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Abstract

The National Democratic Congress (NDC), Ghana's leading opposition political party, has unveiled an ambitious '24-hour economy' policy proposal ahead of the country's forthcoming general elections in 2024. The policy aims to revitalise the nation's economic landscape by fostering round-the-clock operations in key sectors. This paper employs a dynamic Computable General Equilibrium (CGE) model framework, underpinned by the 2015 Ghana Social Accounting Matrix (SAM) and the 2021 Ghana Population and Housing Census (PHC) data, to evaluate the potential impact of the policy on Ghana's economy.

Results indicate that under the proposed '24-hour economy' policy, Ghana's real GDP growth (not to be confused with GDP growth rate) in ten years would be 31.71% higher than it would have been under a 'business-as-usual' scenario in the same timeframe. This indicates substantial augmentations in economic output within the Ghanaian economy under the '24-hour economy' setting. Further, the policy would generate more than 3 million jobs within five years of its implementation, with manufacturing, agriculture, wholesale and retail trade, services, construction and transport sectors experiencing substantial employment gains.

The policy's transformative effects are driven by its ability to stimulate capital investment and capital formation, boost productivity and increase household incomes.

The paper concludes that the NDC's proposed '24-hour economy' policy holds substantial potential for transformative economic growth in Ghana. However, there are challenges associated with the implementation of the policy, which then necessitates a holistic approach to policy formulation, focusing on inclusive growth and sustainable development strategies.

Keywords: 24-hour economy; CGE; Ghana; Economic impact; Employment

1 Introduction

The National Democratic Congress (NDC), Ghana's leading opposition political party, has unveiled an ambitious economic strategy ahead of the country's forthcoming general elections in 2024. This strategy, known as the '24-hour economy' policy,' seeks to transform Ghana's economy by stimulating selected sectors to 'operate 24/7, preferably in a three-shift system of eight hours each' (see Citi New Room, 2023). The goal behind the policy is to enhance productivity, bolster competitiveness and cultivate sustainable high-paying jobs in Ghana.

The broad contours of the NDC's proposed '24-hour economy' policy for Ghana have been clearly outlined in the above cited party FAQ document and in various public engagements by the party's flagbearer and former president John Dramani Mahama (see e.g. JohnMahama.org, 2023). However, the formulation of certain aspects of the policy is currently being developed. The NDC has pledged to produce a comprehensive blueprint for implementing the '24-hour economy' policy upon their potential ascent to power in 2025. Additionally, there are plans to enact an employment act that will define and delineate the regulatory framework of the policy.

The concept of a '24-hour economy' is in itself not novel (see e.g. Presser, 1999; Veron et al., 2007; Glorieux et al., 2008; Altman, 2008). Numerous advanced countries, including the United States, United Kingdom, Germany, France and Australia have successfully implemented the policy in various forms (see e.g. UK Office for National Statistics, 2023; New South Wales Government, 2023). In the African context, Kenya is contemplating the adoption of the policy (see Kenya Government, 2021).

The announcement of the '24-hour economy' policy by the NDC has generated much discourse across the social, economic and political landscape in Ghana. Notably however, there has been a conspicuous absence of an empirical analysis of the policy to evaluate its potential economic impact. Such an analysis is essential to inform and guide public debate.

This paper evaluates the potential impact of the NDC's proposed policy on Ghana's economy. The paper employs a sophisticated computable general equilibrium (CGE) model framework that is designed to yield a systematic assessment of the policy's effects on the whole of the Ghanaian economy. The findings presented here provide some useful insights that would hopefully inform and guide the debate around the proposed policy on Ghana's economy.

The structure of the remainder of this paper is outlined as follows: Section 2 presents the methodology, providing a description of the CGE model utilised in this study, along with an explanation of the underlying scenarios and mechanisms that guide its application. In Section 3, the paper discusses the data sources used. Section 4 presents the results derived from the CGE model, highlighting the key findings of the study. This is followed by Section 5, where a discussion of these results is provided, offering further insights and interpretations. Section 6 concludes the paper, summarising the main outcomes and providing final remarks that encapsulate the essence and implications of this study.

2   Methods

CGE models represent complex numerical frameworks that embody the fundamental economic interactions within an economy. These models harness data pertaining to the economic structure of a country, underpinned by a set of equations grounded in economic theory, to simulate the repercussions of fiscal policies on an economy (see Burfisher, 2021; Devarajan and Robinson, 2005).

A defining attribute of CGE models is their capacity to encapsulate the intricate interdependencies that exist among various sectors (e.g. agriculture, manufacturing, public administration, etc.), factor markets (i.e. labour and capital) and economic agents (i.e. government, households, firms, etc.) within an economy. This capability enables economists to assess how the economic effects of a policy introduction or adjustment reverberates throughout an economy.

The utility of CGE models becomes especially evident when analysing policies that entail indirect effects that are challenging to identify and/or quantify. Furthermore, CGE models excel in capturing the protracted macroeconomic outcomes following a policy introduction or adjustment, focusing on long-term trends rather than short-term predictions (see Abelson, 2011; Beckman et al., 2011; Dwyer, 2015).

This study employs a dynamic CGE model framework to examine the potential economic impact of the NDC's proposed '24-hour economy' policy in Ghana, enabling it to track the evolution of key macroeconomic variables over time in response to the introduction of the policy.

CGE models are extensively employed by governments (see e.g. US CBO, 2004; UK HMRC, 2013); esteemed international institutions such as the World Bank (see e.g. Kabir and Dudu, 2020), the Organisation for Economic Co-operation and Development (OECD) (see e.g. OECD, 2023) and the International Monetary Fund (IMF) (see e.g. Hunt et al., 2020); and in academia (see e.g. Abdul-Salam and Katris, 2023; Mabugu et al., 2013; Bhattarai et al., 2016).

2.1 The PEP 1-t CGE model

This paper utilises the single-country recursive dynamic PEP-1-t CGE model (version 2.1), as developed by the Partnership for Economic Policy (PEP), a global research network renowned for its expertise in CGE modelling techniques (see Decaluwé et al., 2013).

The application of the PEP-1-t CGE model in this paper offers several advantages, particularly in its ability to capture the complex interplay of economic variables over time. By incorporating dynamic elements such as capital investment cycles, demographic shifts, and sectoral interdependencies, the model provides a nuanced understanding of how economic policies and external shocks such as the introduction of a '24-hour economy' can ripple through the Ghanaian economy, affecting various sectors and stakeholders differently.

Moreover, the model's robustness and versatility have been validated through its widespread adoption in academic research across different countries and economic contexts (see e.g. Mabugu et al., 2013; Galindev and Decaluwe, 2022; Phomsoda et al., 2022; Lkhagva et al., 2019; Mitik and Engida, 2013). The widespread usage of the model not only testifies to its reliability and effectiveness but also contributes to a growing body of knowledge, enhancing the model's utility and relevance for economic analysis. The PEP-1-t CGE model is available as an open-source resource under a creative commons license.[1]

2.2 The CGE model scenarios

The task of modelling the economic impact of a policy within a CGE model framework represents a nuanced endeavour, requiring a synthesis of experience, informed judgment and methodological rigour (Dwyer, 2015; Wing and Balistreri, 2018). CGE analyses are conducted through computer simulations of different economic policy or shock scenarios. To conduct a

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[1] The model can be found here; PEP-1-t CGE model

CGE analysis therefore, it is important to first outline these scenarios. Defining these scenarios requires a clear understanding of the main contours of the economic policy or shock being studied.

A major contour of the NDC's proposed '24-hour economy' policy involves the provision of cost-effective and reliable electricity to participating sectors through a time-of-use (TOU) tariff scheme. This scheme discriminates electricity pricing based on the temporal usage of consumption, factoring in both the time of day and the day of the week when electricity is consumed. Sectors subscribing to the '24-hour economy' policy will be awarded modern smart meters, calibrated to apply reduced tariffs during designated night hours. This strategic tariff adjustment scheme effectively reduces the overall production costs for companies and sectors that subscribe to the policy.

In addition to the TOU tariff scheme, the '24-hour economy' policy aims to introduce a suite of tax incentives and financing support mechanisms, strategically tailored to reduce aggregate production costs, with particular emphasis on the manufacturing sector. These initiatives aim to significantly enhance the ease and cost of doing business in Ghana.

Following on from the above, this paper models two distinct scenarios in the CGE model as follows;

2.2.1   The 'business-as-usual' Scenario:

This scenario is generated through the calibration of the CGE model equations and behavioural parameters, anchored to the base year Ghana Social Accounting Matrix (SAM) data. The ensuing CGE model simulation portrays the trajectory of the Ghanaian economy in a 'business-as-usual' setting, characterised by the absence of economic shocks.

2.2.2   The '24-hour economy' Policy Scenario:

CGE models function by introducing economic shocks to the 'business-as-usual' scenario, as outlined above. The ensuing analysis systematically compares the pre-shock economic state (i.e. the 'business-as-usual' scenario) with the post-shock economic landscape. This paper captures the '24-hour economy' policy within the PEP 1-t CGE model through two strategically devised economic shocks as follows:

i.   **Increased demand for electricity:** This study captures this element of the '24-hour economy' policy through a progressive increase in the intermediate demand for

electricity in the manufacturing sector in Ghana. Specifically, the study assumes a gradual increase in intermediate demand for electricity in the manufacturing sector, rising to about 20% by the tenth year of the implementation of the '24-hour economy' policy. Note that this increment is additional to the 'business-as-usual' demand for electricity in the manufacturing sector over the course of the same period. The increased demand for electricity in the manufacturing sector is a natural outcome of the proposed '24-hour economy' policy as more companies within that sector subscribe to working 24/7 in Ghana.

ii. **Increased government expenditures:** A natural consequence of the NDC's proposed plan to introduce a TOU tariff scheme, and to provide tax incentives and financing support mechanisms as part of the '24-hour economy' policy is that government spending would increase. This paper captures this element of the '24-hour economy' policy through a progressive increase in government spending, rising to about 10% by the tenth year. This spending is additional to the government's 'business-as-usual' projected spending over the course of the same period.

The imposition of the above tailored shocks on the Ghanaian economy are implemented in the CGE model as a demonstrative exercise only, with a goal to capture the overarching elements of the '24-hour economy' policy.

Within the CGE model, the imposition of the policy shocks underlying the '24-hour economy' policy scenario as outlined above produces a new counterfactual equilibrium relative to the baseline 'business-as-usual' scenario. Hence, employing a CGE model for policy analysis facilitates a *'what if'* comparison between the two economic equilibria (see Giesecke and Madden, 2013; Dixon and Rimmer, 1998, Capros et al, 1990). Consequently, the study compares the two modelled scenarios, i.e. the 'business-as-usual' scenario and the '24-hour economy' scenario, to ascertain the economic impact of the '24-hour economy' policy on aggregate economic variables such as gross domestic product (GDP), government revenues, capital formation, labour demand (employment), household incomes and so on.

2.3   The transmission mechanism of the 24-hour economy policy

In the PEP 1-t CGE model, the transmission mechanism through which an increase in the intermediate demand for electricity in the manufacturing sector, as simulated under the '24-hour economy' scenario, leads to wider economic impacts involves several interconnected elements:

- **Increased Production in the Manufacturing Sector**: An increase in the intermediate demand for electricity in the manufacturing sector leads to a rise in production in that sector. This is because electricity is a crucial input for manufacturing processes (see Kahane and Squitieri, 1987).

