higher level of aggregation, i.e., resources are allocated to sectors or firms with higher productivity, leading to less resource misallocation.

This study is closely related to the literature on labor productivity and distribution. To the best of our knowledge, no studies examining labor productivity distribution in Ghana using a theoretical and methodological framework similar to this study. This study's high level of sectoral disaggregation is especially noteworthy since it deserves relatively more extensive treatment. Some recent studies also link productivity with resource allocation in Ghana. For instance, Ackah et al. (2018) showed evidence of significant resource misallocation in Ghana's manufacturing industries. Their findings indicate that female-owned, older, and larger firms are more subject to distortions. Electricity and illicit financial payment were found to be two major causes of resource misallocation. Our research offers insights regarding how small fluctuations in micro-structures can contribute to significant changes in the overall economy. Other research has shown productivity differences between firms elsewhere and in Ghana. However, previous studies examining productivity in Ghana have not dealt sufficiently with the issue of the distribution of productivity.

The remainder of the chapter proceeds as follows. The second section provides a brief overview of productivity in Ghana. The third section presents the theory and methodology of productivity dynamics and resource allocation. The fourth sections describe the data. The fifth section presents the results the sixth section concludes with a wrap-up.

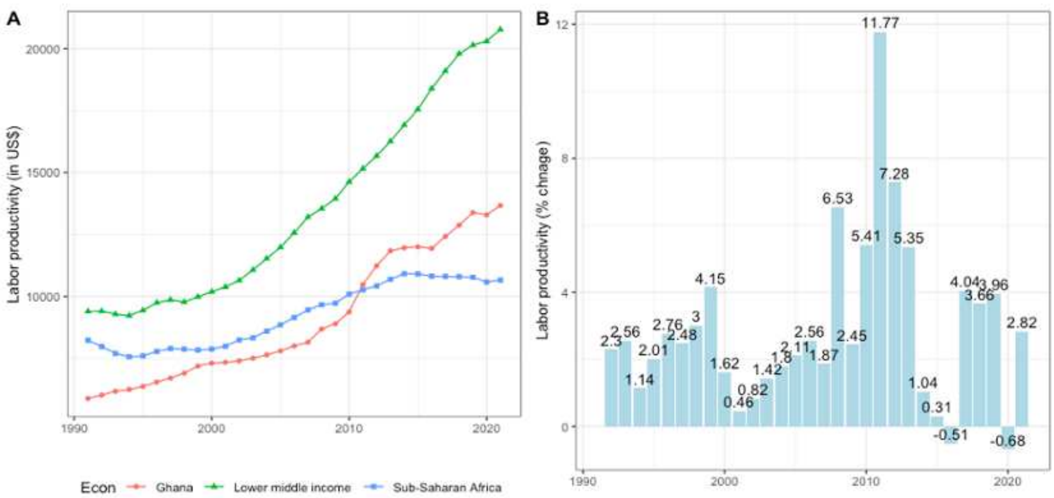
3.2 An overview of productivity in Ghana

According to the World Bank's World Development Indicators data, Ghana has been one of the fastest growing economies (6.83%) in sub-Sahara Africa and the world during the period 2010-2020. In contrast, many scholars emphasize the lack of economic transformation, structural change, and persistence of low productivity, as problems that accumulated in the past and plague long-run economic growth and development in Ghana, despite years of high economic growth (Aryeetey and Kanbur, 2008; McMillan and Harttgen, 2014). Therefore, there is a particularly increasing interest in productivity dynamics and how it relates to economic transformation in Ghana.

Much of the current literature on productivity pays particular attention to the agriculture sector and other case studies. There is a relatively small body of literature that is concerned with the firm-level productivity of the industrial sector. These studies have highlighted several aspects of Ghana's productivity dynamics. Jedwab and Osei (2012) noted that structural changes were minimal. By decomposition of productivity growth, they showed that overall productivity growth in Ghana was explained mainly by the performance of the individual sectors and within-sector resource reallocation rather than the reallocation of resources towards high-productivity sectors. Similarly, Geiger et al. (2019) found that the contribution of structural changes to productivity growth has been limited. They also reported low absorption capability in the productive sector (i.e., manufacturing), which implies a lack of structural changes. Geiger et al. (2019) findings are further supported by Nxumalo and Raju (2020), which show that there was a shift of labor from agriculture towards services, which are by their nature low-productivity sectors, hence leading to negligible productivity gains. As a result, there is evidence from the studies in the existing literature for declining marginal productivity (despite an increase in average productivity) and a decline in wage and wage benefits. Another study by Waldkirch and Ofosu (2010) found a negative impact of foreign firms on domestically owned firms both, and they report no positive effect on wages either.

In summary, while several studies have dealt with the issue of productivity and, more specifically, labor productivity in Ghana, none had the approach taken in this study. Generally, our study is related to the literature that links productivity dispersion with resource misallocation; in the Ghanaian literature context, our study is closely related to Ackah et al. (2018). However, our approach is different.

Figure 3.1: Ghana's labor productivity growth rate over the long-run



Source: Authors calculation from the World Bank data

Figure 3.1 plots Ghana's labor productivity growth rate over the long run. Panel A compares Ghana with lower middle income, and the sub-Saharan African countries' average labor productivity, expressed in US dollars. The figure reveals that there has been a steady increase in Ghana's labor productivity. The rapid increase in labor productivity after 2009 is particularly noteworthy, overtaking the Sub-Saharan Africa average. However, Ghana's labor productivity is still substantially lower than the middle-income economies' average. Panel B plots Ghana's labor productivity growth rate. Labor productivity growth peaked in 2011 at around 11.7% and averaged around 3% after the mid-2010s.

3.3 Productivity growth and resource allocation in Ghana's manufacturing sector

3.3.1 Decomposing labor productivity

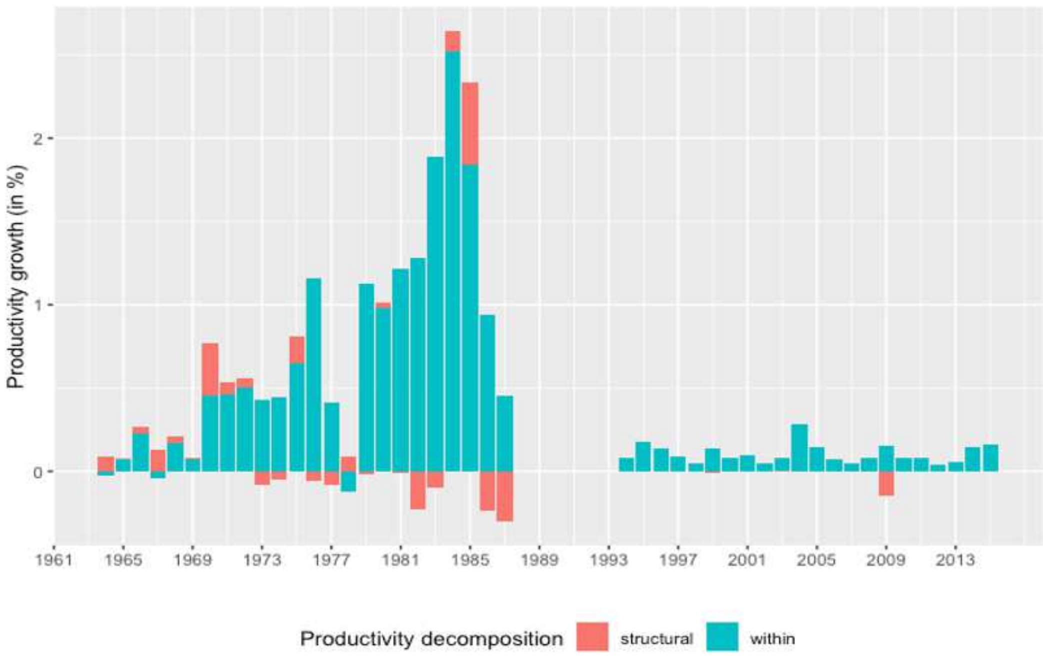
The existing body of research predominantly directs its attention toward the structural change at the aggregated level (i.e. from agriculture to manufacturing), while the internal dynamics of structural change within the manufacturing sector itself receive relatively less scholarly scrutiny (Timmer and Szirmai, 2000). Nevertheless, the concept known as the "structural-bonus hypothesis," has been observed. this concept posits that throughout the course of development, there is a reallocation of factor inputs towards branches of industries that exhibit higher levels of productivity (Timmer and Szirmai, 2000). According to a study by Wang and Szirmai (2008), there is evidence of bonuses for structural changes in China. They found that sectoral shifts accounted for a substantial of the overall growth in productivity. In a similar study Tanuwidjaja and Thangavelu (2007), using shift and share analysis found that superior productivity performance in the Japanese economy takes place in the medium-high-technology sector. Overall these studies use a version of shift-share analysis to decompose the industry's productivity growth into structural change and productivity improvement component (Katz, 2000).

In this section, we first decompose labor productivity into its sources at the outset. For this purpose, we employ the decomposition framework proposed by McMillan and Rodrik (2011). Labor productivity growth can be decomposed into two components as follows:

$$LP_t^g = \frac{\sum_j (LP_{jt} - LP_{jt-1}) \cdot ES_{jt} + LP_{jt-1} \cdot (ES_{jt} - ES_{jt-1})}{LP_{t-1}} \tag{3.1}$$

where the LP_{jt} is labor productivity in sector j in period t, ES_{jt} is the employment share of sector j in year t. The first term on the right-hand side in equation 3.1 is within-sector productivity, and the second term is the structural change component. Within-sector component refers to productivity growth arising from sector-specific causes. The structural component, on the other hand, measures the change in productivity resulting from labor movements across sectors. Specifically, a significant positive figure for the structural change component implies strong productivity dynamics, i.e., labor shifting to high-productivity sectors. Figure 3.2

Figure 3.2: Labor productivity decomposition



plots the findings of manufacturing productivity growth decomposition for Ghana. Labor productivity growth in manufacturing is driven essentially by within-sector resource allocation, and structural change plays a very marginal role. This finding supports a similar finding by Jedwab and Osei (2012). Figure 3.2 also shows that the structural change component was negative in some years, implying that labor shifts across sectors worked against productivity. This can be interpreted as a case of resource misallocation. The structural change component in labor productivity growth is minimal; its contribution was negative.

3.3.2 Allocative efficiency

Allocation of resources from low-productivity sectors to sectors with high productivity plays an important role in curbing resource misallocation at the industry level. In this section, we examine resource reallocation in Ghana using a different method. As discussed above, resource misallocation has been identified as one of the causes of low productivity in developing economies. We adopt the methodology in Syrquin (1986) (cited by Lu (2001)), to estimate labor productivity and the efficiency of resource allocation in Ghana at the industry level. Allocative efficiency is calculated as follows:

$$A(y) = G_y - \sum_c \rho_i G_{yi} \tag{3.2}$$

where A(y) is the gross allocative effect (GAE), and G_y and G_{yi} are the growth rates of industrial labor productivity and sectoral output, respectively. The subscript i stands for industries, and ρ_i is the sector i's share in total industrial output. We use data from the United Nations Industrial Development Organization (UNIDO) and Ghana Statistical Service. UNIDO provides industry-level data at current prices. We used the industrial producer price indices to compute industrial value added at constant prices. GAE measures the "growth rate of aggregate labor productivity that occurs with observed labor shifts" under the supposition that labor productivity remains constant.

The results of the analysis in table 3.1 show that GAE at the industry level in Ghana was negative in all but two years (1995 and 1996). This is strong evidence of resource misallocation at the industry level. GAE measures the sectoral contribution to aggregate labor productivity growth, and the negative values indicate labor movement toward less productive sectors. This is yet another evidence of resource misallocation among manufacturing industries in Ghana.

Figure 3.3: Gross allocation effect (left axis) vs. GDP growth rate (right axis)

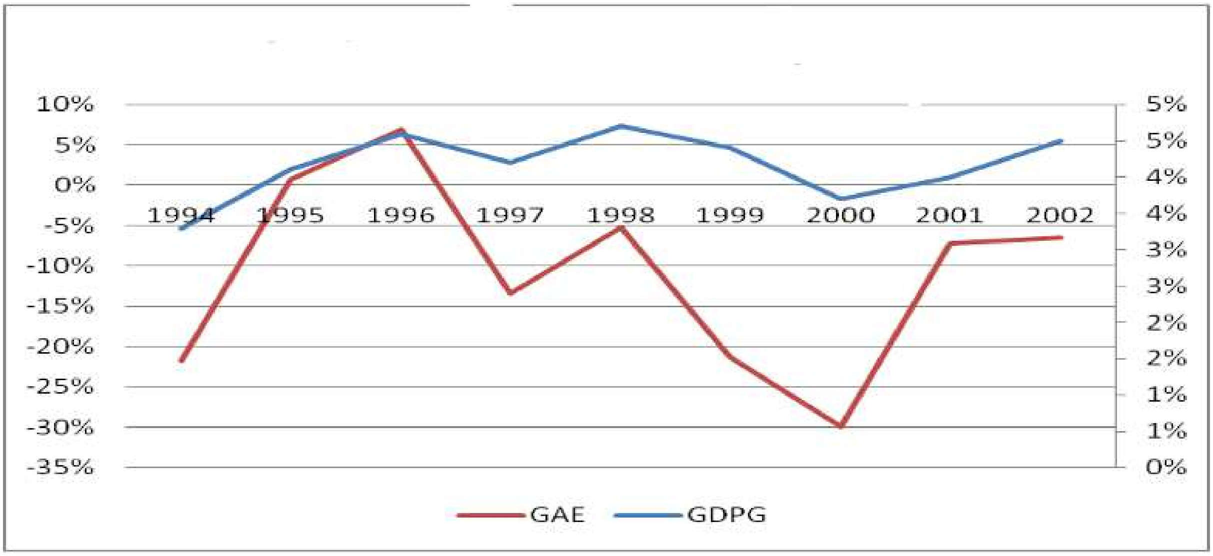


Table 3.1: Gross allocation effect (unit: %)

Years	1994	1995	1996	1997	1998	1999	2000	2001	2002
$\rho_i G_{yi}$									
Textiles	-1.83	0.06	0.59	-1.13	-0.43	1.00	-2.12	-0.51	-0.46
Wearing apparel, fur	-0.20	0.01	0.06	-0.12	-0.05	-0.11	-0.28	-0.07	-0.06
Wood products (excl. furniture)	-6.04	0.20	1.93	-3.72	-1.44	-4.71	-8.73	-2.09	-1.90
Paper and paper products	-0.72	0.02	0.23	-0.45	-0.17	-0.35	-0.41	-0.10	-0.09
Printing and publishing	-0.53	0.02	0.17	-0.33	-0.13	1.65	-1.00	-0.24	-0.22
Rubber and plastics products	-1.24	0.04	0.40	-0.77	-0.29	1.04	-2.63	-0.63	-0.57
Non-metalic mineral products	-1.75	0.06	0.56	-1.08	-0.42	3.03	-4.18	-1.00	-0.91
Basic metals	-3.52	0.12	1.12	-2.17	-0.83	-0.40	-3.49	-0.83	-0.76
Fabricated metal products	-1.35	0.05	0.43	-0.83	-0.32	-0.98	-2.01	-0.48	-0.44
Machinery and equipment	-0.10	0.00	0.03	-0.06	-0.02	-0.05	-0.14	-0.03	-0.03
Electrical machinery & apparatus	-0.60	0.02	0.19	-0.37	-0.14	-0.33	-0.85	-0.20	-0.18
$\sum_i \rho_i G_{yi}$	-17.89	0.61	5.72	-11.02	-4.25	-0.22	-25.84	-6.18	-5.62
G_y	-39.63	1.34	2.68	-24.41	-9.42	-21.51	-55.75	-13.33	-12.12
GAE	-21.74	0.73	6.96	-13.39	-5.17	-21.29	-29.91	-7.15	-6.50

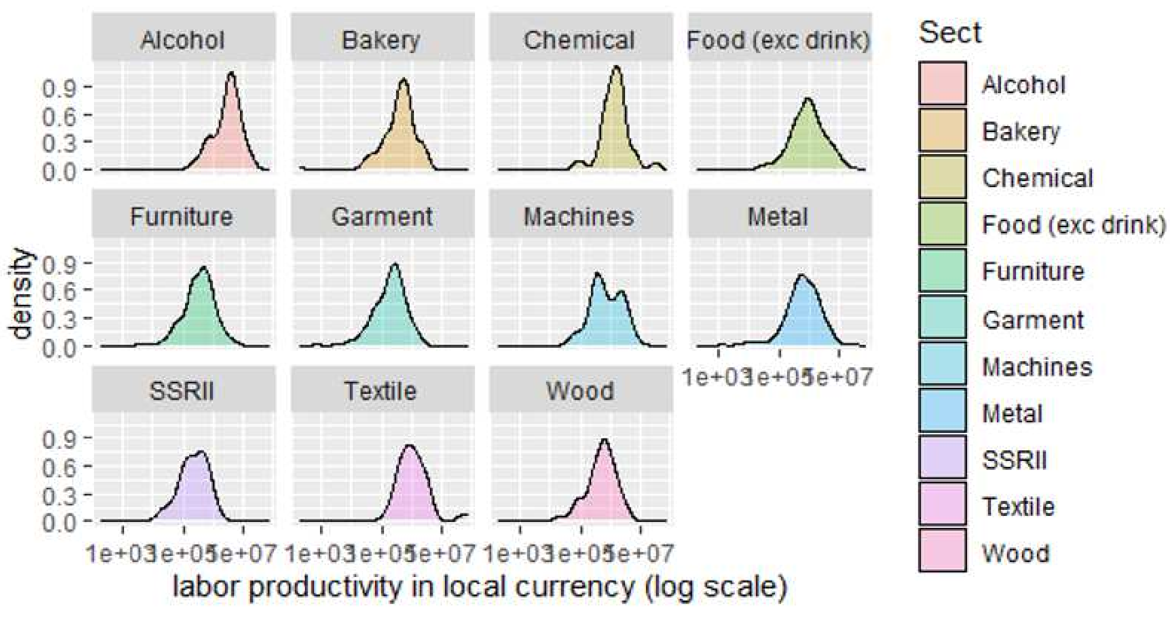
3.3.3 Productivity Distribution

In what follows, we elaborate on a firm-level analysis of resource misallocation through an analysis of the dispersions in productivity levels in the manufacturing sector in Ghana across firms and industries.

3.3.4 Firm-level productivity distribution and resource misallocation

Figure 3.4 plots the kernel density distribution of labor productivity in Ghana. Density distribution is a non-parametric distribution, which allows us to inspect the shape of the distribution better since it does not impose a distribution shape on the data. The figure shows the distribution by manufacturing industries. One conclusion we can draw from this density plot is that the shape of productivity distribution varies with industry. For example, the textile, garment, wood, metal, and food industries demonstrate a somewhat more symmetric distribution. They seem unimodal, displaying a slightly heavy tail mainly to the left. In the other sector distributions, this is not the case. For example, the machine sector distribution seems bimodal, with a negative skew and a heavy left tail.

Figure 3.4: Labor productivity distribution in Ghana by sector (2002)



Having demonstrated the tail features of distribution among industries, we elaborate on a theoretical assessment of choosing the best functional form of distribution among the existing alternatives. An empirical analysis using firm-level data follows.

3.3.5 Distribution of Productivity

Gaussian distribution is the preferred distribution in studying economic phenomena. However, the increased availability of a dataset comprising a significant number of small units (with quantities that can be expressed as the sum of random variables) reveals specific characteristics such as unimodality, skewness, and heavy tail. Distributions with such traits belong to the class of heavy tail distribution, i.e., heavier than normal tail distribution. Power law, in particular, is a probability distribution often used to model distributions that exhibit heavier than the normal tail. It was found that many phenomena in nature, including economics, follow power law distributions (Alstott et al., 2014). Due to its recurrent presence, several statistical methods have recently been developed to measure power-law fit. It has been reported in the literature (e.g., Ikeda and Souma, 2009 and Souma et al., 2009) that firm-level productivity distribution follows power distribution. The power law distribution is calculated as follows:

$$P(x) = cx^{-\alpha} \tag{3.3}$$

In cases where $\alpha < 3$, the distribution's standard deviation can be undefined (Alstott et al., 2014). The power law is used to model distributions with heavy tail behavior. The parameter α can be understood as a Pareto index (Ikeda and Souma, 2009). The tail behavior is studied through complementary cumulative distribution (CCDF), which is computed as follows:

$$P < (x) = \int_{x}^{\infty} p(y)dy = 1 - P > (x) \tag{3.4}$$

CCDF is often referred to as a tail distribution or survival function, and the probability of finding a firm whose probability is more significant than the level x. CCDF is the preferred tool for visualizing the heavy tail distribution (Alstott et al., 2014). Other visualization tools include probability density function (PDF) and cumulative distribution function (CDF).

Due to computation difficulties involved in existing methods, (Alstott et al., 2014) developed a Python package that significantly reduces the computational complexity related to power-law fit computation. In this study, we built on this package to model firm-level productivity distributions in Ghana, exhibiting heavy tail characteristics. As (Ikeda and Souma, 2009; Souma et al., 2009). A smaller α value is interpreted as higher dispersion in productivity distribution and vice versa.

3.3.6 Choosing the Best Fit Distribution

To choose the distribution that better fits the data, we use a procedure that compares each distribution in terms of their goodness of fit with greater likelihood. This is done using the Kolmogorov-Smirnov test (Alstott et al., 2014) The Kolmogorov-Smirnov test generates p-values for individual fit. The test generates an R-value, the log-likelihood between the two candidate distributions. This value is negative when the first distribution is a better fit; otherwise, it is positive. The second value generated by the test is the p-value, which yields statistical significance.

3.3.7 Data

The data used in this study were collected from a survey conducted by the Oxford Centre for the Study of African Economies (CSAE). The original dataset is structured as a panel and contains information about Ghanaian firms over 12 years (each year corresponding to a wave) from 1991 to 2002. The initial sample (1991) includes 200 manufacturing firms at 4-digit industrial classification. Over the survey period, some firms exited the sample, and new firms entered. The dataset consists of firms from different manufacturing sectors such as food processing, textiles and garments, wood products and furniture, metal products, and machinery products. In terms of variables, it contains a wide range of data related to basic information (year, firm age, etc.), output and costs (output, wage bills, material costs), physical capital (plant and machinery, land and buildings), number of workers, employee mobility, among others. We are specifically interested in data on the firms' real value added, total labor employed, age, and respective industry. We then proceeded with cleaning the sample to make sure that there was no firm with missing data. We also purge from the sample the outlier firms. That is, those firms with extreme values for variables under consideration. The dataset does not cover more recent years, and we are bound by data availability as no recent firm-level data are available to be used for this study. Labor productivity is defined as value added divided by the total number of workers employed as follows:

$$LP_{i,t} = \frac{VA_{it}}{L_{it}} \tag{3.5}$$

where the LP stands for labor productivity, VA for value-added, and L for labor, and the subscripts i and t represent firms and time, respectively. The real value added is computed for each firm and year. The values are expressed in Ghanaian cedi.

3.3.8 Results and Discussion

The analyses were carried out across different sub-dimensions. First, we modeled firm-level productivity distribution for the whole sample. Second, we examine productivity distribution for firms engaging in international trade and those not engaging in international trade since international trade is theoretically related with productivity through induced effects on efficiency mainly due to competition. Since the distributions exhibit heavy tails, they can be modeled through power law distribution. Accordingly, we fit power-law using the log-likelihood ratio and Kolmogorov-Smirrov test (which computes the p-value for statistical significance of log-likelihood) to choose from different possible distribution models. Among the appropriate distributions we tested are power law distribution, exponential distribution, lognormal distribution, and truncated power law distribution. The results imply that the power law is a reasonably good fit to model the tail behavior of Ghanaian firms labor productivity distribution. Figure 3.5 shows the results for labor productivity for the entire sample of Ghanaian firms. The solid blue line indicates the density function p(X) (PDF), the complementary cumulative function $p(X > x)$ (CDF), and the dashed line indicates their respective power law fit. Figure 3.4 visualizes the distributional heavy-tail. Therefore, the power law is a good fit for the distribution in our case, and this leads us to an important suggestion that the data indeed display heavy tail characteristics.

