Effects of high global prices of fertilizer and food on agriculture, household welfare and the economy as a whole in Benin

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Executive summary

Successive crises show the high volatility of world market prices of agricultural inputs and staple foods. Between 2019 and 2022, the average staple food price increased by 45% while the price of fertilizer almost tripled (+171% increase). We analyze the economy-wide effects of such a price increase on Benin, using a Computable General Equilibrium (CGE) model.

We find that higher world market prices for staple foods encourage domestic production. The higher world market price of fertilizer, in contrast, reduces the expansion of domestic production. And the total welfare effect as well as the macroeconomic effects are negative for Benin. As an agriculture-based economy, Benin would benefit from making the input supply chain more resilient to exogenous shocks in the long run by introducing/increasing the use of alternative fertilizers (such as manure) and exploring domestic fertilizer (chemical) production capacities. In the short run, subsidizing the fertilizer price could help alleviating the negative effects of the high world market price.

Furthermore, a short-run import tariff abolishment for staple food products as well as restrictions of staple food exports may lower the negative welfare effects of high food prices. Moreover, working on producing more of what is consumed domestically (to depend less on imports) and less of what is not consumed domestically can be important for more resilience vis-à-vis world market price volatility. Domestic food-processing industry development and changes in consumer habits may be important to achieve less import dependency.

Effets de l'augmentation des prix mondiaux des engrais et des produits vivriers sur l'agriculture, le bien-être des ménages et l'ensemble de l'économie au Bénin

Résumé

Les crises successives montrent la grande volatilité des prix des intrants agricoles et des produits vivriers sur le marché mondial. Entre 2019 et 2022, le prix moyen des produits vivriers a augmenté de 45 %, tandis que le prix des engrais a presque triplé (+171 % d'augmentation). Nous avons analysé les effets d'une telle augmentation de prix sur l'ensemble de l'économie du Bénin, à l'aide d'un modèle d'équilibre général calculable (EGC).

Nous avons constaté que l'augmentation des prix des produits vivriers sur le marché mondial encourage la production intérieure. En revanche, l'augmentation du prix des engrais sur le marché mondial réduit l'expansion de la production nationale. L'effet total sur le bien-être ainsi que les effets macroéconomiques sont négatifs pour le Bénin. En tant qu'économie basée sur l'agriculture, le Bénin aurait intérêt à rendre la chaîne d'approvisionnement en intrants plus résistante aux chocs exogènes à long terme en introduisant/augmentant l'utilisation d'engrais alternatifs (tels que le fumier) et en explorant les capacités de production nationale d'engrais chimique. À court terme, la subvention du prix des engrais pourrait contribuer à atténuer les effets négatifs du prix élevé du marché mondial.

En outre, la suppression à court terme des droits de douane sur les importations de produits vivriers ainsi que la limitation des exportations de ces produits pourraient réduire les effets négatifs de la hausse des prix des produits vivriers sur le bien-être des ménages. En outre, s'efforcer de produire plus de ce qui est consommé dans le pays (pour dépendre moins des importations) et moins de ce qui n'est pas consommé dans le pays peut être important pour une plus grande résistance à la volatilité des prix du marché mondial. Le développement de l'industrie agro-alimentaire nationale et les changements d'habitudes des consommateurs peuvent être importants pour réduire la dépendance à l'égard des importations.

1. Background

In the last couple of years, global prices have increased (FAO, 2023) because of the effects of climate change (such as long and intense droughts), sanitary crises or conflicts between countries. The 2008 food crisis was an example. World market prices peaked again during the COVID 19 pandemic, though to a lesser extent, and currently due to Russia's invasion in Ukraine. In west-Africa, repetitive high global prices have created some political instabilities due to social movements (Allen, 2017).

According to World Bank (2022), world market prices of food have increased by 45% on average between 2019 and 2022. Likewise, the world market price of fertilizer has increased by 171% in the same period. Benin has also been affected by higher food and fertilizer prices since 2019. Effects are mixed, as Benin has a comparative advantage in a substantial part of its staple food production (e.g. maize, cassava and yam) (DSA-MAEP, 2022b).