- **Boost in Electricity Sector's Output**: The increased demand for electricity from the manufacturing sector leads to an expansion in the electricity sector. This expansion may involve increased utilisation of existing capacity or investments in new capacity.

- **Enhanced Inter-sectoral Linkages**: The manufacturing and electricity sectors are closely linked with various other sectors of the economy, such as agriculture, transportation and services (see e.g. Pei et al., 2016; Sastry et al., 2003). An upsurge in manufacturing and electricity sector activities would lead to increased demand for these sectors' products and services, thereby stimulating broader economic activity.

- **Employment and Income Effects**: Higher production in the manufacturing and electricity sectors can lead to job creation, both directly within these sectors and indirectly in related sectors. This employment growth can increase household incomes, which in turn can boost consumption and savings rates in the economy.

- **Increased Investments and Capital Formation**: Responding to higher demand, firms in both the manufacturing and electricity sectors, as well as related sectors in the economy, may invest in new machinery, equipment and infrastructure. This investment is a critical component of GDP growth and can lead to long-term increases in productive capacity (see e.g. De Long and Summers, 1991; Abdi, 2008; Herrerias, 2010).

- **Multiplier Effects**: The additional spending and investment within the economy have multiplier effects. Increased activity in one sector leads to more income and spending, which then stimulates further economic activity in other sectors.

- **Government Revenue and Public Spending**: Increased economic activity can lead to higher tax revenues for the government, which, if re-invested prudently in public services, infrastructure, or other growth-enhancing areas, can further stimulate economic growth.

Following the above, let j represent the set of sectors and i represent the set of commodities in the Ghanaian economy. Also let t represent time. The transmission mechanism through which an increase in intermediate demand for electricity in the manufacturing sector directly leads to overall GDP growth, as described above, can be mathematically summarised in the PEP 1-t CGE model as follows;

$$CI_{jt} = {DI_{ijt}}/{a_{ij}} \quad \forall \; j \in (manufacturing), i \in (electricity), t \tag{1}$$

$$XST_{jt} = {CI_{jt}}/{io_j} \quad \forall \; j \in (manufacturing), t \tag{2}$$

$$VA_{jt} = v_j \cdot XST_{jt} \quad \forall \; j \in (manufacturing), t \tag{3}$$

$$GDP_t^{mp} = \sum_j \left(P_{jt}^{VA} \cdot VA_{jt} \right) + Rev_t^{TIPT} + Rev_t^{TPRCTS} \quad \forall \; t \tag{4}$$

where;

Variable	Description
DI_{ijt}	Intermediate demand of commodity i by sector j in period t
CI_{jt}	Total intermediate consumption of sector j in period t
XST_{jt}	Total aggregate output of sector j in period t
VA_{jt}	Value added of sector j in period t
GDP_t^{mp}	GDP at market prices in period t
P_{jt}^{VA}	Price of sector j value added (including taxes on production directly related to the use of capital and labour) in period t
Rev_t^{TIPT}	Total government revenue from production taxes (excluding taxes directly related to the use of capital and labour) in period t
Rev_t^{TPRCTS}	Total government revenue from taxes on products and imports in period t

Parameter	Description
a_{ij}	Input output coefficients for commodity i and sector j
io_j	Coefficient (Leontief - intermediate consumption) for sector j

In equation (1), an increase in the intermediate demand for electricity in the manufacturing sector results an increase in overall intermediate consumption in that sector, leading to an increase in total aggregate output as shown in equation (2). The increase in aggregate output is manifested in the value added of the manufacturing sector, as shown in equation (3). This then contributes to the growth in total GDP (at market prices), as captured in equation (4).

To preserve space, a mathematical description of the transmission mechanism for the indirect effects of an increase in intermediate demand for electricity in the manufacturing sector, and the direct and indirect effects of an increase in total government expenditures, is not provided in this paper. For a full mathematical description of the PEP 1-t CGE model, see Decaluwe et al. (2013).

In summary, the increased intermediate demand for electricity in the manufacturing sector, and the increase in government expenditures in support of the '24-hour economy' policy, triggers a series of interrelated economic activities and responses across various sectors and agents in the Ghanaian economy. These activities and responses, and the resulting economic growth created, are captured in the PEP 1-t CGE model, allowing for this study to examine the complex interactions and feedback loops engendered by the '24-hour economy' policy on the whole of the Ghanaian economy.

2.4   The CGE model calibration and closure

The PEP 1-t CGE model is formulated using the General Algebraic Modelling Systems (GAMS) software and language (see GAMS, 2024). This study utilises the CONOPT4 solver (see Drud, 2020) to solve the model within GAMS.

In calibrating the model, the 2015 Ghana SAM data and exogenous elasticities retrieved from the literature (see Annabi et al., 2006) are used to identify the endogenous parameters of the model equations. The calibration is such that the model exactly replicates the 2015 Ghana SAM data in the baseline 'business-as-usual' scenario. This then provides the benchmark against which to evaluate the effects of the '24-hour economy' scenario.

CGE model results are sensitive to the choice of exogenous elasticities and the choice of model closure rules (see Antimiani et al., 2015; Hertel et al., 2007; Agbahey et al., 2020). This paper implements the PEP 1-t CGE model with the assumption that the supply and demand for labour and capital in the Ghanaian economy are endogenous (see e.g. Elhan and Oum, 2022; Agbahey et al., 2020; Morley et al., 2011). This closure rule implies that the free and optimal movement and allocation of these factors within the Ghanaian economy largely determines the model resolution. The endogenous labour supply closure rule in CGE models, as adopted in this paper, has been supported by Boeters and Leeuwen (2010), Boeters and Savard (2011), Boucekkine (2013), Farhat (2009) and others, arguing that the incorporation of this feature more accurately represents real world labour dynamics.

Overall, there are 23,583 equations and 23,583 variables in the PEP 1-t CGE model implemented in this study. The model is solved as a square constrained nonlinear system (CNS) in GAMS.

3 Data

To calibrate a CGE model, a SAM data is used. A SAM functions as a comprehensive data snapshot of an economy, capturing the economic structure and the intricate circular flow of income and expenditure within a country. It is essentially an economy-wide database that documents the transactions between production activities, factors of production, institutions and international trade over a designated period.

This paper uses the 2015 SAM for Ghana, which was originally compiled by the Ghana Statistical Service (see Ghana Statistical Service, 2023), the Institute of Statistical, Social and Economic Research (ISSER) and the International Food Policy Research Institute (IFPRI). Subsequently, it was modified and extended by the EU-Joint Research Centre (EU-JRC) (see European Union Joint Research Centre, 2023).

For purposes of this study, the 2015 Ghana SAM data was first adjusted to reflect the economic landscape of Ghana in 2021. This calibration involved adjusting nominal figures in the 2015 Ghana SAM data to account for inflation. The adjusted dataset subsequently serves as the foundation for calibrating the CGE model. The choice of 2021 as the base year for the model is motivated by the availability of the latest census data on employment and economic activity in Ghana, namely the 2021 Population and Housing Census (PHC) data (see Ghana Statistical Service, 2021.a; Ghana Statistical Service, 2021.b).

The EU-extended Ghana SAM is highly disaggregated, with 299 distinct accounts covering sectors, commodities, factors of production, households and taxes. To ease computational intensity in the PEP 1-t CGE model implemented in this study, the SAM data was further adjusted by aggregating the sector and commodity accounts into 16 categories each, in alignment with the United Nation's International Standard Industrial Classification (ISIC) of all economic activities (see United Nations, 2008). Appendix I provides a detailed description of the 16 sectors and commodities modelled in this study.

The Ghana SAM provides some useful insights about the structure of the country's economy. It shows that capital plays a more significant role than labour in Ghana's economy, contributing 64.80% to gross domestic product (GDP) while labour contributes 35.20%.

Figure 1: The relative contributions of labour and capital to Ghana's GDP
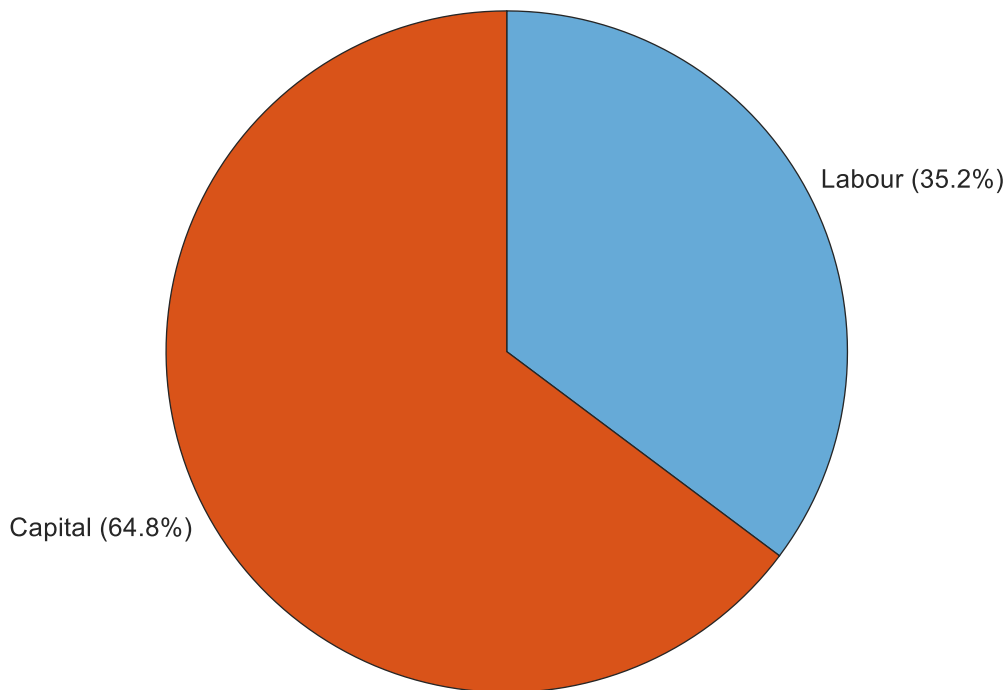
Labour (35.2%)

Capital (64.8%)

Source: Author plot using the 2015 Social Accounting Matrix (SAM) data for Ghana, as provided by the European Union Joint Research Centre (2023)

Sector-wise, the agricultural sector is the largest contributor to Ghana's GDP (19.98%), followed by the construction (16.97%) and the transportation and storage (11.77%) sectors respectively. Further, there are variations in the intensity of labour and capital utilisation by sector (see Figure A1 in the Appendix II), and the sectoral level of reliance on value added versus intermediate consumption (see Figure A2 in the Appendix II). These sectoral characteristics of the structure of the Ghanaian economy have implications for the economic impact of the 24-hour economy policy as resolved in the PEP 1-t CGE model implemented in this paper.

4   Results

CGE model results are typically expressed in terms of relative percentage changes, comparing the baseline 'business-as-usual' economic scenario with an economy subject to a specific policy introduction or alteration. In this case, the policy introduction under study is a purposeful transition to a '24-hour economy' in Ghana. The following sections detail the key findings derived from the CGE model output, contrasting these two economic scenarios.

4.1   Impact on aggregate output (GDP) and output by sector

The model results reveal notable changes in various measures of GDP as shown in Figure 2. These changes, measured in percentage terms, provide a comprehensive view of the economic impact of transitioning to a '24-hour economy' in Ghana.