Figure 3.5: Probability density function and complementary cumulative function

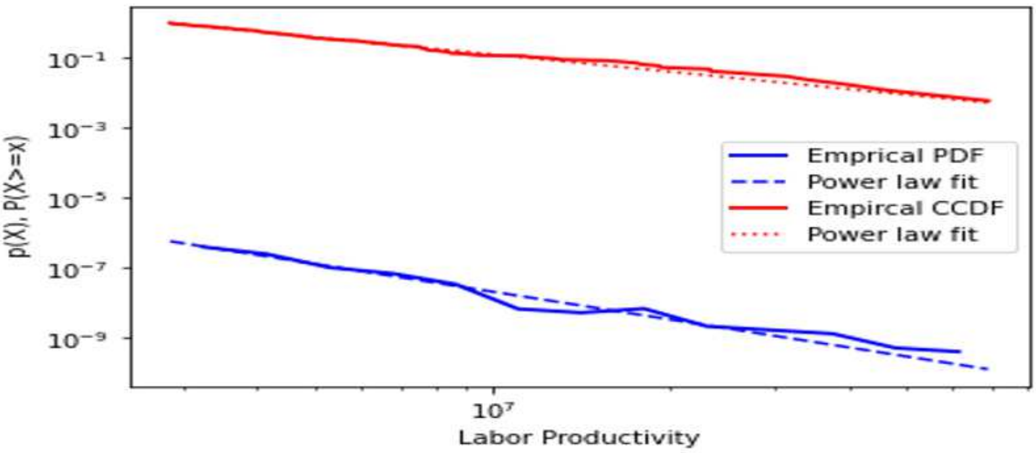


Table 3.2: Matrix for distributional goodness of fit comparison

Distributions	Power law	Exponential	Truncated power law	Lognormal
Power law		3.22 (0.001)	-0.40 (0.712)	0.07 (0.942)
Exponential	-3.22 (0.0012)		-3.26 (0.001)	-3.22 (0.012)
Truncated power law	0.40 (0.71)	3.26 (0.001)		0.47 (0.63)
Lognormal	-0.07 (0.94)	3.22 (0.012)	-0.47 (0.63)	

Table 3.2 presents the Kolmogorov-Smirnov test results in the form of a matrix. The Kolmogorov-Smirnov test computes comparative goodness fit values of different distributions against each other. The test produces two values, R (log-likelihood), which compares the log-likelihood between the two candidate fit distributions. The column fit distribution is a better candidate if the number is negative. If it is positive, the row distribution fit is better. The number in parentheses is the p-value, which attests to the statistical significance of the R-value—the first test between a

power-law fit and an exponential fit. The positive R-value of 3.22 indicates that row distribution fit (power law) is the better candidate. The p-value (statistical significance) is 0.0012, which is lower than the generally accepted threshold of 5 percent. This first test is critical because exponential distribution is the minimum threshold to ascertain if a distribution is a heavy tail distribution. In our case, since the power law proved to be a better fit, we can be sure that our data exhibit a heavy tail distribution. After conducting cross-testing, we have honed in on the Power-law distribution. However, we cannot rule out truncated power law distribution, nor could we rule out lognormal distribution.

Figure 3.6: Complementary cumulative distribution function of labor productivity for the whole sample

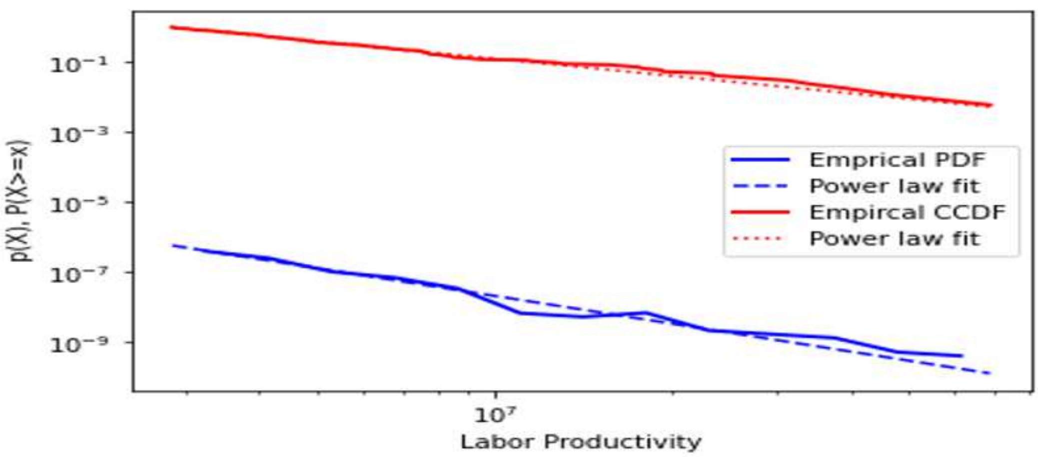
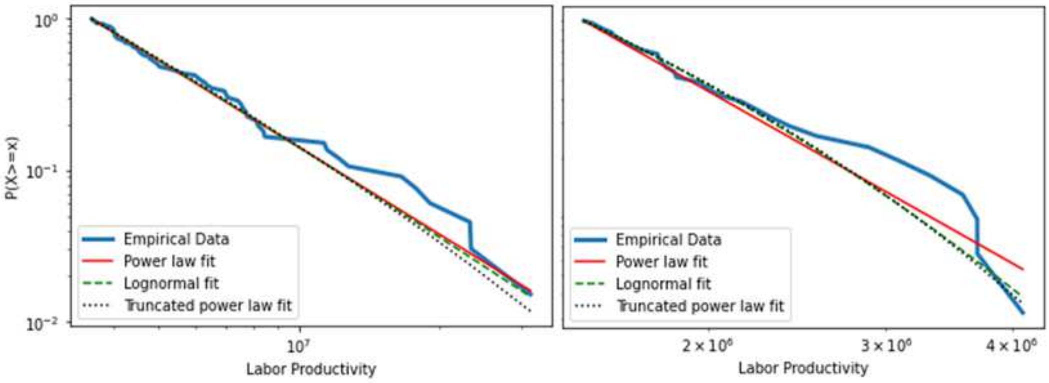


Figure 3.6 presents the three fitted distributions, namely the power law fit, the lognormal it, and the truncated power law fit. We cannot rule out the Kolmogorov-Smirnov method in any of the three distributions as a possible better fit. We show that, among the three candidates, the lognormal and power law fit more closely to empirical data. They are so close that the two candidates overlap with each other.

Figure 3.7 is similar to Figure 3.6, but distinguishes between firms engaging in foreign trade and those not engaging. The left panel represents the sample of firms not engaging in international trade, and the right panel is for firms engaging in trade. We plot the three fitting distributional candidates (power-law fit, lognormal fit, and truncated power-law fit) simultaneously and visually analyze their adequacy

Figure 3.7: Complementary cumulative distribution function labor productivity for trading and non-trading firms



to empirical data. All three qualified distributions seem to stay very close to the power-law fit distribution, which is quite close to the actual (observed) distribution. In addition, Table 3.3 presents the power law distribution exponents along with standard deviations. The results are reported for all three dimensions, namely, for firms not engaging in trade, firms engaging in trade, and all firms.

Table 3.3: Power law exponent and sigma (standard error) for labor productivity by firm categories

Categories of firms	Aplha	Sigma (Standard error)
Firms engaged in trade	3.919	0.524
Firm not engaged in trade	2.908	0.234
All firms	2.644	0.128

Table 3.3 reports a higher exponent for firms involved in international trade compared to domestically-oriented firms. A higher exponent means a higher level of concentration in the labor productivity distribution A higher exponent also indicates smaller labor productivity dispersion and skewness among firms engaging in trade. Since trading firms are exposed to international competition, there is plausibility in the argument that the productivity of these firms is less dispersed, which signals some consolidation of firms around the same level of productivity. When we compare these results with the firms not engaging in trade, we can conclude that labor productivity is more dispersed among domestically-oriented firms, which suggests less labor productivity consolidation. In addition, among domestically-oriented firms,

the distribution of labor productivity is more uneven compared to trading firms. As Sun and Zhang (2012) pointed out, firms that are exposed to foreign trade are expected to be more efficient in terms of resource allocation and more productive due to what they name the "export learning effect."

The link between productivity dispersion and resource misallocation is well-established in the literature Aoyama et al. (2010); Maryam and Jehan (2018). Higher productivity dispersion is connected with resource misallocation. In the case of Ghana, we can safely assert that there is evidence for the preposition that domestically-oriented firms are more exposed to resource misallocation since their productivity distribution reveals more dispersion in contrast to the firms exposed to international trade.

3.4 Conclusion

In this chapter, we examined productivity and its relation with resource allocation through decomposition and gross allocative analysis and a firm-level examination of labor productivity distribution in Ghana using power law distribution. This study has identified that labor productivity growth in Ghana is essentially driven by within-sector resource allocation, with structural change having a very limited contribution. This finding is consistent with findings reported by Geiger et al. (2019); Jedwab and Osei (2012). Geiger et al. (2019) attributed this finding to lower absorption capacity in the higher productive sectors. The gross allocative effect confirmed the existence of labor allocation towards less productive industries. The finding is in line with similar results in the literature. For instance, Nxumalo and Raju (2020) found declining marginal labor productivity in Ghana due mainly to the shift of labor toward less productive sectors.

The major finding is that firms' labor productivity in Ghana follows the power law, which indicates that the firms are not operating in an equilibrium state. We surmise that this may signal resource misallocation in the manufacturing sector in

Ghana. This interpretation is further confirmed by our findings from decomposition analyses that there is evidence of persistent inefficiency in resource allocation at the industrial level. Our finding is related to Aoyama et al. (2010); Di Giovanni and Levchenko (2012); Ikeda and Souma (2009). Our finding can be more closely related to Sun and Zhang (2012), whose findings reported different productivity shapes of productivity distribution of non-exporters and exporters firms.

The results of this research support the idea that trade can affect productivity distribution at the firm level. The find highlights the role of resource allocations and their influence on productivity improvement. The insights gained from this comprehensive investigation of labor productivity distribution can lend support to policies that promote trade as a vehicle for development and productivity catch-up. Our findings may serve as incentives to further research into the implications of power law distribution for labor productivity in Ghana.

It is also important to note that this study has limitations, so the results should be cautiously assessed. First, we were bound by data availability. Firm-level surveys are costly and time-consuming; however, longitudinal data are available to study firm dynamics in Ghana for a certain period. Statistical offices should pay utmost attention to collecting such data for researchers in more recent years. Future research in this avenue will be enriched if more up-to-date data becomes available. A cross-country analysis using firm-level data is also in our research agenda as firms operating in different countries may possess other characteristics, and such factors at work may explain productivity differentials and hence, differing degrees of resource misallocation in Africa.

Chapter 4

An Applied Computable General Equilibrium Model for Ghana

4.1 Introduction

Computable General Equilibrium (CGE) modeling is a sophisticated methodology employed for analyzing the intricate interactions among economic variables within a dynamic and complex economic system (Burfisher, 2021). CGE models, rooted in computational techniques, utilize mathematical equations to simulate the behavioral patterns of key economic agents, including households, firms, and governments (Hosoe et al., 2004). This modeling approach has gained substantial prominence among policymakers, researchers, and analysts owing to its ability to assess the consequences of economic policies and external shocks on a wide range of crucial economic indicators, encompassing variables such as gross domestic product (GDP), inflation, employment, and trade (Chang, 2021). The utilization of CGE modeling enables a comprehensive and rigorous examination of the complex interrelationships and feedback mechanisms that characterize economic systems, thereby enhancing our understanding of the potential impacts of policy interventions and external factors.

This chapter aims to construct a recursive dynamic Computable General Equilibrium (CGE) model to analyze the Ghanaian economy. A recursive dynamic CGE framework incorporates the temporal dynamics of economic policies and external shocks, thereby capturing their inter-temporal effects on various economic variables. In contrast to static CGE models, which assume an equilibrium state and disregard the dynamic consequences of policy changes over time, recursive dynamic CGE models take into account the temporal aspects of resource allocation decisions made by households, firms, and governments (Hosoe et al., 2004). By incorporating these temporal dynamics, the model enables an examination of how such decisions influence prices, quantities, and welfare within the economy. This approach aligns with the theoretical underpinnings of CGE modeling, which emphasizes the interactions and feedback effects between different economic agents and sectors (Chang, 2021).

CGE (Computable General Equilibrium) modeling has been utilized to study the Ghanaian economy and assess the effects of different policies and external shocks on macroeconomic variables. Researchers have applied CGE modeling to evaluate the impacts of trade policies, foreign direct investment (FDI), tariff reductions, oil revenue allocation, environmental policies, and agricultural policies in Ghana. The study conducted by Bhasin and Obeng (2006) examined the consequences of eliminating trade tariffs and increasing foreign borrowing on poverty alleviation in Ghana. Their findings indicated positive effects on poverty reduction. Arbenser (2004) focused on analyzing how an increase in FDI and a reduction in tariff levels influence macroeconomic indicators and household welfare in Ghana. Their results suggested that these policies lead to improvements in current consumption and household welfare. Breisinger et al. (2009a) investigated the impact of alternative oil revenue allocation options in Ghana using CGE modeling. Their study aimed to provide insights into effective strategies for managing oil revenues in the country.Arndt et al. (2015) employed CGE modeling to evaluate the implications of environmental policies in Ghana. The study examined the potential effects of such policies on various aspects of the economy. Furthermore, the field of agriculture has been extensively researched using CGE in numerous studies.

The utilization of CGE modeling for the assessment of industrial policies has garnered increasing attention. Notably, studies conducted by Lee (1993) and Akkemik (2008) have employed CGE modeling techniques to investigate the implications of industrial policy implementation in East Asia. Similarly, Shikur et al. (2021) and Berhane (2013) have utilized CGE modeling to examine the effects of industrial policy in Ethiopia. While numerous studies have explored various facets of Ghana's economy, we have not identified any explicit investigation employing CGE models to analyze industrial policy in Ghana. Thus, our study aims to fill this research gap by offering valuable insights into the comprehensive macroeconomic consequences of industrial policy implementation in Ghana. By employing CGE modeling, we seek to enhance our understanding of the economic-wide impacts of industrial policy interventions in the Ghanaian context.

In the forthcoming sections, we will elucidate the behavioral patterns of key economic agents within the framework of the model, namely firms, households, and the government. To facilitate a thorough understanding of the model structure, an appendix is provided, containing a comprehensive compilation of equations and parameters.

4.2 The structure of the CGE model

The impact of industrial policy works across different sectors of the economy through backward and forward linkages. The best way to quantify these impacts is through a general equilibrium framework. The general equilibrium model allows for analyzing the efficiency and distributional effects of various policy (industrial policy in this case) interventions. We use the Computable General Equilibrium (CGE) model, which applies the general equilibrium theory to a real-world problem. Under certain assumptions and simplifications (described in the model description), which will not significantly affect the model's plausibility, we propose to apply it to study industrial policy options in Ghana.

Our model is a single-country, multi-sector recursive dynamic computable general equilibrium based on the Arrow-Debreu CGE framework. The static part module of our model closely follows the standard CGE model described in Chang (2021) and Lofgren et al. (2002), which we explain in detail below:

In what follows, we explain the behavior of agents, i.e., firms, households, and the government, within the framework of the model. A complete list of the equations and parameters is available in the appendix.

4.2.1 Firms behaviour

Firms engage in production activities that are represented by a nested production function. This function incorporates composite production factors, comprising capital and labor (also known as value-added), as well as intermediate inputs. Through the utilization of these factors, firms generate goods and services.

$$q = A_q\{\delta_q[A_v(\delta_v L^{\rho_v} + (1-\delta_v)K^{\rho_v})^{\frac{1}{\rho_v}}]^{\rho} + (1+\delta_q)M^{\rho}\}^{\frac{1}{\rho}} \tag{4.1}$$

where the parameter A is a scale factor, also called "total factor productivity" (or TFP), q is output, δ is the share parameter, L stands for labor input, K is the capital input, and M is the aggregated intermediate input, and ρ is related to the elasticity parameter. The elasticity of substitution[1] is a constant that varies from 0 to ∞, reflecting the degree to which the inputs are either complements or substitutes.

In the CGE model, we commonly obtain the elasticity of the substitution pa-

[1] The following gives the elasticity of substitution (ε) between two goods x_1 and x_2:

$$\varepsilon = \frac{dln(\frac{x_2}{x_1})}{dlnTRS} = \frac{1}{1-\rho} \tag{4.2}$$

rameter through calibration and then calculate the ρ for the CES function.

$$\rho = 1 - \frac{1}{\varepsilon} \tag{4.3}$$

Based on the value of ρ, the CES function can take different functional forms; when (ε) equals 1 ($\rho = 0$), the CES function becomes Cobb-Douglas function. When (ε) is infinitesimal ($\rho = -\infty$), the CES becomes a Leontief function (the two inputs are perfect complements). Finally, when ε approaches infinity ($\rho = 1$), the CES function becomes linear (the two inputs are perfect substitutes).

At the second level, firms employ intermediate inputs and value-added to produce final output using Leontief and CES production functions, respectively. Using CES to represent the aggregation of value-added means that the firms can change the input used in response to changes in their respective prices.

$$V = A_v[\delta_v L^{\rho_v} + (1 - \delta_v)K^{\rho_v}]^{\frac{1}{\rho_v}} \tag{4.4}$$

where V stands for the aggregated value added for the primary factor input, and A_v is the productivity of factors input. hence when, for instance, wage increases, firms could opt to use more capital and less labor, becoming more capital-intensive, and vice-versa. Using the Leontief function to describe the aggregate intermediate input means that the intermediate input is used in a fixed proportion of the aggregate intermediate input M. Let X_{ij} use input i in sector j. Let a_{ij} be the input coefficient, so

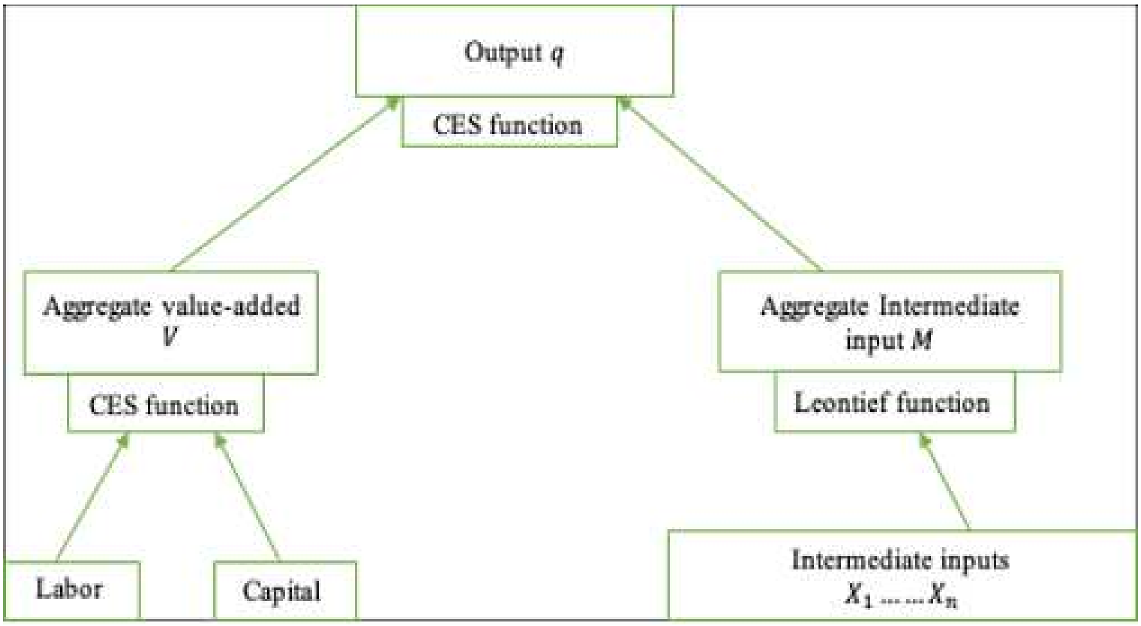
$$X_{ij} = a_{ij}M_j \tag{4.5}$$

And the intermediate input price is given by the following:

$$(p_{M_j}) = \sum_i p_i a_{ij} \tag{4.6}$$

where p_i is the price level of output, the price equation implies the optimum input of intermediate inputs and optimum supply level. The following figure summarizes the output structure of our CGE Model The first-order conditions of the production

Figure 4.1: Nested production function



Source: Author's elaboration based on Chang (2021)

functions yield the optimum amounts of capital and labor employed by firms, which is given by the following equation:

$$p_q = p_v \frac{V}{q} + p_M \frac{M}{q} \tag{4.7}$$

$$p_v = w_l \frac{L}{V} + w_k \frac{K}{V} \tag{4.8}$$

where p_v is the aggregate price of value-added input and p_M is the aggregate price of aggregated intermediate input. w_l and w_k stand for the price of labor and price of capital respectively. p_q is the output price, p_v, p_M, the price of factor input and intermediate input respectively. The higher level in the nested output equation is the weight price at the lower level. These prices imply that the enterprise's output is at its optimum level. The following first-order condition gives the optimum level of capital and labor:

$$\frac{P_v}{P_M} = \frac{\delta_q}{1-\delta_q} \left(\frac{V}{M}\right)^{\rho-1} \tag{4.9}$$

$$\frac{w_l}{w_k} = \frac{\delta_v}{1-\delta_v}\left(\frac{L}{K}\right)^{\rho_v - 1} \tag{4.10}$$

Final goods and services produced by domestic firms are destined for the domestic market or exports. Exports and domestic sales are aggregated to yield final output through a constant-elasticity-of-transformation (CET) function. The first-order conditions for CET functions yield optimal amounts of the production of domestic goods and exports. The constant elasticity of transformation represents the rate at which inputs can be transformed from one industry to another in response to changes in relative prices, while the Armington function is to model consumer preferences for differentiated goods from different countries. both CET and Armington functions are related to trade (Burfisher, 2021).

4.2.2 Household consumption

On the demand side, household preferences are mapped out according to the Linear Expenditure System (LES) as in Chang (2021). LES system is derived from the Stone-Geary utility function, which we use to map household consumption. While most CGE models use Cobb-Douglas or the more general form CES utility function, we opt to use the LES system due to some important advantages over the commonly used utility function just mentioned. One possible disadvantage of CES functions is that it requires information about elasticities of substitution which may not be readily available. Conversely, the Cobb-Douglas function assumes that the substitution elasticity is equal to 1, implying that the household demand for a commodity is based on a fixed-shares based. Therefore, the CES utility function is preferable over its more restrictive form, Cobb-Douglas, in the presence of substitutes or complementary commodities. However, due to its homothetic property, the CES elasticity of substitution remains constant regardless of income level. This property is very restrictive when we want to study the share of household total expenditure on a commodity due to changes in their income, the so-called Engel curve effect. For this reason, we will use the LES system. Here the LES function is superior to the Cobb-Douglas or the general form CET function. The LES function allows us to glance into the mechanism of income change effects on household's demand for commodities. For instance, when household income increases, this may change the composition of their consumption basket (Engel curve effects). Given Stone-Geary utility function ($u(q)$) is as follows:

$$u(q) = \prod_{i=1}^{n}(q_i - \gamma_i)^{\beta_i} \quad \beta_i > 0 \tag{4.11}$$

$$(q_i - \gamma_i) > 0 \tag{4.12}$$

$$\sum_{i=1}^{n} = \beta_i = 1 \tag{4.13}$$

When $\gamma_i = 0$, the Stone-Geary function becomes the familiar Cobb-Douglas function. The Stone-Geary function becomes the ordinary Cobb-Douglas function. The coefficient β_i is the budget share parameter. The γ_i represents the subsistence consumption for every commodity i. The household utility is only defined for consumption above the subsistence level since consumption below this level is unsustainable. Households maximize their utility, and the first-order condition yields the optimum consumption of goods and services.

$$maxu(q) = \sum_{i=1}^{n}\beta_i ln(q_i - \gamma_i) \quad s.t. \sum_{i=1}^{n} p_i q_i = Y \tag{4.14}$$

where Y is the household income, taking the first order condition and after some manipulation and rearrangements (for detailed steps, see Lofgren et al. (2002)), we arrive at the Marshallian demand function expressed as:

$$q_j = \gamma_j + \frac{\beta_j}{p_j}(Y - \sum_i p_i \gamma_i) \tag{4.15}$$

where γ_j is the marginal budget share spent on commodity j, and ε is the subsistence consumption level of commodity j. And $Y - \sum_i p_i \gamma_i$ is the discretionary budget after spending on subsistence amounts of a commodity. The Engel curve is given by $p_j q_j = (p_j \gamma_j - \beta_j \sum_i p_i \gamma_i) + \beta_i Y$, its intercept is given by the expression $p_j \gamma_j - \beta_j \sum_i p_i \gamma_i$ and the slope (marginal budget share) is given by β_j. It can be understood as the incremental spending on j when the income Y increases by one unit. The Engel curve can help us understand the income elasticity of demand. If a good is a normal good, meaning its demand increases with income, the Engel curve will be upward-sloping. This indicates that as a consumer's income increases, they will purchase more of the good. On the other hand, if a good is inferior, meaning that its demand decreases as income increases, the Engel curve will be downward sloping. This indicates that as a consumer's income increases, they will purchase less of the good. The Engel curve can be used to predict consumer behavior based on changes in income. For example, if a consumer's income increases, we can use the Engel curve to predict how much more of a normal good they will purchase. Conversely, if a consumer's income decreases, we can use the Engel curve to predict how much less of normal goods they will buy. Using the original utility form and Marshallian demand, the indirect utility V is given by:

$$V(q) = \prod_{j=1}^{n} \left(\frac{\beta_j}{p_j}\right)^{\beta_j} \left(Y - \sum_i p_i \gamma_i\right) \tag{4.16}$$

The "Frisch parameter" is often used to derive the subsistence income level. The Frisch parameter is used when subsistence commodity consumption information is unavailable. The original definition of this parameter is the income elasticity of marginal utility. The CGE literature, we use some variation of this original definition. It is derived from the indirect utility function defined above. Its expression is the following:

$$\varphi = -\frac{Y}{Y - \sum_i p_i \gamma_i} \tag{4.17}$$

The LES system's similarity to the Keynesian consumption function is very convenient when using Keynesian closure (as is the case in this study) because the subsistence consumption level can be equivalent to the constant term in the consumption function of the Keynesian model.

Household consumption is given by its marginal propensity of consumption (MPC), represented by the following symbols

$$C = C_0 + mpc \cdot (Y - T) \tag{4.18}$$

where C_0 is the constant term, which represents the household's subsistence consumption level akin to the γ_i parameter in our Stone Geary utility function, as explained before. The saving function is given by:

$$S = (Y - T) - [C_0 + mpc \cdot (Y - T)] = -C_0 + mpc \cdot (Y - T) \tag{4.19}$$

where T is the total amount of tax, the saving is the inverse of the consumption function, and the marginal propensity gives its slope for saving (mps). The term $-C_0$ means the case of no disposable income, and the household will have to dissave to finance its necessities. The constant parameter C_0 (subsistence consumption level) and the mps are calibrated from the SAM data in our model. However, in other closures, mps can be an endogenous variable determined by the model. In our model, the household is disaggregated into three groups. Hence each household has its own consumption and saving functions.