To cope with the situation, the government of Benin has taxed the export of staple food commodities such as cassava, maize, rice and yam to restrict exports (Ouin-Ouro, 2022a). Furthermore, the government prohibited fertilizer exports. However, these measures did only work to a limited extent because smuggling especially to Nigeria has been an established practice for decades (USDA, 2014).

Another measure taken by the Government of Benin is making staple food imports cheaper by releasing import tariffs for three months starting by the end of march 2022. Rice, wheat and vegetable oil are the food products targeted by this measure (Ouin-Ouro, 2022c).

Some measures were also taken to control input prices. A subsidy is paid by the government to make chemical fertilizer available at FCFA 280 per kg for farmers, despite the higher world market price (Ouin-Ouro, 2022b).

What are the effects of high world market prices for food and fertilizer on the economy of Benin? Little research has so far tackled the economy-wide effects of high global prices to guide or inspire policymakers in developing coping strategies. In this paper, we therefore analyze:

- The effects of increasing global prices of fertilizer on agricultural production, food consumption and the economy as a whole;
- The effects of increasing global prices of staple foods agricultural production, food consumption and the economy as a whole;
- The welfare effects of increasing fertilizer and staple food prices.

The following sections present the method, the results, the conclusion and policy implications to support decision-making.

2. Methods

2.1 Database

We use an updated 2019 Social Accounting Matrix (SAM) based on Kinkpe *et al.* (2022) and national accounts published by INStaD (2022) and additional data from DSA-MAEP (2022d, 2022c, 2022a). The two labour categories (skilled and unskilled) are disaggregated according to gender. Capital is disaggregated into agricultural and non-agricultural and land is

disaggregated into irrigated and non-irrigated. Households are disaggregated into rural poor and non-poor as well as urban poor and non-poor.

2.2 Model and closure rules

We use the computable general equilibrium (CGE) model STAGE (McDonald & Thierfelder, 2015). A CGE model combines economic theory and numerical models to establish the impact of shocks in an economy. Real economic data is used to fit a set of equations that replicate the structure of the economy. From this framework, it is possible to simulate the effect of exogenous shocks, such as policy changes, including economy-wide interactions. The following presents a summary of the CGE model used:

- Production is structured by a three-level nest of Constant Elasticity of Substitution (CES) and Leontief production functions. At the top level, aggregate value-added, and intermediate inputs are combined using a CES function. Production factors are aggregated using CES functions at different levels, whereas the intermediate input component is aggregated using a Leontief production function (the second level). Aggregate primary factors (i.e., labour and land) are combined using CES functions (the third level).
- Producers sell their products either in the local or foreign markets, based on relative prices, as determined by a Constant Elasticity of Transformation (CET) function.
- Households supply production factors to productive activities through factor markets in exchange for wages that constitute a significant portion of their incomes. After paying taxes and making savings, households spend their income on purchasing products. Households maximise their utility subject to Stone-Geary utility functions, selecting the optimal mix of commodities and services while considering purchase prices, preferences, and income constraints.

As Benin uses a currency pegged to the Euro with a fixed parity, we apply a fixed exchange rate regime and flexible trade balance (deficit) closure. The model is savings-driven. Government savings are fixed and the household tax rate is flexible. Therefore, any policy change implemented in the model is financed through equiproportional changes in household income tax rates.

2.3 Scenarios

Scenarios are developed based on observed changes in aggregate global prices between 2019 and 2022 (World Bank, 2022). Three scenarios are implemented:

1. A 45% increase in the world market price (of imports and exports) for staple foods (PW_food). Staple foods here include the categories staple food crops and animal products (animal husbandry products and fish);
2. A 171% increase in the world market price of imported fertilizer (PWM_fertilizer);
3. A combination of the first two scenarios (PW_food&fertilizer). This scenario reflects a potential reality on the ground. The first two scenarios support understanding the impact pathways.

