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Abstract

This paper analyses wage subsidies on lower-skilled formal workers in the Democratic Republic of Congo (DRC). A multi-sectoral empirically-calibrated general equilibrium model capturing the economy-wide transactions between the formal and informal sectors is used to analyse one policy simulation in the DRC. The short and long run simulation in which the government provides wage subsidy to lower-skilled workers indicates that the government is able to significantly improve the deficiencies of the formal and informal households' real disposable incomes. There is a general increase across formal and informal sectors in real household disposable incomes due to wage subsidy. The simulation results show that subsidy allocation narrowed the income gap between high and low income households, and between formal and informal sectors as well. The result seems somewhat insightful for wage policy simulation as the wage subsidy that targets 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.

JEL classification: C68, D58, E24, E26, O17, R28

Key words: wage subsidy, informal sector, CGE model, Democratic Republic of Congo

1 Introduction

According to World Bank (2009), unemployment is one of DRC's most prevalent socioeconomic challenges that impacts negatively on the majority of the labour force. The high level of unemployment in DRC can be attributed to the underperforming formal sector as well as to the ineffectiveness of the unemployed to penetrate the labour market.

Since job creation in the formal sector has failed to maintain pace with the intensifying labour force involvement, most unemployed people have turned to

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the informal sector, which explains why informal employment has contributed considerably towards job creation over the last two decades (ILO, 2013). Although the informal sector accounts for more than 80% of economic activity in the DRC (World Bank, 2009 and Kawaya, 2008), its impact on the formal sector has never been assessed. Evaluating the impact of the informal sector on the formal sector is important in order to determine the over-all role of the informal sector in the economy. It will also show the extent of intra-trade between the formal and informal sectors. In fact, the informal sector should not be considered as independent of the formal sector, because it relies heavily on the formal sector and stimulates economic growth, safety and opportunities in the economy (Grimm and Günther, 2005).

When compared with other countries with corresponding income levels, the DRC has a large informal sector (Schneider, 2002 and ILO, 2013), perhaps because unemployment in under developed countries is unintentional and informal employment is actually desired. However, considerable barriers exist to penetrate the informal sector, such as lack of finance and access to capital. Although, no empirical study of formal-informal interaction in the DRC could be found, researchers such as Schultz and Mwabu (1998), Lucas and Hofmeyer (2001), Naidoo (2003) and Davies and Thurlow (2010) have analysed the connection between the formal and informal sectors in South Africa with emphasis on tax policies and labour relations. They found that competition in product markets between the formal and informal sectors could affect informal production and employment. This shows that the formal-informal sector competition in product markets can influence the size and composition of the informal sector. Therefore the competition based on the subsidized formal sector producers seems important in encouraging a shift in the composition of informal employment toward traders and casual employment.

Within this context, the purpose of this paper is to assess the impact of a wage subsidy that targets lower-skilled formal workers in the DRC labour market. This study will provide a quantitative assessment of the high level of unemployment and size of the informal sector in the DRC. The main question this study aims to answer is how the structure and size of formal sector affect employment incentives and opportunities in the informal sector. It is important to assess if the wage subsidy directly influences the size and structure of the informal sector and therefore indirectly affects the level of unemployment in the country.

Section 2 briefly 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 3 discusses the model closure and policy shock effect. The findings of this study and their implications for future research are outlined in Sections 4 with policy implication and concluding remarks following in Section 5.

2 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[1], designed for expository purposes was developed by Horridge (1998). 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 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.

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

[1] Horridge, M. 1998. *ORANI-G: A generic single-country computable general equilibrium model* Paper prepared for the practical GE Modelling Course, February 7-11.

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 A4.

3 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 represents the main macro assumptions underlying the interactions among endogenous (oval) and exogenous (rectangular) macro variables in the SR closure.