Households consume composite goods made up of domestically supplied and imported goods, which are assumed to be imperfect substitutes. The aggregation of these two types of goods is ensured by an Armington-type constant elasticity of substitution (CES) function. The first-order conditions for Armington CES functions yield optimal amounts of the consumption of domestic goods and imports.

$$QQ_c = \alpha_c(\delta q_c \cdot QDC_c^{\delta q_c} + (1 - \delta q_c) \cdot QM_c^{\delta q_c})^{\frac{1}{\delta q_c}} \tag{4.20}$$

where δq_c is the domestic product share parameter, QDC_c is the quantity of domestic commodity c supplied, and QM_c is the quantity of commodity c imported. the subscript c, stand for commodities.

Institutions, i.e., households and government, are subject to budget constraints. Therefore, they allocate their respective revenues to consumption and savings. Households own the factors of production (capital and labor), and the revenues emanating from the delivery of these factors accrue to the households. They also receive factors income, transfers from the rest of the world, and the government. Household income is given according to the following equation:

$$\begin{aligned} YH_h = {} & wl \cdot share_{hl} \cdot QLSAGG + wk \cdot share_{hk} \cdot QKSAGG \\ & + transfer_{h,ent} + transfer_{h,g} \cdot cpi + transfer_{h,row} \end{aligned} \tag{4.21}$$

where YH_h is the total income of household h, wl is the factor labor remuneration, $share_{hl}$ is the household h share of total labor supply $QLSAGG$, hence the expression $wl \cdot share_{hl} \cdot QLSAGG$ means to total factor labor remuneration that accrues to household h. While the expression $wk \cdot share_{hk} \cdot QKSAGG$ expresses the total capital remuneration that goes to household h. The others terms represent transferences from the enterprise, the government, and the rest of the world, respectively. The government transference to households is indexed by the consumer price index (CPI).

4.2.3 Government behaviour

In the CGE model, the government demands commodities and makes transfers to households and enterprises. To cover its expenditures, the government receives revenues from various taxes levied on households and firms and transfers from firms (state-owned enterprises). The fiscal balance is given by the difference between government inflows and outflows (revenues and expenditures) and can be deficit or surplus. The government consumption rule is derived from a utility function. Therefore, it can be a CES or LES function, similar to a household consumption function.

In our CGE model, we are faced with three possible government behavior. The first is a situation where the government lacks discretionary expenditure power. The government's behavior is to follow a strict budget balance with zero savings or dissaving. The government income and expenditure are endogenously determined.

$$SAVEG = YG - EG = 0 \tag{4.22}$$

$$PC_c \cdot QG_c = shareg_c(EG - transfer_{hg} \cdot CPI - transfereg) \tag{4.23}$$

where $SAVEG$ is the government savings, YG is the government revenues, and EG is the government expenditure. Equation (4.22) is the balanced budget constraint. Equation (4.23) is the government demand equation. $transfer_{hg} \cdot CPI$ is the government transfer to households adjusted by the consumer price index (CPI), and $transfer_{eg}$ is the government transfer to enterprises. $shareg_c$ describes that the government demand for commodities is a fixed proportion of its net expenditure (net of transfer).

The second government behavior is a combination of government discretionary expenditure and another component of fixed expenditure. The government expenditure is exogenously determined ($\bar{EG}$). However, the government will still be spending on a fixed-share base.

$$SAVEG = YG - \bar{EG} \tag{4.24}$$

$$PC_c \cdot QG_c = shareg_c(\bar{EG} - transfer_{hg} \cdot CPI - transfereg) \tag{4.25}$$

The third government behavior is entirely discretionary, in the sense that the government is not subject to a fixed proportional expenditure. Instead, the government can freely allocate its net expenditure budget.

$$SAVEG = YG - EG \tag{4.26}$$

$$PC_c \cdot \bar{QG}_c = EG - transfer_{hg} \cdot CPI - transfereg) \tag{4.27}$$

In our model, we follow the first approach. Government income and expenditure are exogenously determined, the government peruses a balanced budget policy, and the government demand for commodities is made on a fixed proportion base. Under this model, the government lacked any discretionary power.

4.2.4 Price numeraire

According to Walras's law, in an economy with n market, we have an $n - 1$ independent equation. This law implies that the equilibrium price is not unique. Hence, we cannot study individual price levels due to external shock. This problem is solvable by setting one price as a benchmark and expressing all other prices relative to this benchmark price. We call this benchmark price the numeraire. The numeraire price is a constant set to 1. It's common in the CGE literature for the numeraire to be the price of a broadly used factor. In our model, the numeraire is the Activity Price Index (API). API is the weighted producer price; it measures the average price producers receive for their goods or services. Using API as our numeraire and reporting all prices relative to this numeraire better replicates the real-world scenario. By setting one price as the numeraire, we end up with more equations than variables. Computer programs require squareness conditions (the same number of variables and equations). To deal with this problem, we have three solutions; the first option would be to delete a market clearing equation, preferably one related to our numeraire choice; the second option would be to create a dummy variable in the market clearing equation; when we solve our model, the dummy variable should be zero or close to zero; otherwise, there is something wrong with our model. A third option is to use a Non- Linear Programing (NLP) solver and choose one market to minimize its excess demand. Any of the above techniques should result in similar results.

4.2.5 Macro-closure

Given the differences among economic systems, we must construct our model to fit the specific case (country) we are interested in. This process is denominated as macroeconomic closure. We define closure as the process of defining endogenous and exogenous variables. For instance, we can have a supply-driven classical model or a demand-driven classical model. Neoclassical and Keynesian closures are among the more commonly used macro closure in the CGE literature.

Neoclassical closure implies that factor and commodity prices are fixed, fully employed, and endogenously determined. The Neoclassical closure is widely used, even though it does not accurately represent the real-world situation, especially concerning developing countries. Since it does not allow for factor unemployment, a common feature in developing economies, especially in recession times. The assumption of a fixed price is not very appropriate to describe developing economies, where prices tend to be more rigid. The full employment of factor assumption means that the neoclassical model's usefulness in studying labor unemployment due to policy shock is limited; the model can only allow for factor reallocation between sectors within the model. Keynesian closure is more appropriate for studying recession or developing economies. The model allows for idle factors (capital and labor), the factor is endogenously determined, and unlike the classical model, it is not set to be fully employed. Instead, the demand side determines it. The price is allowed some level of stickiness, which is often prevalent in developing economies, especially when concerned with wages.

Ghana is a small open, developing economy. Therefore, it is appropriate to employ the Keynesian closure to describe it. We set the world prices of exports and imports exogenous as required by the "small country" assumption. Tariff rates are also exogenous in the model. The current account deficit, i.e., the excess of imports over exports, is financed by foreign savings, i.e., borrowing. The ratio of foreign savings to GDP is also set exogenous. The market clearing conditions ensure our model's macro equilibrium and closure rules.

In the goods and services market, aggregate demand equals aggregate supply. Our model allows for unemployed factors in the factor market, characteristic of a developing economy such as Ghana. In addition, foreign savings supplement the gap between total savings and total investment. We assume a fixed exchange rate. Therefore, the current account adjusts to ensure savings-investment equilibrium. In the factors market, the endowment of production factors is fixed within the period, while they are allowed to change across periods in the dynamic module. As a result, wages and the rate of return to capital are flexible. A producer price index is set as the numeraire.

4.2.6 Model dynamics

Some issues are not fully addressed in a standard static model; this includes enterprises' investment decisions, labor force growth, technological progress, etc. Hence to address these issues, we adopted a recursive dynamic model. Based on the theoretical foundation of dynamic and growth theory, we expanded from classical static to a recursive dynamic model. We update the factor endowments across sectors. Total capital stock ($QKSTOCK$), which is constant within the period in the static module, increases yearly with additional aggregate investments ($QINVAGG$) and is subject to depreciation. The depreciation rate (*deprate*) is constant (4.1%) and is taken from the Penn World Tables database.

$$QKSTOCK_{t+1} = (1 - deprate_t) \cdot QKSTCOK_t + QINVAGG_t \tag{4.28}$$

$$QLSAGG_{t+1} = (1 + popgw_t) \cdot QLSAGG_t \tag{4.29}$$

Total labor supply ($QLSAGG$) grows at the same rate as the long-run population growth rate (*popgw*), which is set at 2.1% the projected population growth for the future (The average growth rate of the population for the period 2010-2020 was 2.3%) and obtained from the World Bank World Development Indicators.

We also introduce a total factor productivity (TFP) parameter to capture the improvements in production technology in subsequent periods. As discussed in the baseline scenario below, TFP growth rates are different for different sectors. Therefore, the TFP growth parameter enters the CES production function as a coefficient that magnifies the shift parameter. In the dynamic module, our horizon is twenty years. The fact that we use the LES system to describe household consumption will allow us to observe the Engel demand curve effects.

4.3 Data and SAM analysis

The data we used in the analysis is put into a social accounting matrix (SAM), which is a type of input-output analysis that shows the interdependence of different sectors in an economy. In this sense, SAM is a complete system of accounts that captures all the relations among different economic agents (Cardenete et al., 2012; Khan, 2007). Agents (accounts) in a typical SAM include activities, commodities, factors, enterprises, households, government, capital, and the rest of the world. A SAM is a square matrix depicting the circular flow in the economy, meaning all agents are represented in column and row vectors. In a single cell entry, the value represents income (row agent) and expenditure (column agent) for the involved economic agents. By convention, a column in SAM represents an agent expenditure, and the raw means the income (Burfisher, 2021; Pyatt, 1988). The sum of all payments made by an agent appears in their respective column, and the sum of their income appears at the end of their row. Furthermore, these two sums must be equal for all agents to ensure a balance of payments and receipts for all agents (Burfisher, 2021; Pyatt, 1988). This reflects the core law of economics that states, “for every income, there is a corresponding outlay or expenditure (Pyatt, 1988). A SAM is constructed mainly using input-output tables and national accounts data. We built a SAM for Ghana with 2015 as the benchmark year. An aggregated version of the Ghana SAM is shown in Table 4.1.

Table 4.1: Ghana aggregated SAM

		ACTIVITIES			COMMODITIES				FACTORS			INSTITUTIONS						
		AGR	**IND**	**SERV**	**AGR**	**IND**	**SERV**	**TRC**	**LAB**	**LAND**	**CAP**	**ENT**	**HOH**	**GOV**	**TAX**	**S0I**	**ROW**	**TOTAL**
ACTIVITIES	**AGR**	0	0	0	24,788	0	0	0	0	0	0	0	5,168	0	0	0	0	29,956
	MAN	0	0	0	0	97,980	0	0	0	0	0	0	1,806	0	0	0	0	99,787
	SERV	0	0	0	0	0	119,661	0	0	0	0	0	0	0	0	0	0	119,661
COMMODITIES	**AGR**	782	8,699	1,869	0	0	0	0	0	0	0	0	13,703	0	0	1,300	5,557	31,910
	MAN	3,422	42,067	22,264	0	0	0	0	0	0	0	0	36,599	0	0	37,204	31,105	172,660
	SERV	1,478	11,881	35,100	0	0	0	22,439	0	0	0	0	31,371	22,341	0	0	19,250	143,860
	TRC	0	0	0	5,117	17,323	0		0		0		0		0	0		22,439
FACTORS	**LAB**	8,653	6,520	28,023	0	0	0	0	0	0	0	0	0	0	0	0	0	43,196
	LAND	8,387	0	0	0	0	0		0		0		0		0	0		8,387
	CAP	7,233	30,620	32,405	0	0	0	0	0	0	0	0	0	0	0	0	781	71,038
INSTITUTIONS	**ENT**	0	0	0	0	0	0		0		63,966		0	9,020	0	0		72,986
	HOH	0	0	0	0	0	0	0	43,196	8,387	4,177	59,256	0	1,571	0	0	5,025	121,612
	GOV	0	0	0	0	0	0		0		0	6,101	289		22,455	0	2,762	31,607
	TAX	0	0	0	750	12,781	1,532	0	0	0	0	3,826	3,566	0	0	0	0	22,455
	S0I	0	0	0	0	0	0	0	0	0	0	3,804	29,111	3,053	0	2,540	8,643	41,044
	ROW	0	0	0	1,256	44,576	22,667		0		2,895		0	1,729	0	0		73,123
	TOTAL	29,956	99,787	119,661	31,910	172,660	143,860	22,439	43,196	8,387	71,038	72,986	121,612	31,607	22,455	41,044	73,123	

Source: This three sectors SAM was aggregated from the original 55 sectors 2015 Ghana SAM. Note: AGR - Agriculture, IND - Industries, SERV - Services, TRC - Transaction costs, LAB - Labor, LAND - Land, CAP - Capital, ENT - Enterprises, HOH - Households, GOV - Government, TAX - Taxes, S0I - Savings and Investments, ROW - Rest of the world

The original SAM was produced by the Ghana Statistical Service, the Institute of Statistical, Social and Economic Research at the University of Ghana, and the Ghana Strategy support program of the International Food Policy Research Institute.

The original SAM included 58 production sectors and 13 factors of production. In addition, the household is divided into rural and urban, and their income is split into quintiles. Given the focus of our study, we modified the original SAM by aggregating households into three different household groups. We have a rural farm owner, a rural non-farm owner, and an urban household. Factors of production are divided into two (labor and capital), and production activities and commodities are aggregated into 11 sectors. These sectors and the mapping from the original SAM into the modified SAM are listed in Table 4.2. The aggregated SAM used in this model can be found in Appendix C.

Table 4.2: Input-output coefocients

	AGR	**MING**	**FNB**	**CLTH**	**MAN**	**ENRG**	**WTSAN**	**CONS**	**TRAD**	**TRAN**	**SRV**
AGR	0.03	0.00	0.66	0.13	0.13	0.00	0.00	0.00	0.01	0.00	0.02
MING	0.00	0.00	0.00	0.00	0.28	0.35	0.03	0.01	0.00	0.00	0.00
FNB	0.02	0.00	0.07	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.03
CLTH	0.01	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.01
MAN	0.07	0.39	0.05	0.22	0.27	0.32	0.52	0.26	0.07	0.26	0.08
ENRG	0.01	0.05	0.01	0.06	0.02	0.03	0.09	0.00	0.03	0.00	0.02
WTSAN	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.01	0.00	0.01
CONS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
TRAD	0.01	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04
TRAN	0.02	0.04	0.00	0.02	0.00	0.04	0.10	0.00	0.40	0.03	0.02
SRV	0.03	0.19	0.01	0.05	0.04	0.10	0.07	0.00	0.07	0.05	0.25
LAB	0.29	0.06	0.06	0.13	0.07	0.01	0.01	0.09	0.21	0.22	0.24
CAP	0.52	0.20	0.14	0.24	0.19	0.08	0.17	0.64	0.17	0.43	0.25

Soucre: See table 4.1. Note: When it comes to agriculture, the capital input is a combination of both land and capital. However, when we break it down, we found that labor accounts for 35.65%, while land and capital make up 34.55% and 29.80% respectively. Other sectors do not utilize land in their input.

Table 4.2 is Ghana's input-output coefficient, which quantifies the interdependence between inputs and outputs in an economic system. It quantifies the amount of each input required to produce a unit of output in a particular sector (Breisinger et al., 2009c). As the authors point out, this can also be understood as a production technology. The table highlights the prominent role of the manufacturing sector

Figure 4.2: Sectoral aggregation of the SAM

Code	Description	Corresponding sectors in the original 55-sector SAM
1. AGR	Agriculture	Maize (maiz);Sorghum and millet (sorg); Rice (rice); Other cereal (ocer); Pulses (puls); Groundnuts (gnut); Other oilseeds (oils); Cassava (cass); Other roots (root); Vegetables (vege); Sugar cane (sugr); Tobacco (toba); Cotton and fibers (cott); Fruits and nuts (frui); Cocoa (coco); Coffee and tea (coff); Other crops (ocrp); Cattle (catt); Poultry (poul); Other livestock (oliv); Forestry (fore); Fishing (fish); Coal and lignite (coal)
2. MING	Mining	Other mining, Crude oil
3. FNB	Food and Beverage	Meat, fish and diary (meat); Fruit and vegetables processing (fveg); Fats and oil (foil); Grain milling (gmll); Sugar refining (sref); Other foods (food); Beverages (beve); Tabaco processing (ptob)
4. CLTH	Textile, Clothing	Textile, Clothing (clth); Leather and footwear (leat)
5. MAN	Manufacturing	Other manufacturing, Machinery and equipment, Metals and metal products, Non-metal minerals, Petro-Chemical industries, Wood and paper
6. ENRG	Energy	Electricity, gas, and steam (ELEC);
7. WTSAN	Water supply and sewage	Water supply and sewage (WATR)
8. CONS	Construction	Construction
9. TRAD	Wholesale and retail trade	Wholesale and retail trade
10. TRAN	Transportation and storage	Transportation and storage
11. SERV	Services	Accommodation and food services (hotl); Real estate activities (real); Business services (bsrv); Public administration (padm); Education (educ); Other services (osrv)

within Ghana's economy, demonstrating its substantial contribution as a crucial input to multiple sectors and its significant impact on sectoral outputs. For instance, it contributes 0.39 for each unit of output of the mining sector, and 0.52 for the Water and sanitation sectors. An additional noteworthy observation is a substantial reliance on agricultural input in the production of the food and beverage sector, as evidenced by an input requirement of approximately 0.66 units of agriculture per unit of output. This finding underscores the significance of agricultural advancement as a prerequisite for the successful promotion of agro-industries in Ghana. Such promotion aligns with the government's industrial development plan, which prioritizes the development of agro-industries as a pivotal component.

Table 4.3 illustrates Ghana's import penetration rate[2]. The import penetration

[2]The import penetration rate is calculated by dividing the value of imports by the total value of a specific market or industry's sales. It is commonly used to analyze the competitiveness and market

Table 4.3: Import penetration ratio

Sectors	Imports	Total demand	Import penetration ratio
AGR	1,255.7	31,910.3	3.90%
MING	1,247.6	34,311.4	3.60%
FNB	5,551.6	21,623.1	25.70%
CLTH	1,318.8	5,685.9	23.20%
MAN	36,458.0	69,607.4	52.40%
ENRG	0.0	8,526.0	0.00%
WTSAN	-	4,537.0	0.00%
CONS	-	28,369.7	0.00%
TRAD	-	20,622.4	0.00%
TRAN	3,723.9	25,847.1	14.40%
SRV	18,942.9	97,390.1	19.50%

Soucre: See table 4.1. Note: The values for imports and total demand are in millions of Ghana Cedis

ratio is a metric used to assess how much imported goods are involved in a country's local market (Breisinger et al., 2009c). what stands out in the table is the huge reliance of the manufacturing sector on imports (5.4%), this figure didn't change much from the 54.1% in 2007 as reported by Breisinger et al. (2009c). the food and beverage sector also displays a relatively high reliance on imports (25.7%). The presented figures underscore the significant role of trade in the context of Ghana, highlighting its importance as an essential driver of economic activity and development.

The export intensity of different sectors in Ghana is presented in Table 4.4. Export intensity is the term used to describe the percentage of a country's overall production or sales that is comprised of exports (Breisinger et al., 2009c). About 80% of Ghana's mining output is destined for exports. The manufacturing sector also reveals to be an export-intensive sector with a value of around 26%. Both agriculture and the food and beverage sectors present a figure of around 18%. Once again, these figures highlight the significance of trade in the Ghanaian economy.

dynamics of different sectors, assess the impact of international trade on domestic industries, and evaluate the effectiveness of trade policies in promoting domestic production and reducing import dependence.

Table 4.4: Exports intensity

Sectors	Exports	Gross output	Export Intensity
AGR	5,557.3	29,955.7	18.55%
MING	24,841.2	30,802.9	80.65%
FNB	1,768.7	9,597.6	18.43%
CLTH	72.7	1,155.4	6.30%
MAN	4,422.3	16,798.2	26.33%
ENRG	0.0	8,525.9	0.00%
WTSAN	0.0	4,537.0	0.00%
CONS	0.0	28,369.7	0.00%
TRAD	0.0	20,067.3	0.00%
TRAN	1,810.4	22,118.9	8.19%
SRV	17,439.1	77,474.8	22.51%

Soucre: See table 4.1. Note: The values for exports and gross output are in millions of Ghana Cedis

4.4 Conclusion

In conclusion, this chapter has provided a comprehensive overview of the dynamic recursive CGE that will be used in the subsequent chapter to study industrial policy in Ghana. The model developed in this section is a single-country dynamic recursive CGE model based on Chang (2021) and Lofgren et al. (2002). Throughout the chapter, we have explored the key features and advantages of dynamic recursive CGE models compared to static models. Dynamic recursive CGE models allow for a deeper understanding of the interplay between economic variables, capturing the temporal dynamics of decision-making processes by households, firms, and governments. In addition, we have outlined the database employed in our study, specifically a 2016 SAM, and have elucidated the level of aggregation implemented within the model's structure. we conducted a brief SAM analysis to better understand the structure of Ghana's economy, The outcomes of this analysis hold significant value in informing the formulation of simulation counterfactual scenarios.

Furthermore, this chapter has emphasized the significance of CGE modeling in evaluating the impacts of diverse economic policies, particularly within the context of Ghana. We have highlighted previous studies that have utilized CGE models to investigate various aspects of Ghana's economy. Nonetheless, it is important to note that despite the extensive application of CGE modeling in numerous countries and regions, a research gap persists concerning the explicit examination of industrial policy in Ghana using CGE models. Consequently, our study endeavors to bridge this gap by providing substantial insights into the comprehensive economy-wide effects of industrial policy implementation in Ghana, thereby augmenting the existing body of knowledge on the subject. In the subsequent section, we will leverage the model to examine and evaluate several industrial policy scenarios within the specific context of Ghana's economy.

Chapter 5

Simulation Analysis of alternative industrialization paths in Ghana

5.1 Introduction

Simulation in CGE involves using the CGE model to project the impacts of various economic scenarios. A simulation in the context of CGE can also be understood as an exogenous shock. These scenarios (exogenous shock) might include policy changes, such as changes in taxes or subsidies, changes in trade agreements, or changes in technology. The simulation is based on a counterfactual scenario; in other words, we assume the idea of what if specific policies were to be implemented and the quantitative impact of such policy. The first step is to specify the policy intervention to simulate the effects of an industrial policy using a CGE model. We also need to specify the initial conditions of the economy, such as the starting values of prices, quantities, and wages. We term this the business-as-usual (BAU) path. This scenario is where no policy changes or external shocks affect the economy. The economy continues to function without any significant disruptions or interventions. Under BAU, assumptions are made regarding the economic agents' behaviors and the growth rate of certain variables. In other words, we assume no changes in consumer behavior, production techniques, or government policies would affect the economy significantly.

Based on literature findings, it is expected that the manufacturing sector's total factor productivity (TFP) will increase at a faster rate than agriculture or services. The agriculture sector is projected to have an average annual TFP improvement of 0.1 percent, while services are anticipated to have a TFP growth rate twice that of agriculture. In comparison, the manufacturing industry's TFP is expected to be twice that of the services sector. These TFP growth rates are somewhat arbitrary but plausible rates complying in general with the literature (Bah, 2007; Duarte and Restuccia, 2010). The population growth is assumed to continue at a rate of 2.1% (the current growth rate). For our BAU for Ghana, we used data from the world bank world development indicator (WDI), the PEN world table, and Ghana National Statistic Services. Once the model is calibrated, the policy intervention can be simulated by changing the relevant parameters. It is important to note that the results of CGE simulations depend on the assumptions and data used in the model. Therefore, sensitivity analysis is often necessary to explore the robustness of the results to different assumptions. Once the model is set up, we can use it to simulate different scenarios (in our case, different industrial policy strategies) by changing the input values of specific parameters or exogenous variables, such as government spending, taxes, and subsidies. Based on the new parameter values, the simulation will generate new equilibrium values for the economy, including values for variables such as prices, quantities, and wages.

Finally, our simulations' results are analyzed compared to the BAU scenario. The output of a CGE simulation can provide valuable insights into the impacts of different industrialization strategies on Ghana's economy. For example, we want to use our model to simulate the effect of capital-intensive industrialization against labor-intensive industrialization; we want to measure their respective impact on macro variables such as GDP, wage and capital rent, labor demand, etc. It can also help us understand the distributional effects of policies, such as who would bear the burden of a new tax or benefit from a new subsidy; our model includes different household categories for such analysis. Furthermore, the counterfactual scenario considered in our analysis is informed by the industrial strategy outlined in Chapter 2, section 2.5.1 of this study. Ghana's current industrialization strategy primarily emphasizes the promotion of agro-processing industries, manufacturing improvement, enhancement of the business environment, and increased access to finance, technology, and innovation. By aligning our counterfactual scenario with the aforementioned strategy, we aim to assess the potential implications and outcomes of policy interventions in the industrial sector of Ghana's economy.