3. Results

3.1 Domestic production

With the world market prices of imports and exports of staple foods increasing (PW_food), the domestic production of these products increases (Figure 1) for two reasons. First, the higher import price of staple food induces lower imports and higher domestic prices, incentivizing domestic production. Second, higher world market prices for food exports induce higher staple food production to supply the world market. This effect is especially relevant, because Benin is on average a net staple food exporter. Consequently, other crop and forestry production declines as these sectors rely on the same agricultural production factors, for which prices increase as staple food production increases. Food industry production increases because of more intermediate inputs (staple food crops and animal products) being available, as their production increases. Other industries and services decline because of competition for production factors: the more labour is used by the agricultural sector and food industries, the fewer labour is available for other industries and services.

With a world market price increase for fertilizer (PWM_fertilizer), total staple food production decreases slightly and production of other crops declines more strongly (Figure 1). Some of the individual staple food production activities decline strongly, some decline slightly and some increase. The fertilizer use intensity drives the decline. Those products which decline strongly because of a high fertilizer use intensity, use less production factors that are employed by those activities which are less fertilizer intensive and these activities increase. Total crop production declines (Figure 1) because of lower imports of fertilizer which is an important input for cropping activities. The declining crop production frees some agricultural factors which are additionally employed by animal production and forestry which grow. Food industries also slightly increase as the production of their inputs increases on average. Other industries and services decline because of competition for factors.

With export and import prices for staple foods increasing on top of the fertilizer price increasing, the effect is dominated by the effect of world market prices for staple foods (scenario PW_food). The effect is about half as strong as the pure staple food price effect, as it is partially compensated by the higher fertilizer price. The production of other crops declines because staple food production demands more factors and drives factor prices up. As there are important crops with low fertilizer intensity (e.g. cashew) among the category “other crops”, the combination of the fertilizer price effect and the staple food price effect is just slightly lower than the staple food price effect only for this product category.

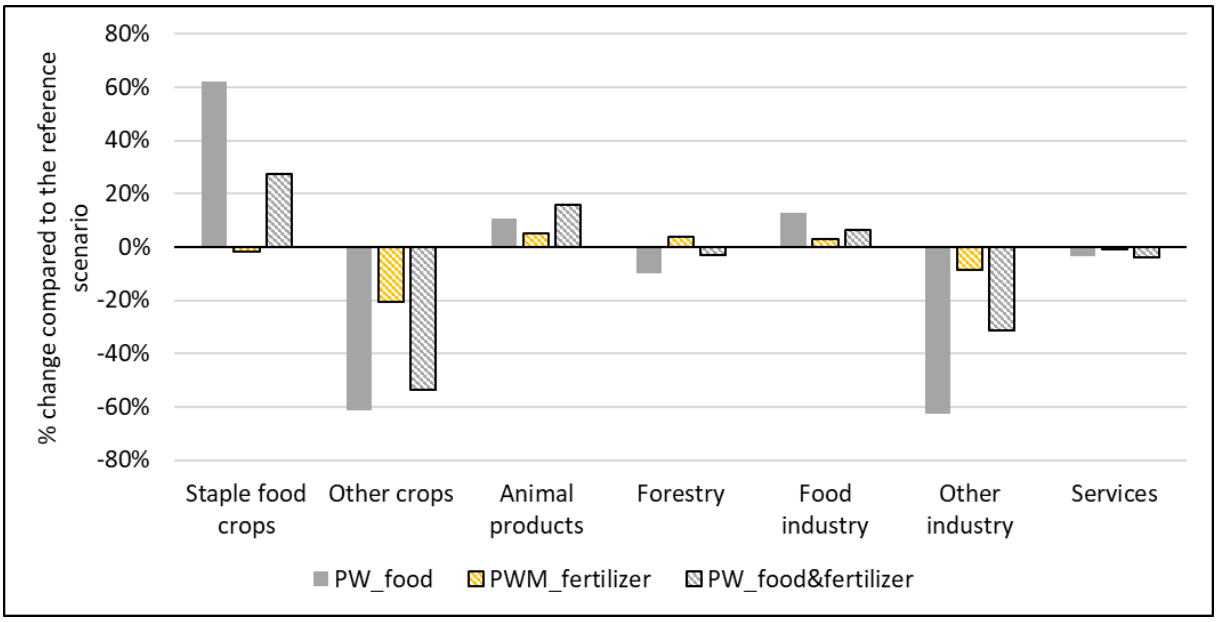

Figure 1: Effects on quantities of domestic production, % change compared to the reference scenario

Source: Author's calculations based on simulation results.

