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Article

# Wage subsidy in the DRC: A CGE analysis

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**Abstract:** This paper analyzes the impact of wage subsidies on lower-skilled formal workers in the Democratic Republic of Congo (DRC). It employs a multi-sectoral, empirically-calibrated general equilibrium model to capture the economy-wide transactions between the formal and informal sectors and assess policy simulations in the DRC. The simulations, both in the short and long run, indicate that when the government provides wage subsidies to lower-skilled workers, it significantly improves the real disposable incomes of both formal and informal households. There is a general increase across formal and informal sectors in real household disposable incomes due to the wage subsidy. The results show that subsidy allocation narrows the income gap between high and low-income households, as well as between formal and informal sectors. The findings are insightful for wage policy simulations, as the wage subsidy targeting lower-skilled formal workers increases real GDP from the expenditure side by 1.19% and 3.19% in the short and long run, respectively, from the baseline economy.

**Keywords:** wage subsidy; informal sector; CGE model; Democratic Republic of Congo
**JEL Classification:** C68; D58; E24; E26; O17; R28

## 1. Introduction

Unemployment remains a pervasive and persistent challenge confronting the African continent (Akeju and Olanipekun, 2014; Baldry, 2016; Golub and Hayat, 2015; Mensah, 2024). It is a multifaceted issue that reflects inefficiencies in labor markets and exacerbates socio-economic disparities, hindering sustainable development and economic prosperity. The gravity of the unemployment situation in Africa is highlighted by statistics that paint a grim picture of the labor market landscape. According to the International Labour Organization (ILO), the average unemployment rate in Sub-Saharan Africa was approximately 6.6% in 2020, with North Africa experiencing a significantly higher rate of 11.8% (ILO, 2020). However, these figures only scratch the surface, as they do not account for underemployment and informal employment, which are prevalent across the continent.

Several studies have proposed various policies to tackle unemployment in Africa. These include enhancing skills and education, promoting entrepreneurship and small businesses, implementing labor market reforms, investing in infrastructure, and providing wage subsidies (AfDB, 2021; Alexander and Warwick, 2007; Baah-Boateng, 2015; Chigunta, 2017; ILO, 2017; World Bank, 2008, 2009, 2010, 2019).

Regarding wage subsidies, Neumark (2015) reviews recent research on the effects of minimum wages on employment. He points out the ongoing debate and mixed evidence regarding the impact of wage subsidies on unemployment. While some studies find negative employment effects, others report minimal or no impact. The author suggests that the variation in findings may be attributed to differences in

methodology, data, and the populations studied. Blumkin and Pinhas (2020) assess a mechanism by which wage subsidies lead to higher social welfare. The authors demonstrate that workers reciprocate higher wage subsidies with increased effort and productivity. Huttunen et al. (2013) examine the employment effects of a Finnish payroll tax subsidy scheme targeted at employers of older, full-time, low-wage workers. Their empirical analysis indicates that the subsidy system had no effect on the employment rate or wages of the eligible groups but slightly increased working hours among those already employed.

While numerous studies have explored the effects of wage subsidies on employment and unemployment, especially in developed economies, there are relatively few such studies conducted in Africa. An exception is the study by Burns et al. (2013), which used a computable general equilibrium (CGE) model of the South African economy to assess the effectiveness of a wage subsidy in increasing employment among semi- and unskilled workers. The authors found that employment for these groups could be significantly increased. Furthermore, they demonstrated that wage subsidy schemes compare favorably with alternative welfare grant schemes in terms of employment growth. To address the gap in the literature on wage subsidies and employment, this paper investigates the impact of wage subsidies in the Democratic Republic of Congo (DRC) using a computable general equilibrium (CGE) model that accounts for the interaction between formal and informal sectors. To the best of our understanding, there is no study that assesses the effect of wage subsidies in the context of CGE modeling while accounting for the interaction between the formal and informal sectors of the economy. The significance of informal sectors in Africa is undeniable, particularly when modeling aspects of the labor market. These sectors, often characterized by unregulated employment and small-scale operations, play a crucial role in providing livelihoods for a substantial portion of the population. They serve as a safety net for those unable to secure formal employment, offering income-generating opportunities with lower barriers to entry. Consequently, any comprehensive analysis of labor market dynamics in Africa must incorporate the informal sectors to accurately capture the full employment landscape and devise effective policy interventions that address the needs of both formal and informal workers.

It is important to note that unemployment is one of the most prevalent socioeconomic challenges in the Democratic Republic of Congo (DRC), negatively impacting a significant portion of the labor force. The high level of unemployment in the DRC can be attributed to the underperformance of the formal sector, as well as the inability of the unemployed to penetrate the labor market. Since job creation in the formal sector has not kept pace with the increasing participation in the labor force, many unemployed individuals have turned to the informal sector. This shift explains why informal employment has played a significant role in job creation over the last two decades (Aikaeli and Mkenda, 2014; Bosch and Esteban-Pretel, 2012; ILO, 2013; Sultana et al., 2022). Although the informal sector accounts for more than 80% of economic activity in the DRC (Kawaya, 2008; World Bank, 2009), its impact on the formal sector has never been thoroughly assessed. Evaluating the impact of the informal sector on the formal sector, especially in the presence of wage subsidies, is crucial to understanding the overall role of the informal sector in the economy. It will

also reveal the extent of intra-trade between the formal and informal sectors.

The primary research question of this paper seeks to address is how the structure and size of the formal sector influence employment incentives and opportunities in the informal sector when a wage subsidy is implemented. It is crucial to assess whether the wage subsidy directly impacts the size and structure of the informal sector and, as a result, indirectly affects the level of unemployment in the country. Understanding the dynamics between wage subsidies, the formal sector, and the informal sector is essential for developing effective policies that can stimulate job creation and reduce unemployment. By exploring the interaction between these elements, this paper aims to provide insights into the potential of wage subsidies as a tool for enhancing employment prospects in both sectors and ultimately improving the overall economic well-being of the country.

The remainder of the paper is structured as follows. Section 2 presents a brief literature review. Section 3 explains the methodology as well as the research instrument, namely the Democratic Republic of Congo Formal-Informal Model (DRCFIM) that was used to analyse the policy shock, while Section 4 discusses the model closure and policy shock effect. The findings of this study and their implications for future research are outlined in sections 5 with policy implication and concluding remarks following in section 6.

## 2. Literature review

A number of studies are conducted to assess the economic effects of wage subsidy, especially in the labour market. Levinsohn and Pugatch (2014) analyze an employer wage subsidy targeted at youth, a policy enacted by the South African government to address the issue of persistently high youth unemployment in the country. The authors estimate a structural search model that incorporates both observed heterogeneity and measurement error in wages and find that a R1000/month wage subsidy paid to employers leads to an increase of R596 in mean accepted wages and a decrease of 12 percentage points in the share of youth experiencing long-term unemployment. Lombardi et al. (2018) investigate how targeted wage subsidies affect the performance of the recruiting firms in Sweden. By using the Swedish administrative data from the period 1998–2008, the authors find that treated firms substantially outperform other recruiting firms after hiring through subsidies, despite identical pre-treatment performance levels and trends in a wide set of key dimensions. The pattern is less clear from 2007 onwards, after a reform removed the involvement of caseworkers from the subsidy approval process. Overall, the results suggest that targeted employment subsidies can have large positive effects on post-match outcomes of the hiring firms, at least if the policy environment allows for pre-screening by caseworkers. Blumkin and Pinhas (2020) assess a mechanism by which wage subsidies lead to higher social welfare. The authors show that workers reciprocate higher wage subsidies with higher effort leading them to reciprocate with higher effort and productivity. Kaiser and Kuhn (2016) assess the effects of a Danish wage subsidy program for highly educated workers on the performance of the persons and firms participating in the program. The authors use data on the population of program participants, both workers and firms. They find that the program had positive effects

on employment and annual earnings during program participation while there are no positive effects for the years after program expiration. At the employer-level, the study finds statistically significant effects on the number of highly educated employees for both the period of program participation and the subsequent time period. Regarding the total number of employees, the study only finds positive effects during program participation while there are no statistically significant effects for value added, net income, return on assets, wages per employee and labor productivity. Beqiraj and Tancioni (2023) evaluate the macroeconomic effects of a selective wage subsidy targeted to newly-hired workers compared with those of standard fiscal instruments. The analyses are based on a search and matching monetary model in which a distinction between the wage negotiated by newly-hired workers and incumbents is introduced. The model is estimated using data for high unemployment countries of the Euro-zone periphery. The results of the study show that, although the labour market policy can be an effective measure to jump-start employment, it is not superior to standard fiscal expansions in stimulating a timely response of economic activity. A liquidity trap environment reinforces these results, showing that policy actions triggering a deflation can be pro-cyclical with zero interest rates.