5.2 Labor-intensive vs. Capital-intensive industrialization

Capital-intensive and labor-intensive industrialization are two approaches to economic development, each with advantages and disadvantages. Capital-intensive industrialization is a development strategy that relies heavily on capital investment in machinery, technology, and infrastructure to increase productivity and output. This approach emphasizes using capital goods and automation to replace labor-intensive production methods. Capital-intensive industries tend to be associated with high levels of technological innovation and require significant capital investment to get started. In Africa, in general, finds, reports that big firms tend to be capital-intensive, and consequently, they offer limited employment opportunities. There is a concern that due to the capital-intensiveness nature of big manufacturing firms, their capacity to create jobs is limited McMillan and Zeufack (2022). On the other hand, labor-intensive industrialization focuses on maximizing output by utilizing a large workforce with relatively low levels of capital investment. This approach often involves using low-tech production methods and employing many workers to produce goods and services. Labor-intensive industries are typically associated with lower levels of technological innovation but can provide employment opportunities for many people, particularly in countries with large labor forces. For instance, literature findings show that the efficiency level and small size of African manufacturing tend to limit the success of African manufacturing exports (Grabowski, 2015b).

The literature highlighted the significance of labor-intensive industrialization as an initial stage in the process of structural transformation and the advancement toward capital-intensive industries. As exemplified by Braude and Menashe (2011), empirical research has demonstrated the presence of a two-stage pattern in the industrialization process of the renowned "Asian tigers." Initially, these economies pursued a labor-intensive trajectory, subsequently transitioning to capital-intensive industries during the 1980s. In a separate investigation, Grabowski (2015a) contends that the presence of labor abundance does not inherently equate to low labor costs. The author establishes a connection between elevated food costs, reduced agricultural productivity, and the resultant escalation in labor expenses. This argument posits that these factors contribute to the phenomenon of certain nations bypassing manufacturing sectors in favor of capital-intensive service sectors. This proposition finds support in the experiences of Taiwan, Indonesia, and Uganda, as discussed by the author. in another study, Grabowski (2015b), reports a similar finding for the case of Ghana, suggesting a parallel pattern of deindustrialization and the shift toward capital-intensive service sectors. In his study, Hanson (2021) explores the dynamics of global specialization in labor-intensive exports, specifically investigating industries such as apparel, footwear, furniture, and related products, which are commonly identified as the initial export manufacturing sectors for low-income countries. The author delves into the transition of these industries from the Asian Tigers to China, highlighting the emergence of a new phase of change and the potential for new participants to enter the global value chain within these sectors.

Against this contextual backdrop, our counterfactual scenario is grounded in the models of industrialization presented, further informed by the Ghana industrial policy plan examined in detail elsewhere within this study.

Table 5.1: Sectoral factor input as a percentage of total

	AGR	MING	FNB	CLTH	MAN	ENRG	WTSAN	CONS	TRAD	TRAN	SERV
Labor	35.65%	22.91%	30.70%	35.15%	27.54%	10.25%	6.62%	12.49%	55.66%	34.09%	46.37%
Land	34.55%										
Capital	29.80%	77.09%	69.30%	64.85%	72.46%	89.75%	93.38%	87.51%	44.34%	65.91%	53.63%

Soucre: See table 4.1

The sectoral factor input composition is depicted in table 5.1. The findings indicate that, overall, Ghana's sectors exhibit a higher reliance on capital inputs compared to labor inputs, with the exception of the Agriculture sector. However, it is important to note that the classification of sectors as capital-intensive or labor-intensive is not fixed or universal. In the SAM framework, sectors are typically classified as capital-intensive if they exhibit a higher proportion of capital expenditure in their production processes compared to labor costs. The classification also takes into account the interdependencies and linkages between sectors namely the input-output coefficient matrix in table 4.2.

Through an examination of inter-sectoral input-output flows, it becomes feasible to evaluate the relative significance of capital and labor inputs in production activities across various sectors. In light of the considerable dependence of the Food and Beverage and Clothing sectors on agricultural inputs, which are primarily associated with labor-intensive activities, our analysis will classify these sectors as labor-intensive. Conversely, the Mining, Manufacturing, Energy, and Construction sectors will be classified as capital-intensive sectors, considering their higher reliance on capital inputs within their respective production processes. hence, we categorize the industry based on the level of labor and capital intensity.

5.2.1 Simulation scenarios

Table 5.2 summarizes our counterfactual policies experimentations :

In scenario S1, we simulate an increase in firms' efficiency by 2%. Ghana's

Table 5.2: Scenario listing

S1	Increase Firms efficiency by 2%
S2	Increase Tariffs by 50%
S3	Decrease Tariffs by 50%
S4	Decrease tax by 50%
S5	Policy mix (combination S3 and S4)

industrial policy aims to support the growth of various sectors by improving the business environment, providing better access to finance and technology, and promoting innovation and entrepreneurship. This counterfactual scenario supposes a situation where such policy lead to a 2% improvement in sectoral productivity. It is a modest increase, given that in Ghana, it's widely reported that firms suffer from low productivity (Worldbank, 2021; Grabowski, 2015b). There is enough room for improvement.

Scenario S2 simulates an increase in tariffs by 50%; this scenario is akin to the police of import substitution, where the government tries to protect national firms from international competition. this policy is widely known as infant industry protection. This policy approach is commonly employed by governments to shield domestic industries from international competition and provide them with a competitive advantage until they can establish a strong foothold in the market. We have shown in the previous chapter in table 4.3, that the import penetration ratio, is very high in Ghana, which means domestic firms in Ghana faces huge competition from imported products. Therefore, implementing a policy that safeguards local enterprises from foreign competition would be a strategic move to promote industrial growth (Akkemik, 2008; Itoh et al., 1991).

Scenario S3 simulates a situation where the government exposes national firms to international competition. In the previous chapter, Table 4.4 displayed export intensity figures, highlighting the importance of exports for industries like mining, manufacturing, and other sectors. When a significant amount of goods are imported, it suggests that local businesses heavily depend on imports to maintain their production operations. In light of this, encouraging free trade can significantly boost industrial growth, given the current economic landscape. It is critical for these sectors to have the capacity to export their products.

In scenario S4, we explore the impact of a 50% reduction in taxes. Tax policy is a powerful tool that governments use to achieve industrial policy goals. By implementing tax measures, governments can shape and support particular industries, boost economic growth, and improve industrial competitiveness. These measures can also influence investment decisions, promote innovation, and encourage industrial development (Akkemik, 2008; Itoh et al., 1991)

The government aims to expand foreign markets by eliminating trade barriers and endorsing free trade agreements. Simultaneously, it may provide assistance to domestic industries through subsidies, tax incentives, and research and development funding to create an equal opportunity for them to compete globally and reap the benefits of free trade. By promoting competitiveness and innovation, domestic industries are better positioned to succeed in global markets and generate economic growth and job creation; these are scenarios simulated in policy mix S5.

5.3 Simulation results

CGE modeling has been used to study diverse aspects of Ghana's economy, including trade, FDI, and climate change; however, few CGE models are used for quantitively evaluating industrial policy. Figure 5.1 The list provided gives a condensed overview of studies that have utilized CGE to analyze various aspects of Ghana's economy, although it is not a comprehensive compilation. Given the CGE's capacity to capture interlinkage between diverse sectors of an economy, we found it to be an excellent framework for quantitatively analyzing the diverse ramification of industrial policy. This study aimed to study industrial policy in Ghana by applying dynamic recursive CGE analysis with Ghana SAM for 2015 as the benchmark database. Our proposal is to analyze various policy alternatives and assess their effects on the variables of our interest, including GDP, wages, exports, imports, CPI, and others. We are particularly interested in these variables' direction and magnitude of change relative to their baseline value. We present the results in three main groups for each simulation scenario. First, we present macro results for a broad view of the changes, then we show sectoral results for a deeper understanding of the underlying changes, and finally, we present the results for household income and consumption change; we will interpret household results in the light of Engel curve theoretical framework, which describes how spending on specific good changes given change in the household income. The results are presented for years 5, 10, 15, and 20, and their respective period averages (To calculate the five-year average, each period's average is determined by taking the average of the first five years, followed by the same process for subsequent periods.), the period average results are intended to give a picture of the trend of the movement of a variable. We present the results comparatively for capital-intensive industries and labor-intensive industries. The results should be interpreted as a percentage deviation from the baseline results.

Figure 5.1: Summary of Studies using CGE in Ghana

Authors	**Research question**	**Methodology/SAM base year**	**Simulations**	**Finding**
Arbenser, l. (2004)	How an FDI increase and reduction in tariff level affects macroeconomic indicators	Static Standard CGE/1993 SAM	Increase FDI inflow, cut tariff, flexible government savings	Increase current consumption, Improve household welfare, etc..,
Bhasin, V.K., Obeng, C.K. (2006)	Impact of trade liberalization on poverty and income distribution	Static Standard CGE Multihousehold model/ 1993 SAM	Elimination of trade tariff and increase foreign borrowing, etc..,	Positive impact on poverty alleviation, increase incidence of poverty. Etc..,
Breisinger, C., Diao, X., Schweickert, R., & Wiebelt, M. (2009)	The impact of alternative oil rent allocation option	Dynamic CGE model (recursive)	Increase public investment, Increase saving into oil funds	An increase in oil revenue should be smoothed out between productive investment and oil fund etc..,
Arndt, C., Asante, F., Thrulow, J. (2015)	The impact of climate change on Ghana economy	Static/ Recursive CGE model/ 2005 SAM	Increase productivity, reallocation of resource base on productivity, structural change as a benchmark of economic path etc..,	Climate change negatively affects household welfare etc..,
Iddrisu, A. M. (2020)	The impact of tariff reform	Static CGE and GHAMOD microsimulation/ 2015 SAM	Microsimulation involving scenario with and without indirect tax	New import tariff regimes reduce overall economic performance, sectorial value added, government revenue etc..,
Boysen, O., Ferrari, E., Nechlifor, V., Tillie, P. (2021)	The impact of introduction of income Differential on farmers income etc..,	DEMETRA CGE model etc.., / 2016 SAM updated to 2019	Increase farmers income (with no increase in final price) etc..,	Positive long-run impact, substantial drop in international cocoa price

5.3.1 Scenario S1: Increase Firms efficiency by 2%

One possible scenario of an external shock is when firms' efficiency, also known as Total Factor Productivity (TFP), increases by 2%. This type of improvement has been tested in various studies and is expected to have a positive impact on different factors. The shock is applied separately to both capital- and labor-intensive sectors.

Table 5.3: Macro results of scenario S1 for capital-intensive industries

Improve efficiency by 2%								
Capital-intesive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	0.23%	0.23%	0.22%	0.22%	0.20%	0.21%	0.19%	0.19%
GDP	2.17%	2.14%	2.28%	2.23%	2.40%	2.35%	2.56%	2.49%
Wage	-1.07%	-0.96%	-1.39%	-1.26%	-1.79%	-1.63%	-2.30%	-2.09%
K.rent	2.81%	2.72%	3.06%	2.96%	3.37%	3.24%	3.75%	3.59%
X	39.82%	38.46%	43.68%	42.09%	48.26%	46.37%	53.73%	51.46%
M	2.13%	2.07%	2.28%	2.22%	2.47%	2.39%	2.70%	2.61%
TLD	-0.21%	-0.19%	-0.28%	-0.25%	-0.36%	-0.33%	-0.46%	-0.42%
TKD	1.11%	1.08%	1.21%	1.17%	1.33%	1.28%	1.48%	1.42%

Notes: CPI: consumer price index; GDP: gross domestic product; Wage: remuneration factor labor; K.rent: rate of return on capital, X: commodities total exports; M: import; TLD: total labor demand; TKD: total demand for capital

Table 5.4: Macro results of scenario S1 for labor-Intesive industries

Improve efficiency by 2%								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	-0.17%	-0.17%	-0.17%	-0.17%	-0.17%	-0.17%	-0.17%	-0.17%
GDP	0.67%	0.67%	0.67%	0.67%	0.66%	0.67%	0.66%	0.66%
Wage	0.84%	0.83%	0.87%	0.86%	0.89%	0.88%	0.92%	0.91%
K.rent	0.36%	0.36%	0.34%	0.35%	0.32%	0.33%	0.30%	0.31%
X	-2.50%	-2.42%	-2.75%	-2.65%	-3.01%	-2.90%	-3.31%	-3.19%
M	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%	0.33%
TLD	0.17%	0.17%	0.17%	0.17%	0.18%	0.18%	0.18%	0.18%
TKD	0.14%	0.14%	0.14%	0.14%	0.13%	0.13%	0.12%	0.12%

See notes in Table 5.3

Tables 5.3 and 5.4 present the macro results obtained by increasing efficiency in the industrial sector by 2%. The direction of the results is, as expected, it has a positive impact on significant macroeconomic variables, and the magnitude of change is somewhat different for capital and labor-intensive industries. (As seen from the results, the impact of sectorial increases in efficiency is somewhat mild for labor-intensive industries, with only a small increase in GDP of 0.6%, while the capital-intensive sectors have a higher effect on GDP growth by an average of 2.1%, reaching the value of 2.49% in the final year. The trend of GDP is hump-shaped; it increases in the beginning, and the growth rates start decelerating after year 5. The impact on wages is negative for capital-intensive industries. Given an increase in productivity, capital-intensive industries tend to invest more; this result is confirmed by the fact that the labor demand will decrease and capital demand will increase on average by -2.09% and 3.59% in the final year, respectively, a somewhat expected result. On the labor-intensive side, there will be a slight increase in wages and capital rent; the sector will increase its demand for labor (0.18%, in the final year) and capital (0.12% in the final year), with the demand for labor slightly higher than the demand for capital. The results for export are starkly different for the two sectors. While capital intensive sector will register a big increase in exports of around 38%, with the final year of export reaching 51%, this spectacular increase in exports is boosted by the mining sector. The export in the labor-intensive will decline by around -3.19% in the final year, perhaps supplying mostly to the domestic market. This can be inferred from the declining consumer price index of around 0.17%, meaning cheaper commodities in the domestic market. At the same time, the capital-extensive industries will cause an increase in the CPI by around 0.19% in the final year.

It is important to analyze the sectorial changes to have a clearer picture of the underlining change that originated macro-changes reported in table 5.3. Tables 5.5 and 5.6 present results for selected sectors. One noticeable trend in the table is the considerable rise in the need for both capital and labor within the Mining and Exports industries. The change in industries (manufacturing) is also worthy of note. The findings indicate significant opportunities for expansion in industries that require high levels of investment. Industries that rely heavily on labor show more modest changes, but agro-industries demonstrate promising potential for export growth due to a productivity boost.

Table 5.5: Improve efficiency by 2% in capital-intesive industries

Improve efficiency by 2%								
Capital-intesive industries								
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
Agriculture								
P.Consu	1.39%	1.41%	1.43%	1.44%	1.46%	1.48%	1.51%	1.53%
Export	-1.79%	-1.77%	-1.73%	-1.70%	-1.65%	-1.61%	-1.55%	-1.50%
Import	3.32%	3.38%	3.48%	3.55%	3.66%	3.74%	3.87%	3.96%
Labor demand	4.19%	4.44%	4.84%	5.14%	5.63%	6.00%	6.60%	7.07%
Capita demand	-1.65%	-1.72%	-1.84%	-1.93%	-2.08%	-2.20%	-2.38%	-2.53%
Q.ValueAdded	0.45%	0.49%	0.55%	0.60%	0.67%	0.73%	0.82%	0.88%
Mining								
P.Consu								
Export	68.77%	70.79%	73.97%	76.31%	80.01%	82.75%	87.08%	90.30%
Import	-8.69%	-8.63%	-8.50%	-8.39%	-8.20%	-8.03%	-7.74%	-7.48%
Labor demand	59.62%	61.72%	65.04%	67.50%	71.42%	74.34%	79.00%	82.51%
Capita demand	53.60%	55.29%	57.95%	59.90%	62.97%	65.23%	68.79%	71.42%
Q.ValueAdded	54.97%	56.75%	59.56%	61.62%	64.88%	67.28%	71.09%	73.91%
Food and Beverage								
P.Consu	1.12%	1.13%	1.15%	1.16%	1.18%	1.20%	1.23%	1.24%
Export	-5.21%	-5.34%	-5.54%	-5.68%	-5.92%	-6.10%	-6.39%	-6.61%
Import	-0.06%	-0.14%	-0.27%	-0.38%	-0.55%	-0.68%	-0.89%	-1.05%
Labor demand	0.16%	0.24%	0.37%	0.47%	0.64%	0.76%	0.97%	1.13%
Capita demand	-5.46%	-5.67%	-6.02%	-6.29%	-6.71%	-7.03%	-7.55%	-7.94%
Q.ValueAdded	-3.72%	-3.85%	-4.05%	-4.20%	-4.45%	-4.64%	-4.94%	-5.16%
Clothing								
P.Consu	1.12%	1.13%	1.15%	1.17%	1.19%	1.20%	1.23%	1.25%
Export	-2.95%	-3.07%	-3.25%	-3.39%	-3.62%	-3.80%	-4.09%	-4.31%
Import	-0.95%	-1.07%	-1.26%	-1.41%	-1.64%	-1.82%	-2.12%	-2.34%
Labor demand	0.03%	0.09%	0.18%	0.25%	0.36%	0.45%	0.59%	0.70%
Capita demand	-5.57%	-5.82%	-6.20%	-6.50%	-6.96%	-7.32%	-7.89%	-8.33%
Q.ValueAdded	-3.59%	-3.73%	-3.95%	-4.11%	-4.38%	-4.59%	-4.91%	-5.16%
Manufacturing								
P.Consu	0.59%	0.60%	0.61%	0.62%	0.64%	0.65%	0.67%	0.68%
Export	41.99%	43.08%	44.81%	46.09%	48.12%	49.62%	52.00%	53.79%
Import	10.60%	11.12%	11.95%	12.57%	13.56%	14.32%	15.53%	16.46%
Labor demand	25.73%	26.73%	28.33%	29.53%	31.44%	32.88%	35.20%	36.97%
Capita demand	20.41%	21.08%	22.15%	22.93%	24.17%	25.10%	26.56%	27.65%
Q.ValueAdded	21.87%	22.63%	23.84%	24.73%	26.15%	27.22%	28.91%	30.18%

Notes: P.Consu: private consumption; Export: exports; Import: imports; Q.ValueAdded: quantity of value added

Tables 5.7 and 5.8 show the results for households. It reports changes in income and the corresponding changes in demand for commodities. The results in the table should be interpreted in light of the Engel curve, which relates the difference in income to the change in the composition of the household commodity basket, as explained in the beginning. The Engel curve is typically upward-sloping, which means that the household tends to buy more of the particular good or service as income increases. As income increases, households have more purchasing power and can afford more goods or services. However, the curve varies with the type of goods. For normal goods, we expect an increasing demand as income increases, while for the "so-called" inferior good, we may see a decline in demand. Productivity shock in capital intensive-industries leads to an increment of 1.98% (in the final year) in household income. In contrast, in the capital-intensive industries, it leads to an

Table 5.6: Improve efficiency by 2% in labor-intesive industries

Improve efficiency by 2%								
Labor-intesive industries								
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
Agriculture								
P.Consu	-0.19%	-0.19%	-0.18%	-0.18%	-0.17%	-0.17%	-0.17%	-0.16%
Export	6.40%	6.39%	6.38%	6.38%	6.37%	6.36%	6.35%	6.34%
Import	-1.24%	-1.23%	-1.23%	-1.23%	-1.23%	-1.23%	-1.22%	-1.22%
Labor demand	-0.39%	-0.41%	-0.44%	-0.47%	-0.50%	-0.53%	-0.57%	-0.60%
Capita demand	0.37%	0.37%	0.37%	0.38%	0.38%	0.38%	0.38%	0.39%
Q.ValueAdded	0.10%	0.09%	0.08%	0.07%	0.06%	0.05%	0.04%	0.03%
Mining								
P.Consu								
Export	-5.69%	-5.80%	-5.96%	-6.08%	-6.27%	-6.40%	-6.60%	-6.75%
Import	2.67%	2.69%	2.72%	2.73%	2.75%	2.77%	2.79%	2.80%
Labor demand	-5.48%	-5.59%	-5.77%	-5.90%	-6.09%	-6.23%	-6.45%	-6.61%
Capita demand	-4.99%	-5.10%	-5.25%	-5.37%	-5.54%	-5.66%	-5.85%	-5.99%
Q.ValueAdded	-5.11%	-5.21%	-5.37%	-5.49%	-5.67%	-5.79%	-5.99%	-6.13%
Food and Beverage								
P.Consu	0.10%	0.10%	0.11%	0.11%	0.11%	0.12%	0.12%	0.12%
Export	14.35%	14.37%	14.39%	14.41%	14.43%	14.45%	14.49%	14.51%
Import	-1.60%	-1.59%	-1.58%	-1.57%	-1.56%	-1.55%	-1.54%	-1.53%
Labor demand	1.86%	1.86%	1.86%	1.85%	1.85%	1.85%	1.84%	1.83%
Capita demand	2.64%	2.66%	2.69%	2.72%	2.75%	2.78%	2.82%	2.85%
Q.ValueAdded	2.40%	2.41%	2.43%	2.45%	2.47%	2.49%	2.51%	2.53%
Clothing								
P.Consu	0.30%	0.31%	0.31%	0.31%	0.31%	0.32%	0.32%	0.32%
Export	9.51%	9.53%	9.55%	9.57%	9.60%	9.62%	9.65%	9.67%
Import	-1.15%	-1.14%	-1.13%	-1.13%	-1.11%	-1.10%	-1.09%	-1.08%
Labor demand	1.04%	1.03%	1.03%	1.03%	1.03%	1.02%	1.02%	1.01%
Capita demand	1.81%	1.83%	1.86%	1.89%	1.92%	1.95%	1.99%	2.02%
Q.ValueAdded	1.53%	1.55%	1.56%	1.58%	1.60%	1.62%	1.64%	1.66%
Manufacturing								
P.Consu	0.48%	0.48%	0.49%	0.49%	0.49%	0.49%	0.50%	0.50%
Export	-2.34%	-2.40%	-2.49%	-2.56%	-2.67%	-2.75%	-2.88%	-2.96%
Import	-0.36%	-0.39%	-0.45%	-0.48%	-0.55%	-0.59%	-0.66%	-0.71%
Labor demand	-2.24%	-2.30%	-2.39%	-2.46%	-2.56%	-2.64%	-2.76%	-2.85%
Capita demand	-1.68%	-1.72%	-1.79%	-1.84%	-1.92%	-1.97%	-2.06%	-2.13%
Q.ValueAdded	-1.83%	-1.88%	-1.96%	-2.01%	-2.10%	-2.16%	-2.26%	-2.33%

See notes in Table 5.5

Table 5.7: Household results of scenario S1 for capital-intensive

Improve efficiency by 2%								
Capital-Intesive Industries								
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
Household Income	1.79%	1.77%	1.84%	1.82%	1.90%	1.88%	1.98%	1.95%
Commodity demand								
CAGR	0.36%	0.35%	0.38%	0.37%	0.40%	0.39%	0.42%	0.41%
CMING								
CFNB	0.69%	0.68%	0.72%	0.71%	0.74%	0.73%	0.78%	0.76%
CCLTH	0.76%	0.75%	0.79%	0.78%	0.82%	0.81%	0.86%	0.84%
CMAN	1.60%	1.58%	1.67%	1.65%	1.75%	1.72%	1.84%	1.80%
CNRG	2.95%	2.89%	3.11%	3.04%	3.28%	3.21%	3.48%	3.38%
CWTSAN	1.45%	1.42%	1.51%	1.49%	1.58%	1.56%	1.67%	1.62%
CCONS	0.26%	0.26%	0.22%	0.24%	0.19%	0.20%	0.13%	0.16%
CTRAD	0.57%	0.56%	0.60%	0.59%	0.63%	0.62%	0.67%	0.65%
CTRAN	0.69%	0.68%	0.72%	0.71%	0.76%	0.75%	0.81%	0.78%
CSRV	0.78%	0.76%	0.84%	0.82%	0.92%	0.88%	1.01%	0.96%

increment of 0.69% in the final year. In general, an increment in income due to labor-intensive productivity improvement leads to less than proportional incremental demand for commodities. When it comes to demand for energy commodities, capital-intensive cases show a greater increase compared to labor-intensive ones.

Table 5.8: Household results of scenario S1, for labor intensive industries

Improve efficiency by 2%								
Labor-Intesive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Household Income	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%
Commodity demand								
CAGR	1.12%	1.12%	1.13%	1.12%	1.13%	1.13%	1.14%	1.13%
CMING								
CFNB	0.80%	0.80%	0.81%	0.81%	0.82%	0.82%	0.83%	0.82%
CCLTH	0.61%	0.61%	0.62%	0.62%	0.63%	0.62%	0.63%	0.63%
CMAN	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
CNRG	0.07%	0.07%	0.06%	0.06%	0.05%	0.05%	0.04%	0.04%
CWTSAN	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.24%	0.24%
CCONS	0.22%	0.22%	0.23%	0.22%	0.23%	0.23%	0.24%	0.23%
CTRAD	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%
CTRAN	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%
CSRV	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%	0.20%

In fact, the increase is more than proportional. Improvements in capital-intensive productivity result in a larger order of magnitude of change compared to the exact change in the labor-intensive sector.

5.3.2 Scenario S2 & S3: Trade policy (Increase and decrease tariffs by 50 2%)

Trade policy is a critical tool for implementing industrial policy intervention. It plays a crucial role in shaping the external environment of domestic industries. Tariffs, quotas, and subsidies are examples of trade policies that can protect domestic industries from foreign competition, providing them with the necessary time and resources to grow and develop. By safeguarding domestic industries, trade policy can promote job creation and economic growth. It can also encourage foreign investment and exports of domestic products, thereby supporting the development of domestic industries. Our analysis involved implementing a protectionist policy scenario where the government increased import tariffs by 50%. We then examined the reaction of each sector (capital and labor-intensive) under this policy option.