Figure 2 shows that in the first year of the implementation of the policy, Ghana's real GDP at market prices will grow by 11.43% higher than it would have been under a 'business-as-usual' scenario. By Year 5, when the economy is expected to be approaching steady-state with respect to the policy, growth in real GDP at market prices would be 26.62% higher under the '24-hour economy' scenario compared to the 'business-as-usual' scenario. Towards Year 10, when the economy had attained steady-state with respect to the implementation of the policy, the growth in real GDP at market prices would be 31.71% higher compared to the 'business-as-usual' scenario.

Such significant increases in GDP growth levels following the introduction of an economy-wide policy have been found in several studies including Bhattarai et al (2016), Boortz and Linder (2005), Jokisch and Kotlikoff (2005) and Arduin et al (2005).

It is important to underscore that these results do not represent year-on-year GDP growth rates. The real GDP at market prices growth level of 31.71% by Year 10 for example implies that Ghana's GDP level under a '24-hour economy' setting will be about a third higher than it would have been under the 'business-as-usual' scenario in a decade. The observed real GDP growth levels, both at basic and market prices, indicate that the sustained growth seen in Figure 2 is not merely nominal but reflects real augmentations in economic output over the ten-year period simulated.

Figure 2: CGE model results for Ghana, showing the change in nominal and real GDP growth levels under a '24-hour economy' scenario compared to the 'business-as-usual' scenario.
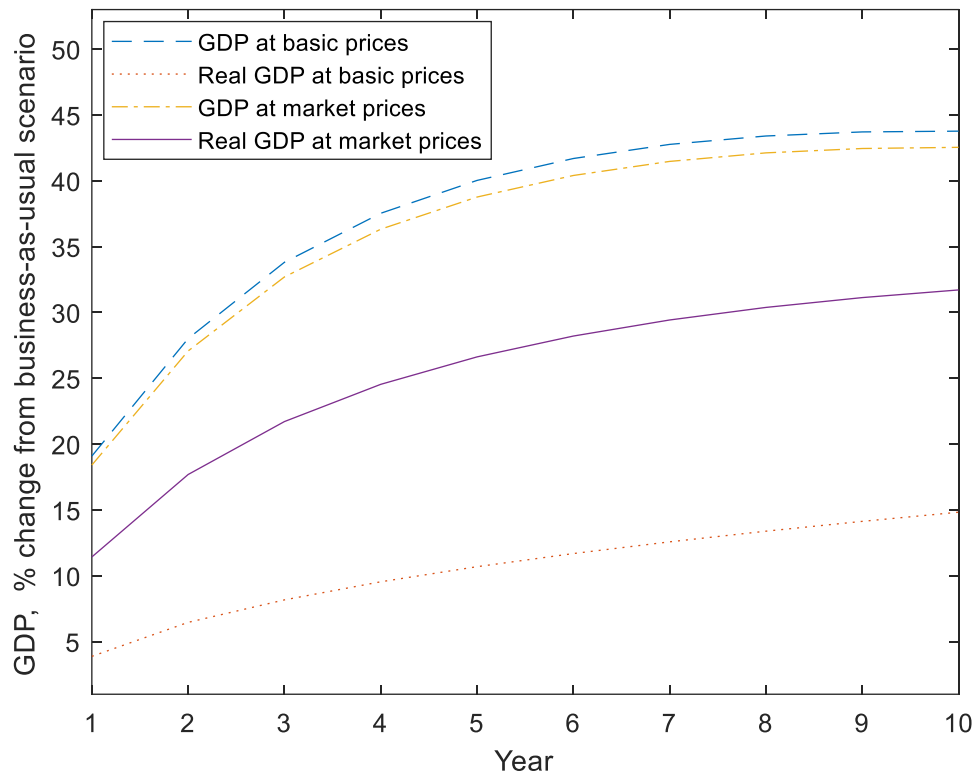
Figure 3 shows a detailed view of the impact on sectoral output from transitioning to a '24-hour economy' in Ghana. The results indicate that the sectors under immediate direct focus, which are the 'manufacturing' sector and the 'electricity' sector, alongside sectors such as 'accommodation and food service activities', 'agriculture, forestry and fishing', 'information and communication', 'education', 'real estate activities' and 'construction', 'financial and insurance activities', 'transportation and storage' and so on experience considerable growth in response to the policy.

This result highlights the large positive spillover effects of the '24-hour economy' policy, with positive shocks on the 'electricity' and 'manufacturing' sectors leading to significant output realisations in other sectors of the economy.

The considerable output growth in the 'agriculture, forestry and fishing' sector, the 'accommodation and food service activities' sector, the 'information and communication' sector and the 'education' sector provide insights into the broad-reaching impact of the '24-hour economy' policy in Ghana as follows:

i. **Agriculture, Forestry, and Fishing Sector:**

The growth in this primary sector indicates an increased demand for food and raw materials, which is driven by the expanded operational hours of other sectors. The 24-hour economy would boost agricultural output by way of the extension of operational hours for processing in the manufacturing sector, marketing in the wholesale and retail trade sector and supply chain operations in the transportation sector.

ii. **Accommodation and Food Service Activities Sector:**

The expansion of the 'accommodation and food service activities' sector suggests that the '24-hour economy' policy could transform consumer behaviour, with increased demand for round-the-clock services in hospitality. Hotels, restaurants and other service providers may extend their hours to cater to a clientele that operates on a non-traditional schedule, thereby contributing to economic growth in Ghana.

iii. **Information and Communication Sector:**

The growth in the 'information and communication' sector reflects the central role of digital and communication infrastructure and services in supporting extended economic activities. This sector's expansion is indicative of the demand for continuous information flow, telecommunication services, and technological support required to sustain a 24-hour operational environment.

iv. **Education Sector:**

The 'education' sector's growth can be attributed to the need for continuous professional development and training to support the workforce in adapting to a 24-hour economy (see this observation further evidenced in the results shown in Figure 7 on page 28). It also reflects an increase in educational services tailored to non-traditional hours, including nighttime and online learning programs, to serve a diverse workforce/student population with flexible scheduling needs.

Of further note is the robust growth in the 'real estates' and the 'construction' sectors. This is attributable to the potential of extended operational hours to expedite project timelines hence facilitating a more rapid response to the infrastructural needs of the country. Under a '24-hour economy' setting, real estate and construction activities can continue beyond traditional working hours, leading to faster completion of projects. This increased efficiency not only accelerates the delivery of infrastructure but also enables quicker utilisation of related capital assets for economic activities. More generally, the output growth in the construction sector is indicative of broader capital formation across the economy, as further evidenced in the results

shown in Figure 4 (see page 19). The growth in the 'real estates' and 'construction' sectors lays the foundation for improved productivity, efficiency in logistics, access to markets and overall long-term development in Ghana under a '24-hour economy' setting.

Interestingly, there is also robust growth in the output of the 'water supply, waste management and remediation activities' sector. This sector's expansion is intricately connected to the activities of sectors such as manufacturing, transportation and agriculture. The intensified economic activities brought about by a '24-hour economy' lead to an uptick in waste generation, particularly in the 'manufacturing' sector, which encompasses high waste generation industries such as chemicals, metals and minerals, machinery and equipment, fruit and vegetable processing, textiles and clothing, leather and footwear, wood and paper, petroleum refining and so on (see Appendix I for a full list of industries under each sectoral classification). This necessitates the need for advanced waste management and remediation services in Ghana. The interdependency between the 'water supply, waste management and remediation activities' sector and the 'transportation and storage' sector is particularly noteworthy. The seamless collection, transportation and disposal of waste are essential in an economy that operates around the clock.

The growth in the 'water supply, waste management and remediation activities' sector also signifies the potential need for adopting a circular economy strategy alongside the '24-hour economy' policy in Ghana. Such a strategy emphasises the reduction of waste and the enhancement of resource efficiency through the promotion of recycling, reusing and the adoption of sustainable consumption practices. The transition to a circular economy framework is not merely a solution to the challenges presented by a '24-hour economy'; it is an avenue for fostering employment and spurring innovation within the waste processing and recycling sectors in Ghana. Implementing this model could yield dual benefits, namely (1) addressing the increased waste management demands, and (2) contributing to economic development through job creation and sustainable resource use (see e.g. Burgon and Wentworth, 2016).

To preserve space, further exposition is not provided on the growth in output observed in other sectors of the economy as shown in Figure 3.

It suffices to say however that the growth in output of all sectors signifies a transition to a more dynamic and responsive economy that capitalises on extended hours of operation. It underscores the importance of cross-sectoral linkages and the need for policies that support the scalability and sustainability of these sectors as they adapt to the new demands of a 24-hour

economy setting. The overall variation in sectoral output responses underscores the need for a nuanced approach to strategy formulation and economic planning relative to the '24-hour economy' policy.

Figure 3: CGE model results for Ghana, showing the change in aggregate sectoral output under a '24-hour economy' scenario compared to the 'business-as-usual' scenario, by the tenth year of the policy implementation.
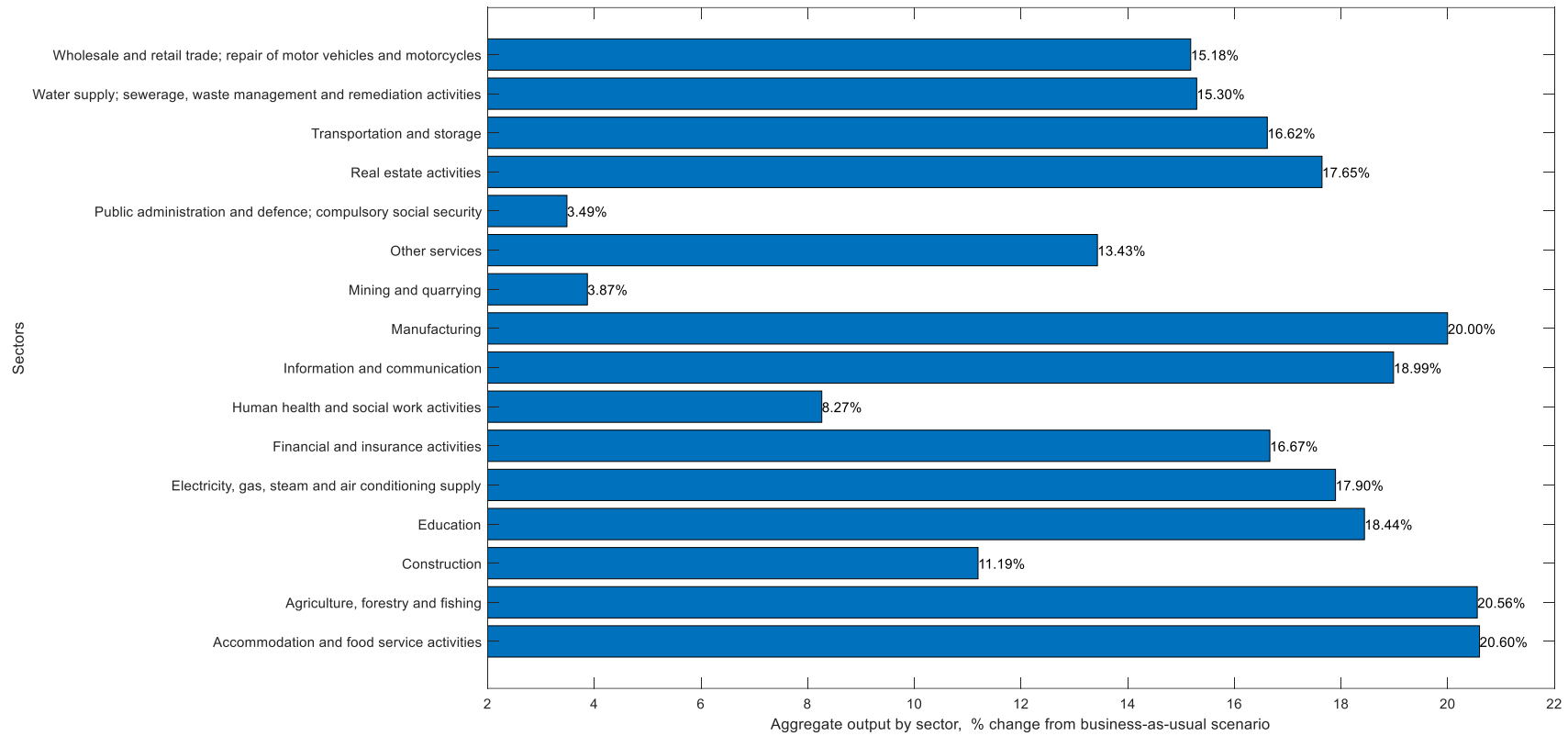
4.2   Government revenues and capital formation

The results also demonstrate significant increase in government revenues from both business and household income taxes as shown in Figure 4. By Year 5, government revenues from business income taxes under the '24-hour economy' setting would have progressively increased to about 50.34% higher compared to what it would have been under a 'business-as-usual' scenario in the same year.

