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Agricultural economic reforms, gender inequalities and poverty in Senegal

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Abstract

In Senegal, as in many developing countries, the agricultural sector plays a key role in the economy. In addition to supplying food, agriculture is the most important source of employment, especially for women. Through the Plan for an Emerging Senegal (PES), the Senegalese government is implementing an ambitious financing plan to improve the productivity of the agricultural sector and enhance employment opportunities for women. Our study assesses the impact of two PES measures (investment subsidies and an increase in production subsidies for the agricultural sectors) on economic growth, women's employment, poverty and inequality using a dynamic computable general equilibrium model linked to a microsimulation model. The results show that both policies have generally positive effects in reducing poverty and gender inequalities. However, investment subsidies in the agricultural sectors have stronger impacts in reducing gender inequality and poverty in the long term.

Keywords: gender, poverty, public policies, agriculture, dynamic CGEM, Senegal

JEL classification : C68 ; E60 ; J16 ; O55

1. Introduction

Senegal, similar to many developing countries, faces a particularly difficult economic and social situation. According to the National Statistics Agency, in 2011, poverty affected approximately 47% of the population, including 57.1% of people living in rural areas. The capital, Dakar, accounts for 26% of the total population living in poverty (ANSD, 2013). This high level of poverty is reflected in gender dynamics. The gender development index, which measures gender inequalities in health, education and economic opportunities, is estimated at 0.88 in Senegal (UNDP 2015). This high index value suggests the occurrence of significant economic and social disparities related to the gender of the economic agent.

Women's low participation rates in the labor market, the dominance of self-employed labor (low paid and vulnerable to economic vagaries), difficulties in accessing credit, and low access to infrastructure are the main factors limiting women's economic activities in Senegal. The results of the National Employment Survey confirm the inequality indicators by showing that women have a less desirable position in the labor market than men. Indeed, the unemployment rate for women is 23.5%, whereas it is 11.4% for men (ANSD, 2015). Women are mostly unskilled (72.1%) and only 42.7% of them are active compared to men who are more active (65.8%).

In addition, the employment rate for women is estimated at 32.8%, while that for men is 59% (ANSD, 2015). In addition, it appears that the female labor force tends to more often be self-employed than employed. Women represent 49.7% of self-employed workers and only 33.2% of salaried workers (ANSD, 2015). Concerning salaried employment, 22% of women work under open-ended contracts, 32% work under fixed-term contracts and 28%

work under seasonal contracts. (ANSD-ESPII 2011). An analysis of the main occupations reveals that most women are self-employed farmers (31.5%) or caregivers (30.5%) (ANSD 2015). The predominance of women in self-employment increases their vulnerability.

To address this situation, the government has established an ambitious economic and social program called the “Plan for an Emerging Senegal” (PES). The program aims to transform the structure of the economy by improving the productivity of current growth drivers, human capital and local governance. The transformation of the economy involves the creation of infrastructures that encourage investment in key productive sectors (for example, agriculture) and services and the improvement of business environments.

The agricultural objective of the PES is to increase productivity and improve the competitiveness of this sector. However, the achievement of these objectives will depend on several prerequisites, such as water management, improving the quality of the soil and the modernization of farming tools. To achieve these goals, the Senegalese government intends to make specific public investments in the agricultural sector. These policies should not only increase and diversify agricultural production but also improve the competitiveness of the sectors. Furthermore, the Senegalese government expects improvements in the agricultural sector to lead to increased job creation, which will in turn have a positive impact on household consumption through increased incomes.

Therefore, the PES should have a positive impact in reducing poverty. Similarly, given that women are mainly involved in agricultural activities, their incomes are likely to increase. Indeed, the distribution of female employment by sector shows that women are mainly active in the agricultural sector. Agriculture accounts for 46.40% of the female workforce (ANSD-ESPII 2011). In addition, 15.3% of female heads of household work in the agricultural sector. Women also cultivate 31.9% of agricultural land in urban areas and 23%

of the land in rural areas. The development of the agricultural sector could therefore increase women's incomes and levels of self-sufficiency.

This study aims to evaluate the effects of two public policies targeting the agricultural sector on growth, employment (notably women's employment), poverty and inequality. Specifically, our study focuses on the impacts of two scenarios: (i) an increase in public subsidies for investment in the agricultural sectors and (ii) an increase in production subsidies for the agricultural sectors. For this assessment, we use a dynamic computable general equilibrium (CGE) model linked to a microsimulation model. We believe that CGE models are the most appropriate tools to capture the interrelations between production activities, labor markets, and the generation of incomes for agents, notably households. The resulting macroeconomic framework makes it possible to consider the impact on the whole economy and on different agents, such as the government. This dynamic dimension allows us to capture the Senegalese government's multiyear plan and the long-term effects of this policy. The use of a micro model allows us to assess the impact of simulated policies on household poverty (a macro model alone would not allow for such an analysis).

Several studies provide information on the role that agriculture can play in reducing poverty and inequality. Indeed, by employing more of the population than any other sector in many developing countries, agriculture remains a lever of choice to reduce inequalities and poverty (Diao *et al.* 2010). However, for several researchers, such as Mellor (1996) and Gollin (2010), the agricultural sector can only be a real asset for development if it undergoes profound transformations in transitioning from traditional to modern agriculture. This transformation requires capital investment to stimulate production and facilitate commercialization (Adelman, 2001).