S2: Increase Tariffs by 50%

The tariff increase scenario can be compared to the concept of import substitution industrialization as mentioned before, where the government supports and develops domestic industries, particularly those that are still in their early stages. Ghana has

Table 5.9: Macro results of scenario S2 for capital-intensive industries

Increase tariff by 50%								
Capital-Intesive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%
GDP	-1.67%	-1.66%	-1.69%	-1.68%	-1.70%	-1.70%	-1.72%	-1.71%
Wage	-1.19%	-1.21%	-1.15%	-1.16%	-1.09%	-1.12%	-1.03%	-1.06%
K.rent	-1.29%	-1.27%	-1.32%	-1.31%	-1.36%	-1.35%	-1.41%	-1.39%
X	-9.18%	-9.02%	-9.61%	-9.43%	-10.10%	-9.90%	-10.65%	-10.43%
M	-4.20%	-4.19%	-4.24%	-4.22%	-4.27%	-4.26%	-4.32%	-4.30%
TLD	-0.24%	-0.24%	-0.23%	-0.23%	-0.22%	-0.22%	-0.21%	-0.21%
TKD	-0.52%	-0.51%	-0.53%	-0.53%	-0.55%	-0.54%	-0.57%	-0.56%

See notes in Table 5.3

Table 5.10: Macro results of scenario S2 for labor-intensive industries

Increase tariff by 50%								
Labor-Intesive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	0.95%	0.95%	0.95%	0.95%	0.95%	0.95%	0.95%	0.95%
GDP	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%
Wage	-0.40%	-0.40%	-0.40%	-0.40%	-0.40%	-0.40%	-0.41%	-0.40%
K.rent	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.12%	-0.11%	-0.11%
X	-0.19%	-0.21%	-0.16%	-0.17%	-0.11%	-0.13%	-0.07%	-0.08%
M	-2.29%	-2.29%	-2.28%	-2.29%	-2.27%	-2.28%	-2.26%	-2.27%
TLD	-0.08%	-0.08%	-0.08%	-0.08%	-0.08%	-0.08%	-0.08%	-0.08%
TKD	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%

See notes in Table 5.3

implemented this policy in the past during its initial push towards industrialization, and the outcomes of this approach are discussed in Chapter 2.

Table 5.9 reports the macro effects of this scenario of trade protection. The table is noteworthy that capital-intensive industries were significantly penalized by this scenario; exports decreases by -10.65% by the final year, while imports also fall by -4.32%, GDP declines, and labor and capital demand and wage all declined. These results mean that import substitution industrial policy exacts a high on the economy. On the other end, the labor-intensive sectors fared much better despite registering negative values, however of much lower magnitudes than those of capital-intensive industries. The only exception is the CPI variable. Protecting labor-intensive industries will increase prices much higher than those for capital-intensive industries.

The sectoral results in table 5.11 and 5.12 show much more detailed results that may help us make sense of the macro results in table 5.9. The picture we get from table 5.11 and 5.12 is that under a scenario where we protect capital-intensive

Table 5.11: Sectoral results of scenario S2 for capital-intensive industries

Increase Tarrrifs by 50%								
Capital-Intesive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Agriculture								
P.Consu	-1.20%	-1.20%	-1.20%	-1.21%	-1.21%	-1.21%	-1.22%	-1.22%
Export	1.88%	1.87%	1.86%	1.85%	1.83%	1.83%	1.81%	1.80%
Import	-2.06%	-2.07%	-2.08%	-2.09%	-2.10%	-2.11%	-2.13%	-2.14%
Labor demand	0.44%	0.40%	0.34%	0.29%	0.23%	0.18%	0.10%	0.04%
Capita demand	0.50%	0.51%	0.53%	0.54%	0.56%	0.57%	0.59%	0.61%
Q.ValueAdded	0.48%	0.47%	0.46%	0.45%	0.44%	0.43%	0.41%	0.40%
Mining								
P.Consu								
Export	-15.20%	-15.41%	-15.75%	-15.98%	-16.34%	-16.60%	-17.00%	-17.28%
Import	6.11%	6.14%	6.18%	6.21%	6.25%	6.27%	6.31%	6.33%
Labor demand	-11.19%	-11.43%	-11.80%	-12.07%	-12.48%	-12.77%	-13.22%	-13.54%
Capita demand	-11.15%	-11.36%	-11.69%	-11.93%	-12.29%	-12.54%	-12.94%	-13.22%
Q.ValueAdded	-11.16%	-11.38%	-11.72%	-11.96%	-12.33%	-12.60%	-13.00%	-13.29%
Food and Beverage								
P.Consu	-0.96%	-0.96%	-0.97%	-0.97%	-0.98%	-0.99%	-0.99%	-1.00%
Export	1.87%	1.88%	1.90%	1.92%	1.95%	1.97%	2.01%	2.04%
Import	-1.43%	-1.42%	-1.41%	-1.40%	-1.38%	-1.37%	-1.35%	-1.34%
Labor demand	1.38%	1.36%	1.34%	1.32%	1.29%	1.27%	1.24%	1.22%
Capita demand	1.45%	1.48%	1.53%	1.57%	1.62%	1.67%	1.74%	1.79%
Q.ValueAdded	1.42%	1.44%	1.47%	1.49%	1.52%	1.54%	1.58%	1.61%
Clothing								
P.Consu	-0.91%	-0.91%	-0.92%	-0.92%	-0.93%	-0.94%	-0.94%	-0.95%
Export	-1.94%	-1.93%	-1.92%	-1.90%	-1.88%	-1.87%	-1.84%	-1.82%
Import	-0.91%	-0.90%	-0.88%	-0.86%	-0.84%	-0.82%	-0.78%	-0.76%
Labor demand	0.91%	0.89%	0.87%	0.86%	0.83%	0.82%	0.80%	0.78%
Capita demand	0.97%	1.01%	1.06%	1.10%	1.17%	1.21%	1.29%	1.35%
Q.ValueAdded	0.95%	0.97%	0.99%	1.02%	1.05%	1.07%	1.11%	1.14%
Manufacturing								
P.Consu	0.39%	0.38%	0.36%	0.35%	0.33%	0.32%	0.30%	0.29%
Export	-4.24%	-4.40%	-4.65%	-4.82%	-5.09%	-5.28%	-5.57%	-5.78%
Import	-2.59%	-2.68%	-2.81%	-2.91%	-3.06%	-3.16%	-3.33%	-3.45%
Labor demand	1.71%	1.56%	1.31%	1.13%	0.86%	0.67%	0.36%	0.14%
Capita demand	1.76%	1.64%	1.45%	1.32%	1.11%	0.96%	0.73%	0.56%
Q.ValueAdded	1.75%	1.62%	1.41%	1.27%	1.04%	0.88%	0.63%	0.45%

See notes in Table 5.5

industries, the results for capital-intensive are ostensively negative, with the mining sector leading in the decline of export, labor demand, value-added, etc., while the labor-intensive sector actual increase their demand for labor and capital, slightly improve their value-added. This confirmed our inference that the labor-intensive sector deals with trade protection much better. When we target the protection scenario of labor-intensive industries, we notice positive results in sectors like Food & Beverage and the Clothing sector—these sector benefits from trade protection. Even the capital-intensive sectors fare much better than when we target capital-intensive industries with trade protection. Overall, trade protection is a good policy for capital-intensive industries but a wrong approach for labor-intensive industries.

The household results in tables 5.13 and 5.14 confirm the cost of the trade protection scenario. The protection in either industry leads to a decline in household

Table 5.12: Sectoral results of scenario S2 for labor-intensive industries

Increase Tarrrifs by 50%								
Labor-Intesive industries								
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
Agriculture								
P.Consu	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%
Export	2.26%	2.26%	2.26%	2.25%	2.25%	2.25%	2.24%	2.24%
Import	-3.97%	-3.97%	-3.97%	-3.97%	-3.98%	-3.98%	-3.98%	-3.98%
Labor demand	2.70%	2.70%	2.70%	2.70%	2.70%	2.70%	2.70%	2.70%
Capita demand	2.22%	2.22%	2.22%	2.21%	2.21%	2.21%	2.20%	2.20%
Q.ValueAdded	2.39%	2.39%	2.39%	2.39%	2.39%	2.38%	2.38%	2.38%
Mining								
P.Consu								
Export	0.50%	0.52%	0.54%	0.56%	0.58%	0.60%	0.63%	0.65%
Import	-0.91%	-0.92%	-0.93%	-0.94%	-0.95%	-0.96%	-0.97%	-0.97%
Labor demand	0.76%	0.77%	0.80%	0.81%	0.84%	0.86%	0.89%	0.91%
Capita demand	0.44%	0.46%	0.48%	0.50%	0.52%	0.54%	0.57%	0.59%
Q.ValueAdded	0.52%	0.53%	0.55%	0.57%	0.60%	0.61%	0.64%	0.66%
Food and Beverage								
P.Consu	1.55%	1.54%	1.52%	1.51%	1.50%	1.49%	1.47%	1.46%
Export	7.82%	7.80%	7.77%	7.75%	7.72%	7.70%	7.67%	7.65%
Import	-0.70%	-0.71%	-0.73%	-0.74%	-0.76%	-0.77%	-0.79%	-0.80%
Labor demand	11.25%	11.23%	11.21%	11.20%	11.18%	11.17%	11.15%	11.13%
Capita demand	10.73%	10.72%	10.69%	10.68%	10.65%	10.64%	10.61%	10.60%
Q.ValueAdded	10.89%	10.88%	10.86%	10.84%	10.82%	10.80%	10.78%	10.76%
Clothing								
P.Consu	0.98%	0.97%	0.96%	0.95%	0.94%	0.93%	0.92%	0.91%
Export	9.35%	9.33%	9.30%	9.28%	9.25%	9.23%	9.19%	9.17%
Import	-1.32%	-1.33%	-1.35%	-1.37%	-1.39%	-1.41%	-1.43%	-1.44%
Labor demand	11.86%	11.85%	11.82%	11.81%	11.78%	11.76%	11.74%	11.72%
Capita demand	11.34%	11.33%	11.30%	11.28%	11.25%	11.23%	11.21%	11.19%
Q.ValueAdded	11.53%	11.51%	11.49%	11.47%	11.44%	11.42%	11.40%	11.38%
Manufacturing								
P.Consu	-0.21%	-0.21%	-0.21%	-0.21%	-0.21%	-0.21%	-0.22%	-0.22%
Export	-0.29%	-0.28%	-0.28%	-0.27%	-0.27%	-0.26%	-0.25%	-0.24%
Import	-0.29%	-0.29%	-0.28%	-0.28%	-0.27%	-0.26%	-0.26%	-0.25%
Labor demand	0.20%	0.21%	0.22%	0.22%	0.23%	0.24%	0.25%	0.26%
Capita demand	-0.14%	-0.14%	-0.14%	-0.13%	-0.12%	-0.12%	-0.11%	-0.10%
Q.ValueAdded	-0.05%	-0.04%	-0.04%	-0.03%	-0.02%	-0.02%	-0.01%	0.00%

See notes in Table 5.5

Table 5.13: Household results of scenario S2 for capital intensive industries

Increase tariff by 50%								
Capital-Intesive Industries								
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
Household Income	-1.62%	-1.61%	-1.62%	-1.62%	-1.63%	-1.63%	-1.64%	-1.64%
Commodity demand								
CAGR	-0.48%	-0.48%	-0.49%	-0.49%	-0.50%	-0.49%	-0.50%	-0.50%
CMING								
CFNB	-0.79%	-0.79%	-0.80%	-0.80%	-0.81%	-0.81%	-0.83%	-0.82%
CCLTH	-0.96%	-0.95%	-0.97%	-0.96%	-0.98%	-0.98%	-1.00%	-0.99%
CMAN	-2.69%	-2.68%	-2.72%	-2.71%	-2.75%	-2.74%	-2.79%	-2.77%
CENRG	-2.22%	-2.20%	-2.27%	-2.25%	-2.33%	-2.31%	-2.39%	-2.36%
CWTSAN	-1.97%	-1.96%	-2.00%	-1.99%	-2.03%	-2.01%	-2.06%	-2.04%
CCONS	-0.88%	-0.88%	-0.89%	-0.89%	-0.89%	-0.89%	-0.89%	-0.89%
CTRAD	-0.75%	-0.74%	-0.76%	-0.75%	-0.77%	-0.77%	-0.78%	-0.78%
CTRAN	-0.95%	-0.94%	-0.96%	-0.96%	-0.98%	-0.97%	-0.99%	-0.98%
CSRV	-0.70%	-0.69%	-0.71%	-0.71%	-0.73%	-0.72%	-0.75%	-0.74%

income. However, the fall is more profound when we protect capital-intensive industries than when we protect labor-intensive sectors. The income decline leads to an across-the-table drop in demand for commodities. There is a more than proportional decline for items in either industry targeted.

Table 5.14: Household results of scenario S2 for labor-intensive industries

Increase tariff by 50%								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Household Income	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%	-0.27%
Commodity demand								
CAGR	-0.50%	-0.49%	-0.50%	-0.50%	-0.51%	-0.50%	-0.51%	-0.51%
CMING								
CFNB	-2.28%	-2.27%	-2.29%	-2.29%	-2.31%	-2.30%	-2.33%	-2.32%
CCLTH	-1.80%	-1.80%	-1.81%	-1.81%	-1.82%	-1.82%	-1.83%	-1.82%
CMAN	-0.20%	-0.19%	-0.20%	-0.20%	-0.20%	-0.20%	-0.20%	-0.20%
CENRG	-0.13%	-0.13%	-0.13%	-0.13%	-0.13%	-0.13%	-0.13%	-0.13%
CWTSAN	-0.15%	-0.15%	-0.15%	-0.15%	-0.15%	-0.15%	-0.15%	-0.15%
CCONS	-0.13%	-0.13%	-0.13%	-0.13%	-0.13%	-0.13%	-0.14%	-0.14%
CTRAD	-0.21%	-0.21%	-0.21%	-0.21%	-0.21%	-0.21%	-0.21%	-0.21%
CTRAN	-0.12%	-0.12%	-0.12%	-0.12%	-0.13%	-0.13%	-0.13%	-0.13%
CSRV	-0.23%	-0.23%	-0.23%	-0.23%	-0.24%	-0.23%	-0.24%	-0.24%

Table 5.15: Macro results of scenario S3 for capital-intensive industries

Decrease tariff by 50%								
Capital-intensive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	-0.22%	-0.22%	-0.22%	-0.22%	-0.22%	-0.22%	-0.23%	-0.22%
GDP	1.83%	1.82%	1.86%	1.85%	1.89%	1.88%	1.92%	1.91%
Wage	1.06%	1.08%	0.98%	1.01%	0.88%	0.92%	0.77%	0.82%
K.rent	1.51%	1.49%	1.58%	1.55%	1.65%	1.62%	1.73%	1.70%
X	13.16%	12.85%	14.04%	13.68%	15.04%	14.63%	16.21%	15.72%
M	4.79%	4.77%	4.86%	4.83%	4.94%	4.90%	5.03%	4.99%
TLD	0.21%	0.22%	0.19%	0.20%	0.18%	0.18%	0.15%	0.16%
TKD	0.60%	0.59%	0.63%	0.62%	0.66%	0.64%	0.69%	0.68%

See notes in Table 5.3

Table 5.16: Macro results of scenario S3 for labor-intensive industries

Decrease tariff by 50%								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	-1.02%	-1.02%	-1.02%	-1.02%	-1.02%	-1.02%	-1.02%	-1.02%
GDP	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Wage	0.43%	0.42%	0.43%	0.43%	0.43%	0.43%	0.44%	0.43%
K.rent	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%
X	0.19%	0.21%	0.16%	0.17%	0.11%	0.13%	0.06%	0.08%
M	2.58%	2.58%	2.57%	2.57%	2.56%	2.56%	2.55%	2.55%
TLD	0.08%	0.08%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%
TKD	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%

See notes in Table 5.3

S3: Decrease Tariffs by 50%

Tables 5.15 and 5.16 present the results of a scenario where the government implements a free trade industrial policy instead of a protectionist policy, as in scenario S2. Tables 5.15 and 5.16 show that Ghana could benefit from such an industrial policy, especially in capital-intensive industries with a significant reliance on imported intermediate supplies. The exports expand by 16.21% by the year-end. The import growth is much lower than exports, evidencing increased domestic content in Ghana exports. The capital-intensive industries are positive also, however of much lower magnitude.

Table 5.17: Sectoral results of scenario S3 in capital-intensive industries

Decrease tariffs by 50%								
Capital-intensive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Agriculture								
P.Consu	1.28%	1.29%	1.29%	1.30%	1.30%	1.31%	1.32%	1.32%
Export	-1.94%	-1.94%	-1.93%	-1.92%	-1.91%	-1.90%	-1.89%	-1.88%
Import	2.23%	2.25%	2.26%	2.27%	2.29%	2.31%	2.33%	2.34%
Labor demand	-0.12%	-0.06%	0.03%	0.10%	0.21%	0.29%	0.42%	0.51%
Capita demand	-0.70%	-0.72%	-0.76%	-0.78%	-0.82%	-0.85%	-0.90%	-0.93%
Q.ValueAdded	-0.49%	-0.48%	-0.47%	-0.46%	-0.45%	-0.44%	-0.42%	-0.41%
Mining								
P.Consu								
Export	22.24%	22.69%	23.40%	23.91%	24.70%	25.28%	26.18%	26.84%
Import	-6.51%	-6.54%	-6.58%	-6.60%	-6.62%	-6.63%	-6.64%	-6.64%
Labor demand	16.77%	17.24%	17.98%	18.51%	19.34%	19.95%	20.90%	21.60%
Capita demand	16.31%	16.72%	17.36%	17.81%	18.52%	19.04%	19.84%	20.42%
Q.ValueAdded	16.42%	16.84%	17.50%	17.97%	18.71%	19.25%	20.08%	20.69%
Food and Beverage								
P.Consu	1.03%	1.03%	1.04%	1.05%	1.06%	1.06%	1.07%	1.08%
Export	-2.14%	-2.16%	-2.21%	-2.24%	-2.30%	-2.34%	-2.41%	-2.46%
Import	1.38%	1.36%	1.34%	1.31%	1.28%	1.25%	1.21%	1.17%
Labor demand	-1.27%	-1.25%	-1.21%	-1.19%	-1.14%	-1.11%	-1.06%	-1.03%
Capita demand	-1.85%	-1.91%	-1.99%	-2.06%	-2.16%	-2.24%	-2.36%	-2.45%
Q.ValueAdded	-1.67%	-1.70%	-1.75%	-1.79%	-1.84%	-1.89%	-1.96%	-2.01%
Clothing								
P.Consu	0.98%	0.98%	0.99%	1.00%	1.01%	1.01%	1.02%	1.03%
Export	1.85%	1.83%	1.79%	1.76%	1.72%	1.68%	1.62%	1.57%
Import	0.78%	0.76%	0.71%	0.68%	0.63%	0.59%	0.52%	0.47%
Labor demand	-0.83%	-0.81%	-0.78%	-0.76%	-0.73%	-0.71%	-0.67%	-0.64%
Capita demand	-1.41%	-1.47%	-1.57%	-1.64%	-1.75%	-1.83%	-1.97%	-2.07%
Q.ValueAdded	-1.20%	-1.23%	-1.29%	-1.32%	-1.39%	-1.43%	-1.51%	-1.56%
Manufacturing								
P.Consu	-0.35%	-0.33%	-0.31%	-0.30%	-0.28%	-0.27%	-0.25%	-0.24%
Export	6.31%	6.56%	6.96%	7.25%	7.71%	8.04%	8.55%	8.93%
Import	3.65%	3.79%	4.02%	4.18%	4.44%	4.63%	4.93%	5.16%
Labor demand	-0.31%	-0.08%	0.29%	0.56%	0.99%	1.30%	1.79%	2.15%
Capita demand	-0.75%	-0.58%	-0.30%	-0.10%	0.20%	0.43%	0.78%	1.04%
Q.ValueAdded	-0.63%	-0.44%	-0.14%	0.08%	0.42%	0.67%	1.06%	1.35%

See notes in Table 5.5

The sectoral results in tables 5.17 and 5.18 illustrate which sectors are boosting the positive results at the macro level. Lower tariffs on capital-intensive industries increase labor demand, capital demand, exports, and value-added in the Mining sector. Manufacturing also sees an increase in exports, however, a decline in value-added. Worthy of note is that tariffs in manufacturing were already low, so a 50% drop does have as significant an impact as in a scenario where we set the tariff to zero. Indeed such a scenario has much better results, as we confirmed; however not presented here. A free trade scenario in the labor-intensive shows that the labor-intensive sector would be the big loser. Their value-added, labor demand, and exports all decline, particularly in Agro-industries and clothing industries.

The household sees positive income gains, as evidenced by tables 5.19 and 5.20. The pay increases much higher when we cut tariffs on capital-intensive industries,

Table 5.18: Sectoral results of scenario S3 for labor-intensive industries

Decrease tariffs by 50%								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Agriculture								
P.Consu	-0.09%	-0.09%	-0.09%	-0.09%	-0.09%	-0.09%	-0.08%	-0.08%
Export	-2.40%	-2.40%	-2.40%	-2.39%	-2.39%	-2.39%	-2.38%	-2.38%
Import	4.58%	4.58%	4.58%	4.59%	4.59%	4.59%	4.59%	4.59%
Labor demand	-2.84%	-2.84%	-2.84%	-2.84%	-2.84%	-2.84%	-2.84%	-2.84%
Capita demand	-2.37%	-2.37%	-2.36%	-2.36%	-2.36%	-2.36%	-2.35%	-2.35%
Q.ValueAdded	-2.54%	-2.54%	-2.54%	-2.54%	-2.53%	-2.53%	-2.53%	-2.53%
Mining								
P.Consu								
Export	-0.54%	-0.55%	-0.58%	-0.59%	-0.62%	-0.64%	-0.67%	-0.69%
Import	1.02%	1.03%	1.04%	1.05%	1.06%	1.07%	1.08%	1.09%
Labor demand	-0.80%	-0.82%	-0.84%	-0.86%	-0.89%	-0.91%	-0.94%	-0.97%
Capita demand	-0.48%	-0.50%	-0.52%	-0.54%	-0.56%	-0.58%	-0.61%	-0.63%
Q.ValueAdded	-0.55%	-0.57%	-0.59%	-0.61%	-0.64%	-0.66%	-0.69%	-0.71%
Food and Beverage								
P.Consu	-1.63%	-1.62%	-1.61%	-1.60%	-1.58%	-1.57%	-1.56%	-1.55%
Export	-8.03%	-8.02%	-7.99%	-7.97%	-7.94%	-7.92%	-7.89%	-7.87%
Import	0.36%	0.37%	0.39%	0.40%	0.42%	0.44%	0.46%	0.47%
Labor demand	-11.21%	-11.20%	-11.18%	-11.17%	-11.15%	-11.14%	-11.12%	-11.11%
Capita demand	-10.78%	-10.76%	-10.74%	-10.73%	-10.71%	-10.70%	-10.68%	-10.66%
Q.ValueAdded	-10.91%	-10.90%	-10.88%	-10.87%	-10.85%	-10.83%	-10.81%	-10.80%
Clothing								
P.Consu	-1.05%	-1.04%	-1.03%	-1.02%	-1.01%	-1.00%	-0.99%	-0.98%
Export	-9.75%	-9.73%	-9.71%	-9.69%	-9.66%	-9.64%	-9.61%	-9.59%
Import	0.88%	0.90%	0.92%	0.94%	0.96%	0.98%	1.00%	1.02%
Labor demand	-11.98%	-11.96%	-11.94%	-11.93%	-11.91%	-11.89%	-11.87%	-11.86%
Capita demand	-11.55%	-11.54%	-11.51%	-11.50%	-11.47%	-11.46%	-11.43%	-11.42%
Q.ValueAdded	-11.70%	-11.69%	-11.67%	-11.65%	-11.63%	-11.61%	-11.59%	-11.57%
Manufacturing								
P.Consu	0.23%	0.23%	0.23%	0.23%	0.23%	0.23%	0.23%	0.24%
Export	0.35%	0.35%	0.34%	0.34%	0.33%	0.32%	0.31%	0.31%
Import	0.32%	0.32%	0.31%	0.31%	0.30%	0.30%	0.29%	0.28%
Labor demand	-0.19%	-0.20%	-0.21%	-0.21%	-0.22%	-0.23%	-0.24%	-0.25%
Capita demand	0.17%	0.17%	0.16%	0.16%	0.15%	0.14%	0.13%	0.13%
Q.ValueAdded	0.07%	0.06%	0.06%	0.05%	0.05%	0.04%	0.03%	0.02%

See notes in Table 5.5

Table 5.19: Household results of scenario S3 for capital-intensive industries

Decrease tariff by 50%								
Capital-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Household Income	1.74%	1.74%	1.76%	1.75%	1.77%	1.77%	1.79%	1.78%
Commodity demand								
CAGR	0.51%	0.51%	0.52%	0.52%	0.53%	0.53%	0.54%	0.54%
CMING								
CFNB	0.85%	0.84%	0.86%	0.86%	0.87%	0.87%	0.89%	0.88%
CCLTH	1.03%	1.02%	1.04%	1.03%	1.06%	1.05%	1.07%	1.06%
CMAN	2.98%	2.97%	3.02%	3.01%	3.06%	3.04%	3.10%	3.08%
CENRG	2.53%	2.50%	2.59%	2.57%	2.67%	2.64%	2.75%	2.71%
CWTSAN	2.16%	2.14%	2.19%	2.18%	2.23%	2.21%	2.27%	2.25%
CCONS	0.92%	0.92%	0.92%	0.92%	0.92%	0.92%	0.92%	0.92%
CTRAD	0.80%	0.79%	0.81%	0.81%	0.83%	0.82%	0.84%	0.84%
CTRAN	1.02%	1.02%	1.04%	1.03%	1.06%	1.05%	1.07%	1.07%
CSRV	0.77%	0.76%	0.79%	0.78%	0.81%	0.80%	0.83%	0.82%

as opposed to tariff cuts on labor-intensive industries. Income change derived from capital-intensive will lead to more than proportional change in demand, manufacturing, energy, and water and sewage commodities. While income increase derived from labor increase income will lead to a greater than proportion demand for food and beverage and clothing industries. Its worth noting that these changes in household demand may stem from the fact that the house household variable is a composite

Table 5.20: Household results of scenario S3 for labor-intensive

Decrease tariff by 50%								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Household Income	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%	0.30%
Commodity demand								
CAGR	0.57%	0.57%	0.58%	0.58%	0.58%	0.58%	0.59%	0.59%
CMING								
CFNB	2.63%	2.62%	2.64%	2.64%	2.66%	2.66%	2.68%	2.67%
CCLTH	2.07%	2.07%	2.08%	2.08%	2.09%	2.09%	2.10%	2.09%
CMAN	0.21%	0.21%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%
CENRG	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%
CWTSAN	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.17%	0.17%
CCONS	0.14%	0.14%	0.14%	0.14%	0.15%	0.15%	0.15%	0.15%
CTRAD	0.23%	0.23%	0.23%	0.23%	0.23%	0.23%	0.23%	0.23%
CTRAN	0.13%	0.13%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%
CSRV	0.25%	0.25%	0.25%	0.25%	0.26%	0.26%	0.26%	0.26%

of different households (rural farm owner, rural, not farm owner, and urban), which was aggregated here for the simplicity in the results display, given that the primary focus of our analysis is not household behavior.