This trend suggests that firms experience increased profitability under the '24-hour economy' scenario, an observation that is attributable to the extended operational hours under the policy, leading to higher taxable incomes and consequently, increased tax revenues for the government. Similarly, the revenues from household income taxes show a significant increase, reaching 35.41% higher by the fifth year under the '24-hour economy' scenario compared to the 'business-as-usual' scenario. This increase is attributable to higher employment levels and increased wages under the '24-hour economy' scenario, resulting in greater household incomes and higher household tax contributions. The increase in household incomes is further evidenced in Figure 8 (see page 31), where household disposable incomes are shown to have significantly increased under the '24-hour economy' setting.

The results also illustrate significant changes in capital formation under the '24-hour economy' scenario. There is substantial increase in gross fixed capital formation, progressing to 96.49% higher by the fifth year under the '24-hour economy' scenario, compared to business-as-usual. This marked increase indicates a robust expansion in investment in capital goods, which include buildings, machinery, equipment and technology within the economy. This result is further supported by the observation in Figure 3 which showed robust growth in the 'real estates' and 'construction' sectors under a '24-hour economy' setting. Such significant increases in capital formation following the introduction of nation-wide policies have been found in studies such as Boortz and Linder (2005) and Jokisch and Kotlikoff (2005). The accelerated growth in capital formation suggests that the '24-hour economy' policy fosters a conducive environment for increased investment, leading to enhanced business opportunities and economic vibrancy in Ghana.

Figure 4: CGE model results for Ghana, showing the change in government revenues and capital formation under a '24-hour economy' scenario compared to the 'business-as-usual' scenario.
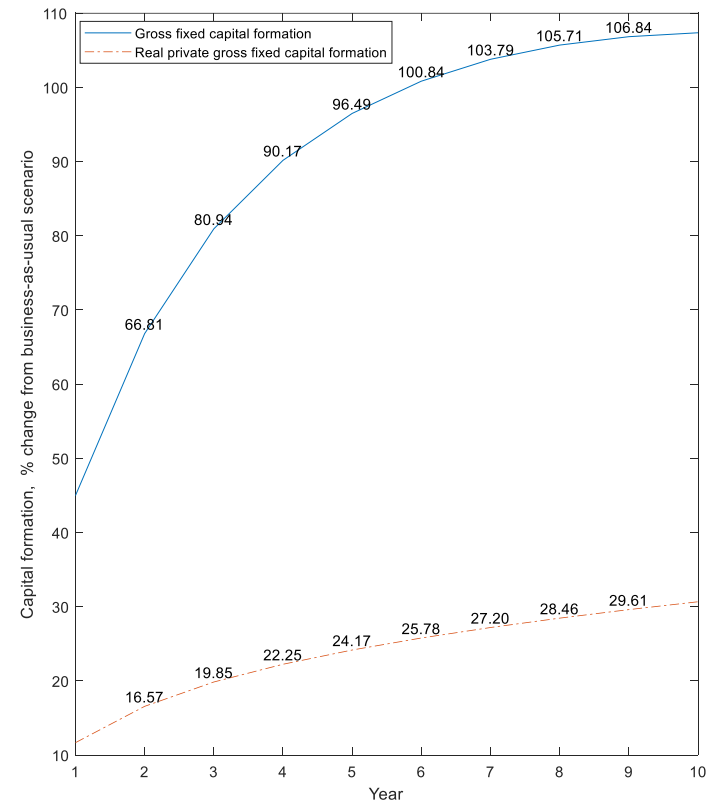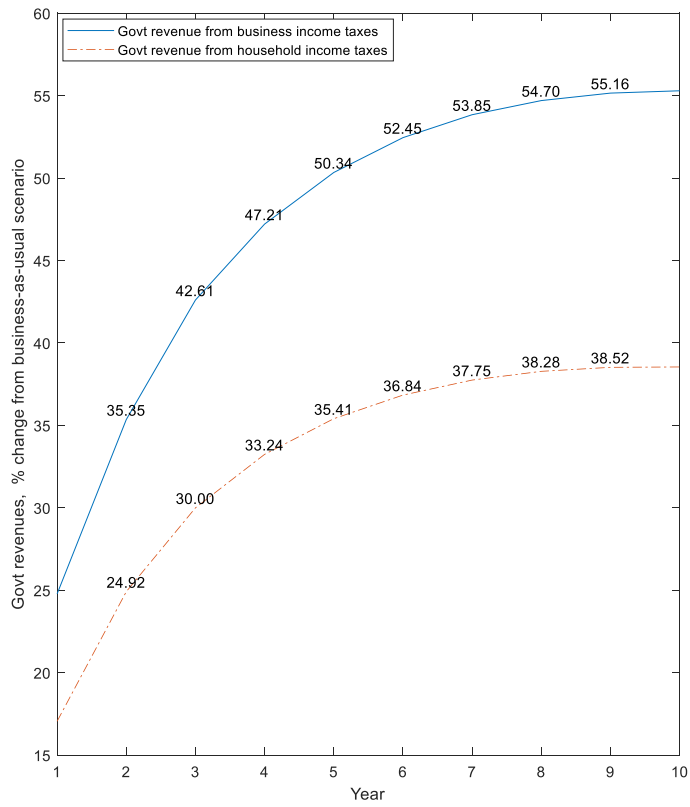
4.3 Labour and Employment

4.3.1 Total labour

The model results shown in Figure 5 reveal a considerable year-on-year increase in demand for labour under the '24-hour economy' scenario compared to the baseline 'business-as-usual' scenario. The first year shows an increase in demand for labour to approximately 1.42 million jobs, indicating an immediate response to the shift towards a '24-hour economy' in Ghana. This suggests an initial boost in employment opportunities as businesses extend their operational hours to take advantage of the policy. In the second year, labour demand escalates to around 2.20 million jobs, indicating an addition of about 778,000 jobs from the previous year. This substantial increase is attributable to the continued adaptation of businesses to the extended economy and reflects the expanded services and production activities under the new economy.

By the third year, the demand for labour grows to approximately 2.64 million jobs under the '24-hour economy' setting compared to the 'business-as-usual' scenario, indicating an addition of about 441,000 jobs from the previous year. This steady growth indicates that the economy is sustaining its momentum with ongoing job creation across various sectors. The fourth year sees demand for labour rising to about 2.92 million jobs, indicating an addition of 281,000 jobs from the previous year. The growth, while still positive, shows signs of stabilising as the economy approaches a new equilibrium in labour requirements. In the fifth year, the demand for labour reaches about 3.09 million jobs, indicating an addition of 175,000 jobs from the previous year. This continued growth, albeit at a slower pace, suggests that while the initial surge in labour demand may be levelling off, the '24-hour economy' continues to support higher employment levels compared to the baseline 'business-as-usual' scenario.

The results indicate a significant and sustained increase in demand for labour under the '24-hour economy' scenario, reaching more than 3 million jobs by Year 10. This trend reflects the potential of extended operational hours to create new employment opportunities and boost economic activity in Ghana. The gradual stabilisation of labour growth in the latter years suggests the full absorption of initial labour market shocks and the establishment of a new, higher baseline for employment in Ghana under a '24-hour economy' setting.

It is important however to recognise that whilst the '24-hour economy' scenario inherently engenders these job opportunities within the Ghanaian economy, proactive employment strategies are necessary to ensure that these prospects are fully and promptly embraced by the workforce. There are examples of economies where the number of available jobs is either

comparable to or exceeds the number of job seekers (see example UK Office for National Statistics, 2022; US Bureau of Labour Statistics, 2023). This situation is often attributed in part to a discrepancy between .the skills required for the available jobs and the skill sets possessed by those seeking employment.

The jobs created by the '24-hour economy' in Ghana are diverse, covering a range of sectors, geographical regions, and localities (including both urban and rural areas). These jobs vary in terms of skill level, from highly skilled to unskilled positions, and span across both the private and public sectors, as well as formal and informal employment segments. Without targeted employment policies to enhance skill sets, retrain the labour force, and incentivise workers towards appropriate employment opportunities created nationwide, the potential of these opportunities may not be fully harnessed in the timeframe suggested in this paper.

As of Q2 2022, over 6.73 million Ghanaians were classified as being 'outside the labour force', with 1.73 million classified as 'unemployed' (see Ghana Statistical Service, 2022; page 35). The results presented herein reveal that the '24-hour economy' policy holds considerable potential to markedly reduce unemployment levels in Ghana if implemented properly.