For Pinstруп-Andersen and Shimokawa (2007), improving agricultural productivity requires not only the construction of irrigation systems, the adoption of new farming practices

or the financing of inputs to improve agricultural yields and ensure quality production. Rather, the authors also emphasize the importance of the creation of physical infrastructures such as roads, storage areas, markets, and so on to improve producers' access to markets. This view is shared by Fan *et al.* (2000), who report that in India, the increase in public investment in agricultural research and development and in equipment has led to an increase in yields. Farmers' incomes have in turn increased, leading to a reduction in poverty and inequality. Again, in India, Baba *et al.* (2010) show that the combined increase in private and public investment in the agricultural sector between 1969 and 2002 stimulated economic growth. However, the unequal redistribution of wealth did not significantly reduce poverty during this period. This study highlights that in addition to the efforts made to increase agricultural production, special attention must be paid to income redistribution. Without a fair redistribution of wealth, poverty and inequality are likely to persist.

Sennoga and Matovu (2013) conclude that public resources directed to sectors that can serve as a base for transferrable skills and that can support the broad-based expansion of economic capacities of both individuals and firms can lead to improved productivity and effectively combat poverty. The authors analyze the Ugandan case and conclude that a reallocation of public resources from nonproductive sectors (e.g., public administration and security) to agriculture as a productive sector leads to a reduction in poverty. This outcome is made possible by strong farming sector linkages within other industries. Benin *et al.* (2008) reached similar conclusions through their analysis of Uganda's agricultural modernization plan. In the authors' view, without the proper integration of the agricultural sector into the rest of the economy, increased investments in the sector will not have a significant impact on the economy as a whole. These findings show that the integration of the agricultural sector into the rest of the economy influences the amplitude of the resulting impacts on growth, poverty and inequality.

Mogues *et al.* (2012) note that investment in the agricultural sector can play a key role in economic development through two channels: by improving people's health and by improving their incomes. According to the authors, investment in agriculture can lead to improved productivity and can improve farmers' resources. Additionally, such investments lead to a reduction in product prices, which can result in an increase in household purchasing power. Stefel and Randrianarisoa (2006) have shown in the case of Madagascar that agricultural reforms favoring the reduction of the interseasonal price of agricultural products and of the urban-rural market margin reduce poverty reduction. This is made possible when agricultural reforms are based on investments made in agricultural infrastructure, such as storage warehouses and irrigation devices. Although the decline in poverty has affected all households, rural households have benefitted the most, as they are mainly employed in agricultural sectors and have experienced an increase in their income through this reform. In addition, the fall in the prices of agricultural products, which are mainly consumed in rural areas, has led to an increase in the purchasing power of these households.

The studies presented above demonstrate that several tools can be used to improve the agricultural sectors. Depending on these tools, the impact of agriculture reforms on household welfare can vary. In analyzing the impact of agriculture reforms on welfare, Jonasson *et al.* (2014) found in reference to Ghana and Malawi that the impacts on households are different depending on whether a reform adopts a subsidy (input price or production subsidy) or a cash transfer, for instance. Although the results differ across countries, the authors conclude that investment policy through input subsidies has the strongest effects on welfare gains. However, this is only the case when input prices do not increase. Matchaya (2020) confirmed this general conclusion in reference to Malawi, Swaziland, and Zambia by demonstrating that increasing investment within agricultural sectors in terms of research and development and production subsidies is key to improving

agricultural performance and the agricultural contribution to GDP growth. Irz *et al.* (2001) conclude that a 1% increase in agricultural GDP through public investment leads to an average 1.61% increase in income for the poorest quintile of the population in developing economies. Similarly, a 1% increase in agricultural productivity in developing countries leads to a reduction in the poverty head count ratio of between 0.62% and 1.3%.

Concerning Senegal, Boccanfuso *et al.* (2007) evaluate the impacts of a 10% increase in agricultural productivity on poverty using a static CGE model including a multihousehold model. This methodological approach allows the authors to carry out a more detailed analysis of poverty situations. The authors find an interesting result: The effect of increasing agricultural productivity seems to mainly benefit urban households even though the policy was originally aimed at reducing poverty in rural areas. The authors attribute this result to sources of income for poor rural households decreasing and to the increase in agricultural productivity leading to a reduction in prices, which benefits net buyers but disadvantages net sellers.

Most studies that use a CGE model and incorporate a gender dimension address the impact of trade liberalization on gender (Fontana and Wood, 2000; Cockburn *et al.*, 2007; Chitiga *et al.*, 2010; Latorre, 2016). Few studies address the gender impacts of agricultural policies. Arndt *et al.* (2000) show that an improvement in agricultural productivity through the incorporation of new production technologies leads to an increase in farmers' incomes in Mozambique. Additionally, since women in Mozambique are more heavily engaged in agriculture than men, their incomes increase more significantly as a result, which reduces female poverty and women's dependence on men and reduces gender disparities in terms of income.

Zidouemba *et al.* (2018) analyze effects of the transformation of agriculture on the economic situation of women in Burkina Faso. With the help of a CGE model, the authors

show that an increase in investment in agricultural capital has positive effects on employment in general and especially for women. This improvement in employment opportunities positively impacts women's incomes and enables a reduction in gender disparities in terms of jobs and revenue.