Most of the above-mentioned studies have used econometric model to assess the effects of wage subsidy on the labor markets. These models range from linear to nonlinear regression and random experiments. Studies that make use of computable general equilibrium in assessing the effect of wage subsidy on the labour market are rare, except the study by study by Burns et al. (2013) who used a computable general equilibrium (CGE) model of the South African economy to assess the effectiveness of a wage subsidy in raising employment of semi- and unskilled workers. Unfortunately, their model did not account for the interaction of the formal and informal sectors when assessing the general equilibrium effects of the wage subsidy. To fill this gap, this paper assesses the effect of wage subsidy in the context of CGE modelling when accounting for the interaction between formal and informal sectors of the DRC economy.

## 3. Methodology

Using GEMPACK (General Equilibrium Modelling Package) software, the DRCFIM was developed as a research tool to assess the impact of wage subsidies on lower-skilled formal workers in the DRC. The DRCFIM from which simulations are conducted in this study is mainly based on ORANI model of the Australian economy. The generic version of the model, ORANI-G, designed for expository purposes was developed by Horridge (2002). The model has a theoretical composition which is typical of a static AGE model. It consists of equations describing, for some time period such as producers' demands for produced inputs and primary factors; producers' supplies of commodities; demands for inputs to capital formation; household demands; export demands; government demands; the relationship of basic values to production costs and to purchasers' prices; market-clearing conditions for commodities and primary factors; and numerous macroeconomic variables and price indices. **Figure 1** below is a schematic illustration of the model's input-output database. It shows the main structure of the model. The absorption matrix from the

figure distinguishes the following economic agents:

(1) domestic producers divided into I industries;
(2) investors divided into I industries;
(3) a single representative household;
(4) an aggregate foreign purchaser of exports;
(5) an 'other' demand category, broadly corresponding to government; and
(6) changes in inventories.

Each cell in the descriptive absorption matrix in **Figure 1** includes the name of the corresponding data matrix. For instance, V2MAR is a 4-dimensional array showing the cost of *M* margins services on the flows of *C* goods, both domestically produced and imported (*S*), to *I* investors.

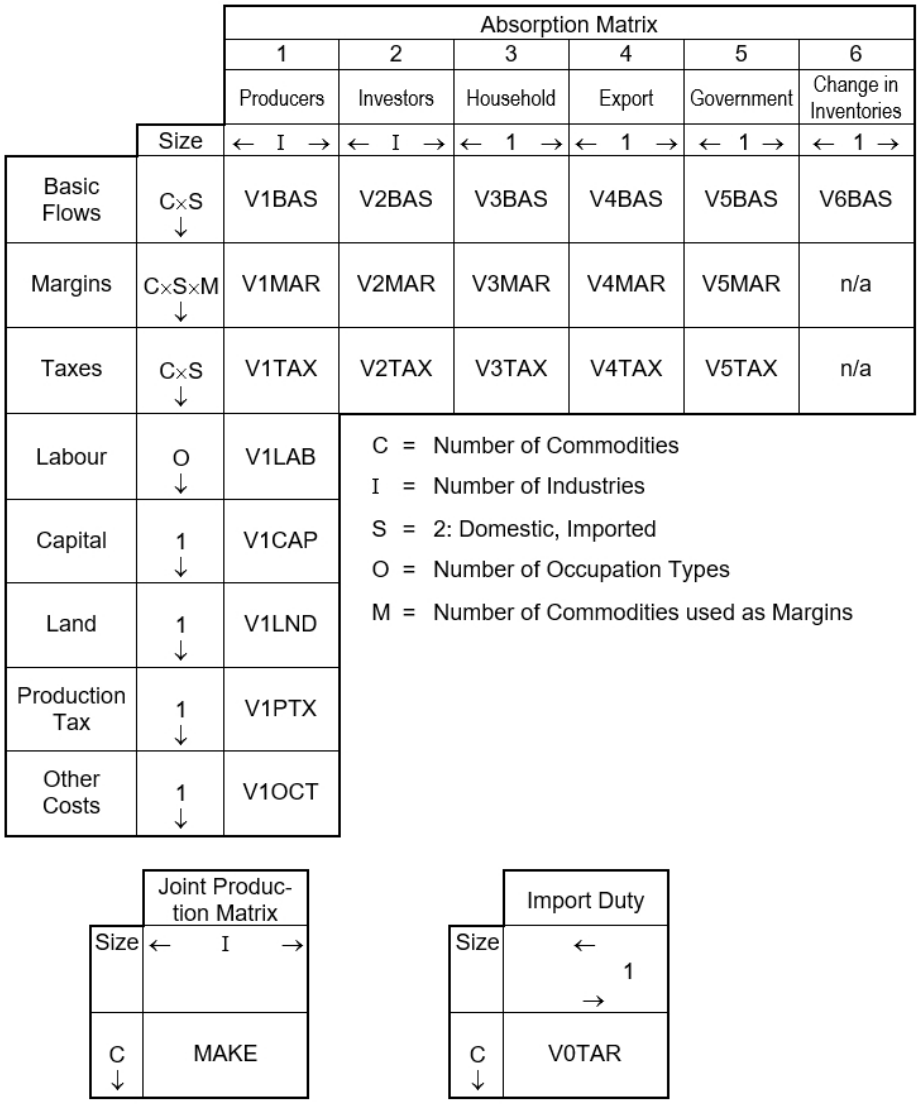


**Figure 1.** The ORANI-G flows database (Horridge, 2002).

In general, each industry is qualified to produce any of the *C* commodity types. The MAKE matrix at the bottom of **Figure 1** shows the value of output of each commodity by each industry. Furthermore, tariffs on imports are assumed to be levied at rates which vary by commodity but not by user. The revenue obtained is represented

by the tariff vector V0TAR.

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

Besides using its own core database, the DRCFIM is based on the 2007-DRC Social Accounting Matrix (SAM), which reconciles a wide range of data sources, including national accounts, household income and expenditure surveys, as well as labour force surveys. The primary data sources used in constructing the 2007-SAM are the 2007-DRC bureau of statistics (INS) supply-and-use tables, 2008-DRC Reserve Bank (BCC) macroeconomic data and the 2007-Household Survey (HS).

The supply-and-use tables were utilised to establish the sector links and relationships, while the HS data provided information regarding employment levels and average wages across different labour groups and sectors. For lack of better information, the 1996-Income and Expenditure Survey data generated by INS was used to model household factor income distribution and consumption behaviour. The 2007-SAM consisted of comprehensive information on demand and supply for 15 activities or commodities in the formal and informal sectors each. The labour component was divided between the formal and informal sector. Four labour groups were specifically identified in each of the formal and informal sector, namely: (1) subsistence factor, (2) child labour, (3) female adult labour and (4) male adult labour. The household sector of 2007-SAM was disaggregated according to income into rural and urban areas with four groups in each of the formal and informal sector: i.e., (1) rural poor households, (2) rural non poor households, (3) urban poor households and (4) urban non poor households. The land component was also divided between the formal and informal sector.

It is important to note that there are endogenous and exogenous accounts in the disaggregated 2007-SAM. The endogenous accounts are composed of activities, commodities, labour, capital, land, enterprises and households, while the exogenous accounts consist of government, capital account, rest of the world and residual. Thus the 2007-SAM is an economy-wide database that accounts for all monetary flows in the DRC economy during 2007. It was used as database for the construction of the DRCFIM and the parameters of the model equations were calibrated to observed data from the 2007-SAM. The equations used to capture the factor markets which allow a suitable analysis of wage subsidies are presented in Appendix A.

## 4. Model closure and policy shocks

We used the short run (SR) and long run (LR) closures by keeping in mind the realities of the DRC labour force. A significant amount of employments exist within the skilled and lower-skilled market. A wage subsidy targeted at lower-skilled formal workers should affect the overall level of employment, regardless the possible intervention of outweighing tax increases and rigidities in the labour force. The

introduction of a wage subsidy at the lower-skilled formal workers in the SR is important because the time-horizon for possible increase in government spending is usually short-term. **Figure 2** below represents the main macro assumptions underlying the interactions among endogenous (oval) and exogenous (rectangular) macro variables in the SR closure.