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:

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

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

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

$$MPL = positive functionofL/K. \tag{3}$$

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

$$gdp = S_l l + S_k k. \tag{4}$$

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:

$$xlab\_i(f) = \alpha * averealwage(f) + \lambda \tag{5}$$

Where xlab_i(f) is total employment in sector f, and λ is a slack variable determined by fixed national employment within a sector $f$wage relativities. We experimented with α values[2] 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

[2] We did not find any empirical study of DRC migration which allowed proper estimation for our study

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 A1 for the SR and Appendix A2 for the LR). One way of explaining the shock is through the theory of demand and supply. Figure 3 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 (Pauw and Edwards 2006 and Go *et al.*, 2009). For instance we shocked the model by applying ffac(*"FSUB_F"*, *"AGRIC_F"*) = -10 for all lower-skilled workers in the formal sector[3]. 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%.

4 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.

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.

4.1 Macroeconomic results

Table 1 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

[3] FSUB_F is the female subsistence worker (lower-skilled) in the formal sector and AGRIC_F is the agriculture sector in the formal sector

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, 2010:453).

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 is 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 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. 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.

4.2 Sectoral results

Table 2 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.

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 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 notes 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.

4.3 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 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.

4.4 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%).

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, 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 (Edwards, 2001, Go *et al.,* 2009 and Davies & Thurlow, 2010).

5 Policy implication and conclusion

5.1 Policy implication

In this study, we tested the hypothesis that the introduction of specific policies such as a wage subsidy could be used to address the problem of increasing unemployment and the concurrence of poverty. We attempted to assess the DRC's socioeconomic challenges through CGE technique.

The short and long run simulations in which the DRC government provides a wage subsidy to lower-skilled formal workers indicate that the government is able to improve the deficiencies of the formal and informal households' real disposable incomes in a significant way.

Considering the assumption in the short run simulation that labour supply is elastic, the results of policy simulations contribute positively to the lower-skilled workers in the DRC labour force. The results seem somewhat insightful for wage policy simulation as the wage subsidy raises both earnings and employment. Nonetheless, this is consistent with the findings of previous, similar studies conducted in South Africa where evidence has also shown that the prevailing effect of wage subsidies was to increase social security registration of firms, reduce the cost of workers for firms and increase demand for labour (Pauw and Edwards 2006, Go *et al.*, 2009 and Schünemann *et al.,* 2011).

From a neoclassical point of view, this finding indicates that the government should grant a subsidy to lower-skilled employees themselves to augment their current wage, rather than to grant it to employers. This theory would hold that the government should tax the employers to raise the money for this subsidy and then transfer it to lower-skilled employees in order to eliminate the gap between the productivity-based real wage and the actual wage that is earned by

lower-skilled employees. Neoclassical thinking analyses productivity using the production function. This function relates inputs, such as labour and capital, to output. Under perfectly competitive conditions, neoclassical theory holds that the real wage paid to the employee must equal the marginal productivity of labour. If the real wage exceeds marginal productivity, there will be unemployment (Todaro, 1969). This is indeed observed in the case of the DRC where there is a large gap between real wages and productivity. This implies that policymakers should consider both labour and production market conditions when designing policies to address DRC's competitiveness and unemployment challenge.

6 Conclusion

The primary aim of this paper was to analyse the impact of a wage subsidy on unemployment among lower-skilled formal workers in the DRC. The paper gives a general understanding of the DRC's labour market and elaborates on the challenges that the country faces with regard to job creation in the formal sector. It attempts to provide a strategic policy direction that could inform the government of the DRC with plans that could reduce unemployment, while monitoring and evaluating the policy's progress. The DRCFIM may be used as just such a measuring instrument to gauge the progress of the wage subsidy.

