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NATURAL RESOURCE AND FOOD IMPORT DEPENDENCE OF AFRICA: CAN DEMOCRACY SLOWDOWN DEPENDENCE?

Forthcoming: Sustainable Development

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Abstract

Despite Africa's huge agricultural potential and natural resource abundance, the continent is paradoxically the most food import dependent and food unsecured in the world. Based on this paradoxical observation, this study seeks to analyze the effect of natural resources on food import dependence in a panel of 38 sub-Saharan African countries over the period of 2000 to 2020. The following findings are established. First, natural resource-dependent countries in Africa are associated with over-reliance on food dependence. Second, oil and gas rents significantly accentuate food dependence while mineral rent reduces dependence. We find that this situation is reversible, as liberal, egalitarian, deliberative and electoral democracies mitigate the effect of natural resources on food import dependence. These findings call for a rethinking of the food policy strategy in Africa. Therefore, we suggest that African governments should reduce their over-reliance on food imports by implementing food import substitution strategies. This can be done by investing part of the revenues from natural resources in agricultural infrastructures and by strengthening institutions, especially democracy.

***Keywords*:** natural resource; food dependence; food imports; cereal dependence, democracy; Africa

JEL Classification: H11; L66; O55; Q50

Introduction

The African continent is one of the richest in natural resources in the world. In fact, the continent has diverse extractive (e.g., cobalt, platinum, aluminum, oil, and gas) and non-extractive (e.g., arable land, water resources, and climate) natural resources. Africa's population is also growing at a rapid rate, which presents a threat to food security but also a huge potential for increased food production and a market. Yet, the continent is the most dependent on food imports. Based on this paradoxical observation, this study proposes to analyze the impact of natural resources on food dependence. Despite the high potential for food production, food imports have gradually become the key strategy for the continent's food security. Van Berkum (2021) identifies four ways in which food imports contribute to food security to justify the high level of food imports in Africa. First, trade improves access to food by reducing consumer prices. Second, trade improves food utilization because the induced income growth enables the higher income share to purchase nutrient-rich foods and a more diversified diet that are not available locally. Third, trade reduces food instability by offsetting food surpluses and deficits caused, *inter alia*, by the seasonality of local production. Fourthly, trade contributes to food availability as imports can compensate for insufficient domestic supply. The promotion of food imports for achieving food security has been bolstered by a variety of factors, including the gradual liberalization of economies and trade, the advancement of transport infrastructure, and the emergence of fresh preservation and transformation technologies that allow for more efficient and widespread distribution of food. Additionally, cultural, anthropological, and geographical barriers have been disrupted, further contributing to this trend.

According to UNCTAD (2020), almost 80% of the basic food consumed in Africa was imported from outside of the continent. From 2000 to 2016, the total global food imports increased from 214 million tons to 378 million tons, corresponding to an average annual increase of 2.59% (Smyth et al., 2016), as reported by the FAO (Food and Agriculture Organization). The food import bill has risen from $35.4 billion in 2015 to $60.1 billion in 2022, with a projected amount of $110 billion in 2025. Despite the aforementioned potential benefits, food dependence has shown its limits for the past two decades. First, the 2008 price spikes on global food markets, high price volatility in international markets, the Covid-19 pandemic and the ongoing Russia-Ukraine conflict, all threat food security. These crises highlight the disadvantages of overlying on food imports, as examined by Sternberg *et al*. (2020). Secondly, overreliance on food imports often create external trade imbalances for most African countries and consequently result in growing government budget deficits since many countries subsidize food imports. Thirdly, in relation to the second point, Ariezki (2021) states that food imports in African countries are controlled by a small group of powerful businessmen who benefit from high market concentration markups at the expense of welfare. Fourthly, imported food can displace local production, resulting in increased unemployment and poverty, especially in the