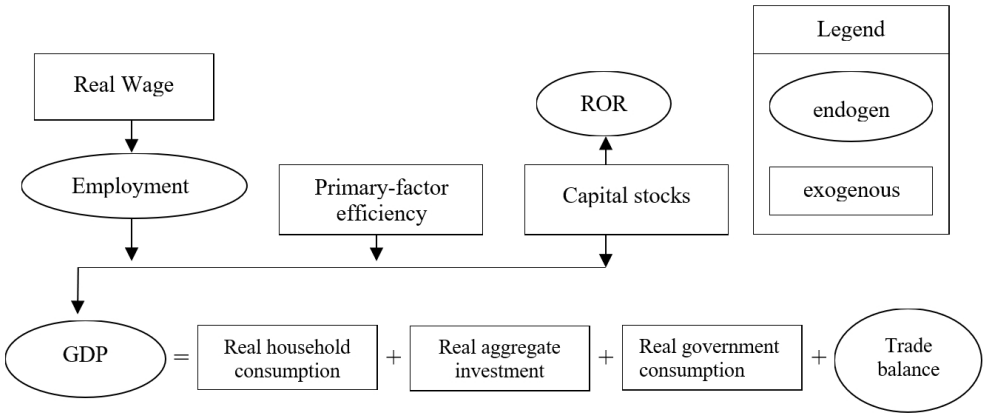


**Figure 2.** Macro-economic interaction (Horridge, 2002).

**Figure 2** shows that on the expenditure side of GDP, real household consumption, real aggregate investment and real government consumption are assumed to be constant (note: although the real factor price shift is shocked, the trade balance is presented as endogenous in **Figure 2**).

On the income side, the primary-factor efficiency and capital stocks are assumed to be constant. Only employment is free to adjust. To understand the income-side macro results, a stylized model can be used:

$$\text{GDP} = F(K, L) \tag{1}$$

However, the marginal productivity of labour (MPL) can be expressed in two different percentage change equations:

$$\text{MPL} = \text{AveRealWage} + (\text{CPI}/\text{GDPPI}) \tag{2}$$

$$\text{MPL} = \text{positive function of } L/K \tag{3}$$

Using an aggregate production function in percentage change form, the real GDP can be expressed as a function of capital and labour:

$$\text{GDP} = S_l l + S_k k \tag{4}$$

Equation (4) above indicates that GDP, $l$ and $k$ are the percentage changes in GDP, $L$, and $K$; $S_l$ and $S_k$ are the shares of labour and capital in production.

Overall, in the SR closure, capital and land usage in each industry are fixed, while labour is in elastic supply everywhere at fixed real wages. Constant real wages in the SR closure determine employment. As indicated above, on the national expenditure side, real consumption, real aggregate investment, and real government consumption are fixed. Also, it allocates fixed national investment across industries following endogenously determined rates of return (ROR). Foreign currency prices of imports are naturally exogenous. The exchange rate is fixed as numeraire. Population is also held constant. There are other exogenous variables in this closure such as changes in technology, price and quantity shift variables. We assume that in the DRC, labour is completely mobile between formal and informal sectors. However, a wage differential is needed to induce labour movement between formal and informal sectors. In

percentage change form:

$$x\text{lab\_}i(f) = \alpha \times \text{averealwage}\ (f) + \lambda \quad (5)$$

where $x$lab_$i(f)$ is total employment in sector $f$, and $\lambda$ is a slack variable determined by fixed national employment within a sector $f$ wage relativities. We experimented with $\alpha$ values (we did not find any empirical study of DRC migration which allowed proper estimation for our study) and chose 1 for the simulations reported in this paper. Hence, a 1% boost in real wages (relative to the other sector) is needed to increase the sectoral labour force by 1%.

In the LR closure, capital stock is allowed to change. Apart from the capital stock, the lower-skilled and informal sector labour force is also allowed to change. The supply of land and skilled labour is fixed. The assumption with regards to the DRC labour market is made to reflect the high level of unemployment of unskilled labour in the country, which might have a diverse impact in the LR.

In this policy simulation, we shock the variable "ffac" (real factor price shift) in the model (see Appendix B for the SR and Appendix C for the LR). One way of explaining the shock is through the theory of demand and supply. **Figure 3** below illustrates the interaction between lower-skilled demand and supply in the LR closure. The initial equilibrium is at point E. The shock shifts the supply curve down from S to S'. As a result, the equilibrium shifts from point E to E′, which has lower price and higher quantity than initially. Because of input-output linkages, employment, wages and household income all increase. As a result, the demand curve will move upward from D to D′. It creates a new equilibrium at point E″, which has greater quantity and higher price than point E′. In this respect, the appropriate shock applied to this scenario is a 10% wage subsidy simulated to lower-skilled workers in the formal sector. We prefer 10%, because it is in line with previous studies conducted in countries such as South Africa in response to the ongoing debate regarding the effectiveness of a wage subsidy to reduce unemployment in the country (Go et al., 2009; Pauw and Edwards, 2006). For instance, we shocked the model by applying ffac ("FSUB_F", "AGRIC_F") = −10 for all lower-skilled workers in the formal sector (FSUB_F is the female subsistence worker (lower-skilled) in the formal sector and AGRIC_F is the agriculture sector in the formal sector). This variable has two dimensions, industry and real factor price shift. The 'ffac' represents an ordinary change in real factor price shift. The negative figure "−10" means that we subsidise lower-skilled formal workers by 10%.

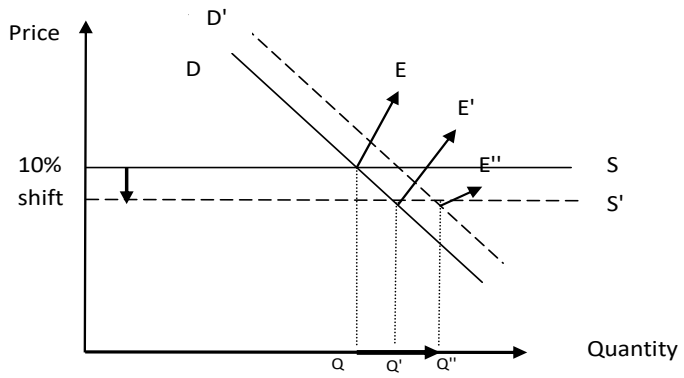


**Figure 3.** Interaction between demand and supply for lower-skilled workers (LR).

## 5. Simulation results

Below is a summary of results of the simulation for the macroeconomic variables generated by DRCFIM. Since there are no defined formulas for interpreting macroeconomics results, two approaches may be used to improve on these interpretations. Firstly, it is important to identify the kind of variables, especially those which are affected by the shock. Secondly, the stylized models proposed by Adams (2003) may be used to better understand the evolution of the variables such as factor quantities and real factor prices (see Appendix D).

The details of the simulation results concern mostly the coherent order of the explanation of the results expected from the DRCFIM. An appropriate explanation contributes especially in examining the model's performance. The integrity of the interpretation of the results is therefore improved and offers a wide-ranging economic perceptive.

### 5.1. Macroeconomic results

**Table 1** below reports the SR and LR simulation results obtained when applying the shock of 10% of the wage subsidy on lower-skilled workers in the formal sector. The simulation results show that a wage subsidy targeted at lower-skilled workers increases the overall level of employment by 2.48% and 4.8% in the SR and LR, respectively. The results support observations that the wage subsidy reduces the cost of workers for enterprises and thus raises demand for labour (Davies and Thurlow, 2010).