Figure 5: CGE model results for Ghana, showing the change in demand for labour under a '24-hour economy' scenario compared to the 'business-as-usual' scenario.
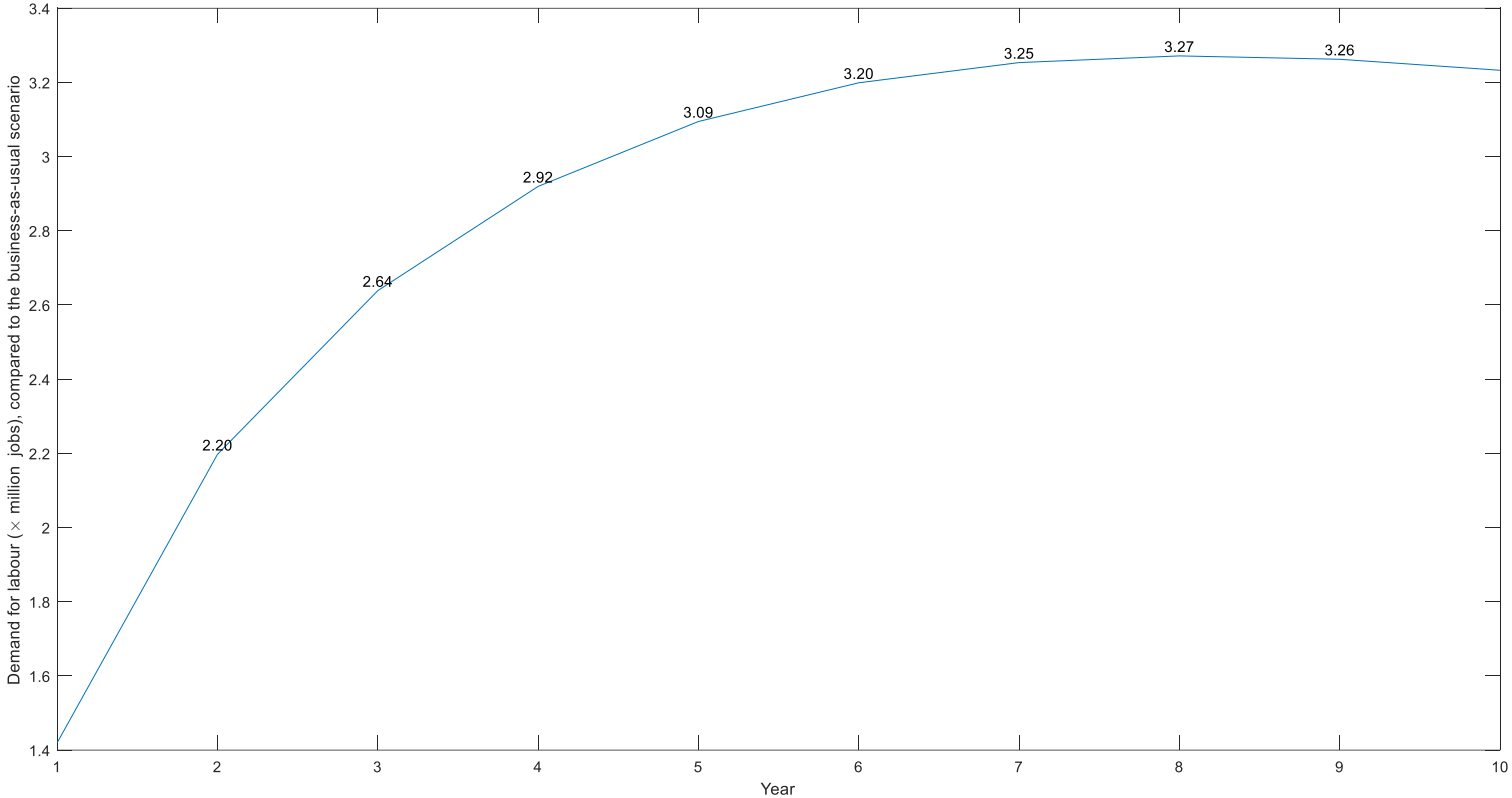
4.3.2 Labour by sector

The CGE model result in Figure 6 reveals significant variations in labour demand across different sectors under the '24-hour economy' scenario. The sectoral results provide vital insights into the differential impacts of a '24-hour economy' on Ghana's labour market.

In terms of the total number of jobs generated, the 'agriculture, forestry and fishing' sector emerges as the most important beneficiary of the '24-hour economy' policy, creating close to 1.40 million jobs by Year 10. This is to be expected given the pivotal role of the sector in the value chain underpinning an extended economy. The 'agriculture, forestry and fishing' sector for example is connected to the 'manufacturing' sector by way of its provision of feedstock to that sector, supporting its production activities. It is also intricately linked to the 'transportation and storage' sector, facilitating an extensive value chain that thrives on efficient logistics and storage solutions which are amplified under a '24-hour economy' setting.

It is important to emphasise here that the observed increase in labour demand within the 'agriculture, forestry, and fishing' sector does not directly suggest the adoption of round-the-clock activities such as farming, fishing or logging. Instead, this trend reflects the need for expansion in this sector to bolster other sectors that are more inherently suited to a 24-hour operational framework but rely on the outputs from agriculture to operate. Essentially, the rise in labour demand in agriculture is more attributable to a heightened demand for this sector's products, rather than an expectation for the workforce in agriculture to operate continuously, 24/7.

Other sectors such as the 'wholesale and retail trade' sector (441,000 jobs), the 'manufacturing' sector (251,000 jobs), the 'construction' sector (267,000 jobs), 'accommodation and food services' sector (198,000), the 'transportation and storage' sector (161,000 jobs) and the 'other services' sector (264,000) collectively generate more than 1.5 million jobs by Year 10 under the '24-hour economy' scenario compared to the 'business-as-usual' scenario.[2]

In terms of percentage growth in demand for labour, the 'construction' sector (51.37%), the 'agriculture, fishing and forestry' sector (42.34%), the 'accommodation and food services' sector (37.75%), the 'manufacturing' sector (37.55%) and the 'ICT' sector (36.17%) see the largest increases outside agriculture.

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[2] The 'Other services' sector includes industries such as 'business services', 'professional, scientific and technical activities', 'administrative and support service activities' and 'arts, entertainment and recreation activities'. See Appendix I for a full list of industries under each sectoral classification.

The diverse pattern in demand for labour across sectors further highlights the multifaceted nature of the '24-hour economy' and its capacity to stimulate employment in different areas of Ghana's economic landscape. The substantial growth in labour demand in sectors like 'accommodation and food services', 'financial and insurance activities', 'Other services' and 'ICT' indicates some shift towards more service-oriented and technologically driven economic activities. These sectors, essential for supporting extended operational hours, become increasingly vital in a round-the-clock economy. Similarly, the expansion in labour demand in the 'real estate' sector points towards a growing demand for commercial and residential spaces, aligning with the extended operational hours. This growth can lead to urban development and the revitalisation of city spaces to accommodate a 24-hour economy lifestyle.

Growth in demand for labour in the 'electricity' sector is indicative of the heightened demand for energy, essential for powering extended business operations day and night. This increase suggests the need for robust infrastructure and sustainable energy solutions to support the continuous activity. The 'manufacturing' sector's significant growth reflects its role in supporting the extended economy through continuous production. The growth in demand for labour in the 'electricity' and the 'manufacturing' sectors are to be expected given these are the sectors most directly infused under the '24-hour economy' policy.

These sectoral trends emphasise the transformative impact of the '24-hour economy' policy on Ghana's economic structure with respect to labour dynamics. They highlight the need for strategic planning and investment across the various sectors to fully leverage the potential of extended operational hours in providing jobs for the Ghanaian populace.

Figure 6: CGE model results for Ghana, showing the sectoral change in demand for labour (i.e. jobs generated) by Year 10 under a '24-hour economy' scenario compared to the 'business-as-usual' scenario scenario, by the tenth year of the policy implementation.
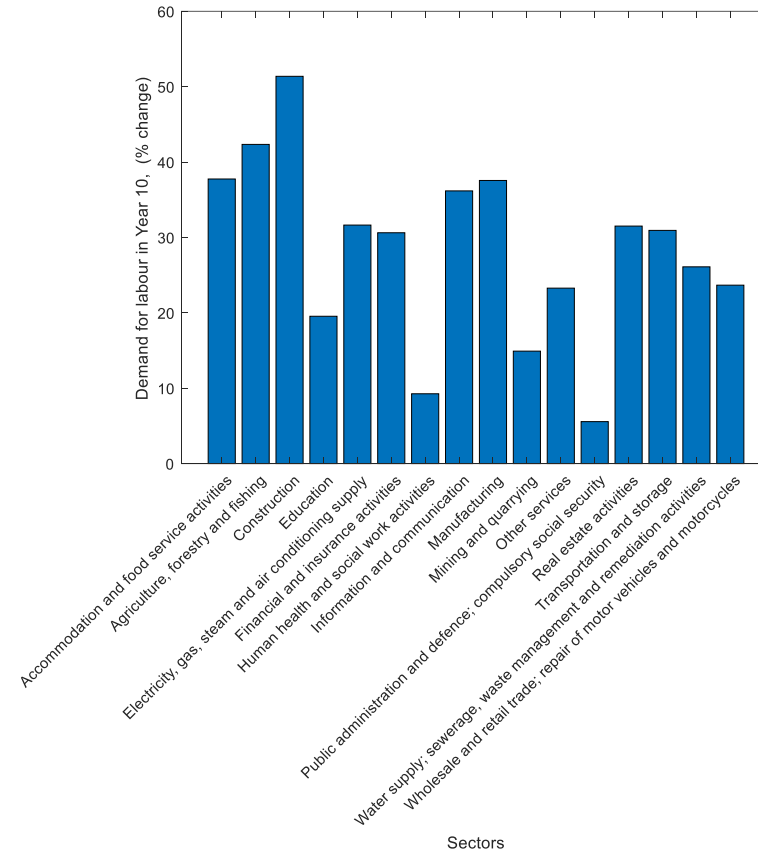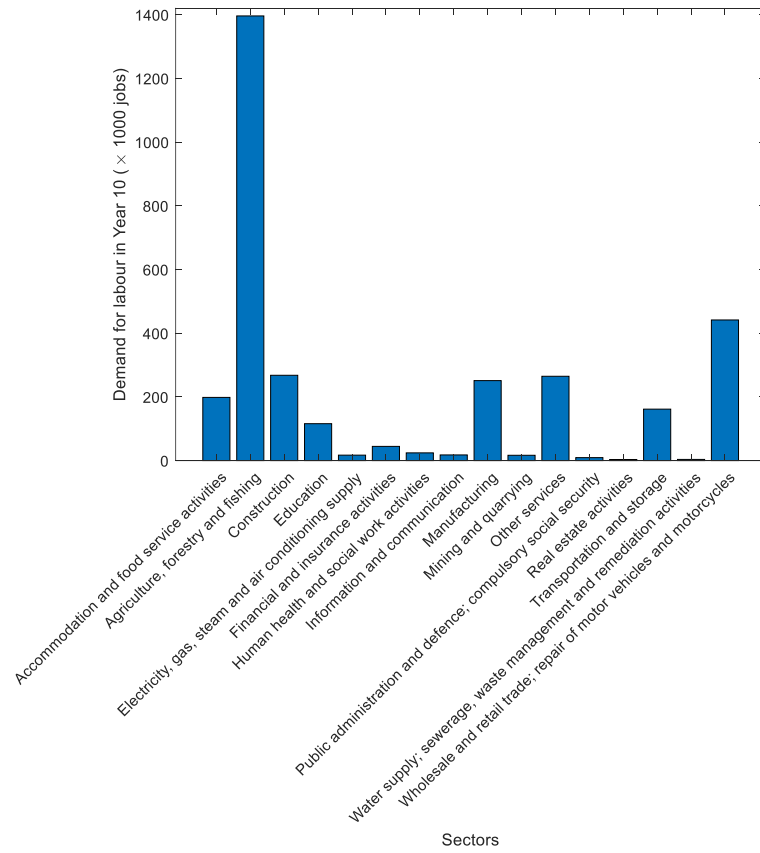
4.3.3 Labour by geography and skill level

The model results shown in Figure 7 presents a detailed picture of labour demand shifts under the '24-hour economy' scenario, demonstrating marginal yet important variations across different geographical belts and localities in Ghana.