The simulated 10% wage subsidy aimed at lower-skilled workers in the formal sector illustrated how significant improvements in competitiveness can be achieved in creating a shift from production of goods for the local market to exports, which consequently results in positive GDP effects. In these simulations, real GDP from the expenditure side increases by 1.19% and 3.19% in the short and long run respectively from the baseline economy. The simultaneous boom in productivity causes a drop in CPI of 2.19% and 1.25% in the short and long run individually. The advantages of the productivity increase cause producers to become more competitive, which leads to substantial higher growth in exports, with export volumes increasing respectively by 6.96% and 7.09% in the short and long run. Increases in exports favour industries in the formal more than those in the informal sector, which motivates informal entrepreneurs to migrate toward the formal sector goods. The trade balance in these simulations remains positive with an increase of 0.94% in the SR and 0.55% in the LR. A wage subsidy would also cause more robust trading between the formal and informal sectors of the DRC.

A wage subsidy targeted lower-skilled formal workers significantly expands real incomes and favours households toward the low-income distribution, because the informal producers face increased competition from subsidized formal sector producers. This encourages the informal sector to become more formalised and structured towards traders and temporary employment. A 10% wage subsidy simulated to lower-skilled workers in the formal sector increases the aggregate employment by 2.48% in the SR and 4.8% and the LR. The increase in employment represents an increase of labour in the production process.

Results indicate economy-wide increases in productivity, which has a positive impact on employment.

The simulation shows that the introduction of a wage subsidy results in a general increase across formal and informal sectors in households' real disposable incomes, although the impact thereof is not the same for all household groups. The simulation results show that subsidy allocation narrowed the income gap between high and low income households, as well as those between workers in the formal and informal sectors.

Results from the policy simulation indicate that a decrease in the terms of trade holds positive consequences for DRC's exports and therefore also for the country's competitiveness. Both formal sector output and employment increase, due in part to improved production efficiency and expanded export opportunities. As export increases respectively by 6.96% and 7.09% in the short and long run, the formal sector benefits the most and stimulates informal workers to get involved in trading and temporary employment in the formal sector. Thus, informal workers can migrate toward sectors that encounter lesser penetration of formal sector products and less opportunity for export displacement.

Our simulation results furthermore indicate that the DRC's largest export products are intensive in the use of lower-skilled labour, which is ideal since the DRC has a large informal producer sector and a disproportionately large informal trader sector.

The fact that the results of this study are consistent with those of previous studies, underline the importance of further research into specifically the interaction and impact of the formal and informal sectors of the economy on each other. When designing policies to address DRC's competitiveness and unemployment challenges, policymakers should carefully consider the link between the two sectors of the economy along with the effects of employment policies on both labour and product markets.

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Table 1: Main macro variables

Main macro variables	Description	Wage subsidy	
		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

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)		xFac_f (Value added)		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
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

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

Figure 1: The ORANI-G Flows Database

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Household	Export	Government	Change in Inventories
	Size	← I →	← I →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	C×S ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	C×S×M ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
Taxes	C×S ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
Labour	O ↓	V1LAB					
Capital	1 ↓	V1CAP					
Land	1 ↓	V1LND					
Production Tax	1 ↓	V1PTX					
Other Costs	1 ↓	V1OCT					

C = Number of Commodities
I = Number of Industries

S = 2: Domestic, Imported
O = Number of Occupation Types

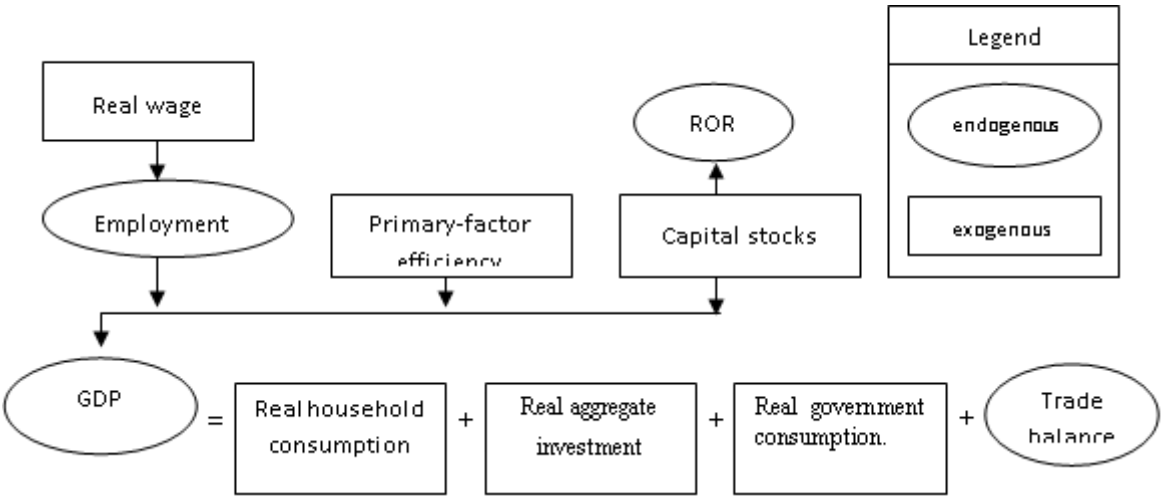
M = Number of Commodities used as Margins