Cockburn *et al.* (2010), following Annabi *et al* (2008), use a sequential dynamic CGE model with microsimulations to analyze the effects of trade liberalization on poverty and gender disparities. The authors' simulations reveal that rural households benefit more from the liberalization process than urban residents. Regarding gender, the authors find an increase in gender pay disparities, as liberalization is more profitable for sectors that use more male labor. Male-headed households in turn experience much lower less poverty than households headed by women. Thus, while liberalization leads to increased economic growth, this increase reinforces wage disparities as well as differential access to jobs among men and women.

Our study may shed light on the impact of agricultural sector reforms on women's employment, economic growth, poverty and inequality in Senegal and may further fuel the public debate under the PES framework that is currently taking place.

2. Model and Data

To evaluate the effects of the studied policies, we use a dynamic CGE model following Decaluwé *et al.* (2013). The model is fully described in Decaluwé *et al.* (2013). Here, we present the main characteristics of the model and changes made for the purposes of our study. In line with the Social Accounting Matrix (SAM), the model includes 22 activities and commodities, including two agricultural sectors (subsistence and export agriculture). Figure 1 below illustrates the production process of the Senegalese economy.

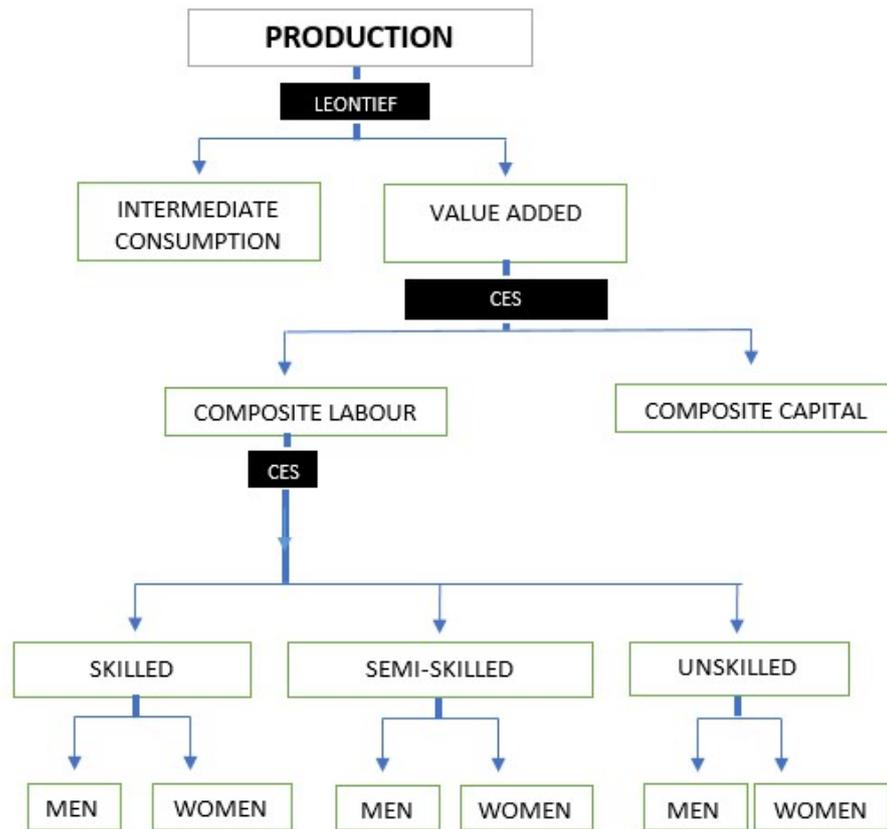


Figure 1: Economic production process

The production function technology is assumed to be of constant returns to scale and is presented within a four-level production process. At the first level, output is a Leontief input-output of value added and intermediate consumption. At the second level, a CES function is used to represent substitution between composite labor and capital. At the third level, composite labor demand is also a CES function between skilled, semiskilled and unskilled labor. Finally, at the fourth level, each of these skills categories is further disaggregated between men and women.

Each activity involves different types of production factors but in different proportions. Indeed, men, with a higher activity rate (60.5% vs. 39.6% for women), are relatively more numerous in most sectors of the economy (ANSD, 2017). Women are in the majority only in a small number of specific sectors, including the manufacturing and marketing of dairy

products, the catering sector and drinking establishments, which concentrate more than 80% of the female workforce (ANSD, 2017). In addition, from the structure of the labor force according to qualifications, more than eight out of 10 women have no qualifications, and only 2.5% of women have a baccalaureate or higher.

Households are disaggregated by location as either rural or urban. The model discerns three sources of income: labor income (salaries and wages), capital income and transfers income from institutional sectors (households, firms, the government and the rest of the world). For both types of households, labor income is the main source of income (62.19% for urban households and 49.69% for rural households). Capital income (22.78%) and transfers received (15.04%) are other sources of income for urban households. For rural areas, on the other hand, transfers (34.08%) represent the second greatest source of income, and capital income (16.23%) is the least significant. The importance of salaried employment in the economy and the concentration of economic activities in urban areas explain the dominance of salaried and capital income among households and especially urban households.

Households use their income to pay taxes, make transfers to other institutions, for consumption and for savings. Both types of households spend most of their income on consumption expenditures (94.65% for rural households vs. 87.96% for urban households).