**Table 1.** Main macro variables.

| | | **Wage subsidy** | |
|---|---|---|---|
| **Main Macro Variables** | **Description** | **Short-run** | **Long-run** |
| ExpVol | Export Volume | 6.96 | 7.09 |
| ImpVol | Import Volume | -0.25 | 1.67 |
| RealGDP | Real GDP | 1.19 | 3.19 |
| RealHou | Real Household | 0 | 2.86 |
| RealInv | Real Investment | 0 | 0 |
| RealGov | Real Government | 0 | 0 |
| AggEmploy | Aggregate Employment | 2.48 | 4.8 |
| AveRealWage | Average Real Wage Rates | -3.51 | -2.32 |
| AggCapStock | Aggregate Capital Stock | 0 | 2.23 |
| AggLand | Aggregate land | 1.06 | 4.85 |
| GDPPI | GDP Price Index | -1.7 | -1.47 |
| CPI | Consumer Price Index | -2.19 | -1.25 |
| ExportPI | Export Price Index | -1.34 | -1.36 |
| ImportPI | Import Price Index | 0 | 0 |
| BOT_GDP | Contribution of BOT to real expenditure-side GDP | 0.94 | 0.55 |

The increase in employment represents an increase in labour in the production

process, which naturally leads to a rise in productivity. This economy-wide improvement in productivity in turn has a significant impact on employment with increased output stimulating more job creation. The expansionary economy coupled with increased export demand raises the demand for factors of production. Usually, in cases where producers conserve their labour force through labour-saving technical improvements, the improvement in labour productivity is achieved through better management, capacity building or training and development of staff. With a reduction in the average real wage rates (−3.51% in SR and −2.32% in LR), the unit costs of labour are actually reduced through improved productivity. In this respect, there is subsequently a considerable increase in employment for lower-skilled and semi-skilled workers in the formal sector, which stimulates the growth in output.

Despite the economic reality of the DRC's formal sector underperforming in terms of job creation, this 10% wage subsidy ensures significant improvements in the country's competitiveness as its production shifts from being focused on the local market to production for the export market. This, in turn, results in positive effects for the gross domestic product (GDP). It is clear from **Table 1** above that real GDP from the expenditure side increases by 1.19% and 3.19% in the SR and LR respectively from the baseline economy. As a direct result of the growth in productivity, the consumer price index (CPI) declines by 2.19% and 1.25% respectively in the SR and LR. The increased output and consequent drop in domestic prices (−1.7% in SR and −1.47% in LR) reflect significant efficiency and lower costs per unit output, resulting in increased real GDP.

The higher level of real GDP allows consumers to enjoy a higher level of consumption as the CPI declines. For instance, in the SR simulation, the consumers shift their demand toward formal products at the expense of informal producers, whose production decreases in a number of sectors such as livestock (−0.88%), clothing (−0.2%) and food processing (−0.1%) as is evidenced by **Table 2** in section 5.2 below. This stimulates the formal sector to export more as the export volume increases respectively by 6.96% and 7.09% in the SR and LR. This increase is to be expected since the wage subsidy reduces the cost of production in the formal sector. However, the wage subsidy does not benefit the informal producers directly. Thus, informal workers can migrate towards specific sectors that encounter a lesser penetration of formal sector products where there is less opportunity for export displacement due to the wage subsidy. Those sectors are typically the service sectors where trade intensities are minimal. Moreover, the decrease in export price (−1.34% in SR and −1.36% in LR) also causes the term of trade to decline.

The wage subsidy also has an effect on imports. Given a fixed import price in the SR, import volume decreases by 0.25%, which implicitly creates less demand for imported goods. The overall decrease in imports has macroeconomic implications that do not place pressure on the current account balance. In addition, decreased imports create less demand for foreign currency. Therefore, the balance of trade is on the positive side with a 0.94% increase in the SR and 0.55% increase in the LR. The resultant surplus causes real GDP to rise by 1.19% in the SR and 3.19% in the LR.

As there is substitutability among factors, which favour the cheapening resources, a wage subsidy to lower-skilled formal workers induces the aggregate land to increase by 1.06% and 4.85% in the SR and LR respectively, because the land is used as an

intermediate inputs for some sectors such as the agricultural and livestock sector.

## 5.2. Sectoral results

**Table 2** below provides a breakdown of the changes in sectoral output brought about by the wage subsidy policy simulations. In general, the wage subsidy had a positive economic impact on some sectors in both the formal and informal sectors. For instance, in the SR, the simulation results show that the formal sectors benefits the most from the subsidy in terms of output. These sectors include agriculture (AGRI_F at 3.66%), livestock (LIVES_F at 1.77%) and processed food (FOOD_F at 1.32%) as is evidenced by the data in Column 1 in **Table 2**. Most of these sectors are labour-intensive sectors that absorb the majority of lower-skilled workers. Thus, the increase in output in these sectors is driven especially by the subsidy allocation. The main reason for this improvement in output is that the wage subsidy cuts the cost of production in the formal sector. Furthermore, the formal sector production and employment also increases to a certain extent due to the enhanced production efficiency and expanded export opportunities.

**Table 2.** Sectoral production under wage subsidy policy shock (SR and LR simulations).

| Sectors (Formal & Informal) | Column 1 | | Column 2 | | Column 3 | | Column 4 | | Column 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | xTot (Output) | | xExp (Export) | | xHou (Household demands) | | wFac_f (Expenditure) | | pTot (Output prices) | |
| | Short-run | Long-run | Short-run | Long-run | Short-run | Long-run | Short-run | Long-run | Short-run | Long-run |
| AGRIC_F | 3.66 | 9.55 | 28.88 | 34.48 | 2.9 | 7.77 | 0.55 | 10.09 | –1.26 | –5.75 |
| AGRIC_I | 0.48 | 1.7 | 8.12 | 0.39 | –0.65 | 1.65 | 0.06 | 1.68 | –0.68 | –0.08 |
| LIVES_F | 1.77 | 9.22 | 9.25 | 19.36 | –0.44 | 5.23 | 0.98 | 9.5 | –0.7 | –3.48 |
| LIVES_I | –0.08 | 1.71 | 11.36 | 0.13 | –0.06 | 1.6 | –0.33 | 1.7 | –1.63 | –0.03 |
| MININ_F | –1.48 | 1.06 | –1.76 | 0.23 | –2.53 | 1.62 | 2.72 | 1.04 | 0.03 | –0.05 |
| MININ_I | –0.09 | 1.34 | 18.72 | 0.03 | 1.23 | 1.58 | 0.06 | 1.34 | –1.53 | –0.01 |
| FOOD_F | 1.32 | 6.99 | 16.65 | 25.5 | 0.87 | 6.29 | 0.14 | 7.15 | –0.72 | –4.44 |
| FOOD_I | –0.1 | 1.89 | 11.15 | 1.43 | –0.1 | 1.86 | –0.38 | 1.79 | –0.81 | –0.28 |
| CLOTH_F | –0.9 | 3.09 | 4.93 | 6.09 | –1.24 | 2.78 | 0.81 | 3.49 | –0.27 | –1.17 |
| CLOTH_I | –0.2 | 1.85 | 10.57 | 0.58 | –0.2 | 1.69 | –0.4 | 1.81 | –0.71 | –0.12 |
| MANUF_F | –1.65 | 1.5 | –1.36 | 0.27 | –2.45 | 1.63 | 1.2 | 1.52 | –0.06 | –0.05 |
| MANUF_I | –0.07 | 1.62 | 10.12 | 0.19 | –0.28 | 1.61 | 0.1 | 1.61 | –0.71 | –0.04 |
| EQUIP_F | –0.17 | 0.36 | –2.76 | 0.03 | –2.73 | 1.58 | –0.64 | 0.36 | 0.09 | –0.01 |
| EQUIP_I | –0.15 | 1.56 | 8.46 | 0.09 | –0.58 | 1.59 | 0.62 | 1.55 | –0.57 | –0.02 |
| UTILI_F | –1.15 | 2.8 | 7.02 | 1.42 | –0.85 | 1.86 | 1.46 | 2.74 | –0.64 | –0.28 |
| UTILI_I | 1.26 | 4.62 | 0 | 0 | –2.19 | 1.57 | 0.44 | 6.97 | 0 | 0 |
| CONST_F | 0.02 | 0.22 | 7.09 | 0.94 | –0.84 | 1.76 | –0.07 | 0.2 | –0.52 | –0.19 |
| CONST_I | 0 | 0.92 | 10.09 | 0.14 | –0.29 | 1.6 | –0.08 | 0.91 | –0.72 | –0.03 |
| TRADE_F | 1.11 | 4.36 | –64.11 | 1.05 | –20.31 | 1.79 | 0.58 | 4.32 | 4 | –0.21 |
| TRADE_I | 0.13 | 1.77 | 5.74 | 0.21 | –1.09 | 1.62 | –0.07 | 1.75 | 0.1 | –0.04 |
| HOTEL_F | 0.9 | 1.93 | 7.79 | 6.97 | –0.71 | 2.95 | 1.64 | 1.93 | –0.43 | –1.34 |
| HOTEL_I | –0.17 | 1.71 | 10.24 | 0.77 | –0.26 | 1.73 | –0.41 | 1.66 | –0.71 | –0.15 |
| TRANS_F | 0.37 | 0.86 | 0.39 | 0.75 | –2.11 | 1.72 | 15.94 | 0.87 | –0.02 | –0.15 |
| TRANS_I | 0.34 | 1.38 | 3.15 | 0.21 | –1.58 | 1.62 | 0.11 | 1.37 | –0.19 | –0.04 |
| ESTAT_F | 1.23 | 3.36 | 40.49 | 28.78 | 4.69 | 6.84 | 0.8 | 4.62 | –0.64 | –4.93 |