In the Coastal Belt and Greater Accra region,[3] there is an observed increase in demand for unskilled labour that surpasses the demand for skilled labour in the context of the '24-hour economy'. The Greater Accra region, serving as both the capital and the economic hub of the nation, hosts the largest population of workers and a high concentration of skilled jobs. However, it also faces a burgeoning challenge due to the influx of unskilled workers from other geographical belts. The model's indication of rising demand for unskilled workers in the Greater Accra Belt could potentially amplify the existing rural-to-urban migration, further straining the urban infrastructure and exacerbating disparities between rural and urban areas.

Conversely, the Middle Belt exhibits a higher increase in demand for skilled labour, hinting at a possible transition towards a more knowledge-intensive economy. This Belt, known for having the highest population of agricultural workers, may experience diversification in its labour market with more knowledge-based job opportunities arising.

In terms of locality, urban areas are seeing the higher uptick in skilled labour demand under the '24-hour economy' scenario. This trend reflects the urban centre's role as hubs for industry and services that require skilled personnel and are likely to expand their operations due to the extended hours of economic activity. The Greater Accra region, with its high concentration of skilled workers is poised to benefit significantly from this trend.

The CGE model results underscore the critical need for a balanced regional development strategy as part of the '24-hour economy' policy. Such policies would ensure that the growth in labour demand, particularly for skilled labour in urban localities and the evolving economic structure in the Middle Belt, does not widen the development gap between urban and rural areas, and between the geographical belts in the country. It is imperative that the benefits of the '24-hour economy' are distributed equitably across all geographic regions, fostering inclusive

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[3] The SAM data which underpins the CGE model contains Ghana's ten regions under the then regional demarcation framework in 2015. The Coastal Belt in this paper is an aggregation of the following regions under the ten-region framework: Western region, Central region and Volta region. Greater Accra has not been included in this aggregation. It is given standalone treatment in this paper given its prominence as the capital and major economic hub. The Middle Belt under the ten-region framework consists of the following regions: Eastern region, Ashanti region and Brong Ahafo region. The Northern Belt consists of the Northern region, Upper East region and Upper West region.

growth that leverages the capabilities of both rural and urban workforces (see World Bank, 2018; Gupta and Vegelin, 2016; Kamran et al., 2023).

Figure 7: CGE model results for Ghana, showing the change in demand for labour by geography and skill level under a '24-hour economy' scenario compared to the 'business-as-usual' scenario scenario, by the tenth year of the policy implementation.
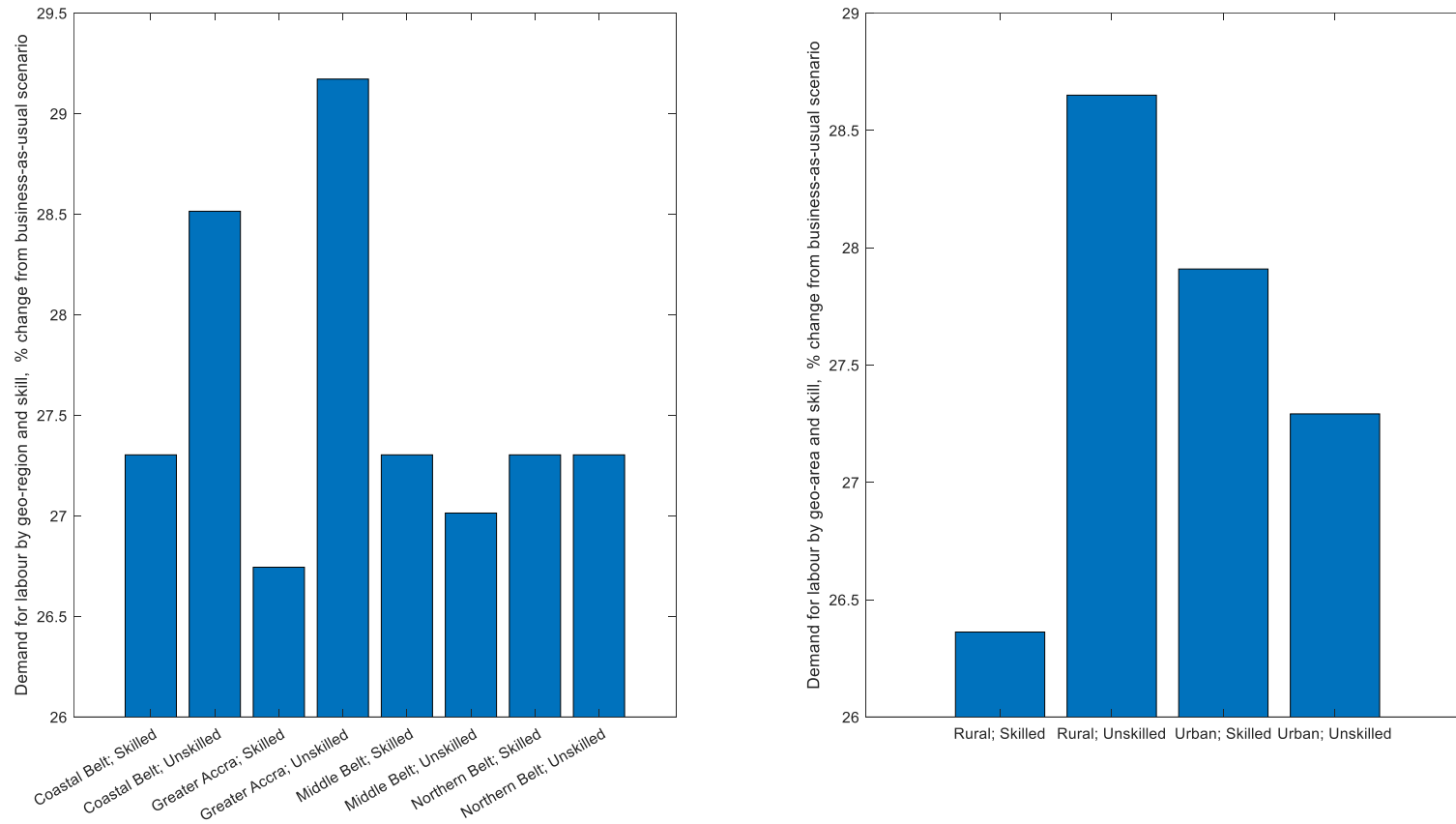
4.4 Household income and welfare effects

Figure 8 shows the shifts in disposable incomes across various demographic groups in Ghana under a '24-hour economy' setting. Although all income groups experience growth in disposable incomes, there are marginal yet important disparities between the groups.

In urban localities in the Greater Accra region and the Middle Belt, households witness substantial gains in disposable income, a reflection of the agglomeration of economic activities in these regions and localities. These regions, particularly the Greater Accra region with its economic clout, benefit from a concentration of sectors that would thrive under extended operating hours.

Conversely, rural households in the Coastal and Northern Belts see notable increases in disposable incomes too. This could be indicative of the spread of economic benefits brought about by the '24-hour economy', particularly through enhanced agricultural productivity and related downstream activities that stimulate rural economies.

In urban localities, there are important disparities in the growth of disposable incomes, with high-income groups experiencing greater increases across all belts. This pattern suggests that the '24-hour economy' potentially widens the income gap in urban areas, favouring those already in higher-income brackets who are positioned to capitalise on the new economic activities.

For rural areas, the picture is more heterogeneous, suggesting that the impact of the '24-hour economy' varies significantly based on local economic structures and the presence of industries that can operate effectively around the clock.

The Northern Belt, predominantly rural and the source of a significant migrant workforce to urbanised regions like Greater Accra, shows the least growth in disposable income for low-income urban households. This outcome points to the necessity of targeted economic policies to address income disparities and to provide opportunities for low-income groups, preventing further socioeconomic stratification.

The most pronounced increase in disposable income is found among high-income urban households in the Greater Accra region, emphasising the region's capacity to maximise the '24-hour economy's benefits. As the political and economic heart of the nation, Greater Accra is well-positioned to harness the policy's full potential, translating extended business hours into considerable income growth for its affluent urban residents.

These results not only highlight the variable impact of the '24-hour economy' across different demographic groups but also underscore the need for nuanced policy interventions. Such interventions should aim to balance the growth across regions, support lower-income urban households, particularly in the Northern Belt, and ensure that the '24-hour economy' fosters inclusive economic development throughout Ghana.

Figure 8: CGE model results for Ghana, showing the change in disposable income under a '24-hour economy' scenario compared to the 'business-as-usual' scenario by the tenth year scenario, by the tenth year of the policy implementation.
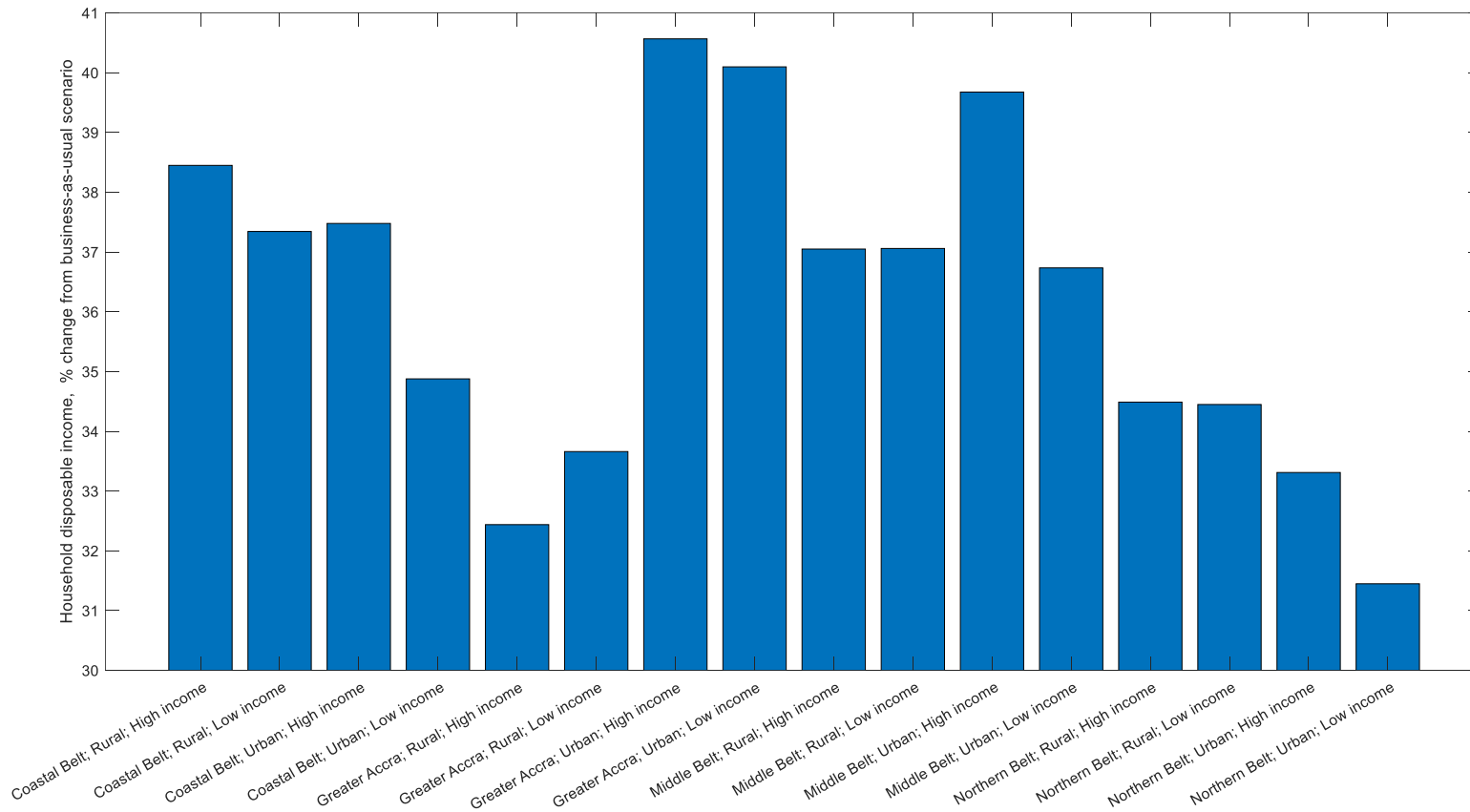
5 Discussion

The above results provide a multifaceted view of the economic transformation that Ghana could experience under a '24-hour economy' setting. This transformation is characterised by significant growth in various sectors, increase in government revenues, increase in household disposable incomes across different income groups, and changes in labour demand and labour dynamics.