On the consumption side, household behavior is modeled as a linear expenditure system and subject to budget constraints. Rural households spend two-thirds of their consumption budget on food commodities, while this share drops to 41.3% for urban households. Urban households spend almost 10% of their budget on telecommunications (vs. 7.9% for rural households) and 9% on education services (vs. 2.2% for rural households).

Firms mainly derive their income from capital income and from transfers from other institutions and pay income tax and transfers to other institutions (dividends) and save the surplus. Government income is derived from direct taxes (23.17% of total income) paid by

households and firms, indirect taxes on domestic sales (34.38%), import tariffs (25.28%), transfers from other institutions (13.94%), and a share of capital income (3.23%).

Government savings are equal to government income minus consumption and transfers paid to other institutions.

To relate Senegal to the rest of the world, we adopt the traditional small country assumption by assuming that Senegal does not have any influence on global prices. We also assume that Senegalese producers cannot sell as much as they would prefer to on international markets. To sell more in these markets and to increase their market shares, producers have to be more competitive than other producers. Thus, export supply is constrained by export demand, which is assumed to have finite elasticity, reflecting the competitiveness of local producers in the international market. The structure of foreign trade is dominated by industrial commodities (which represent 55.34% of Senegalese imports and 39.92% of their exports), food products (18.65% of imports and 17.86% of exports) and extractive activities (10.23% of imported products and 8.68% of those exported).

To consider the Senegalese context, we change a hypothesis of the PEP 1-t model. Senegal is experiencing unemployment for both skilled and semiskilled workers. Following Blanchflower and Oswald (1994), we assume that there is an equilibrium wage rate compatible with the unemployment rate. The authors find an empirical relation between wage and unemployment rates called the “wage curve.” This relation shows a negative slope between unemployment rates and wage rates.

Labor is mobile across sectors, whereas capital is sector specific. The stock of labor increases according to the annual population growth rate, while the stock of capital increases in the ensuing periods due to new investments made in the sector. The allocation of new private investment follows the accumulation equation developed by Jung and Thorbecke (2003). In this equation, the volume of new capital allocated to private sectors is proportional to the

existing stock of capital and depends on the ratio of the rental rate of capital to the user cost of capital.

To implement our first scenario, we slightly modify the equation explaining the user cost of capital. In the PEP model, the user cost of capital ($U_{k,j,t}$) is equal to the price of new capital in sector ($PKPRI_t$) adjusted by the depreciation rate of capital ($\delta_{k,j,t}$) and the interest rate (IR_t). In our scenario, we consider a subsidy for investment in agriculture. We assume that this subsidy applies to the acquisition of agricultural capital. Therefore, the user cost of the capital equation is modified by adding the subsidy rate for agricultural capital ($ttks_{k,agr,t}$) only.

$$U_{k,agr,t} = (PKPRI_t) * (1 - ttks_{k,agr,t}) * (\delta_{k,agr,t} + IR_t)$$

By reducing the user cost of capital in agriculture, the subsidy would increase the attractiveness of investment in the sector. As shown in the following equation, given the reduced user cost of capital, the volume of new capital allocated to the agricultural sectors ($IND_{k,agr,t}$) would increase.

$$IND_{k,agr,t} = \varphi_{k,agr} \left[\frac{R_{k,agr,t}}{U_{k,agr,t}} \right]^{\sigma_{k,agr}^{INV}} KD_{k,agr,t}$$

With:

$R_{k,agr,t}$: Rental rate of type k capital in industry agr

$KD_{k,agr,t}$: Demand for type k capital by industry agr

$\varphi_{k,agr}$: Scale parameter (allocation of investment to industries)

$\sigma_{k,agr}^{INV}$: Elasticity (allocation of investment to industries)

In terms of closure rules, we assume that the nominal exchange rate is the numeraire. The rest of the world's savings are fixed, meaning that Senegal cannot borrow from the rest of the world. Then, global prices are fixed based on the assumption that Senegal is a small country. Government spending is also fixed.

To capture the impacts of the government's intervention in the agricultural sectors on poverty, we must link the CGE model to a micro model. The microsimulation model, which is based on Tiberti *et al* (2017), determines the Foster, Greer and Thorbecke (FGT) poverty indicators (i.e., poverty headcount ratio (P0) and poverty gap ratio (P1)) and the Gini inequality index. Specifically, once the CGE model is run, the new prices and volumes after a change in government policy are transmitted to the micro model (top-down) to estimate changes in monetary poverty and inequality.

To implement a macro-micro approach, we must use different sets of data of different sources from the social accounting matrix (SAM), which is based on national accounts and input-output tables, and household survey to infer the impact of the policies on income distribution and poverty. Specifically, our SAM is based on Fofana *et al's* (2015); it includes 22 sectors and commodities, including two agricultural sectors (subsistence agriculture and export agriculture). Using the household survey, we disaggregate the labor force by gender. Thus, labor is disaggregated by both gender and skills. We have five representative agents: the government, firms, households (rural and urban) and the rest of the world.

To calibrate unemployment rates, we use the 2015 employment survey; we borrow income and trade elasticities from Zidouemba and Gerard (2015) and use the population growth rate from the Senegalese National Statistics Agency.