3.2 Household welfare

The total welfare and income effects are similar. The size is slightly different because of consumer price effects being included in the welfare calculations, but the welfare effects are dominated by the income effects.

With higher world market prices of imports and exports of staple foods, poor households in rural and urban areas gain welfare in the long run (Figure 2) because of the production effects (Figure 1) inducing increasing factor prices (Figure 3). Both higher import prices and higher export prices of staple foods drive the production of these commodities up in the long run. Higher production induces higher demand for agricultural factors they are intensive in (unskilled labour and land). These factors, being the most important income providers to poor households, these households gain income and therefore welfare. At the same time, the factors non-intensively used by staple food crop and animal product production (capital and skilled labour) become relatively abundant and their prices decline (Figure 3). These factors are the most important income providers to non-poor households and thus they lose welfare.

When only the fertilizer price increases, non-poor urban households gain welfare (Figure 2) because of the price decline for commodities that they consume the most such as animal products and processed food. At the same time, crop production declines, letting unskilled labour and land prices decline and resulting in higher food prices, causing welfare losses for rural households (because of lower factor prices) and urban poor households (because of higher food prices).

The combined welfare effects of increased world market prices for staple foods and fertilizer is positive for rural and urban poor households and negative for rural and urban non-poor households (Figure 2) because of the changes in factor wages (Figure 3) and consumer prices. These effects show the combination of the staple food price effects and the fertilizer price effects described earlier.

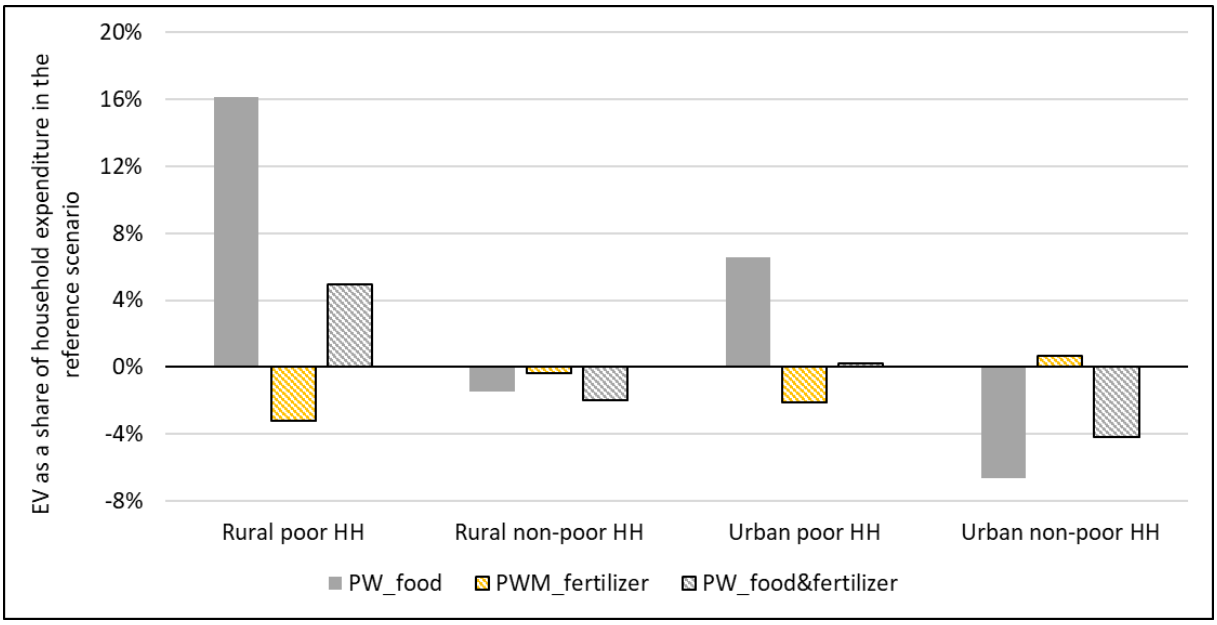

Figure 2: Effects on household welfare, Equivalent variation (EV) as a share of household expenditure in the reference scenario[1]

Source: Author's calculations based on simulation results.