5.1 Economic Growth and Diversification:

The substantial increase in both nominal and real GDP under the '24-hour economy' scenario is indicative of enhanced economic activity and productivity in Ghana. This growth reflects more than just inflationary trends, pointing to real augmentations in economic output under a '24-hour economy' setting. The policy's potential to drive significant economic development is evident, particularly in urban localities and sectors conducive to a 24-hour operational model.

To sustain the observed growth however, the results call for economic diversification in Ghana, ensuring resilience against potential vulnerabilities in labour-intensive sectors.

5.2 Fiscal Implications and Revenue Growth:

The significant rise in government revenues from business and household income taxes is a testament to the increased economic vibrancy under the '24-hour economy' setting. This fiscal boost offers opportunities for reinvestment in key areas such as infrastructure, education, and health, thereby fostering further economic growth in Ghana. The expanded tax base also offers the government an opportunity to manage public expenditure and public debt.

5.3 Income Distribution and Equity Considerations:

The disparities in disposable income growth between urban and rural localities, and among different income groups point to potential challenges in ensuring equitability and inclusivity in the distribution of the benefits from the '24-hour economy' policy. Policies must aim to bridge these gaps to avoid exacerbating existing inequalities between the different income groups in Ghana.

5.4 Labour Market Dynamics and Employment Growth:

The marked increase in demand for labour, particularly in sectors such as 'agriculture, forestry and fishing', 'manufacturing', 'wholesale and retail trade', etc. indicates job creation and opportunities for workforce engagement in Ghana. This development is particularly important in tackling the challenges of unemployment and underemployment in the country.

The nuanced growth in skilled and unskilled labour demand across different regions and localities highlights the varying impacts of the '24-hour economy' on the labour market. It suggests the need for targeted workforce development and protection strategies to equip workers with the skills needed in a changing economic landscape.

The implementation of the '24-hour economy' policy therefore necessitates a comprehensive approach, not only in its execution but also in its integration with broader employment strategies. To effectively leverage the employment potential of this policy, several key actions and strategies related to workforce development are required, which may include the following:

- **Upskilling and Retooling the Workforce:**
  Specific programs must be developed to upskill and retool the existing workforce to align with the demands of a '24-hour economy' setting. This includes training in new technologies, flexible work practices and skills pertinent to emerging sectors. Collaboration with educational institutions and vocational training centres is essential to ensure that the skills being taught are in sync with the evolving job market.

- **Incentivising Workforce Participation:**
  Incentives should be created to encourage participation in the workforce, particularly in sectors that are expected to see the most growth, and in job roles that are not traditionally desired. These incentives could include tax breaks, wage subsidies, enhanced worker protection provisions and/or other financial incentives for both employers and employees.

  Special attention should be paid to groups that are typically under-represented in the labour force, such as women, youth, and rural populations, to ensure inclusive growth. As of 2022, over 2.71 million Ghanaian youth aged 15 – 35 years old were reported as not being in education, employment or training (GSS, 2022; see page 109). Of these, more than a million reside in rural localities, with close to 60% of this cohort being female. This highlights the considerable potential for transformation of the labour force landscapte in Ghana under a '24-hour economy' setting.

- **Geographical and Sectoral Alignment:**

  Employment strategies must also consider the geographical and sectoral distribution of new job opportunities. This involves creating employment opportunities in regions with high unemployment rates and aligning job creation with sectoral growth patterns. Infrastructure development, particularly in transportation and digital connectivity, will be key to supporting employment in different geographic regions.

- **Policy Synergy and Coordination:**

  There should be a coordinated effort between various government agencies to ensure that employment policies are synergistic and complement the goals of the '24-hour economy'. Regular monitoring and evaluation mechanisms should be implemented to assess the effectiveness of these policies and make adjustments as necessary. This would ensure a timely realisation of the employment opportunities presented by the '24-hour economy' policy.

The actions, policies, and strategies focused on workforce development mentioned above represent only a portion of the comprehensive measures required to fully capitalise on the employment potential offered by the '24-hour economy' policy in Ghana.

6 Conclusion

With the aid of a dynamic recursive CGE model, this study finds that the proposed policy to transition to a '24-hour economy' in Ghana presents the country with a unique opportunity to stimulate economic growth, diversify its economy, and create considerable employment opportunities.

The findings reveal that with the implementation of the '24-hour economy' policy, Ghana's real GDP growth (not to be confused with the GDP growth rate) is projected to be approximately one-third higher in a decade compared to what it would have been under a 'business-as-usual' scenario. This points to significant enhancements in economic output within the Ghanaian economy under the new policy framework. Additionally, the policy is expected to create over 3 million jobs within the first five years of its enactment. Key sectors such as manufacturing, agriculture, wholesale and retail trade, services, construction and transport are anticipated to witness notable increases in employment opportunities.

However, this transformation is not without challenges. The differential growth impacts across sectors, regions and households highlight the complexity of the transition. The CGE model results highlight the need for a holistic approach in policy formulation and implementation to address these complexities. Policies should aim to support sectoral growth while addressing potential disparities and ensuring equitable distribution of economic gains.

To fully harness the benefits of a '24-hour economy', Ghana requires a multifaceted approach encompassing investments in human capital (i.e. education and skill training), infrastructural development, digital transformation and environmental sustainability. The government's role in managing this transition is pivotal, particularly in ensuring that the fiscal benefits are effectively utilised to support long-term economic development and social welfare. A number of stragtegies would need to be formulated to accompany the transition to the '24-hour economy'. These may include, but not limited to, the following;

- Workforce development (and protection) strategy
- Energy security strategy
- Circular economy strategy
- Balanced regional development strategy
- Equality and inclusivity strategy
- Economic diversification strategy

In essence, the '24-hour economy' policy has the potential to be a catalyst for accelerated development and job creation in Ghana. Its success will however depend on careful planning, inclusive strategies and adaptive policy measures. With the right implementation approach, as guided by the principles of good governance and economic management, Ghana can leverage this opportunity to achieve sustainable growth, enhanced productivity and long-term prosperity for all segments of its populace.

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Appendix I: Detailed description of sectors and commodities

Sectors and commodities in the model	UN ISIC classification description; and aggregation scheme in Ghana SAM data
Manufacturing and processing	This sector is concerned with the physical or chemical transformation of materials, substances, or components into newly manufactured products. These materials, substances, or components typically consist of raw materials obtained from sectors such as agriculture, forestry, fishing, mining, or quarrying, along with outputs from other manufacturing processes. Activities in this sector usually involve significant modification, refurbishment, or rebuilding of goods. In this paper, the sectors/commodities in the Ghana SAM data that have been aggregated under this ISIC sector classification include the following: 'Fruit and vegetable processing', 'Fats and oils', 'Grain milling', 'Sugar refining', 'Other foods', 'Beverages', 'Tobacco (processed)', 'Textiles', 'Clothing', 'Leather and footwear', 'Wood and paper', 'Petroleum, Chemicals', 'Non-metal minerals', 'Metals and metal', 'Machinery and equipment' and 'Other manufacturing'.
Electricity, gas, steam and air conditioning supply	This sector encompasses the provision of essential utilities such as electric power, natural gas, steam, and hot water, delivered through a comprehensive and permanent infrastructure of lines, mains and pipes. The scope of this network's size varies, covering both large-scale distribution systems and localised supply within industrial parks or residential buildings. This sector primarily involves the operation of electric and gas utilities responsible for generating, regulating, and distributing electricity and gas. This sector does not cover the operations of water and sewerage utilities. In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Agriculture, forestry and fishing	This sector encompasses the utilisation of plant and animal natural resources. It covers a range of activities, including crop cultivation, animal husbandry and breeding, as well as the harvesting of timber, along with other plant and animal products, either from cultivated farms or their natural environments. In this paper, the sectors/commodities in the Ghana SAM data that have been aggregated under this ISIC sector classification include the following: 'Maize', 'Sorghum and millet',

Sectors and commodities in the model	UN ISIC classification description; and aggregation scheme in Ghana SAM data
	'Rice', 'Pulses', 'Groundnuts', 'Other oilseeds', 'Cassava', 'Other roots', 'Vegetables', 'Fruits and nuts', 'sugar cane', 'Tobacco', 'Cotton and fibres', 'Fruits and nuts', 'Cocoa', 'Coffee and tea', 'Other crops', 'Cattle', 'Poultry', 'Other livestock', 'Forestry', 'Fishing'.
Accommodation and food service activities	This sector encompasses the offering of temporary accommodation for visitors and travellers, along with the provision of complete meals and beverages ready for immediate consumption. The range and nature of additional services offered in this sector or commodity can differ significantly. It is important to note that this category does not include the provision of long-term accommodation intended as primary residences, which falls under the category of 'Real Estate activities'.

In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data. |
| Public administration and defence; compulsory social security | This sector involves activities typically undertaken by public administration, encompassing various aspects of government operations. It includes the creation, judicial interpretation, and enforcement of laws, along with the administration of programs established under these laws. Key activities in this sector range from legislative functions and taxation to national defence, public safety and order, immigration services, and foreign affairs, as well as the management of government-initiated programs. Additionally, this sector covers activities related to compulsory social security services.

In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data. |
| Construction | This sector encompasses a broad range of construction activities, covering both general and specialised construction tasks for building structures and civil engineering projects. This includes not only new constructions but also repair work, expansions, and modifications. Activities in this sector also involve setting up prefabricated structures on designated sites and various types of temporary construction projects. General construction within this sector refers to the building of complete structures like residential dwellings, office buildings, retail spaces, and various buildings for public use and utilities, including agricultural structures. Additionally, the sector covers the construction of substantial civil engineering works. These encompass a wide array of projects such as highways, local roads, bridges, tunnels, railway |

| Sectors and commodities in the model	UN ISIC classification description; and aggregation scheme in Ghana SAM data
	lines, airports, ports and other maritime structures, water management projects like dams and irrigation systems, sewage networks, industrial facilities, pipelines, electrical transmission lines, and sports infrastructure.
	In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Education	This sector covers educational services at all levels and for any profession, delivered through various modes including oral, written, radio, television, and other communication mediums. It encompasses formal education provided by institutions within the standard school system across different levels, as well as adult education and literacy programs. Additionally, this sector includes specialised educational institutions like military academies and prison schools, each at their respective educational levels. Both public and private educational services fall under this sector.
	In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Financial and insurance activities	This sector encompasses activities related to financial services, including those in insurance, reinsurance, and pension funding, as well as activities that provide support to financial services. In addition, this sector covers the management and holding of assets, including the operations of holding companies and the activities of trusts, funds, and similar financial entities.
	In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Human health and social work activities	This sector encompasses a broad spectrum of health and social work activities. It ranges from healthcare services delivered by trained medical professionals in hospitals and similar settings to residential care activities that incorporate some level of healthcare. Additionally, the sector includes social work activities conducted without the direct involvement of healthcare professionals.