As mentioned above, our model is dynamic. Without simulation, the economy grows following the ‘business-as-usual’ (BAU) trajectory. The BAU scenario reflects the Senegalese Ministry of Finance GDP growth rates and forecasts for the period of 2011-2024 (2011 is the base year of our SAM, and 2024 marks the end of our simulation). The estimated GDP growth rate occurring over the period ranges between 6.6% and 7.7%. We therefore compare the results of our 2 scenarios with a context in which production increases for all sectors, thereby reducing unemployment and poverty.

3. Findings and discussion

1- Scenarios:

For the first scenario (Sim 1) and in line with the PES, we simulate subsidies on investment in agriculture over a three-year period. The total value of subsidies is divided between the subsistence agricultural sector and the export agricultural sector. New investments made in the agricultural sectors will enable the acquisition of agricultural equipment such as tractors, irrigation equipment, seed drills, etc. For the second scenario (Sim 2), we evaluate an increase in production subsidies for the subsistence agricultural sector of 6% in 2018 and 4% in 2019 and 2020 and of 10% for the export agricultural sector in 2018 and 6% in 2019 and 2020. The total value of the subsidies is the same for both scenarios, allowing the results to be comparable.

The analysis of the results is based on both the short-term economic effects occurring in 2018 and on the long-term economic effects occurring in 2024. The analysis focuses on the effects of the reforms on economic dynamics and macroeconomic impacts on employment and wages, allowing for the observation of gender inequalities and economic agents, notably households, for the purpose of assessing poverty.

2- Results:

Macroeconomic impacts:

As shown in Table 1, both reforms have positive impacts on real GDP. In the short term, both scenarios lead to a relative increase in GDP of 0.11%. However, in the long term, simulation 1 leads to a 0.12% increase in GDP, while simulation 2 results in only a 0.01% increase. Subsidies on investment in the agricultural sectors (subsistence and export) for the first scenario make the sectors more attractive for investment, which increases the stock of capital for each sector the following year and consequently production levels. To increase their levels of production, each of the agricultural sectors increases its intermediate consumption and therefore positively impacts the other sectors.

Table 1: Impact on macroeconomic variables (in % change to the BAU)

	SHORT TERM		LONG TERM	
	sim1	sim2	sim1	sim2
REAL GDP	0.11	0.11	0.12	0.01
REAL CONSUMPTION, RURAL HH	0.17	0.06	0.03	0
REAL CONSUMPTION, URB. HH	0.17	0.05	0.06	0
CONSUMER PRICE INDEX	0.11	0.08	0.04	0.01
TOT. INVESTMENT EXPENDITURES	-0.57	-0.01	0.15	0.01

The macroeconomic impacts of increasing production subsidies (Sim2) for the two agricultural sectors are quite modest. Indeed, impacts are only observed for the years in which

the subsidies are increased, after which there is basically no further impact with regard to BAU trends. The increase in production subsidies for both sectors leads to an increase in production and intermediate consumption. The impact on employment is positive, as we observe a decrease in the unemployment rate of 0.17%. Real household consumption is 0.06% higher for rural households and 0.05% higher for urban households in the short term, but over the long term, there is no change with respect to BAU trends.

Sectoral impacts:

Encouraging investment in the agricultural sectors (Sim1) makes it possible to increase the production of both sectors and notably that of the export agricultural sector in the short and long term. Therefore, in the short term, there is an increase in export agricultural production of 0.94% compared to an increase of 2.76% over the long term. For subsistence agriculture, production increases by 0.43% in the short term, while in the long term, production increases by 1.41%. One of the objectives of the Plan for an Emerging Senegal is to promote agricultural exports. Concerning this sector, exports increase by 1.07% in the short term and by 3.24% compared to BAU levels in the long term. The objective of increasing exports has been achieved in this respect.

Moreover, this reform (Sim 1) has strong positive spillover effects on the livestock, fisheries, food, energy production, education, health and personal activity sectors in the short term and exclusively on the livestock, fisheries and food industries in the long term. These sectors tend to recruit more workers. Other sectors are subject to the negative repercussions of this policy. Indeed, by subsidizing investment in the agricultural sectors, the government encourages private investment to shift toward these two agricultural sectors and thus away from other less profitable sectors. Furthermore, the budget for subsidies reduces government revenues and, at constant public expenditure, reduces government savings, resulting in a

crowding-out effect on private investment from public investment. The sectors most affected by this effect are those producing capital goods, such as the construction sector, which experiences a decline in production (- 3.48%). These sectors, which heavily employ unskilled male workers, tend to free up labor in the short term. Overall, the impacts on wage rates are positive for all categories of workers except for unskilled men.

In the long term, however, the increase in private investment is more dynamic in the nonagricultural sectors in general and particularly in the food (0.60%) and finance industries (0.31%). This positive trend offsets the short-term negative effects such that the effect on employment in the long term is positive. Furthermore, there is an increase in wage rates for all categories of workers in the long term with women's wages increasing more than those of men. This is the case because expanding sectors employ more female labor.