5.3.3 Scenario S4: Decrease tax by 50

Tax policy is one of the industrial policy tools that the government may use to target desired sectors for promotion. Capital-intensive industrialization demands more considerable up-front investment when in comparison with labor-intensive industrialization. Through its tax incentives policy, the government can significantly reduce these costs through tax allowance, subsidies, or accelerated depreciation policies. In this section, we try a scenario where the government cuts firms' tax by 50%. Given their reliance on capital, we expect higher positive results in the capital-intensive sector than in the labor-intensive industry.

Table 5.21: Macro results of scenario S4 for capital-intensive industries

Decrease tax by 50%								
Capital-intensive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	-0.31%	-0.31%	-0.31%	-0.31%	-0.32%	-0.31%	-0.32%	-0.32%
GDP	2.53%	2.51%	2.58%	2.56%	2.64%	2.62%	2.72%	2.69%
Wage	0.69%	0.75%	0.54%	0.60%	0.35%	0.43%	0.12%	0.22%
K.rent	2.42%	2.37%	2.54%	2.49%	2.69%	2.63%	2.87%	2.80%
X	23.75%	23.13%	25.49%	24.78%	27.50%	26.67%	29.84%	28.87%
M	4.49%	4.46%	4.59%	4.55%	4.70%	4.65%	4.83%	4.77%
TLD	0.14%	0.15%	0.11%	0.12%	0.07%	0.09%	0.02%	0.04%
TKD	0.96%	0.94%	1.01%	0.99%	1.07%	1.04%	1.14%	1.11%

See notes in Table 5.3

The results in tables 5.21 and 5.22 confirm our expectations; a 50% cut in tax

Table 5.22: Macro results of scenario S4 in labor-intensive industries

Decrease tax by 50%								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	-1.34%	-1.34%	-1.34%	-1.34%	-1.34%	-1.34%	-1.34%	-1.34%
GDP	0.37%	0.37%	0.37%	0.37%	0.37%	0.37%	0.37%	0.37%
Wage	0.30%	0.29%	0.30%	0.30%	0.31%	0.31%	0.32%	0.31%
K.rent	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%
X	-0.58%	-0.57%	-0.62%	-0.61%	-0.67%	-0.65%	-0.73%	-0.71%
M	0.66%	0.66%	0.66%	0.66%	0.66%	0.66%	0.66%	0.66%
TLD	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%
TKD	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%

See notes in Table 5.3

faced by capital-intensive industries generates a significant positive outcome in the form of a 27.5% increase in exports by the final year. The imports grow by around 4% and the capital rent increases by nearly 3% by the year-end. The growth in capital demand is more significant than the increment in labor demand, evidencing a capital deepening. Conversely, the results of a cut in the tax rate in labor-intensive industries are positive but modest. The export registers a slight decline of -0.73% by the final year. The domestic commodity prices decrease by -1.34% by the year-end.

Tables 5.23 and 5.24 report the sectoral results. The results for capital-intensive industries reinforce the macro findings; the capital-intensive sectors benefit greatly from a tax cut. The mining sector exports grow by 48%; its labor demand increases by 41%, even more, significant than its capital demand growth of 37%. On the same trend, manufacturing also grows reasonably well. Around 23% in the exports, 14% labor demand, also higher than the capital demand of 12%. The results for labor-intensive sectors are positive but of lower magnitude. The food and beverage sector registered export growth of around 5%, labor demand, capital demand, and value-added growth all around 2%.

The household findings reported in tables 5.26 and **??** show an increase in the income of around 2.5% derived from the tax cut in the capital-intensive industries. In contrast, the income increase from the tax cut in labor-intensive industries is more modest, around 0.35%. Worth on note is the relatively significant increase in clothing commodities when labor-intensive face a tax cut. In addition, the manufacturing

Table 5.23: Sectoral results of scenario S4 for capital-intensive industries

Decrease tax by 50%								
Capital-intensive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Agriculture								
P.Consu	1.69%	1.70%	1.71%	1.72%	1.73%	1.74%	1.76%	1.77%
Export	-1.66%	-1.64%	-1.60%	-1.58%	-1.54%	-1.51%	-1.47%	-1.44%
Import	3.90%	3.94%	4.00%	4.04%	4.11%	4.15%	4.23%	4.28%
Labor demand	1.89%	2.02%	2.22%	2.37%	2.61%	2.79%	3.07%	3.29%
Capita demand	-0.65%	-0.68%	-0.72%	-0.76%	-0.82%	-0.87%	-0.94%	-1.00%
Q.ValueAdded	0.27%	0.30%	0.34%	0.37%	0.42%	0.45%	0.50%	0.54%
Mining								
P.Consu								
Export	40.53%	41.42%	42.81%	43.81%	45.39%	46.53%	48.33%	49.64%
Import	-2.41%	-2.37%	-2.30%	-2.24%	-2.14%	-2.06%	-1.92%	-1.80%
Labor demand	33.43%	34.36%	35.80%	36.85%	38.50%	39.71%	41.61%	43.01%
Capita demand	31.21%	31.98%	33.18%	34.04%	35.39%	36.37%	37.91%	39.03%
Q.ValueAdded	31.72%	32.52%	33.78%	34.68%	36.10%	37.13%	38.75%	39.93%
Food and Beverage								
P.Consu	1.35%	1.36%	1.38%	1.39%	1.40%	1.41%	1.43%	1.44%
Export	-3.38%	-3.44%	-3.53%	-3.61%	-3.72%	-3.81%	-3.95%	-4.05%
Import	1.31%	1.27%	1.21%	1.16%	1.09%	1.03%	0.94%	0.86%
Labor demand	-1.10%	-1.06%	-1.00%	-0.95%	-0.87%	-0.81%	-0.72%	-0.65%
Capita demand	-3.56%	-3.67%	-3.85%	-3.98%	-4.18%	-4.34%	-4.59%	-4.77%
Q.ValueAdded	-2.79%	-2.86%	-2.96%	-3.03%	-3.15%	-3.25%	-3.39%	-3.50%
Clothing								
P.Consu	1.28%	1.29%	1.30%	1.32%	1.33%	1.34%	1.36%	1.37%
Export	1.69%	1.64%	1.56%	1.49%	1.39%	1.31%	1.18%	1.07%
Import	0.33%	0.27%	0.18%	0.11%	0.00%	-0.08%	-0.22%	-0.32%
Labor demand	-0.70%	-0.67%	-0.62%	-0.59%	-0.53%	-0.49%	-0.43%	-0.38%
Capita demand	-3.17%	-3.29%	-3.48%	-3.63%	-3.86%	-4.03%	-4.30%	-4.51%
Q.ValueAdded	-2.29%	-2.36%	-2.46%	-2.55%	-2.68%	-2.77%	-2.93%	-3.05%
Manufacturing								
P.Consu	-0.44%	-0.43%	-0.40%	-0.38%	-0.36%	-0.34%	-0.31%	-0.30%
Export	23.96%	24.46%	25.24%	25.81%	26.70%	27.35%	28.38%	29.13%
Import	10.19%	10.46%	10.89%	11.21%	11.71%	12.09%	12.68%	13.12%
Labor demand	14.95%	15.42%	16.15%	16.70%	17.55%	18.19%	19.19%	19.94%
Capita demand	12.80%	13.13%	13.64%	14.01%	14.59%	15.02%	15.70%	16.19%
Q.ValueAdded	13.40%	13.76%	14.33%	14.75%	15.41%	15.89%	16.66%	17.22%

See notes in Table 5.5

and energy commodities registered more than proportional demand growth, echoing previous scenario changes' findings.

5.3.4 Scenario S5: Policy mix (combination S3 and S4)

Our policy mix scenario is a mixture of two simulation scenarios applied simultaneously. We decrease tariffs while at the same time as we decrease taxes for the firms. This is a scenario where the government exposes domestic firms to international competition by lowering domestic first protection. In contrast, the government supports them to withstand this international competition.

The macro results in tables 5.27 and 5.28 show that the economy fares better when capital-intensive industries under this policy mix scenario. Given the capital-intensive reliance on imported intermediate goods, making these imported cheaper

Table 5.24: Sectoral results of scenario S4 for labor-intensive industries

Decrease tax by 50%								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Agriculture								
P.Consu	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.20%	0.20%
Export	0.79%	0.79%	0.79%	0.80%	0.80%	0.81%	0.81%	0.81%
Import	0.99%	0.99%	0.99%	0.99%	0.99%	0.99%	0.99%	0.99%
Labor demand	0.47%	0.47%	0.47%	0.46%	0.46%	0.46%	0.45%	0.44%
Capita demand	0.50%	0.50%	0.51%	0.51%	0.51%	0.52%	0.52%	0.52%
Q.ValueAdded	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%
Mining								
P.Consu								
Export	-0.98%	-1.00%	-1.04%	-1.07%	-1.11%	-1.14%	-1.19%	-1.22%
Import	0.90%	0.90%	0.91%	0.92%	0.92%	0.93%	0.94%	0.94%
Labor demand	-1.06%	-1.08%	-1.12%	-1.15%	-1.20%	-1.23%	-1.28%	-1.32%
Capita demand	-1.04%	-1.06%	-1.10%	-1.12%	-1.16%	-1.19%	-1.23%	-1.27%
Q.ValueAdded	-1.04%	-1.07%	-1.10%	-1.13%	-1.17%	-1.20%	-1.24%	-1.28%
Food and Beverage								
P.Consu	-2.14%	-2.13%	-2.11%	-2.10%	-2.08%	-2.07%	-2.05%	-2.04%
Export	5.03%	5.04%	5.05%	5.06%	5.08%	5.09%	5.11%	5.12%
Import	2.74%	2.75%	2.76%	2.77%	2.79%	2.80%	2.81%	2.83%
Labor demand	2.76%	2.77%	2.78%	2.78%	2.79%	2.80%	2.81%	2.82%
Capita demand	2.79%	2.80%	2.82%	2.83%	2.85%	2.86%	2.88%	2.90%
Q.ValueAdded	2.78%	2.79%	2.80%	2.82%	2.83%	2.84%	2.86%	2.87%
Clothing								
P.Consu	-2.62%	-2.61%	-2.59%	-2.57%	-2.55%	-2.54%	-2.52%	-2.50%
Export	8.03%	8.05%	8.08%	8.10%	8.13%	8.15%	8.19%	8.21%
Import	3.15%	3.16%	3.17%	3.18%	3.19%	3.20%	3.22%	3.23%
Labor demand	3.69%	3.70%	3.71%	3.72%	3.73%	3.74%	3.75%	3.76%
Capita demand	3.72%	3.73%	3.75%	3.77%	3.79%	3.80%	3.82%	3.84%
Q.ValueAdded	3.71%	3.72%	3.74%	3.75%	3.77%	3.78%	3.80%	3.81%
Manufacturing								
P.Consu	0.28%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%
Export	-0.27%	-0.28%	-0.30%	-0.32%	-0.34%	-0.36%	-0.39%	-0.41%
Import	0.38%	0.37%	0.37%	0.36%	0.35%	0.34%	0.32%	0.31%
Labor demand	-0.27%	-0.28%	-0.30%	-0.32%	-0.34%	-0.36%	-0.39%	-0.41%
Capita demand	-0.25%	-0.26%	-0.27%	-0.28%	-0.30%	-0.31%	-0.33%	-0.35%
Q.ValueAdded	-0.25%	-0.26%	-0.28%	-0.29%	-0.31%	-0.33%	-0.35%	-0.36%

See notes in Table 5.5

Table 5.25: Household results of scenario S4 for capital-intensive industries

Decrease tax by 50%								
Capital-intensive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Household Income	2.31%	2.30%	2.34%	2.33%	2.37%	2.36%	2.41%	2.39%
Commodity demand								
CAGR	0.67%	0.67%	0.69%	0.68%	0.70%	0.69%	0.72%	0.71%
CMING								
CFNB	1.11%	1.10%	1.13%	1.12%	1.15%	1.14%	1.18%	1.16%
CCLTH	1.34%	1.33%	1.37%	1.36%	1.39%	1.38%	1.42%	1.41%
CMAN	3.96%	3.93%	4.02%	4.00%	4.09%	4.06%	4.17%	4.13%
CENRG	3.37%	3.33%	3.48%	3.43%	3.60%	3.55%	3.72%	3.66%
CWTSAN	2.84%	2.82%	2.90%	2.88%	2.97%	2.94%	3.03%	3.00%
CCONS	1.11%	1.11%	1.10%	1.10%	1.10%	1.10%	1.09%	1.09%
CTRAD	1.06%	1.05%	1.08%	1.07%	1.11%	1.10%	1.13%	1.12%
CTRAN	1.36%	1.34%	1.38%	1.37%	1.41%	1.40%	1.45%	1.43%
CSRV	1.07%	1.06%	1.11%	1.09%	1.15%	1.13%	1.20%	1.18%

while at the same time lowering their tax burden is a huge incentive to expand production. The GDP has grown by around 5% so far, and this policy generates a more significant increment in GDP. The exports develop by nearly 60%, while the imports grow to around 10%. With this stimulus, we target the labor-intensive sector; it could be more impressive. The GDP growth was a mere 0.66% over the long run. While the exports fell, at the same time as imports grew.

Table 5.26: Household results of scenario S4 for labor-intensive industries

Decrease tax by 50%								
Labor-intensive industries								
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
Household Income	0.35%	0.34%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
Commodity demand								
CAGR	0.32%	0.32%	0.32%	0.32%	0.32%	0.32%	0.33%	0.33%
CMING								
CFNB	3.42%	3.41%	3.45%	3.44%	3.48%	3.47%	3.51%	3.50%
CCLTH	4.62%	4.60%	4.66%	4.64%	4.70%	4.68%	4.74%	4.72%
CMAN	0.24%	0.24%	0.24%	0.24%	0.24%	0.24%	0.24%	0.24%
CENRG	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%
CWTSAN	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%
CCONS	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%
CTRAD	0.28%	0.28%	0.29%	0.28%	0.29%	0.29%	0.29%	0.29%
CTRAN	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%
CSRV	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.36%	0.36%

Table 5.27: Macro results of scenario S5 for capital-intensive industries

Policy mix(Decrease tariff and tax by 50%)								
Capital-Intesive Industries								
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
CPI	-0.53%	-0.53%	-0.54%	-0.54%	-0.55%	-0.55%	-0.56%	-0.56%
GDP	4.58%	4.54%	4.70%	4.65%	4.84%	4.78%	5.02%	4.94%
Wage	1.10%	1.22%	0.72%	0.88%	0.26%	0.45%	-0.31%	-0.07%
K.rent	4.44%	4.34%	4.73%	4.61%	5.08%	4.93%	5.50%	5.33%
X	48.10%	46.56%	52.50%	50.68%	57.71%	55.55%	63.94%	61.36%
M	10.18%	10.08%	10.47%	10.35%	10.82%	10.67%	11.26%	11.07%
TLD	0.22%	0.24%	0.14%	0.17%	0.05%	0.09%	-0.06%	-0.01%
TKD	1.75%	1.71%	1.86%	1.82%	2.00%	1.94%	2.17%	2.10%

See notes in Table 5.3

Table 5.28: Macro results of scenario S5 for labor-intensive industries

Policy mix (Decrease tariff and tax by 50%)								
Labor-intensive industries								
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
CPI	-2.30%	-2.30%	-2.30%	-2.30%	-2.30%	-2.30%	-2.30%	-2.30%
GDP	0.66%	0.66%	0.66%	0.66%	0.66%	0.66%	0.66%	0.66%
Wage	0.71%	0.71%	0.72%	0.72%	0.73%	0.73%	0.74%	0.74%
K.rent	0.40%	0.40%	0.40%	0.40%	0.39%	0.39%	0.39%	0.39%
X	-0.37%	-0.34%	-0.44%	-0.41%	-0.53%	-0.50%	-0.64%	-0.59%
M	3.29%	3.29%	3.28%	3.28%	3.27%	3.28%	3.26%	3.27%
TLD	0.14%	0.14%	0.14%	0.14%	0.15%	0.14%	0.15%	0.15%
TKD	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%

See notes in Table 5.3

The sectoral results in tables 5.29 and 5.30 show impressive growth in mining exports of 95%, while labor demand, capital demand, and Value-added all g by around 60%, under a scenario where we target capital-intensive. Manufacturing also registered impressive growth and around 40% for exports; the imports grew by a significant margin of around 23%, and labor demand also increased. The sectoral table confirms that targeting the labor-intensive sector with this same policy produces less impressive results than targeting capital-intensive industries.

Household benefits reasonably when we target capital-intensive industries with this policy scenario. Tables 5.31 and 5.32 show that their income grows by around

Table 5.29: Sectoral results of scenario S5 for capital-intensive industries

Policy mix(Decrease tariff and tax by 50%)								
Capital-Intesive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Agriculture								
P.Consu	3.04%	3.05%	3.08%	3.09%	3.12%	3.14%	3.17%	3.19%
Export	-3.58%	-3.55%	-3.50%	-3.46%	-3.41%	-3.37%	-3.30%	-3.25%
Import	6.34%	6.40%	6.49%	6.56%	6.66%	6.74%	6.87%	6.96%
Labor demand	2.84%	3.12%	3.55%	3.88%	4.42%	4.82%	5.48%	5.98%
Capita demand	-1.88%	-1.96%	-2.10%	-2.21%	-2.39%	-2.53%	-2.75%	-2.92%
Q.ValueAdded	-0.18%	-0.14%	-0.07%	-0.03%	0.05%	0.10%	0.19%	0.25%
Mining								
P.Consu								
Export	82.02%	84.35%	88.02%	90.73%	95.00%	98.16%	103.16%	106.88%
Import	-8.97%	-8.90%	-8.77%	-8.65%	-8.43%	-8.25%	-7.92%	-7.64%
Labor demand	66.35%	68.72%	72.47%	75.25%	79.68%	82.99%	88.27%	92.24%
Capita demand	61.22%	63.13%	66.12%	68.32%	71.78%	74.33%	78.35%	81.31%
Q.ValueAdded	62.39%	64.40%	67.56%	69.89%	73.57%	76.29%	80.59%	83.77%
Food and Beverage								
P.Consu	2.43%	2.45%	2.48%	2.50%	2.53%	2.55%	2.59%	2.61%
Export	-6.05%	-6.19%	-6.40%	-6.56%	-6.81%	-7.01%	-7.32%	-7.56%
Import	2.26%	2.16%	2.02%	1.90%	1.71%	1.56%	1.32%	1.13%
Labor demand	-1.91%	-1.82%	-1.66%	-1.55%	-1.36%	-1.22%	-0.99%	-0.82%
Capita demand	-6.41%	-6.65%	-7.04%	-7.33%	-7.79%	-8.14%	-8.71%	-9.15%
Q.ValueAdded	-5.02%	-5.16%	-5.38%	-5.54%	-5.81%	-6.01%	-6.34%	-6.59%
Clothing								
P.Consu	2.31%	2.33%	2.36%	2.38%	2.41%	2.43%	2.46%	2.49%
Export	2.89%	2.76%	2.56%	2.39%	2.13%	1.92%	1.59%	1.32%
Import	0.52%	0.38%	0.17%	0.01%	-0.26%	-0.47%	-0.80%	-1.06%
Labor demand	-1.20%	-1.13%	-1.02%	-0.93%	-0.80%	-0.70%	-0.54%	-0.42%
Capita demand	-5.73%	-6.00%	-6.42%	-6.75%	-7.26%	-7.66%	-8.29%	-8.78%
Q.ValueAdded	-4.12%	-4.27%	-4.51%	-4.69%	-4.98%	-5.21%	-5.57%	-5.84%
Manufacturing								
P.Consu	-0.69%	-0.66%	-0.61%	-0.58%	-0.53%	-0.49%	-0.44%	-0.40%
Export	36.73%	37.89%	39.71%	41.05%	43.18%	44.76%	47.27%	49.14%
Import	17.03%	17.67%	18.69%	19.46%	20.68%	21.60%	23.08%	24.20%
Labor demand	19.07%	20.12%	21.79%	23.05%	25.05%	26.57%	29.00%	30.85%
Capita demand	14.95%	15.65%	16.77%	17.59%	18.89%	19.85%	21.38%	22.52%
Q.ValueAdded	16.08%	16.88%	18.15%	19.08%	20.57%	21.69%	23.46%	24.79%

See notes in Table 5.5

4%, while their consumption growth is also reasonably well. The demand for manufacturing, energy, water, and sanitation commodities grows by an impressive 7%, 6%, and 5%, respectively. We target labor-intensive sectors; the results confirm our previous finding when this policy mix needs to steer more growth in household income or their demand for commodities.