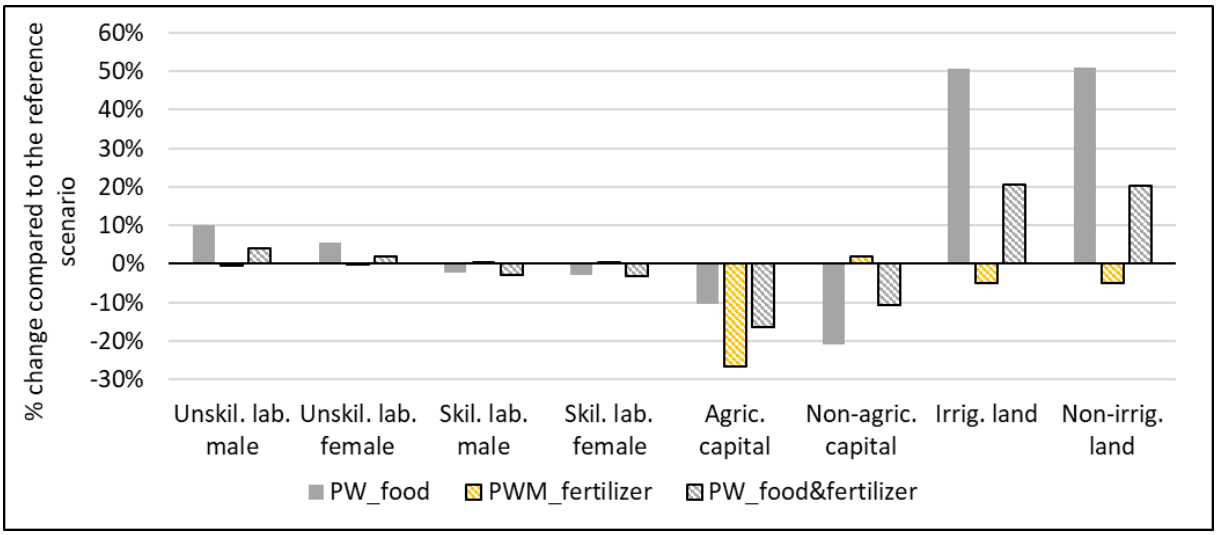

Figure 3: Effects on factor prices, % change compared to the reference scenario

Source: Author's calculations based on simulation results.

3.3 Macroeconomic effects

GDP declines for all scenarios (Figure 4). The decline in GDP is mostly driven by the decline in investment demand. At the same time, the trade deficit is turning into a trade surplus. With higher import and export prices for staple foods, production of these commodities grows,

[1] Equivalent variation (EV) refers to a change in income that would have an equivalent effect on utility as all price and income changes combined.

imports decline and exports increase. This makes the trade deficit turning into a surplus and investment demand declines in order to keep the balance of payments in equilibrium.

Under an increasing import price of fertilizer, production declines in general and imports increase while exports decrease. Accordingly, the trade deficit is getting stronger and therefore investment is higher (Figure 4).

The effect of the higher fertilizer import price together with the higher import price and export price of staple food is a combination of the above-described effects. The trade deficit becomes a trade surplus, lowering investment demand. Household demand is lower because of price and income effects (Figure 4).