Regarding the second scenario (Sim 2), as we note above, the effects of the reform are mainly felt in the short term (in the years of the reform). The export agriculture sector mostly benefits from this policy. Production increases by 6.55% in the short term and by 0.39% over the long term. To produce more, the sector recruits all categories of workers and increases its intermediate consumption. This has a positive spillover effect on certain sectors (the livestock, forestry, food, energy production, trade, education and health sectors) in the short term. These sectors increase their labor demand, leading to an increase in wages for all categories of workers. Wages increase by 0.17% for unskilled men, while unskilled women experience a wage increase of 0.23%. Semiskilled men experience a wage increase of 0.09% compared to an increase of 0.13% for semiskilled women, while skilled men experience a wage increase of 0.08% compared to an increase 0.14% for skilled women in the short term. In terms of foreign trade in nonagricultural products, the two policies have negative effects overall. Over the period, Sim 1 encouraged an increase in exports exclusively in fishing (0.12%). In addition, imports increased for eight of the fifteen imported products, especially

for livestock (0.45%), health (0.34%), and food products (0.25%), in the short term. For Sim 2, exports fell over the period for all nonagricultural products. On the import side, levels increased except in the case of extractive activities (-0.05% in the short term and -0.01% in the long term) and business services (-0.05% in the short term). This trend is explained by the loss of competitiveness observed in nonagricultural sectors.

Impacts on agents:

The first policy (Sim 1) has positive effects on nongovernmental agents in both the short and long term. Indeed, the good performance of the agricultural sector and of some nonagricultural sectors (livestock, fisheries, food production, etc.) has led to an increase in capital income. Therefore, firms' income increases by 1.44% in the short term and by only 0.15% over the long term. Firm savings also increase by 1.37% in the short term and 0.13% over the long term. Household incomes and savings increase by 0.28% in the short term and by 0.08% for rural households and by 0.10% for urban households over the long term. The short-term increase in household income is partially due to the increase in capital income (+0.22% for the two household categories) but especially due to transfer income, which increases by 1.09% for rural households and by 0.79% for urban households.

For the rural population over the long term, the increase in household income is attributed to a 0.21% increase in capital income and a 0.13% increase in transfer income. For urban households, this trend results from a 0.08% increase in labor income, a 0.21% increase in capital income and a 0.11% increase in transfer income.

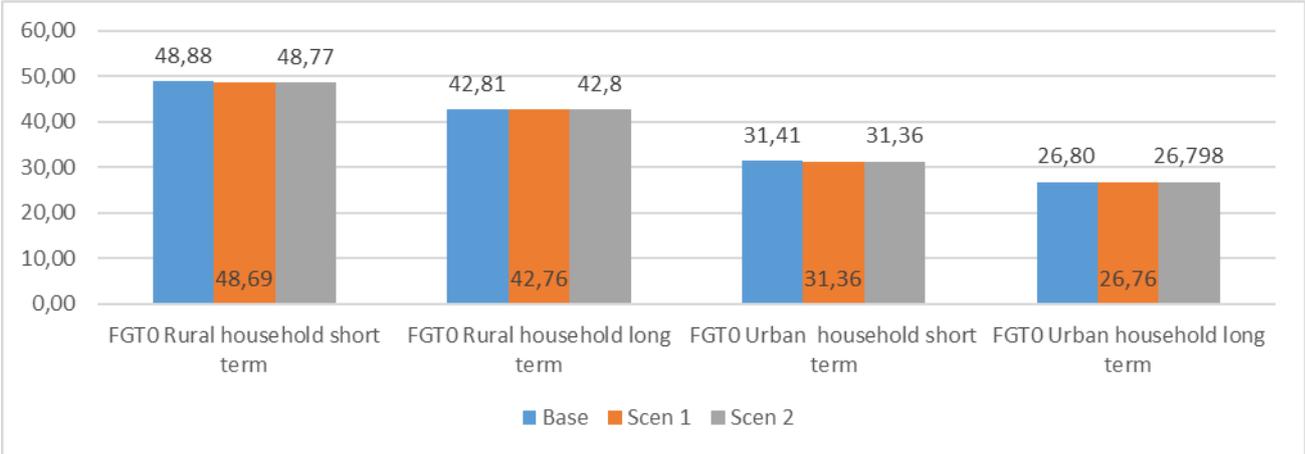
Government savings decline in the short term (-6.50%) and increase by 0.28% in the long term. This is the case because the public deficit is used to finance the reform over the simulation period.

For the second simulation (Sim 2), rural households experience an increase in their income and savings of 0.14%, while urban households experience an increase of 0.13%. This outcome favors an increase in consumption. Over the long term, however, the trend is different as household incomes increase slowly and household consumption follows this trend. Firms also experience a significant improvement in their income. In the short term, firms' incomes increase by 0.10% and their savings increase by 0.07%; however, over the long term, this increase is much lower at only 0.01%. These positive figures are due to the development of the export agricultural sector, where production is reaching significant levels. Government revenue declines by 0.09% during the three-year simulation period as agricultural subsidies increase, leading to a 0.30% decline in government savings, which affects total investment (-0.01%). By the end of the simulation 2 period, government income increases by 0.01% and savings increase by 0.02%.

Poverty results:

Both scenarios have positive impacts on poverty in the short and long term. This slight decrease in poverty, especially in the short term, is due to the positive impacts of the reforms on wages and labor demand. Rural households under both policies experience the greatest declines in the incidence of poverty. This decline in poverty can be attributed to increases in household income and consumption. Gender inequality is declining due to better trends in women's employment and wages. The positive trends identified in terms of poverty and inequality reduction reflect the effectiveness of the reforms in improving the employability and means of marginalized populations, notably women and rural dwellers. The impact on inequality across the country is quite positive, with a decrease in the Gini index of 0.13%. Gender inequality declines more in rural areas than in urban areas, although this trend is reversed in the long term.