Sectors and commodities in the model	UN ISIC classification description; and aggregation scheme in Ghana SAM data
	In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Information and communication	This sector is involved in the creation and dissemination of information and cultural products. It includes activities related to the provision and distribution of these products, as well as services related to data communication, information technology, and the processing of data and other information services. Key components of this sector encompass software publishing, activities related to motion pictures and sound recording, radio and television broadcasting and programming, telecommunications activities, information technology services, and other information service activities. In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Mining and quarrying	This sector is engaged in the extraction of naturally occurring minerals, which can be in the form of solids (like coal and ores), liquids (such as petroleum), or gases (like natural gas). The extraction process employs various methods, including underground and surface mining, well operations, and mining from the seabed. Additionally, the sector encompasses ancillary activities that prepare these raw materials for market. These processes include crushing, grinding, cleaning, drying, sorting, and concentrating ores, as well as the liquefaction of natural gas and the agglomeration of solid fuels. In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Real estate activities	This sector involves a range of activities related to real estate, functioning in capacities such as lessors, agents, or brokers. These activities encompass various services, including the sale and purchase of real estate properties, rental services, and other related services like real estate appraisal and functioning as escrow agents in real estate transactions. The sector also encompasses the construction of buildings and structures, coupled with either retaining ownership of these properties or leasing them out.

Sectors and commodities in the model	UN ISIC classification description; and aggregation scheme in Ghana SAM data
	In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Transportation and storage	This sector is involved in offering transportation services for passengers or freight, utilising various modes such as rail, pipeline, road, water, or air. It also includes related activities like the management of terminals and parking facilities, along with cargo handling and storage services.
	In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Water supply; sewerage, waste management and remediation activities	This sector encompasses activities associated with the management of waste, including its collection, treatment, and disposal. It deals with various types of waste, including both solid and non-solid forms originating from industrial or household sources, as well as the remediation of contaminated sites. Additionally, activities related to water supply are included in this sector, often because they are conducted in conjunction with, or by the same entities involved in, sewage treatment.
	In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Wholesale and retail trade; repair of motor vehicles and motorcycles	This sector covers the wholesale and retail trade, involving the sale of various kinds of goods without any modification, and includes services related to the sale of these goods. Both wholesaling and retailing represent the final stages in the distribution process of goods. Additionally, this sector also encompasses the repair of motor vehicles and motorcycles.
	In this paper, there is no aggregation scheme for this sector as there is direct one-to-one matching between the ISIC sector classification and the sector representation in the Ghana SAM data.
Other services	This section, serving as a catch-all category, comprises the activities of membership organisations, repair services for computers, personal and household items, and a range of personal service activities that do not fit into other classification categories.

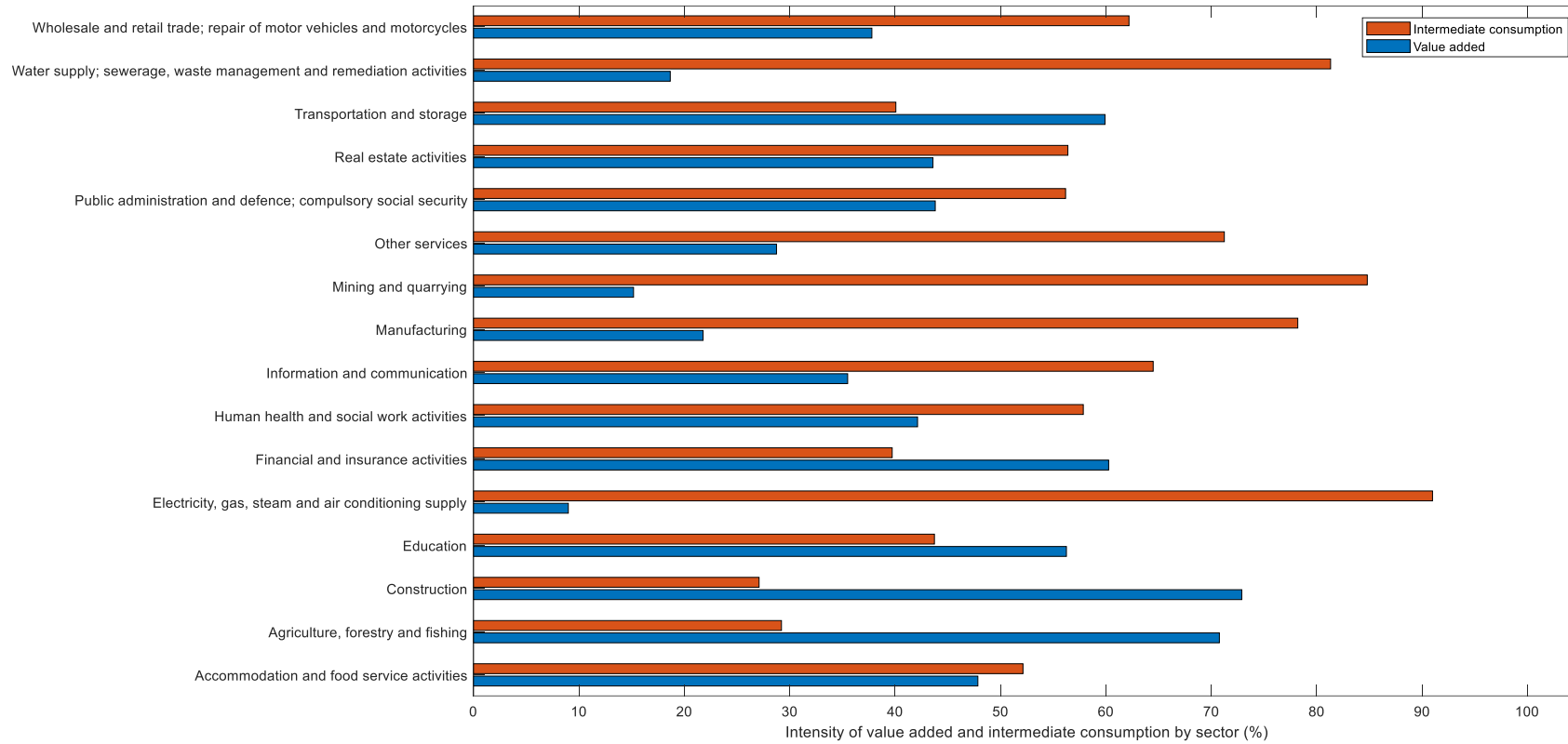| Sectors and commodities in the model	UN ISIC classification description; and aggregation scheme in Ghana SAM data
	In this paper, 'business services' as represented in the Ghana SAM data has been grouped under this sector. Also, 'professional, scientific and technical activities', 'administrative and support service activities' and 'arts, entertainment and recreation activities' as represented in the Ghana census data for employment figures have been aggregated under this sector.

Appendix II: Insights from the 2015 Ghana Social Accounting Matrix Data

Figure A1: Insights about the structure of the Ghanaian economy, showing sectoral contribution to GDP (%) and sectoral intensity of labour and capital utilisation (%).
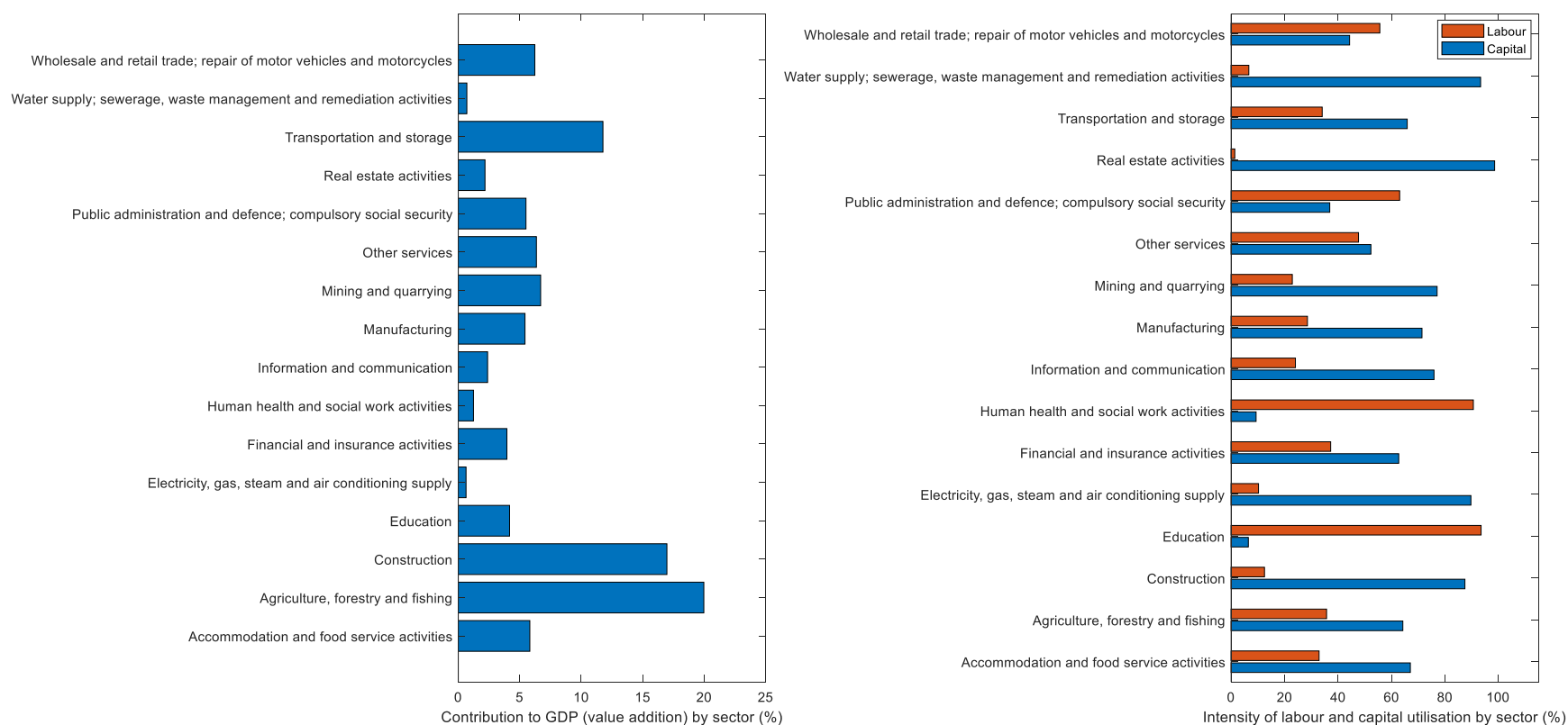
Source: Author plot using the 2015 Social Accounting Matrix (SAM) data for Ghana, as provided by the European Union Joint Research Centre (2023)

Figure A2: Insights about the structure of the Ghanaian economy, showing the intensity of value added and intermediate consumption by sector (%).

Source: Author plot using the 2015 Social Accounting Matrix (SAM) data for Ghana, as provided by the European Union Joint Research Centre (2023)