	Joint Production Matrix
Size	← I →
C ↓	MAKE

	Import Duty
Size	← 1 →
C ↓	V0TAR

Source: Horridge, 2000

Figure 2: Macro-economic interaction



Source: Horridge (2000:95)

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

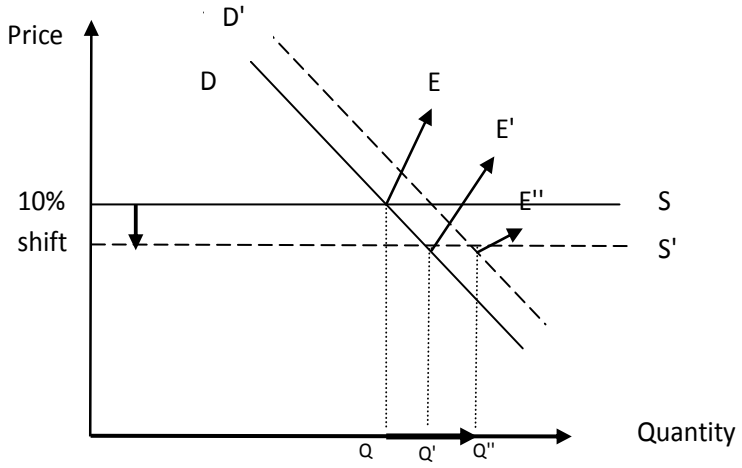
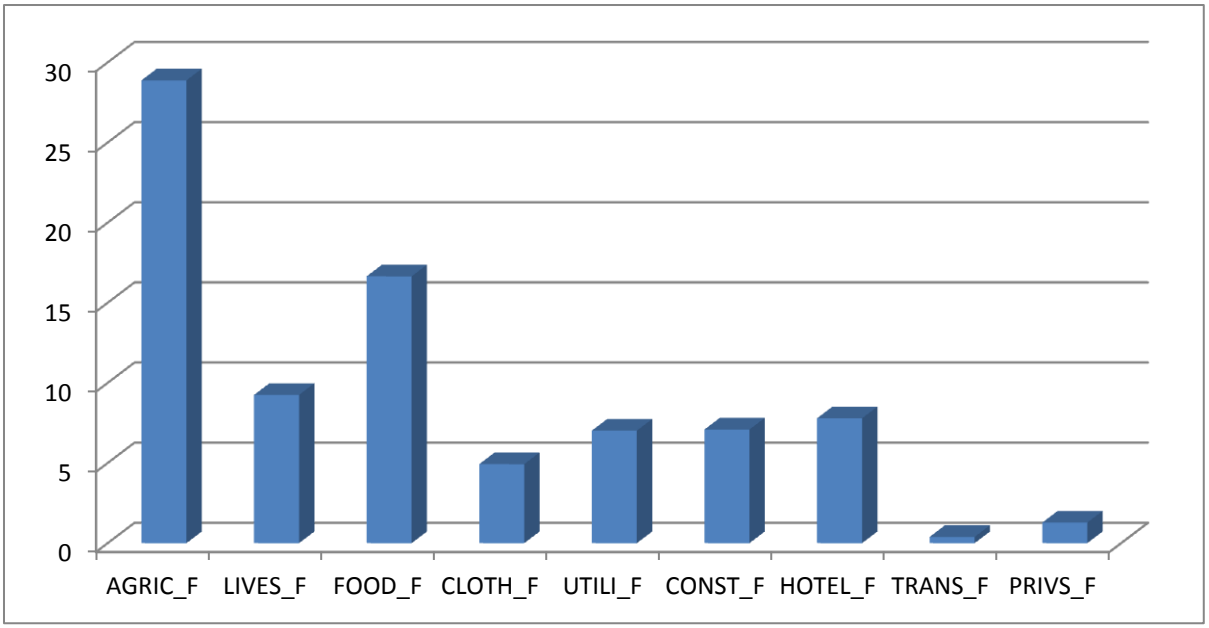