Figure 2: Incidence of poverty (Scenarios 1 and 2) for households in (%)



4. Conclusion and policy advisory

We built a dynamic CGE model to analyze the effects of two agricultural reforms on gender inequalities and poverty in Senegal. Both simulations show positive impacts on growth, exports for agricultural sectors, employment and poverty.

Considering these findings, a number of policy implications can be made. First, as mentioned above, both policies bring positive results but the policy of subsidizing investments (Sim 1) generates better results in the short and long term. While the policy of subsidizing production (Sim 2) only brings positive results in years when the subsidy is available, the policy of subsidizing investment in the agricultural sectors (Sim 1) leads to more sustainable growth and results. Second, upon analyzing the results from a gender perspective, both policies have broadly positive impacts on women's employment and wages over the simulation periods; however, only the policy of subsidizing investments (Sim 1) has long lasting effects in reducing gender inequalities because it enables women’s employment and wages to increase more than men’s in the long run. This is an important economic policy outcome: in order to reduce gender inequality in the long term, the government should favour an investment

subsidy policy over an agricultural input subsidy policy. Consequently, we would recommend the introduction of investment subsidies in the agricultural sectors.

Moreover, we assume that the government has fully funded both policies. A complementary step in this work would be to find alternative means of funding (such as tax reforms) to prevent the crowding-out phenomenon that has been observed. Finally, our paper provides evidence of the impact of public policies on gender inequality in Senegal, which, like most developing countries, faces high levels of gender inequality. The results of this study could inform policy discussions in other countries, particularly in West Africa, where agriculture is female-labour intensive and where levels of gender inequality are high.

References

Adelman, I. (2001): "Fallacies in development theory and their implications for policy". In G. M. Meier, & J. E. Stiglitz (Eds.), *Frontiers of development economics: The future in perspective* (pp. 103-135). New York: World Bank

Annabi, N., Cissé, F., Cockburn, J. & Decaluwé, B. (2008). Libéralisation commerciale, croissance et pauvreté au Sénégal : une analyse à l'aide d'un MEGC microsimulé dynamique. *Economie & Prévision*, 186(5), 117-131. <https://www.cairn.info/revue-economie-et-prevision-2008-5-page-117.htm>.

Arndt, C., Jensen, H.T., Robinson, S., & Tarp, F. (2000): Marketing margins and agricultural technology in Mozambique, *Journal of Development Studies*, 37(1), 121-137.

ANSD - Agence Nationale de la Statistique et de la Démographie (2013) Rapport définitif de la deuxième Enquête de Suivi de la Pauvreté au Sénégal (ESPS II - 2011). Ministère de l'Economie et des Finances, Dakar.

ANSD - Agence Nationale de la Statistique et de la Démographie (2015) Rapport national de l'Enquête Nationale Sur l'Emploi au Sénégal. Ministère de l'Economie et des Finances, Dakar.

Agence Nationale de la Statistique et la Démographie (ANSD) (2017) Enquête Nationale sur l'Emploi au Sénégal, ANSD, Dakar, Sénégal

Baba, S. H., Saini, A. S., Sharma, K. D. and Thakur, D. R. (2010): Impact of investment on agricultural growth and rural development: Dynamics of public and private investment in Himachal Pradesh. *Indian Journal of Agricultural Economics*, 65: 136-157

Benin, S., Nkonya, E., Okecho, G., Pender, J., Nahdy, S., Mugarura, S., Kato, E. & Kayobyo, G., (2007) Assessing the impact of the national agricultural advisory services (NAADS) in the Uganda rural livelihoods, IFPRI Discussion Paper 00724. International Food Policy Research Institute, Washington DC, <http://www.ifpri.org/sites/default/files/publications/ifpridp00724.pdf>.

Blanchflower, D., Oswald, A. (1994) Estimating a wage curve for Britain: 1973-90. *The Economic Journal*, 104(426), 1025-1043. <https://doi.org/10.2307/2235062>.

Boccanfuso, D., Cabral, F., Cissé, F., Diagne, A. & Savard, L. (2007). Stratégies de réduction de la pauvreté au Sénégal : une analyse par la modélisation en équilibre général calculable microsimulé. *L'Actualité économique*, 83 (4), 483–528. <https://doi.org/10.7202/019390ar>

Chitiga, M., Cockburn, J., Decaluwé, B., Fofana, I., & Mabugu, R. (2010). Case Study: A Gender-focused Macro-Micro Analysis of the Poverty Impacts of Trade Liberalization in South Africa. *International Journal of Microsimulation* 3(1), 104-108

Cockburn, J., Fofana, I., Decaluwe, B., Mabugu, R., & Chitiga, M. (2007). A Gender-Focused Macro-Micro Analysis of the Poverty Impacts of Trade Liberalization in South Africa.