**Table 2.** (*Continued*).

| Sectors (Formal & Informal) | Column 1 | | Column 2 | | Column 3 | | Column 4 | | Column 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | xTot (Output) | | xExp (Export) | | xHou (Household demands) | | wFac_f (Expenditure) | | pTot (Output prices) | |
| | Short-run | Long-run | Short-run | Long-run | Short-run | Long-run | Short-run | Long-run | Short-run | Long-run |
| ESTAT_I | 0.12 | 1.89 | 12.05 | 1.26 | 0.06 | 1.83 | –0.09 | 1.81 | –0.74 | –0.25 |
| ADMIN_F | 1.32 | 1.82 | 16.46 | 13.22 | 0.84 | 4.13 | 1.28 | 2.1 | –0.44 | –2.45 |
| ADMIN_I | 0 | 0 | 0 | 0 | –2.19 | 1.57 | 0 | 0 | 0 | 0 |
| PRIVS_F | 1.02 | 2.08 | 1.28 | 2.03 | –1.94 | 1.98 | 11.42 | 2.23 | –0.06 | –0.4 |
| PRIVS_I | –0.06 | 1.72 | 9.78 | 0.28 | –0.34 | 1.63 | –0.16 | 1.7 | –0.61 | –0.06 |

A snowball effect results from the higher demand for lower-skilled workers in the formal sector as this leads to workers previously employed in the informal sector now shifting into trading and temporary employment in the formal sector, making space for the influx of previously unemployed work-seekers.

Column 5 in **Table 2** above depicts the increase in the price of goods in the following sectors: the formal and informal trade sector (TRADE_F at 4% and TRADE_I at 0.1%) and in the mining formal sector (MININ_F at 0.03%). Therefore, the wage subsidy does not stimulate consumers to budge demand towards formal goods to the detriment of informal producers, since increases in the output is observed in some informal sectors such as utility (UTILI_I at 1.26%), agriculture (AGRIC_I at 0.48%), transport (TRANS_I at 0.34%) and real estate (ESTA_I at 0.12%). See Column 1 in **Table 2** for more details.

In contrast with the SR simulation shock, the LR shock simulation shows output increases and decreases in domestic prices across all sectors, reflecting more efficiency and lower costs per unit of output. This means that wage subsidy leads to increased output in all sectors, which results in an increase of 3.19% in real GDP. Economy-wide productivity is therefore expansionary under this simulation as indicated by a considerable increase of more than one percent in domestic output in all sectors of the economy. This is mainly due to the wage subsidy aimed at the lower-skilled formal workers. The noteworthy growth in the level of real GDP allows consumers to enjoy a considerable level of consumption as household demands increase across all sectors in the LR as can be seen in the data of Column 3 of **Table 2**.

Regarding exports, in the SR most sectors note an increase in export reflecting the significant mutual trade that occurs between the formal and informal sectors. The increase in export volumes is to be expected, since the formal sector plays a major role in exporting goods and services abroad. Nonetheless, as it is the formal sector that is involved in foreign exports rather than the informal producers, formal producers benefit the most and export considerably more in sectors such as agriculture (AGRI_F at 28.9%) and real estate (ESTAT_F at 40.5%) due to the wage subsidy. Although formal production in these sectors rises, production decreases for informal producers, who encounter greater import competition without any enhanced access to foreign export markets.

In the LR however, exports increase in all sectors reflecting export opportunities for producers and consumers in both the formal and informal sectors shifting between local and foreign markets based on the relative prices of imports, exports and locally

produced products. This is in line with the decision of formal and informal producers to supply local or foreign markets as described in the model through a nested constant elasticity of transformation function. This means that if the informal sector is initially a net importer of a specific good, it can still become a net exporter if prices, policies, or productivity expand. Nonetheless, producers in the formal sector are better able to take advantage of the foreign market opportunities as their production expands. The increase in production within the formal sector driven by expanding exports generates jobs for workers in the formal sector, especially for lower-skilled workers, because of the wage subsidy. Indeed, formal sector production and employment expands, in part due to improved efficiency and enhanced export opportunities.

It is further noticed that this policy shock affects mostly formal household demands. Data in **Table 2** indicates that there is an overall significant increase in household demands in sectors such as food (FOOD_F at 0.87%), agricultural products (AGRI_F at 2.9%), and real estate (ESTAT_F at 4.69%), because of the wage subsidy and increasing employment in these sectors.

## 5.3. The terms of trade

The price of exports decreases respectively by 1.34 and 1.36% in the SR and LR (see **Table 1**). It represents the terms of trade and its decrease implies positive effects for DRC's exports and general competitiveness. Exports increase with a production-based tax, because the competitiveness of producers is stimulated by foreign markets. This can prompt a slight depreciation of the real exchange rate necessary to support exports.

From the results it is clear that the DRC's largest export products are labour intensive utilising mainly lower-skilled labour and land. They are mostly from the primary sector of DRC's production and include sectors such as agriculture, food and livestock. The introduction of a wage subsidy for lower-skilled labour results in a decrease in the price of intermediate goods, which, in turn, leads to economy-wide decreases in the prices of the fixed factors of production. As a result, the aggregate price of exports decreases. Due to the fact that the nominal exchange rate is fixed by assumption in the SR, the price of exports decreases, resulting in an increase in aggregate exports.

The export intensities observed reflect the considerable intra-trade that exists between the formal and informal sectors. Moreover, the wage subsidy to lower-skilled labour stimulates the decrease in the prices of the fixed factors of production thereby creating an increase in the demand for products that are all relatively capital, land and lower-skilled labour intensive.

**Figure 4** below shows the relative changes in the exports of a selected number of industries in the formal sector that experience a considerable increase in their exports in the SR. The largest increase in exports was in agricultural industries, followed by food and livestock. Therefore, the increase in the demand for these factors sustains the prices of the production factors, which are sourced in the industries that produce them.

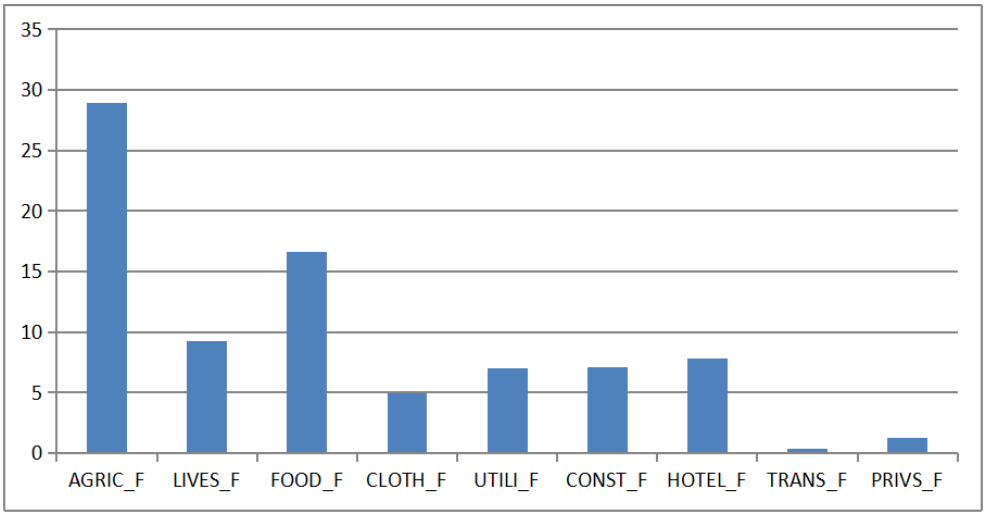


**Figure 4.** Increase in exports in selected industries from the formal sector (SR).

## 5.4. Household demands

Output increased in all sectors in the LR. Although the slight decrease in production in some formal sectors in the SR, it did not impact negatively on either the formal or informal real disposable incomes of households. In fact, the inverse happened: the real incomes increased. One possible reason for this could be that lower-skilled workers benefitted from the wage subsidy.