Figure 4: Increase in exports in selected industries from the formal sector (SR)



Appendix A1: 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.LCHILD_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 A2: 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.LCHILD_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 A3: Stylised Macro Model, levels equations

$$Y^{MP}(r) = C(r) + I(r) + G(r) + (X(r) - M(r)) \quad (1)$$

$$Y^{FC}(r) \times A(r) = F_Y(L(r), K(r)) \quad (2)$$

$$Y^{MP}(r) = Y^{FC}(r) + Y^{TAX}(r) \quad (3)$$

$$P^C(r) \times C(r) = \Omega(r) \times P^{MP}_{GDP}(r) \times Y^{MP}(r) \quad (4)$$

$$P^G(r) \times G(r) = \Gamma(r) \times P^{MP}_{GDP}(r) \times Y^{MP}(r) \quad (5)$$

$$M(r) = F_M(Y^{MP}(r), RER(r), 1/(1+T(r))) \quad (6)$$

$$X(r) = F_X(-RER(r)) \times Y_W(r) \quad (7)$$

$$I(r) / K(r) = \Phi(r) \quad (8)$$

$$RER(r) = P^{MP}_{GDP}(r) / (\Theta(r) \times P_W(r)) \quad (9)$$

$$P^{MP}_{GDP}(r) = P^{FC}_{GDP}(r) \times (1 + T(r)) \quad (10)$$

$$TOT(r) = 1/\{F_{TOT}(X(r)) \times P_W(r)\} \quad (11)$$

$$P^C(r) / P^{MP}_{GDP}(r) = 1 / F_{P_C}(TOT(r)) \quad (12)$$

$P^{G}(r)/P^{MP}_{GDP}(r) = 1/F_{P_G}(TOT(r))$	(13)
$K(r)/L(r) = F_{KL}\left(RP_L(r)/RP_K(r)\right)$	(14)
$RP_L(r)^{S_L(r)} = RP_K(r)^{-S_K(r)} \times A(r)$	(15)
$RP_L(r) = F_{RP_L}(RW(r),(1/TOT(r)),(1+T(r))$	(16)
$RP_K(r) = F_{RP_K}(ROR(r),(1/TOT(r)),(1+T(r)))$	(17)

Source: Adam, 2003

Appendix A4: Factor markets equations

Equation 1:

$$E\_fFacA(all, f, LAB)(all, i, IND)$$
$$pFac(f,i) = fFac(f,i) + fFac\_i(f) + pTotHou \quad (1)$$

Equation 2:

$$E\_fFacB(all, f, CAP)(all, i, IND)$$
$$pFac(f,i) = fFac(f,i) + fFac\_i(f) + pTotInv \quad (2)$$

Equation 3:

$$E\_wFac\_i(all, f, Fac)wFac\_i(f) = pFac\_i(f) + xFac\_i(f) \quad (3)$$

Equation 4:

$$E\_aveRealWage$$
$$aveRealWage = aveWage - pTotHou \quad (4)$$

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