Lambert, P. (Ed.) *Equity (Research on Economic Inequality, Vol. 15)*, Emerald Group Publishing Limited, Bingley, 269-305. [https://doi.org/10.1016/S1049-2585\(07\)15011-0](https://doi.org/10.1016/S1049-2585(07)15011-0)

Cockburn, J., Corong, E., Decaluwé, B., Fofana, I., and Robichaud, V. (2010) Case Study: The growth and poverty impacts of trade liberalization in Senegal. *International Journal of Microsimulation* 3: 109-13.

Decaluwé, B., Lemelin, A., Maisonnave, H., Robichaud, V. (2013): PEP-1-t (Single Country, Recursive Dynamic Version). <https://www.pep-net.org/pep-1-t-single-country-recursive-dynamic-version>

Diao, X., Hazell, P., and Thurlow, J. (2010) The Role of Agriculture in African Development. *World Development* 38 (10): 1375-83. <https://doi.org/10.1016/j.worlddev.2009.06.011>.

Fan, S.; P. Hazell, and S. K. Thorat (2000) Government Spending, Growth and Poverty in Rural India. *American Journal of Agricultural Economics*, Vol. 82, No. 4, pp. 1038-1051

Fofana, I., Diallo, M.Y., Sarr, O., Diouf, A. (2015) 2011 Social Accounting Matrix for Senegal, IFPRI Discussion Paper 1417. Washington, D.C.: International Food Policy Research Institute (IFPRI). <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/128960>

Fontana, M., and Wood, A. (2000). Modeling the Effects of Trade on Women, at Work and at Home. *World Development*, 28 (7) 1173-90.

Fond Monétaire International-FMI (2019) Rapport des services du FMI pour les consultations de 2018 au titre de l'article iv, septième revue de l'instrument de soutien à la politique économique et demande de modification de critères d'évaluation — analyse de la viabilité de la dette, communiqué de presse et déclaration de l'administrateur pour le Sénégal. Rapport du FMI no 19/27.

Gollin, D. (2010) Agricultural productivity and economic growth. pp. 3825-3866. In P. Pingali and R. Evenson (Eds.) Handbook of agricultural economics. New York: Elsevier.

Irz, X.; Lin, L.; Thirtle, C. and Wiggins, S. (2001) Agricultural Growth and Poverty Alleviation, *Development Policy Review* 19 (4): 449-66.

Jung, H.S. and Thorbecke, E (2003) The impact of public education expenditure on human capital, growth, and poverty in Tanzania and Zambia: a general equilibrium approach, *Journal of Policy Modeling* 25(8): 701-725

Jonasson, E., Filipski, M., Brooks, J., & Taylor, J. E. (2014) Modeling the welfare impacts of agricultural policies in developing countries. *Journal of policy Modeling*, 36(1), 63-82.

Latorre, M.C (2016) A CGE Analysis of the Impact of Foreign Direct Investment and Tariff Reform on Female and Male Workers in Tanzania, *World Development*, 77: 346-366

Matchaya, G. C. (2020). Public spending on agriculture in Southern Africa: Sectoral and intra-sectoral impact and policy implications. *Journal of Policy Modeling*, 42(6), 1228-1247.

Mellor, J.W. (1996): "Agriculture on the road to industrialization". In Development strategies reconsidered. J.P. Lewis and V. Kallab (Ed.). New Brunswick, N.J.: Transaction Book for Overseas Development Council.

Mogues, T., Yu B., Fan S. and McBride, L. (2012) The impacts of public investment in and for agriculture. Synthesis of the existing evidence (ESA Working paper No. 12-07). Rome: FAO. Retrieved from <http://www.fao.org/docrep/016/ap108e/ap108e.pdf>

Pinstrup-Andersen, P. and Shimokawa, S. (2007) Rural infrastructure and agricultural development. In F. Bourguignon and B. Pleskovic (Eds.) Annual World Bank Conference on Development Economics – Global 2007: Rethinking Infrastructure for Development (pp. 175-203). Washington, D.C.: The World Bank.

Sennoga, E. B. and Matovu, J. M. (2013). Public spending composition in Uganda and its implications for growth and poverty reduction. *Public Finance Review*, 41(2), 227-247.
<https://doi.org/10.1177/1091142112448412>

Stifel, D. C., & Randrianarisoa, J. C. (2006). Agricultural policy in Madagascar: A seasonal multi-market model. *Journal of Policy Modeling*, 28(9), 1023-1027.

Tiberti, L., Cicowiez, M. and Cockburn, J. (2017) A top-down behaviour (TDB) microsimulation toolkit for distributive analysis: A manual". <https://www.pep-net.org/microsimulation-distributive-analysis>

United Nations Development Program (2015) Human development report 2015: Work for human development: Main report (English). United Nations Development Program.
http://hdr.undp.org/sites/default/files/2015_human_development_report.pdf

Zidouemba, P. and Gérard, F. (2015) Investissement public et sécurité alimentaire au Burkina-Faso : une analyse en équilibre général calculable dynamique". *Revue d'Etudes en Agriculture et Environnement*, 96(3), 411-437.
<https://ideas.repec.org/a/rae/jourae/v96y2015i3p411-438.html>

Zidouemba, P., Kinda, S.R., Nikiema, P.R., Hien, D.R. (2018) Transformation de l'agriculture et inégalités de genre au Burkina Faso". https://www.pep-net.org/sites/pep-net.org/files/typo3doc/pdf/files_events/2018_Bangalore_Conference/MPIA_20066_Conference_Version.pdf