**Table 3** reports the results of the policy shock on the household incomes. There is a general increase across both the formal and informal sectors in real household disposable incomes due to wage subsidy. However, the impact across household groups differs slightly. The simulation results show that the subsidy allocation narrowed the income gap between high- and low-income households, as well as between those in the formal and those in the informal sectors. The increase in production within the formal sector that was driven by expanding exports generated more income for workers in the formal sector, primarily for lower-skilled and medium skilled workers. For instance, in the SR, lower-skilled employment composed of female subsistence (FSUB_F) and child labour (LCHIL_F), which increased by 6.49% and 6.86% respectively in the formal sector. This is higher than the growth in the high skilled employment of male labour (MALELAB_F at 0.87%).

**Table 3.** Changes in incomes under wage subsidy policy simulations.

| Variables | Description | Short run | Long run |
|---|---|---|---|
| FSUB_F | Female subsistence low wage employment (formal sector) | 6.49 | 0.03 |
| FSUB_I | Female subsistence low wage employment (informal sector) | 0.36 | 1.73 |
| LCHILD_F | Child labour low wage employment (formal sector) | 6.86 | 0.72 |
| LCHILD_I | Child labour low wage employment (informal sector) | 0.11 | 1.66 |
| FEMLAB_F | Female labour medium wage employment (formal sector) | 6.68 | −0.97 |
| FEMLAB_I | Female labour medium wage employment (informal sector) | 0.24 | 1.7 |
| MALELAB_F | Male labour high wage employment (formal sector) | 0.87 | 2.47 |
| MALELAB_I | Male labour high wage employment (informal sector) | 0.28 | 1.52 |

Considering wage subsidy policy, this finding implies that if producers were to transfer the high cost of production onto buyers, real incomes will increase amongst non-beneficiary households in the informal sector. The results show that low-income informal households benefit more from this policy than higher-income informal households. This is due to the concentration of the lower-skilled workers amongst the low-income informal households. Subsequently, the shock was not applied to higher-income formal sector households that depend heavily on high-skilled workers who do not benefit from the wage subsidy. Therefore, these higher-income households will possibly have to face the rise in direct taxes to foot the bill for the cost of the wage subsidy.

Looking at the data in **Table 3** above, it is clear that the lower-income worker in the formal sector is the primary beneficiary of the wage subsidy with income in those households growing more than that of other workers. In a nutshell, the shock applied to related wage subsidy stimulates real incomes considerably. Although the wage subsidy benefits all household incomes, lower-skilled labour in the formal sector benefit the most from it, while those working in the informal sector face consistent competition from their subsidised formal sector counterparts.

These findings provide the motivation that policymakers need in order to change the organisation or structure of the informal job market towards becoming traders and temporary jobs. In this manner, the findings of this study are consistent with those of previous similar studies such as that of Davies and Thurlow (2010), which underline the importance of evaluating the interaction between the formal and informal sectors of the economy, taking into consideration the impact of employment policies on both labour and product markets. It can be stated unequivocally that the wage subsidy reduces unemployment (Davies and Thurlow, 2010; Edwards, 2001; Go et al., 2009; Schünemann et al., 2015; Sjögren and Vikström, 2015).

## 6. Conclusion and policy implication

The primary aim of this paper was to analyse the economy-wide impacts of a wage subsidy shocks in the Democratic Republic of Congo (DRC), taking into account the interaction between formal and informal sectors. To this end, the Democratic Republic of Congo Formal-Informal Model (DRCFIM) was employed. Using this model, the paper simulated a 10% wage subsidy targeted at lower-skilled workers in the formal sector. The findings from this simulation indicate that real GDP from the expenditure side increases by 1.19% and 3.19% in the short and long run, respectively, compared to the baseline economy. Moreover, the simultaneous boom in productivity leads to a drop in the consumer price index (CPI) of 2.19% and 1.25% in the short and long run, respectively. The increase in productivity also makes producers more competitive, resulting in significantly higher growth in exports, with export volumes increasing by 6.96% and 7.09% in the short and long run, respectively.

The simulation also reveals that a wage subsidy targeted at lower-skilled formal workers significantly boosts real incomes and benefits households toward the lower end of the income distribution, as informal producers face increased competition from subsidized formal sector producers. Furthermore, our simulation results indicate that the DRC's largest export products are intensive in the use of lower-skilled labor, which

is advantageous given the country's large informal producer sector and disproportionately large informal trader sector.

These findings suggest that the government should provide a subsidy directly to lower-skilled employees to supplement their current wage, rather than granting it to employers. This approach proposes that the government should tax employers to raise funds for this subsidy and then transfer it to lower-skilled employees to bridge the gap between the productivity-based real wage and the actual wage earned by these employees. Neoclassical economics analyzes productivity using the production function, which relates inputs such as labor and capital to output. Under perfectly competitive conditions, neoclassical theory posits that the real wage paid to an employee must equal the marginal productivity of labor. If the real wage exceeds marginal productivity, unemployment will result (Todaro, 1969). This phenomenon is observed in the DRC, where there is a significant gap between real wages and productivity. This implies that policymakers should consider both labor and production market conditions when designing policies to address the DRC's competitiveness and unemployment challenges.

While this paper focused on understanding the immediate effects of wage subsidy shocks on the DRC economy, future research should consider using a dynamic CGE model to capture the temporal aspects of wage subsidy policy impacts, thus providing insights into the long-term economic changes and growth dynamics of the policy.

**Supplementary materials:** The existing 2007 SAM was used and updated to include the informal sector, which validly represent the structure of the DRC economy.

**Author contributions:** Conceptualization, JLE and LBB; methodology, JLE; software, JLE; validation, JLE and LBB; formal analysis, JLE; investigation, JLE; resources, JLE; data curation, JLE; writing—original draft preparation, JLE; writing—review and editing, JLE; visualization, JLE; supervision, LBB; project administration, JLE; funding acquisition, LBB. All authors have read and agreed to the published version of the manuscript.

**Conflict of interest:** The authors declare no conflict of interest.

## References

Adams, P. D. (2003). Interpretations of Macroeconomic Results from a CGE Model such aGTAP. Paper delivered at the 6th Annual Conference on Global Trade and Policy Analysis, The Hague, Netherlands.

Aikaeli, J., & Mkenda, B. K. (2014). Determinants of informal employment: A case of Tanzania's construction industry. Botswana Journal of Economics, 12(2), 51–73. https://doi.org/10.2139/ssrn.2706021

Akeju, K. F., & Olanipekun, D. B. (2014). Unemployment and economic growth in Nigeria. Journal of Economics and Sustainable Development, 5(4), 138–144.

Alexander, C., & Warwick, K. (2007). Governments, Exports and Growth: Responding to the Challenges and Opportunities of Globalisation. The World Economy, 30(1), 177–194. https://doi.org/10.1111/j.1467-9701.2007.00877.x

Baah-Boateng, W. (2015). Unemployment in Africa. International Journal of Manpower, 36(5), 650–667. https://doi.org/10.1108/ijm-02-2014-0047

Baldry, K. (2015). Graduate unemployment in South Africa: social inequality reproduced. Journal of Education and Work, 29(7), 788–812. https://doi.org/10.1080/13639080.2015.1066928

Beqiraj, E., & Tancioni, M. (2023). Subsidizing new jobs in the Euro-zone periphery. International Review of Economics & Finance, 86, 380–401. https://doi.org/10.1016/j.iref.2023.03.018

Blumkin, T., Pinhas, H., & Zultan, R. (2020). Wage Subsidies and Fair Wages. European Economic Review, 127, 103497. https://doi.org/10.1016/j.euroecorev.2020.103497

Bosch, M., & Esteban-Pretel, J. (2012). Job creation and job destruction in the presence of informal markets. Journal of Development Economics, 98(2), 270–286. https://doi.org/10.1016/j.jdeveco.2011.08.004

Burns, J., Edwards, L., & Pauw, K. (2013). Revisiting wage subsidies: How pro-poor is a South African wage subsidy likely to be? Development Southern Africa, 30(2), 186–210. https://doi.org/10.1080/0376835x.2013.801197

Chigunta, F. (2017). Entrepreneurship as a possible solution to youth unemployment in Africa. Laboring and learning, 10(2), 433–451.