5.4 Sensitivity and robustness test

Many assumptions are underlying our model; there is some dependence between the simulation results and the assumptions made. These assumptions include suppositions about various elasticities and other parameters used in this study. Therefore, we have to run a sensitivity analysis to ensure that our model is robust to our choice of parameters. Sensitivity analysis and robustness testing are essential tools to ex-

Table 5.30: Sectoral results of scenario S5 for labor-intensive industries

Policy mix (Decrease tariff and tax by 50%)								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Agriculture								
P.Consu	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%
Export	-1.68%	-1.67%	-1.66%	-1.66%	-1.65%	-1.64%	-1.63%	-1.63%
Import	5.56%	5.56%	5.56%	5.56%	5.56%	5.57%	5.57%	5.57%
Labor demand	-2.41%	-2.42%	-2.42%	-2.42%	-2.43%	-2.43%	-2.44%	-2.44%
Capita demand	-1.92%	-1.91%	-1.91%	-1.90%	-1.90%	-1.89%	-1.89%	-1.88%
Q.ValueAdded	-2.10%	-2.10%	-2.09%	-2.09%	-2.09%	-2.09%	-2.09%	-2.09%
Mining								
P.Consu								
Export	-1.47%	-1.51%	-1.57%	-1.61%	-1.67%	-1.72%	-1.80%	-1.85%
Import	1.90%	1.91%	1.93%	1.95%	1.97%	1.98%	2.00%	2.01%
Labor demand	-1.80%	-1.84%	-1.90%	-1.95%	-2.02%	-2.07%	-2.15%	-2.21%
Capita demand	-1.47%	-1.51%	-1.56%	-1.60%	-1.67%	-1.71%	-1.78%	-1.83%
Q.ValueAdded	-1.55%	-1.58%	-1.64%	-1.68%	-1.75%	-1.79%	-1.87%	-1.92%
Food and Beverage								
P.Consu	-3.68%	-3.66%	-3.63%	-3.60%	-3.57%	-3.55%	-3.52%	-3.50%
Export	-3.38%	-3.35%	-3.31%	-3.28%	-3.23%	-3.20%	-3.16%	-3.13%
Import	3.18%	3.21%	3.24%	3.26%	3.30%	3.32%	3.36%	3.38%
Labor demand	-8.68%	-8.66%	-8.63%	-8.62%	-8.59%	-8.57%	-8.54%	-8.53%
Capita demand	-8.21%	-8.19%	-8.16%	-8.13%	-8.09%	-8.07%	-8.03%	-8.00%
Q.ValueAdded	-8.36%	-8.34%	-8.31%	-8.28%	-8.25%	-8.23%	-8.19%	-8.17%
Clothing								
P.Consu	-3.59%	-3.56%	-3.53%	-3.51%	-3.48%	-3.45%	-3.42%	-3.40%
Export	-2.49%	-2.46%	-2.40%	-2.36%	-2.31%	-2.27%	-2.21%	-2.17%
Import	4.17%	4.19%	4.23%	4.25%	4.29%	4.32%	4.36%	4.38%
Labor demand	-8.64%	-8.61%	-8.58%	-8.56%	-8.53%	-8.50%	-8.47%	-8.45%
Capita demand	-8.17%	-8.14%	-8.10%	-8.07%	-8.03%	-8.00%	-7.96%	-7.92%
Q.ValueAdded	-8.34%	-8.31%	-8.27%	-8.25%	-8.21%	-8.18%	-8.14%	-8.11%
Manufacturing								
P.Consu	0.50%	0.51%	0.51%	0.51%	0.51%	0.51%	0.52%	0.52%
Export	0.11%	0.09%	0.06%	0.04%	0.01%	-0.01%	-0.05%	-0.07%
Import	0.70%	0.69%	0.68%	0.66%	0.65%	0.63%	0.61%	0.59%
Labor demand	-0.44%	-0.46%	-0.48%	-0.50%	-0.54%	-0.56%	-0.60%	-0.63%
Capita demand	-0.06%	-0.07%	-0.09%	-0.11%	-0.13%	-0.15%	-0.18%	-0.20%
Q.ValueAdded	-0.17%	-0.18%	-0.20%	-0.22%	-0.24%	-0.26%	-0.29%	-0.32%

See notes in Table 5.5

Table 5.31: Household results of scenario S5 for capital-intensive industries

Policy mix(Decrease tariff and tax by 50%)								
Capital-Intesive Industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Household Income	4.17%	4.15%	4.23%	4.20%	4.30%	4.27%	4.38%	4.35%
Commodity demand								
CAGR	1.21%	1.20%	1.24%	1.23%	1.27%	1.26%	1.30%	1.29%
CMING								
CFNB	1.99%	1.98%	2.03%	2.02%	2.08%	2.06%	2.12%	2.10%
CCLTH	2.41%	2.40%	2.46%	2.44%	2.51%	2.49%	2.57%	2.54%
CMAN	7.20%	7.16%	7.32%	7.27%	7.45%	7.40%	7.59%	7.52%
CENRG	6.27%	6.19%	6.49%	6.40%	6.72%	6.62%	6.98%	6.85%
CWTSAN	5.16%	5.12%	5.27%	5.23%	5.39%	5.34%	5.51%	5.45%
CCONS	1.98%	1.99%	1.96%	1.97%	1.93%	1.95%	1.89%	1.91%
CTRAD	1.90%	1.88%	1.94%	1.92%	1.99%	1.97%	2.05%	2.02%
CTRAN	2.44%	2.42%	2.49%	2.47%	2.55%	2.53%	2.62%	2.59%
CSRV	1.94%	1.91%	2.02%	1.99%	2.11%	2.07%	2.22%	2.17%

amine the sensitivity of model results to changes in model parameters, assumptions, or data. Sensitivity analysis involves varying one or more model parameters, assumptions, or data points to see how the model results change. Robustness testing consists in examining the sensitivity of the model results to changes in the model

Table 5.32: Household results of scenario S5 for labor-intensive industries

Policy mix (Decrease tariff and tax by 50%)								
Labor-intensive industries								
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
Household Income	0.63%	0.63%	0.64%	0.63%	0.64%	0.64%	0.64%	0.64%
Commodity demand								
CAGR	0.89%	0.88%	0.90%	0.89%	0.90%	0.90%	0.91%	0.91%
CMING								
CFNB	6.19%	6.17%	6.24%	6.22%	6.29%	6.27%	6.34%	6.32%
CCLTH	6.83%	6.81%	6.88%	6.86%	6.93%	6.91%	6.98%	6.95%
CMAN	0.44%	0.44%	0.45%	0.45%	0.45%	0.45%	0.45%	0.45%
CENRG	0.32%	0.32%	0.32%	0.32%	0.32%	0.32%	0.32%	0.32%
CWTSAN	0.34%	0.33%	0.34%	0.34%	0.34%	0.34%	0.35%	0.34%
CCONS	0.27%	0.27%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%
CTRAD	0.50%	0.50%	0.50%	0.50%	0.51%	0.51%	0.51%	0.51%
CTRAN	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%	0.30%	0.30%
CSRV	0.59%	0.59%	0.59%	0.59%	0.60%	0.60%	0.61%	0.60%

structure or specification. Or the model is considered robust if, due to a change in some specific parameter, the difference in results is not significantly different. In our model, we conduct sensitivity analysis by changing the exponent (ρ) of the CES production function by 25% either way. We increased this parameter by 25% and decreased it by the same amount.

Table 5.33: Sensitivity analysis results

	Simulation															
	Increase the exponent (ρ) of the CES production function of q by 25%								**Decrease the exponent (ρ) of the CES production function of q by 25%**							
Sectors/Var	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**	**Year 5**	**period avrg**	**Year 10**	**period avrg**	**Year 15**	**period avrg**	**Year 20**	**period avrg**
CPI	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
GDP	-0.02%	-0.02%	-0.02%	-0.02%	-0.02%	-0.02%	-0.01%	-0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.01%	0.02%
Wage	0.25%	0.26%	0.24%	0.24%	0.23%	0.24%	0.23%	0.23%	-0.23%	-0.24%	-0.22%	-0.23%	-0.22%	-0.22%	-0.21%	-0.21%
K.rent	-0.13%	-0.13%	-0.13%	-0.13%	-0.12%	-0.12%	-0.12%	-0.12%	0.12%	0.13%	0.12%	0.12%	0.11%	0.12%	0.11%	0.11%
X	-0.05%	-0.11%	0.10%	0.04%	0.25%	0.19%	0.40%	0.34%	0.02%	0.07%	-0.10%	-0.05%	-0.22%	-0.17%	-0.35%	-0.30%
M	-0.11%	-0.16%	0.02%	-0.03%	0.16%	0.10%	0.29%	0.24%	0.08%	0.12%	-0.02%	0.02%	-0.13%	-0.09%	-0.24%	-0.19%
TLD	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	-0.05%	-0.05%	-0.04%	-0.05%	-0.04%	-0.04%	-0.04%	-0.04%
TKD	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.04%	0.04%

The results in table 5.33 show the changes in variables is reasonably tiny, meaning our model is robust to change in this parameter. The difference in the price level is practically zero. The GDP change is also minimal, around 0.02%. Therefore, we can reasonably accept that our model is robust enough to the change in the parameter.

5.5 Summary of the results

This chapter proposed to analyze counterfactual policies for Ghana's economy using recursive dynamic CGE developed in Chapter 4. We conceptualized two industrialization strategies for Ghana, one based on capital-intensive industrialization and the other on labor-intensive industrialization. We elaborated 5 counterfactual policies to be simulated. In the first, we entertained a scenario where the efficiency (Total factor productivity) would increase by 2%. The second, we supposed the government increases tariff by 50%; this is a protectionist policy, in the same tradition as Import Substitution Industrialization. The third scenario is where the tariff is reduced by 50%. The fourth is a tax cut scenario, where the tax would be reduced by 50%. Finally, the fifth it's a policy mixing supposition, where the government would combine a policy of trade opening (reduce tariff by 50 percent) and domestic support to firms, through a tax cut by 50%. We analyzed our simulation results from a Macro, sectoral, and household perspective, for both capital- and labor-intensive industries.

Our simulation results show that the capital-intensive sector would benefit greatly under a 2 percent efficiency improvement compared to labor-intensive industries. According to Worldbank (2021), manufacturing (one of the capital-intensive sectors) in Ghana suffers from low productivity. Ghana's manufacturing productivity was reported to be only 20% higher than agriculture productivity (one of the capital-intensive sectors); in comparison, this ratio is 500% in China. The manufacturing and mining sectors led to an increase in positive results. Hence it does make sense that capital-intensive industries see this big boost, while labor-intensive responses were more modest.

When we increase tariffs by 50%, the general result indicates that the cost of protecting capital-intensive industries is high, while the cost is lower for labor-intensive industries. These results must be understood in the sense that capital-intensive industries rely greatly on the import of intermediate supplies for their production; any increase in the price of these supplies would negatively impact their level of operation. While labor-intensive sectors such as agriculture and Food and beverage would benefit from a level of protection, they would increase their labor and capital demand. Their import would decline while their export would improve. The value-added aggregation would also improve. The conclusion is that trade protection would hurt manufacturing and mining while benefiting agriculture, clothing, and food and beverage industries.

The scenario of reducing tariffs unsurprisingly gives a big boost to capital-intensive industries. These sectors increased their exports while reducing their import, meaning there is an increase in domestic input in the exports, with implication for increased demand for labor (in the mining sector); the policy would translate into a trade surplus for Ghana. While the labor-intensive sector corroborates the previous find, they would be losers from a trade opening program. In conclusion, a free trade policy would boost the capital-intensive sectors while hurting the labor-intensive sector.

A tax reduction policy would also benefit capital-intensive industries; given the huge capital requirement of these sectors, it's unsurprising that they would be benefited from a cost reduction. A tax cut in these sectors would encourage investment and growth in these industries and promote job creation. On the other end, tax reduction for the labor-intensive sector, would not amount to much in terms of a positive outcome.

In the policy mix scenario, the government would reduce tariffs, exposing domestic firms to international competition, while giving them domestic support through tax reduction. The capital-intensive sector would fare much better under such a policy; they would bust their value-added, increase labor and capital demand, and lead to a big increase in the GDP. Targeting labor-intensive industries with such a policy would not produce significantly positive results.

There's higher growth potential derived from an efficiency improvement in capital-intensive industries, while the results for the labor-intensive industries are modest. A protectionist policy would benefit labor-intensive industries while hurting capital-intensive sectors. While a free trade policy would benefit capital-intensive industries. A tax reduction would produce better results when targeted at capital-intensive industries.

After we confirm that our model produces the expected results, we run a sensitivity and robustness check. We change a key parameter by the same amount either way. Our conclusion is that our model is reasonably robust since the change in the variables caused by the change in parameter was small enough.

The findings of this study align with previous research on CGE analysis in Ghana, as summarized in table 5.1. For example, our results corroborate the findings of Breisinger et al. (2009b), who concluded that the acceleration of individual sectors alone is insufficient for achieving overall economic acceleration in Ghana. Similarly, we observed that increased tariffs have a negative impact on GDP and sectoral output, which is consistent with the findings reported by Iddrisu (2020). Furthermore, our study reinforces the positive effect of policies such as tariff cuts or elimination on household welfare, which is in line with the findings of Bhasin and Obeng (2006); Arbenser (2004). These studies also reported a positive impact on household welfare resulting from such policies. Lastly, our research highlights the strong interlinkage between the development of agro-industries and overall industrial improvement. We find that the industry sector in Ghana heavily relies on imported inputs for its output, a finding that supports the existing literature.

Overall, the findings of this study are consistent with previous CGE research conducted in Ghana, confirming the relationships and impacts identified in earlier studies. By building upon and reinforcing these existing findings, our study contributes to the broader understanding of the Ghanaian economy and the implications of various policy interventions.

5.6 Conclusion

This chapter focuses on constructing a counterfactual scenario based on Ghana's industrial policy plan to analyze the potential outcomes of various policy options proposed for the country. The aim is to provide a rigorous assessment of the implications of different policy choices and their potential impact on Ghana's industrial development.

The outcomes generated from our simulations provide intriguing observations regarding the dynamics of the labor market and its response to various policy interventions. To capture household behavior, we employed the Linear Expenditure System (LES), which enabled us to gain valuable insights into the composition of household consumption baskets in response to changes in income. Specifically, we were able to analyze how households may adjust their consumption patterns, increasing their consumption of certain goods while reducing their consumption of others, based on the classification of these commodities as normal or inferior goods.

The results of our analysis provide evidence in favor of implementing industrial policies that specifically target certain sectors in Ghana. Our findings suggest that if the government focuses on capital-intensive industries and implements measures such as tariff reductions, tax cuts, or initiatives to enhance their efficiency, it can yield substantial positive outcomes in terms of economic growth, value-added generation, and increased demand for labor and capital, among other factors. Additionally, such policies would have a notable impact on household income, leading to significant improvements.

Conversely, our analysis indicates that protecting capital-intensive industries through tariffs can have detrimental effects on economic growth. The preservation of such sectors incurs considerable costs that hinder overall economic progress. In contrast, our findings suggest that labor-intensive industries exhibit indications of benefiting from protectionist policies, which can foster positive outcomes for the economy. Therefore, based on our findings, targeted industrial policies that focus on capital-intensive industries with measures to enhance efficiency are recommended, while caution is advised when considering protectionist measures for these sectors. Meanwhile, protectionist policies may prove more favorable for labor-intensive industries.

The findings of this chapter are expected to be of significant interest to academic research focusing on industrial policy, as well as the dynamics of capital-intensive and labor-intensive industries. By employing our approach, we contribute to the broader understanding of the intricate linkages between these industries and the overall economy. Our research sheds light on the potential implications of targeted industrial policies on economic growth and development. Furthermore, our findings offer valuable insights that can inform policymakers. The identification of sectors with higher potential to drive economic growth and development can guide policy decisions and interventions. As such, our research holds relevance for policymakers seeking to design effective strategies to promote economic prosperity. Overall, our study contributes to both academic research and policymaking by expanding the knowledge base surrounding industrial policy, capital-intensive and labor-intensive industries, and their impact on economic growth and development.

It is important to acknowledge the limitations of this study, which stem from the absence of comprehensive information on various parameters necessary for model estimation. Specifically, the lack of detailed data on elasticities constrains the model's realism and flexibility, potentially limiting the depth of insights into Ghana's economy. Furthermore, the utilization of a more recent and updated Social Accounting Matrix (SAM) as a benchmark would enhance the accuracy and relevance of the findings. Despite these limitations, the study still provides valuable insights into Ghana's economy and the potential outcomes associated with the implementation of industrial policies. The findings offer a valuable starting point for understanding the potential effects of policy interventions and their implications for economic growth and development in the country. It is important to recognize the need for further research and data collection to refine and improve the model's accuracy. Future studies that address the limitations mentioned can contribute to a more comprehensive understanding of Ghana's economy and the potential impacts of industrial policy implementation.

The next logical step in advancing this research is to conduct a detailed estimation of the various elasticities involved in the model, aiming to enhance its realism and accuracy. By incorporating these estimated elasticities, the model can capture a more nuanced understanding of the economic dynamics and interactions within Ghana's economy. Considering Ghana's increasing integration within regional economic blocs and the study's findings on the significance of trade, it would be particularly intriguing to extend the analysis by developing a multi-country dynamic model. Such a model could enable an examination of the hypothesis of a free trade industrial policy, not only for Ghana but also for the broader region. By incorporating the interactions and interdependencies between multiple countries, this expanded analysis could provide valuable insights into the potential implications of regional trade agreements, harmonized policies, and cooperative approaches to industrial policy.

This extension would not only offer a more comprehensive understanding of the impacts of trade policies but also contribute to the ongoing discussions and debates surrounding regional economic integration and cooperation. The findings could be particularly relevant for policymakers in Ghana and other countries within the region, helping to inform their decision-making processes regarding trade and industrial policies. Overall, building a multi-country dynamic model to analyze the hypotheses of a free trade industrial policy would be a valuable and thought-provoking direction for further research, broadening the scope and implications of the study's initial findings.

Appendix A

Appendix (Chapter 2)

Figure A.1: Labor and Manufacture value-added as share on total 1960s to 2010s
Source: UNIDO

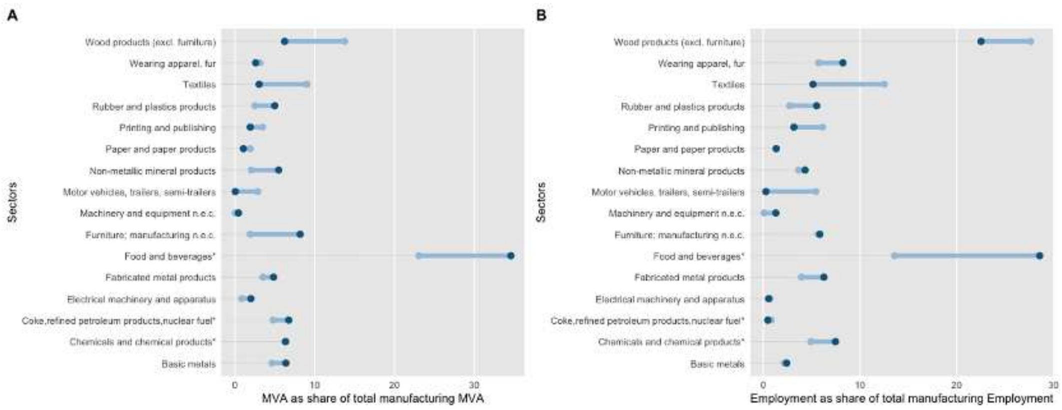


Figure A.2: Industries and Manufacture share in GDPSource: WDI

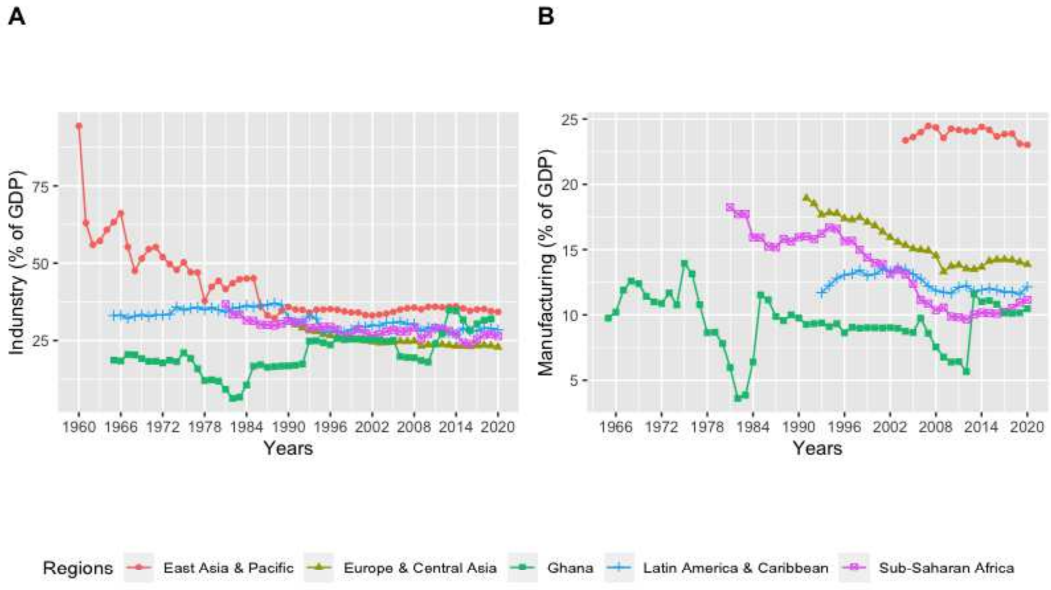


Figure A.3: Ghana'GDP composition (In million USD)Source: UNIDO

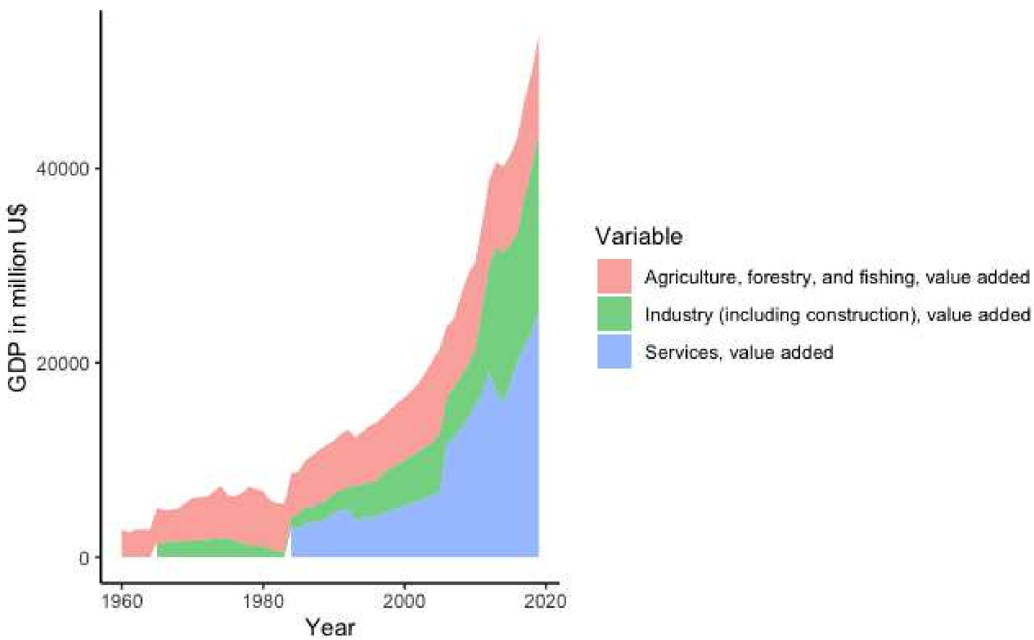
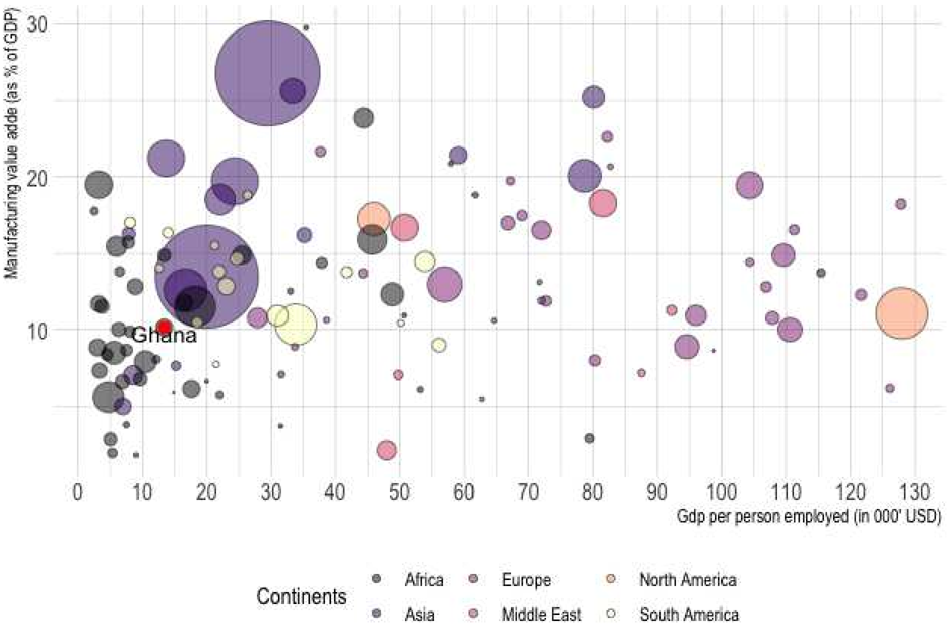


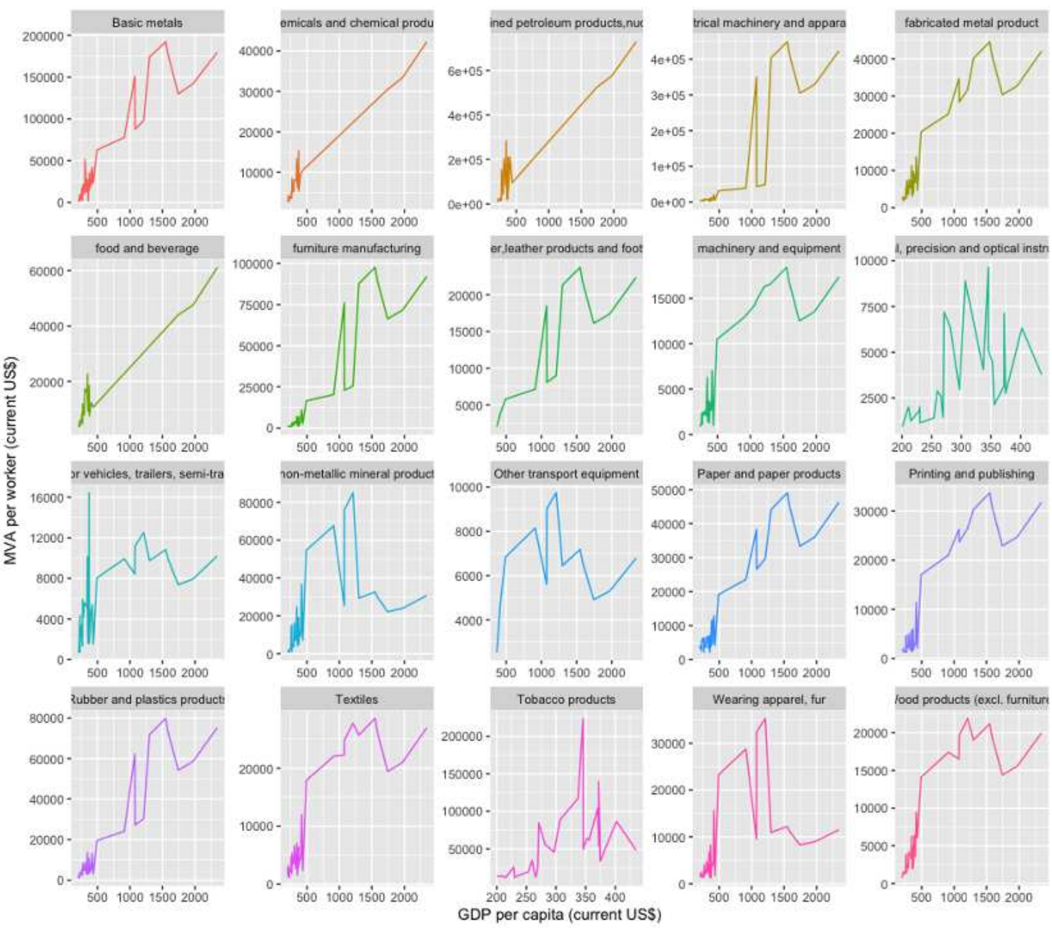
Figure A.4: Manufacturing value-added vs. GDP per workerSource: World Bank