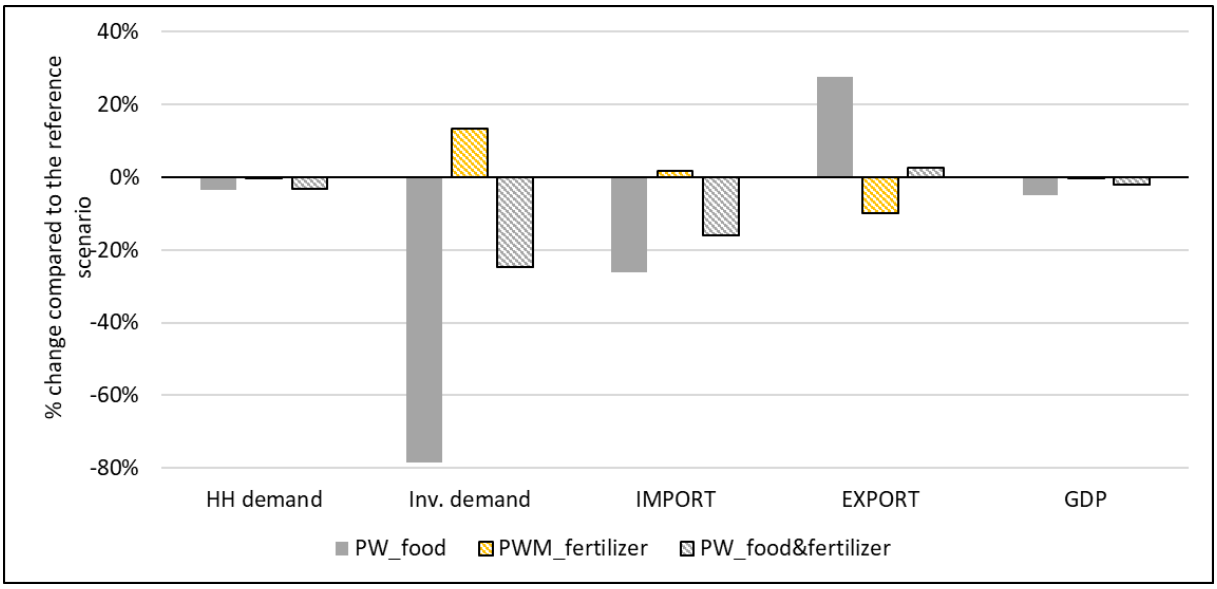

Figure 4: Effects on macroeconomic indicators, % change compared to the reference scenario

Source: Author's calculations based on simulation results.

4. Conclusions

This paper shows that agriculture-based economies such as Benin can be heavily affected by world market price changes for agricultural inputs and staple foods. The economy is negatively affected by higher world market prices: high fertilizer import prices restrict domestic production and high staple food prices of imports and exports encourage domestic production which is mostly exported while total domestic demand declines.

For a net staple food exporting country, the effect of an increasing world market price of staple food imports has a relatively small impact in comparison to an increasing world market price of staple food exports. Therefore, the combined effects of increasing world market prices of imports and exports of staple foods is driven by the export side.

In the real world, the full realization of the simulated effects would also depend on market power along the country specific value chains, as price transmission may be imperfect. Moreover, some of the trade may be informal cross borders regional trade, such as a substantial share of the exports to Nigeria in the case of Benin. These exports may not experience the same price changes as official exports and be more driven by local market conditions.

5. Policy implications

Agriculture in Benin heavily relies on fertilizer imports. This paper shows that the agricultural sector is strongly affected by increasing world market prices of fertilizer. To make the economy of Benin more resilient to international fertilizer price changes, the government could in the short term emphasize fertilizer subsidies (as it was proposed as a measure already) to farmers.

In the long run, measures to decrease the import dependency of Benin regarding fertilizer could be envisaged. The government may enhance nutrient efficiency, promote the integration of alternatives to chemical fertilizers (e.g. manure where available and composted plant materials) and explore domestic fertilizer (chemical) production capacities. Feasibility studies may be necessary to assess to which extent each of these measures can be effective in achieving the final goal.

Regarding increasing staple food prices, this paper shows that the effects are pro-poor because of production increasing in the long run and the related factor price changes. However, in the short run, poor households would suffer from higher food prices. Therefore, the government could decrease the pressure on the poor population in the short run by abolishing staple food import tariffs and restricting staple food exports for a short period. Alternatively, the government may use direct transfers to low-income households in order to support them to afford the high food prices. This would allow producers reaping the benefits of higher prices while not harming the most vulnerable domestic consumer groups.

In the long run, the government could work on enhancing self-sufficiency for less dependency on imports for important food commodities. Domestic food-processing sector development would contribute to this objective. For instance, more cassava could be used to produce flour for the bread industry instead of wheat. For that, shifting consumption habits may be important to make the domestic market more resilient to exogenous world market price shocks. It may be important to study the effects of such a shift on the economy and analyze how exactly such a shift could be initiated in an efficient way.

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