Davies, R., & Thurlow, J. (2010). Formal-informal economy linkages and unemployment in South Africa. South African Journal of Economics, 78(4), 437–459. Portico. https://doi.org/10.1111/j.1813-6982.2010.01250.x

Edwards, L. (2001). Globalisation and the skills bias of occupational employment in South Africa. South African Journal of Economics, 69(1), 40–71. https://doi.org/10.1111/j.1813-6982.2001.tb00002.x

Go, D. S., Kearney, M., Korman, V., et al. (2009). Wage Subsidy and Labor Market Flexibility In South Africa. In Policy Research Working Papers. The World Bank. https://doi.org/10.1596/1813-9450-4871

Golub, S., & Hayat, F. (2014). Employment, Unemployment, and Underemployment in Africa. The Oxford Handbook of Africa and Economics, 135–153. https://doi.org/10.1093/oxfordhb/9780199687114.013.25

Horridge, M. (2002). ORANI-G: A generic single-country computable general equilibrium model. Paper prepared for the practical GE Modelling Course, 7–11 February.

Huttunen, K., Pirttilä, J., & Uusitalo, R. (2013). The employment effects of low-wage subsidies. Journal of Public Economics, 97, 49–60. https://doi.org/10.1016/j.jpubeco.2012.09.007

International Labour Organization (ILO). (2020). ILOSTAT database. Available online: https://ilostat.ilo.org/ (accessed on 8 March 2024).

Kaiser, U., & Kuhn, J. M. (2016). Worker-level and firm-level effects of a wage subsidy program for highly educated labor: Evidence from Denmark. Research Policy, 45(9), 1939–1943. https://doi.org/10.1016/j.respol.2016.05.008

Kawaya, S. P. (2008). The Issue of Social Security for Migrants in the Democratic Republic of Congo. University of Kinshasa, Department of International Relations.

Levinsohn, J., & Pugatch, T. (2014). Prospective analysis of a wage subsidy for Cape Town youth. Journal of Development Economics, 108, 169–183. https://doi.org/10.1016/j.jdeveco.2014.02.006

Lombardi, S., Skans, O. N., & Vikström, J. (2018). Targeted wage subsidies and firm performance. Labour Economics, 53, 33–45. https://doi.org/10.1016/j.labeco.2018.04.002

Mensah, J. T. (2024). Jobs! Electricity shortages and unemployment in Africa. Journal of Development Economics, 167, 103231. https://doi.org/10.1016/j.jdeveco.2023.103231

Pauw, K., & Edwards, L. (2006). Evaluating the general equilibrium effects of a wage subsidy scheme for South Africa. South African Journal of Economics, 74(3), 442–462. Portico. https://doi.org/10.1111/j.1813-6982.2006.00082.x

Schünemann, B., Lechner, M., & Wunsch, C. (2015). Do Long-Term Unemployed Workers Benefit from Targeted Wage Subsidies? German Economic Review, 16(1), 43–64. https://doi.org/10.1111/geer.12040

Sjögren, A., & Vikström, J. (2015). How long and how much? Learning about the design of wage subsidies from policy changes and discontinuities. Labour Economics, 34, 127–137. https://doi.org/10.1016/j.labeco.2015.03.009

Sultana, N., Rahman, M. M., & Khanam, R. (2022). Informal Sector Employment and Economic Growth: Evidence from Developing Countries in SDG Perspective. Sustainability, 14(19), 11989. https://doi.org/10.3390/su141911989

Todaro, M. P., (1969). A Model of Labour Migration and Urban Unemployment in Less Developed Countries. American Economic Review, 59, 138–148.

World Bank. (2008). World Bank Board Discusses Inspection Panel Investigation of Forest Sector Operations in the Democratic Republic of Congo.

World Bank. (2009). The Macroeconomic Foundation, World Development Report. Oxford University Press.

World Bank. (2010). World Bank Development Indicators. World Bank.

World Bank. (2019). The World Bank Annual Report 2019: Ending Poverty, Investing in Opportunity. World Bank.

# Appendix A

## Factor markets equations

Equation (6):

$$E\_fFacA(all, f, LAB)(all, i, IND)$$
$$pFac(f, i) = fFac(f, i) + fFac\_i(f) + pTotHou \quad (6)$$

Equation (7):

$$E\_fFacB(all, f, CAP)(all, i, IND)$$
$$pFac(f, i) = fFac(f, i) + fFac\_i(f) + pTotInv \quad (7)$$

Equation (8):

$$E\_wFac\_i(all, f, Fac)wFac\_i(f) = pFac\_i(f) + xFac\_i(f) \quad (8)$$

Equation (9):

$$E\_ave\ Re\ a\ lWage$$
$$ave\ Re\ a\ lWage = aveWage - pTotHou \quad (9)$$

where:

- *E_fFacA* is the equation-determining factor markets where labour is mobile with wages indexed to Consumer Price Index (CPI)
- *fFac_i*(*f*) represents all-industry real factor price shift
- *pTotHou* represents household total price
- *fFac*(*f*,*i*) represent the real factor price shift for industry *i*
- *pFac*(*f*,*i*) represents factor prices for industry *i*
- *E_fFacB* is the equation-determining capital factor for industry *i*
- *pTotInv* is the investment price index
- *E_wFac_i* is the equation-determining gross income of factors from industry *i*
- *pFac_i*(*f*) is the average wage to factors
- *xFac_i*(*f*) is the total factor use with wage-weighted
- *E_aveRealWage* is the equation-determining the average labour real wage
- *aveRealWage* is the average labour real wage
- *aveWage* is the average labour wage

# Appendix B

## Command file for the short run simulation

**auxiliary files** = DRC2;
**File** InFile = LAB1.har;
**File** summary = summary.har;
**log file** = **yes**;
**updated file** INFILE = <**cmf**>.upd;
**check-on-read all** = **yes**;
**check-on-read exact** = **yes**;
**method** = **Gragg**;
**steps** = 3 5 7;
*! Automatic closure generated by TABmate Tools...Closure command Variable Size*
**Exogenous** a; *! COM*IND Technological change, firm demands for Local goods*
**Exogenous** aFac; *! FAC*IND Factor technological change*
**Exogenous** aTot; *! IND Neutral technological change, ind i*
**Exogenous** fFac_i; *! FAC All-Industry Real Factor price shift*
**Exogenous** fpExp; *! COM*EXP Export demand shift*
**Exogenous** pFac; *! FAC*IND Factor prices*
**Exogenous** pImp; *! IMP*IND Import prices*
**Exogenous** rFacTax; *! 1 Factor Tax rate*
**Exogenous** rSavHou; *! 1 Household Saving rate*
**Exogenous** rHouTax; *! 1 Income Tax rate*
**Exogenous** rVAT; *! 1 % Change in ad valorem rate of VAT*
**Exogenous** wTrans; *! 1 Transfers from Gov to Hou*
**Exogenous** xGov; *! COM Gov demands*
**Exogenous** xInv; *! COM Inv demands*
**Rest endogenous**; *! end of TABmate automatic closure*
*! Automatic closure above is a basic input-output closure: factors and imports in elastic !supply at fixed prices consumption and savings linked to income*
*! Note: in SWAP statements below, NEW exogenous is on left.*
*! SHORT-run closure:*
**swap** ffac(LAB,IND) = pfac(LAB,IND); *! labour mobile with wages indexed to CPI*
**swap** ffac(Land,IND) = pfac(Land,IND); *! option A,*
**swap** xfac(CAP,IND) = pfac(CAP,IND); *! capital fixed by sector*
**swap** xTotHou = rSavHou; *! real consumption fixed, savings rate free*
**verbal description** = 10% wage subsidy for lower skilled workers in the formal
sectors, SHORT-run closure;
*!1.FSUB_F!*
**shock** ffac(*"FSUB_F", "AGRIC_F"*) = -10;
**shock** ffac(*"FSUB_F", " "LIVES_F"*) = -10;
**shock** ffac(*"FSUB_F", "MININ_F"*) = -10;
**shock** ffac(*"FSUB_F", "FOOD_F"*) = -10;
**shock** ffac(*"FSUB_F", "CLOTH_F"*) = -10;
**shock** ffac(*"FSUB_F", "MANUF_F"*) = -10;