Appendix B

Appendix (Chapter 3)

Figure B.1: Manufacturing value-added vs GDP per capita



Appendix C

Appendix (Chapter 4)

Paramters

α^q scale parameter of CES production function of q

α_c^q scale parameter of CES production function for c

α_c^q scale parameter of the Armington CES function for c

α_a^a scale parameter of CES production function for a

α_a^t scale parameter of the CET function of a

α^{va} scale parameter of the value-added CES production

α_c^{ac} scale parameter the CES function in the QX block for c

β_c LES system, marginal budget share spending on commodity c

γ_c LES subsistence consumption on c

δ^q share parameter of the output CES production function of q

δ_c^q share parameter of the output CES production function of c

δ_c^q share parameter of the Armington CES function of C

δ_a^a share parameter of the output CES function of a

δ_c^t share parameter of the CET function of a

δ^{va} share parameter of the value-added CES function

δ_{ac}^{ac} share parameter of the CES production in the QX block for c

ε elasticity of substitution (definition may vary depending on the context)

ρ exponent of the CES production function of q

ρ_c exponent of the CES production

ρ_c^q function of c exponent of the Armington CES function for c

ρ_a^a exponent of the CES production function of a

ρ_a^t exponent of the CET function in trade models

ρ^{va} exponent of the value-added CES function

ρ_c^{ac} exponent of the CES function for c in the QX block

Parameters (latin letters)

apiwt activity price index weights

cpiwt CPI weights

eho constant term of the consumption function

a'_{cc} input coefficient of using c to produce c'

ica_{ca} input coefficient of using a to produce c

$ictt_{(ct,c)}$ trade and transport margin input ct used to produce one of c

iett proportion of transport margin to the amount of export

mpc marginal propensity to consume

mps marginal propensity to save

$oxac_{ac}$ output c per unit of activity a in the QX block

pwe_c world price of export of commodity c

pwe_a world price of export of activity product a

ppiwt PPI weights

pwm_c world price of import of commodity c

rvati VAT refund of intermediate inputs

$shareg_c$ share of government's consumption expenditure on commodity c

$shareh_c$ share of households' consumption expenditure on commodity c

$shareif_entk$ share of the capital income kept internally in enterprises

$shareif_hk$ share of the capital income paid to households (or to group h)

$shareif_hl$ share of the labor income paid to household group h

$sube_a$ subsidy rate for export of activity product a

$trasfer_{(hent)}$ enterprise's transfer payment to households (or group h)

$trasfer_{(hg)}$ government's transfer payments to households (or group h)

$trasfer_{(hrow)}$ rest-of-the-world's transfer payments to enterprises

te_a export tax rate of activity product a

te_c export tax rate of commodity c

ti income tax rate of households

$tibus$ tax rate on the business capital income

ti_{ent} business income tax rate, corporate income tax rate

tm_c Import tarrif rate for c

$tpayment$ employers' payroll tax rate

$tpayhh$ households' payroll tax rate

$tsale_c$ sales' tax rate

$tvat$ VAT tax rate

$tvatl$ VAT tax rate on employment (consumption-type VAT rate)

$tvatk$ VAT tax rate on capital

$tvatp_c$ VAT tax rate, tax burden on consumers

Variables

API Activity Price Index

CPI Consumer Price Index

$DUMMYSI$ Dummy variable for the dependency of the savings-Investment function

EG Government total expenditure

EH Total consumption expenditure of households

EXR Exchange rate

GDP Gross Domestic Product

$INVADJ$ Investment adjust factor

PA_a Price of activity a

PC_a Price of the commodity c

PDA_a Price of activity a produced and supplied domestically

PDC_c Price of commodity c produced and supplied domestically

PE_a Export price of a including subsidy

PE_c Export price of c including subsidy

$PINTA_a$ Price of aggregate intermediate input a

PM_c Import price of c including tarrif paid by domestic buyers

PP_c Producer's price of commodity c

PPI Producer Price Index (Note PPI is not weighted PP_c)

PQ_c Purchaser's price of commodity c

$PQENT_c$ Enterprises' purchaser's price of commodity c

PQH_c Household purchaser's price of commodity c

PQS_c Supplier's price of commodity c

PVA_a Price of aggregate value-added input for activity a

PX_c Price of composite c from activity a

$PXAC_{(a,c)}$ Price of commodity c from activity a

QA_a Quantity of activity a

QC_c Quantity of the commodity c

$QCTT_c$ Trade and transport margin input used in commodity c

$QCTT_{(ct,c)}$ Trade and transport margins of ct used in commodity c

$QCTTA$ Sum of trade and transport margin input

QDA_a Quantity of activity a produced and supplied domestically

QDC_c Quantity of commodity c produced and supplied domestically

QE_a Quantity of export a

QE_c Quantity of export c

QG_c Quantity of government consumption of commodity c

QH_c Quantity demanded for c by households

$QH_{(c,h)}$ Quantity demanded for c by households of group h

$QINT_{(c,a)}$ Quantity of intermediate input c used in production of a

$QINTA_a$ Quantity of aggregate intermediate input of a

$QINV$ Quantity of investment of c by enterprises

QKD_a Capital demand by activity a

QKS Total capital supply

QKS_h Capital supply of group h

$QKSAGG$ Total capital supply

QLD_a Labor demanded by activity a

QLS Total labor supply

QLS_h Labor supply of group h

$QLSAGG$ Total labor supply

QM_c Quantity of import c

QQ_c Total composite commodity supplied in domestic market

QVA_a Quantity of aggregate value-added input for activity a

QX_c Quantity of composite commodity c

$QXAC_{(a,c)}$ Quantity of commodity c from activity a

$SAVEENT$ Enterprise savings

$SAVEF$ Foreign savings or balance of payment

$SAVEG$ Net government savings or fiscal budget balance

$SAVEH$ Household savings

$SAVEH_h$ Household savings of group h

WK Capital price

WL Labor price

$YDISH$ Disposable income of households

$YENT$ Enterprise income

YG Government total revenue

YH Household income

$WALRAS$ Dummy variable for the dependency due to Walras' law

Equations

Production function

$QA_a = \alpha_a^a \cdot (\delta_a^a \cdot QVA_a^\rho + (1-\delta_a^a) \cdot QINTA_a^\rho)^{\frac{1}{\rho}}$

First order condition for optimal use of inputs

$\frac{PVA_a}{PINTA_a} = (\frac{\delta_a^a}{(1-\delta_a^a)}) \cdot (\frac{QVA_a}{QINTA_a})^{(\rho_a - 1)}$

Breakeven condition (supply function)

$PA_a \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a$

$QVA_a = \alpha_{(va)} \cdot ((\alpha_{(va)} \cdot QLD_a^{\rho_{va}}) + (1-\delta_{(va)}) \cdot QKD_a^{\delta_{(va)}})^{(\frac{1}{\rho_a})}$

$(\frac{(1+tpayment) \cdot WL}{WK} = (\frac{\delta_{(va)}}{(1-\delta_{(va)})}) \cdot (\frac{QLD_a}{QKD_a}))^{(\rho^{(va)}-1)}$

$PVA_a \cdot QVA_a = (1 + tpayment_a) \cdot WL \cdot QLD_a + WK \cdot QKD_a$

$QINT_{c,a} = ica_{c,a} \cdot QINTA_a$

$PINTA_a = \sum_a ica_{c,a} \cdot PQ_c$

QX block

$QXAC_{a,c} = oxac_{a,c} \cdot QA_a \cdot PA_a = \sum_a PXAC_{a,c} \cdot oxac_{a,c}$

$QX_c = \alpha_c^{a,c} \cdot \sum_c (\delta_{a,c}^{a,c} \cdot QXAC_{a,c}^{\rho_c^{ac}})^{(\frac{1}{\rho_c^{ac}})}$

$PXAC_{a,c} = PX_c \cdot QX_c \cdot \sum_c (\delta_{a,c}^{ac} \cdot QXAC_{a,c}^{\rho_c^{ac}})^{-1} \cdot \delta_{a,c}^{ac} \cdot QXAC_{a,c}^{(\rho_c^{ac}-1)}$

CET block

$QX_c = \alpha_c^{(cet)} \cdot (QDC_c^{\rho_c^{(cet)}} + (1-\delta_c^{(cet)}) \cdot QE_c^{\delta_c^{(cet)}})$

$\frac{PDC_c}{PE_c} = (\frac{\delta_c^{(cet)}}{(1-\delta_c^{(cet)})}) \cdot (\frac{QDC_c}{QE_c})^{(\delta_c^{(cet)-1})}$

$PX_c \cdot QX_c = PDC_c \cdot QDC_c + PE_c \cdot QE_c$

$PE_c = pwe_c \cdot EXR$

Armington block

$QQ_c = \alpha_c(\delta Qq_c \cdot QDC_c^{\delta Qq_c} + (1 - Qq_c) \cdot QM_c^{\delta Qq_c})^{(\frac{1}{\delta Qq_c})}$

$QQ_c = QDC_c$

$\frac{PDC_c}{PM_c} = (\frac{\delta Qq_c}{(1-\delta Qq_c)}) \cdot (\frac{QDC_c}{QM_c})^{(\delta Qq_c - 1)}$

$PQS_c = QDC_c$

$QQ_c = PDC_c \cdot QDC_c + PM_c \cdot QM_c$

$PM_c = pwm_c \cdot (1 + tm_c) \cdot EXR$

Trade and transport margins block

$QCTT_c = ictt_c \cdot QQ_c$

$QCTTA = \sum_c QCTT_c$

$PQ_c \cdot QQ_c = (1 + tsale_c) \cdot (PQS_c \cdot QQ_c + QTT_c \cdot PQ_c)$

Household block

$YH_h = WL \cdot sharel_h \cdot QLSAGG + shareifhk_h \cdot WK \cdot QKSAGG + transferhg_h \cdot CPI$

$EH_h = eho_h \cdot CPI + mpc_h \cdot (1 - tih_h) \cdot YH_h$

$PQ_c \cdot QH_{c,h} = PQ_c \cdot LESsub_{c,h} + LESbetac, h \cdot (EH_h - sum_c(PQ_c \cdot LESsubc, h))$

$SAVEH_h = eho_h \cdot CPI + (1 - mpc) \cdot (1 - tih_h) \cdot YH_h$

Enterprise block

$YENT = shareifentk \cdot WK \cdot QKSAGG$

$QINV_c = QINV0_c \cdot INVADJ$

$SAVEENT = (1 - tint) \cdot YENT$

Government

$YG = \sum_a (tpayment_a \cdot WL \cdot QLD_a) + \sum_h (tih_h \cdot YH_h) + tiENT \cdot YENT +$

$\sum_c (tsale_c \cdot (PQS_c \cdot QQ_c + QCTT_c \cdot PQ_c) + tm_c \cdot pwm_c \cdot QM_c \cdot EXR)$

$EG = YG - SAVEG$

$PQ_c * QG_c = shareg_c \cdot (EG - \sum_h (transferg_h \cdot CPI))$

Commodity and factor marketing clearing

$QQ_c = \sum_a (QINT_{c,a}) + \sum_h (QH_{c,h}) + QINT_c + QG_c + QCTTA_c$

$\sum_a QLD_a = QLSAGG$

$QLSAGG = LSscale \cdot WL^{LSelas}$

$\sum_a QKD_a = QKSAGG$

$QKSAGG = KSscale \cdot WK^{KSelas}$

Price Indices

$CPI = \sum_c (PQ_c \cdot cpiwt_c)$

$API = \sum_a (PA_a \cdot apiwt_a)$

$SAVEF \cdot EXR = \sum_c (pwm_c \cdot QM_c \cdot EXR) - \sum_c (pwe_c \cdot QE_c \cdot EXR)$

$\sum_c PQ_c \cdot QINV_c =$

$\sum_h (SAVEH_h) + SAVEENT + SAVEG + SAVEF \cdot EXR + dummysi$

Table C.1: Aggregated SAM used in the model

	AAGR	AMING	AFNB	ACLTH	AOIND	AELEC	AWATR	ACONS	ATRAD	ATRAN	ASRV	CAGR	CMING	CFNB	CCLTH	COIND
AAGR	0	0	0	0	0	0	0	0	0	0	0	24,788	0	0	0	0
AMING	0	0	0	0	0	0	0	0	0	0	0	0	30,803	0	0	0
AFNB	0	0	0	0	0	0	0	0	0	0	0	0	0	7,791	0	0
ACLTH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,155	0
AOIND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16,798
AELEC	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
AWATR	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
ACONS	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
ATRAD	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
ATRAN	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
ASRV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAGR	782	0	6,332	147	2,221	0	0	0	222	0	1,647	0	0	0	0	0
CMING	8	87	3	0	4,688	2,962	133	332	0	0	17	0	0	0	0	0
CFNB	540	0	691	5	87	0	0	0	454	67	2,444	0	0	0	0	0
CCLTH	394	47	32	165	26	41	0	0	0	0	972	0	0	0	0	0
COIND	2,107	12,137	486	252	4,494	2,698	2,368	7,309	1,465	5,843	6,532	0	0	0	0	0
CELEC	229	1,403	63	73	259	278	409		537	41	1,806	0	0	0	0	0
CWATR	37	0	7	2	0	496			161		454	0	0	0	0	0
CCONS	108	0	0	5	0			25	89		1,381	0	0	0	0	0
CTRAD	204	1,805	3	0	0	40			68	173	3,395	0	0	0	0	0
CTRAN	519	1,340	45	26	26	349	474	23	8,048	611	1,330	0	0	0	0	0
CSRV	755	5,820	52	61	620	893	305	0	1,438	1,045	18,993	0	0	0	0	0
TRC	0	0	0	0	0						0	5,117	2,222	5,010	2,103	7,987
LAB	8,653	1,870	578	148	1,205	79	56	2,584	4,222	4,888	18,913	0	0	0	0	0
CAP	15,620	6,293	1,305	272	3,172	689	791	18,097	3,364	9,451	19,591	0	0	0	0	0
ENT	0	0	0	0	0						0	0	0	0	0	0
HOHRF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOHNRF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOHU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOV	0	0	0	0	0						0	0	0	0	0	0
DTAX	0	0	0	0	0						0	0	0	0	0	0
ETAX	0	0	0	0	0						0	361	0	0	0	0
MTAX	0	0	0	0	0						0	293	15	1,046	273	3,388
STAX	0	0	0	0	0						0	97	24	2,224	836	4,976
INV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROW	0	0	0	0	0						0	1,256	1,248	5,552	1,319	36,458
TOTAL	29,956	30,803	9,598	1,155	16,798	8,526	4,537	28,370	20,067	22,119	77,475	31,910	34,311	21,623	5,686	69,607

	CELEC	CWATR	CCONS	CTRAD	CTRAN	CSRV	TRC	LAB	CAP	ENT	HOHRF	HOHNRF	HOHU	GOV	DTAX	ETAX	MTAX	STAX	INV	ROW	TOTAL
AAGR	0	0	0	0	0	0	0	0	0	0	3,780	491	896	0	0	0	0	0	0	0	29,956
AMING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30,803
AFNB	0	0	0	0	0	0	0	0	0	0	1,120	184	502	0	0	0	0	0	0	0	9,598
ACLTH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,155
AOIND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16,798
AELEC	8,526					0		0	0		0	0	0						0		8,526
AWATR		4,537				0		0	0		0	0	0						0		4,537
ACONS			28,370			0		0	0		0	0	0						0		28,370
ATRAD				20,067		0		0	0		0	0	0						0		20,067
ATRAN					22,119	0		0	0		0	0	0						0		22,119
ASRV	0	0	0	0	0	77,475	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77,475
CAGR	0	0	0	0	0	0	0	0	0	0	2,717	1,598	9,388	0	0	0	0	0	1,300	5,557	31,910
CMING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,239	24,841	34,311
CFNB	0	0	0	0	0	0	0	0	0	0	3,445	1,771	10,351	0	0	0	0	0	0	1,769	21,623
CCLTH	0	0	0	0	0	0	0	0	0	0	909	424	2,603	0	0	0	0	0	0	73	5,686
COIND	0	0	0	0	0	0	0	0	0	0	2,078	962	6,882	0	0	0	0	0	9,571	4,422	69,607
CELEC						0		0	0		266	268	2,894						0	0	8,526
CWATR						0		0	0		259	221	2,899						0	0	4,537
CCONS						0		0	0		77	28	261						26,394	0	28,370
CTRAD						0	14,925	0	0		4	0	4						0	0	20,622
CTRAN						0	7,514	0	0		579	317	2,836						0	1,810	25,847
CSRV	0	0	0	0	0	0	0	0	0	0	4,560	2,346	20,724	22,341	0	0	0	0	0	17,439	97,390
TRC						0		0	0		0	0	0						0		22,439
LAB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43,196
CAP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	781	79,425
ENT						0		0	63,966		0	0	0	9,020					0		72,986
HOHRF	0	0	0	0	0	0	0	8,385	9,547	4,160	0	0	0	128	0	0	0	0	0	703	22,923
HOHNRF	0	0	0	0	0	0	0	6,116	0	4,239	0	0	0	195	0	0	0	0	0	556	11,106
HOHU	0	0	0	0	0	0	0	28,695	3,017	50,857	0	0	0	1,248	0	0	0	0	0	3,767	87,583
GOV						0		0	0	6,101	9	16	264		7,392	361	5,014	9,688	0	2,762	31,607
DTAX						0		0	0	3,826	102	184	3,280						0		7,392
ETAX						0		0	0		0	0	0						0		361
MTAX	0					0		0	0		0	0	0						0		5,014
STAX				555	4	972		0	0		0	0	0						0		9,688
INV	0	0	0	0	0	0	0	0	0	3,804	3,017	2,294	23,800	-3,053	0	0	0	0	2,540	8,643	41,044
ROW	0	0	0	0	3,724	18,943		0	2,895		0	0	0	1,729					0		73,123
TOTAL	8,526	4,537	28,370	20,622	25,847	97,390	22,439	43,196	79,425	72,986	22,923	11,106	87,583	31,607	7,392	361	5,014	9,688	41,044	73,123	

Appendix D

Appendix (Chapter 5)

Figure D.1: Free trade vs. Protectionist policy (Capital Intensive)

	Protectionism								Free Trade							
	50% Increase in protection for capital-intensice industries								50% Decrease in protection for capital-intensice industries							
Sectors/Var	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg	Year 5	period avrg	Year 10	period avrg	Year 15	period avrg	Year 20	period avrg
Agriculture																
P.Consu	-1.20%	-1.20%	-1.20%	-1.21%	-1.21%	-1.21%	-1.22%	-1.22%	1.28%	1.29%	1.29%	1.30%	1.30%	1.31%	1.32%	1.32%
Export	1.88%	1.87%	1.86%	1.85%	1.83%	1.83%	1.81%	1.80%	-1.94%	-1.94%	-1.93%	-1.92%	-1.91%	-1.90%	-1.89%	-1.88%
Import	-2.06%	-2.07%	-2.08%	-2.09%	-2.10%	-2.11%	-2.13%	-2.14%	2.23%	2.25%	2.26%	2.27%	2.29%	2.31%	2.33%	2.34%
Labor demand	0.44%	0.40%	0.34%	0.29%	0.23%	0.18%	0.10%	0.04%	-0.12%	-0.06%	0.03%	0.10%	0.21%	0.29%	0.42%	0.51%
Capita demand	0.50%	0.51%	0.53%	0.54%	0.56%	0.57%	0.59%	0.61%	-0.70%	-0.72%	-0.76%	-0.78%	-0.82%	-0.85%	-0.90%	-0.93%
Q.ValueAdded	0.48%	0.47%	0.46%	0.45%	0.44%	0.43%	0.41%	0.40%	-0.49%	-0.48%	-0.47%	-0.46%	-0.45%	-0.44%	-0.42%	-0.41%
Mining																
P.Consu																
Export	-15.20%	-15.41%	-15.75%	-15.98%	-16.34%	-16.60%	-17.00%	-17.28%	22.24%	22.69%	23.40%	23.91%	24.70%	25.28%	26.18%	26.84%
Import	6.11%	6.14%	6.18%	6.21%	6.25%	6.27%	6.31%	6.33%	-6.51%	-6.54%	-6.58%	-6.60%	-6.62%	-6.63%	-6.64%	-6.64%
Labor demand	-11.19%	-11.43%	-11.80%	-12.07%	-12.48%	-12.77%	-13.22%	-13.54%	16.77%	17.24%	17.98%	18.51%	19.34%	19.95%	20.90%	21.60%
Capita demand	-11.15%	-11.36%	-11.69%	-11.93%	-12.29%	-12.54%	-12.94%	-13.22%	16.31%	16.72%	17.36%	17.81%	18.52%	19.04%	19.84%	20.42%
Q.ValueAdded	-11.16%	-11.38%	-11.72%	-11.96%	-12.33%	-12.60%	-13.00%	-13.29%	16.42%	16.84%	17.50%	17.97%	18.71%	19.25%	20.08%	20.69%
Food and Beverage																
P.Consu	-0.96%	-0.96%	-0.97%	-0.97%	-0.98%	-0.99%	-0.99%	-1.00%	1.03%	1.03%	1.04%	1.05%	1.06%	1.06%	1.07%	1.08%
Export	1.87%	1.88%	1.90%	1.92%	1.95%	1.97%	2.01%	2.04%	-2.14%	-2.16%	-2.21%	-2.24%	-2.30%	-2.34%	-2.41%	-2.46%
Import	-1.43%	-1.42%	-1.41%	-1.40%	-1.38%	-1.37%	-1.35%	-1.34%	1.38%	1.36%	1.34%	1.31%	1.28%	1.25%	1.21%	1.17%
Labor demand	1.38%	1.36%	1.34%	1.32%	1.29%	1.27%	1.24%	1.22%	-1.27%	-1.25%	-1.21%	-1.19%	-1.14%	-1.11%	-1.06%	-1.03%
Capita demand	1.45%	1.48%	1.53%	1.57%	1.62%	1.67%	1.74%	1.79%	-1.85%	-1.91%	-1.99%	-2.06%	-2.16%	-2.24%	-2.36%	-2.45%
Q.ValueAdded	1.42%	1.44%	1.47%	1.49%	1.52%	1.54%	1.58%	1.61%	-1.67%	-1.70%	-1.75%	-1.79%	-1.84%	-1.89%	-1.96%	-2.01%
Clothing																
P.Consu	-0.91%	-0.91%	-0.92%	-0.92%	-0.93%	-0.94%	-0.94%	-0.95%	0.98%	0.98%	0.99%	1.00%	1.01%	1.01%	1.02%	1.03%
Export	-1.94%	-1.93%	-1.92%	-1.90%	-1.88%	-1.87%	-1.84%	-1.82%	1.85%	1.83%	1.79%	1.76%	1.72%	1.68%	1.62%	1.57%
Import	-0.91%	-0.90%	-0.88%	-0.86%	-0.84%	-0.82%	-0.78%	-0.76%	0.78%	0.76%	0.71%	0.68%	0.63%	0.59%	0.52%	0.47%
Labor demand	0.91%	0.89%	0.87%	0.86%	0.83%	0.82%	0.80%	0.78%	-0.83%	-0.81%	-0.78%	-0.76%	-0.73%	-0.71%	-0.67%	-0.64%
Capita demand	0.97%	1.01%	1.06%	1.10%	1.17%	1.21%	1.29%	1.35%	-1.41%	-1.47%	-1.57%	-1.64%	-1.75%	-1.83%	-1.97%	-2.07%
Q.ValueAdded	0.95%	0.97%	0.99%	1.02%	1.05%	1.07%	1.11%	1.14%	-1.20%	-1.23%	-1.29%	-1.32%	-1.39%	-1.43%	-1.51%	-1.56%
Industries																
P.Consu	0.39%	0.38%	0.36%	0.35%	0.33%	0.32%	0.30%	0.29%	-0.35%	-0.33%	-0.31%	-0.30%	-0.28%	-0.27%	-0.25%	-0.24%
Export	-4.24%	-4.40%	-4.65%	-4.82%	-5.09%	-5.28%	-5.57%	-5.78%	6.31%	6.56%	6.96%	7.25%	7.71%	8.04%	8.55%	8.93%
Import	-2.59%	-2.68%	-2.81%	-2.91%	-3.06%	-3.16%	-3.33%	-3.45%	3.65%	3.79%	4.02%	4.18%	4.44%	4.63%	4.93%	5.16%
Labor demand	1.71%	1.56%	1.31%	1.13%	0.86%	0.67%	0.36%	0.14%	-0.31%	-0.08%	0.29%	0.56%	0.99%	1.30%	1.79%	2.15%
Capita demand	1.76%	1.64%	1.45%	1.32%	1.11%	0.96%	0.73%	0.56%	-0.75%	-0.58%	-0.30%	-0.10%	0.20%	0.43%	0.78%	1.04%
Q.ValueAdded	1.75%	1.62%	1.41%	1.27%	1.04%	0.88%	0.63%	0.45%	-0.63%	-0.44%	-0.14%	0.08%	0.42%	0.67%	1.06%	1.35%

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