**shock** ffac(*"FSUB_F"*, *"EQUIP_F"*) = -10;
**shock** ffac(*"FSUB_F"*, *"UTILI_F"*) = -10;
**shock** ffac(*"FSUB_F"*, *"CONST_F"*) = -10;
**shock** ffac(*"FSUB_F"*, *"TRADE_F"*) = -10;
**shock** ffac(*"FSUB_F"*, *"HOTEL_F"*) = -10;
**shock** ffac(*"FSUB_F"*, *"TRANS_F"*) = -10;
**shock** ffac(*"FSUB_F"*, *"ESTAT_F"*) = -10;
**shock** ffac(*"FSUB_F"*, *"ADMIN_F"*) = -10;
**shock** ffac(*"FSUB_F"*, *"PRIVS_F"*) = -10;
*!2.LCHILD_F!*
**shock** ffac(*"LCHILD_F"*, *"AGRIC_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"LIVES_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"MININ_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"FOOD_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"CLOTH_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"MANUF_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"EQUIP_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"UTILI_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"CONST_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"TRADE_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"HOTEL_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"TRANS_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"ESTAT_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"ADMIN_F"*) = -10;
**shock** ffac(*"LCHILD_F"*, *"PRIVS_F"*) = -10;
*!3.FEMLAB_F!*
**shock** ffac(*"FEMLAB_F"*, *"AGRIC_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"LIVES_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"MININ_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"FOOD_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"CLOTH_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"MANUF_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"EQUIP_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"UTILI_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"CONST_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"TRADE_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"HOTEL_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"TRANS_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"ESTAT_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"ADMIN_F"*) = -10;
**shock** ffac(*"FEMLAB_F"*, *"PRIVS_F"*) = -10;

# Appendix C

## Command file for the long run simulation

**auxiliary files** = DRC2;
**File** InFile = LAB1.har;
**File** summary = summary.har;
**log file** = **yes**;
**updated file** INFILE = <**cmf**>.upd;
**check-on-read all** = **yes**;
**check-on-read exact** = **yes**;
**method** = **Gragg**;
**steps** = 3 5 7;
*! Automatic closure generated by TABmate Tools...Closure command Variable Size*
**Exogenous** a; *! COM*IND Technological change, firm demands for Local goods*
**Exogenous** aFac; *! FAC*IND Factor technological change*
**Exogenous** aTot; *! IND Neutral technological change, ind i*
**Exogenous** fFac_i; *! FAC All-Industry Real Factor price shift*
**Exogenous** fpExp; *! COM*EXP Export demand shift*
**Exogenous** pFac; *! FAC*IND Factor prices*
**Exogenous** pImp; *! IMP*IND Import prices*
**Exogenous** rFacTax; *! 1 Factor Tax rate*
**Exogenous** rSavHou; *! 1 Household Saving rate*
**Exogenous** rHouTax; *! 1 Income Tax rate*
**Exogenous** rVAT; *! 1 % Change in ad valorem rate of VAT*
**Exogenous** wTrans; *! 1 Transfers from Gov to Hou*
**Exogenous** xGov; *! COM Gov demands*
**Exogenous** xInv; *! COM Inv demands*
**Rest endogenous**; *! end of TABmate automatic closure*
*! Automatic closure above is a basic input-output closure: factors and imports in elastic !supply at fixed prices consumption and savings linked to income.*
*! Note: in SWAP statements below, NEW exogenous is on left.*
*! Long-run closure:*
**verbal description** = 10% wage subsidy for lower skilled workers in the formal
sectors, long-run closure;
*!1.FSUB_F!*
**shock** pfac(*"FSUB_F", "AGRIC_F"*) = -10;
**shock** pfac(*"FSUB_F", "LIVES_F"*) = -10;
**shock** pfac(*"FSUB_F", "MININ_F"*) = -10;
**shock** pfac(*"FSUB_F", "FOOD_F"*) = -10;
**shock** pfac(*"FSUB_F", "CLOTH_F"*) = -10;
**shock** pfac(*"FSUB_F", "MANUF_F"*) = -10;
**shock** pfac(*"FSUB_F", "EQUIP_F"*) = -10;
**shock** pfac(*"FSUB_F", "UTILI_F"*) = -10;
**shock** pfac(*"FSUB_F", "CONST_F"*) = -10;
**shock** pfac(*"FSUB_F", "TRADE_F"*) = -10;

**shock** pfac(*"FSUB_F", "HOTEL_F"*) = -10;
**shock** pfac(*"FSUB_F", "TRANS_F"*) = -10;
**shock** pfac(*"FSUB_F", "ESTAT_F"*) = -10;
**shock** pfac(*"FSUB_F", "ADMIN_F"*) = -10;
**shock** pfac(*"FSUB_F", "PRIVS_F"*) = -10;
*!2.LCHILD_F!*
**shock** pfac(*"LCHILD_F", "AGRIC_F"*) = -10;
**shock** pfac(*"LCHILD_F", "LIVES_F"*) = -10;
**shock** pfac(*"LCHILD_F", "MININ_F"*) = -10;
**shock** pfac(*"LCHILD_F", "FOOD_F"*) = -10;
**shock** pfac(*"LCHILD_F", "CLOTH_F"*) = -10;
**shock** pfac(*"LCHILD_F", "MANUF_F"*) = -10;
**shock** pfac(*"LCHILD_F", "EQUIP_F"*) = -10;
**shock** pfac(*"LCHILD_F", "UTILI_F"*) = -10;
**shock** pfac(*"LCHILD_F", "CONST_F"*) = -10;
**shock** pfac(*"LCHILD_F", "TRADE_F"*) = -10;
**shock** pfac(*"LCHILD_F", "HOTEL_F"*) = -10;
**shock** pfac(*"LCHILD_F", "TRANS_F"*) = -10;
**shock** pfac(*"LCHILD_F", "ESTAT_F"*) = -10;
**shock** pfac(*"LCHILD_F", "ADMIN_F"*) = -10;
**shock** pfac(*"LCHILD_F", "PRIVS_F"*) = -10;
*!3.FEMLAB_F!*
**shock** pfac(*"FEMLAB_F", "AGRIC_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "LIVES_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "MININ_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "FOOD_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "CLOTH_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "MANUF_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "EQUIP_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "UTILI_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "CONST_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "TRADE_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "HOTEL_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "TRANS_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "ESTAT_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "ADMIN_F"*) = -10;
**shock** pfac(*"FEMLAB_F", "PRIVS_F"*) = -10;

# Appendix D

## Stylised macro model, levels equations (Adam, 2003)

$$\boldsymbol{Y^{MP}(r) = C(r) + I(r) + G(r) + (X(r) - M(r))} \quad (10)$$

$$\boldsymbol{Y^{FC}(r) \times A(r) = F_Y(L(r), K(r))} \quad (11)$$

$$\boldsymbol{Y^{MP}(r) = Y^{FC}(r) + Y^{TAX}(r)} \quad (12)$$

$$\boldsymbol{P^C(r) \times C(r) = \Omega(r) \times P^{MP}_{GDP}(r) \times Y^{MP}(r)} \quad (13)$$

$$\boldsymbol{P^G(r) \times G(r) = \Gamma(r) \times P^{MP}_{GDP}(r) \times Y^{MP}(r)} \quad (14)$$

$$\boldsymbol{M(r) = F_M(Y^{MP}(r), RER(r), 1/(1 + T(r)))} \quad (15)$$

$$\boldsymbol{X(r) = F_X(-RER(r)) \times Y_W(r)} \quad (16)$$

$$\boldsymbol{I(r)/K(r) = \Phi(r)} \quad (17)$$

$$\boldsymbol{RER(r) = P^{MP}_{GDP}(r)/(\Theta(r) \times P_W(r))} \quad (18)$$

$$\boldsymbol{P^{MP}_{GDP}(r) = P^{FC}_{GDP}(r) \times (1 + T(r))} \quad (19)$$

$$\boldsymbol{TOT(r) = 1/\{F_{TOT}(X(r)) \times P_W(r)\}} \quad (20)$$

$$\boldsymbol{P^C(r)/P^{MP}_{GDP}(r) = 1/F_{P_C}(TOT(r))} \quad (21)$$

$$\boldsymbol{P^G(r)/P^{MP}_{GDP}(r) = 1/F_{P_G}(TOT(r))} \quad (22)$$

$$\boldsymbol{K(r)/L(r) = F_{KL}(RP_L(r)/RP_K(r))} \quad (23)$$

$$\boldsymbol{RP_L(r)^{S_L(r)} = RP_K(r)^{-S_K(r)} \times A(r)} \quad (24)$$

$$\boldsymbol{RP_L(r) = F_{RP_L}(RW(r), (1/TOT(r)), (1 + T(r)))} \quad (25)$$

$$\boldsymbol{RP_K(r) = F_{RP_K}(ROR(r), (1/TOT(r)), (1 + T(r)))} \quad (26)$$