current context where 60% of the population in Sub-Saharan African countries consists of smallholders. Moreover, the corresponding population relies on subsistence agriculture as their primary source of income. The actual food dependence jeopardizes the attainment of the second United Nations Sustainable Development Goal (SDG2), which targets the elimination of all types of hunger by encouraging sustainable agriculture, providing equal access to land, technology and markets for small-scale farmers, and investing in infrastructure and technology to enhance agricultural productivity. Although food imports play a crucial role in achieving food security (IPES Food, 2017; IISD, 2019), it is important to note that, trade does not necessarily improve food security for all (OECD, 2019) on a sustainable basis, especially for the most vulnerable populations, such as those in Africa. Moreover, the ongoing pandemic and India's decision to ban rice exports has demonstrated the vulnerability of internationally connected food value chains and their disruptive consequences for food security (IFPRI, 2020). In the face of threats to food security, which can result in social and political instability, riots, underdevelopment, weakened political powers, and internal and international migration (Natalini *et al*., 2019), many African countries have expressed concerns over their reliance on food dependence as an approach to achieving food security (SDG 2). The African Development Bank (AfDB) and many African government officials have recently expressed concerns about the increasing dependence on food imports and have indicated their commitment to reversing this trend.

Increasingly, empirical studies aim to identify the factors that contribute to food dependency, with particular focus on domestic resource endowments (Atif *et al*., 2017), including cultivated land, water resources (Maslak *et al*., 2020; Han and Li, 2021), and economic development (Norton *et al*., 2021; Ren *et al*., 2021). 2021), exchange rates, and international food prices (Ikuemonisan *et al*., 2018), population growth (Dorninger *et al*., 2021; Qingjie, 2021), advancements in science, technology and infrastructure development (Geng *et al*., 2007), as well as per capita food yield and consumption (Maslak *et al*., 2020; Han and Li, 2021). Despite the abundant literature on the topic, few studies have explored the relationship between food dependence and natural resource dependence, particularly in the context of poor institutions. Therefore, we assert that uncovering the role of natural resources in explaining food dependence is essential. Theoretically, well-managed non-renewable natural resources such as oil, gas, minerals, and coal, abundant agricultural resources, and high-quality institutions can contribute to boost local food production, reduce food dependence and accelerate the economic development of Africa.

Decades of research have proven that countries rich in natural resources tend to export fewer products, including food, following the natural resource booms (Sachs and Warner, 1999; Auty, 2001; Sharma and Pal, 2021). Such scenarios have been designated as the natural resource curse, which is the paradoxical situation where resource-rich countries perform less well economically than their poorer counterparts. An extensive body of literature has explored

the impact of natural resources on various developmental aspects, such as health (Wigley, 2017), entrepreneurship (Majbouri, 2016), the development of the financial sector (Bhattacharyya and Hodler, 2014), inequality in income (Kim *et al*., 2020), allocation of aid (Couharde *et al*., 2020), as well as education and health (Stijns, 2006). However, the impact of natural resources on food dependency in Africa is unclear and remains controversial. For instance, some studies suggest a positive correlation between natural resources and food insecurity (Abdlkarim et al. 2018; Djella *et al.* 2019; Azizi, 2020) while another strand studies suggest the opposite (Omisakin *et al*., 2020; Mkodzongi and Spiegel 2019; Hilson and Garforth, 2013; Chigumira, 2018). Some scholars such as Van der Ploeg (2011), Badeeb *et al*. (2017), and Rodriguez and Sachs (1999) contend that the quality of institutions justifies the natural resource curse. However, this has not been applied to food dependence. Sen (2000) asserts that poverty or the absence of democracy explain the prevalence of food insecurity in many countries while Pinstrup-Andersen and Pandya-Lorch (1998) are of the position that population growth and urbanization will require more food but they do no specifically mention food imports as a means of satisfying additional demand. Moreover, Sen's positions have been criticized by others and have not been empirically extended to food dependence to the best of our knowledge.

The lack of consensus concerning the impact of natural resources on food dependency and the influence of democracy on such effects indicates a need for further research to enrich the literature on the natural resource curse and provide solutions to the ongoing challenge of ending hunger, which is the second SDG of the United Nations. Based on these facts and arguments, this study aims to analyze the impact of natural resources on food dependency and investigate the role of democracy in such a relationship.

In this study, it is posited that African countries' predatory nature (Bates, 2008), combined with their reliance on natural resources, heightens the chances of conflict, corruption, and inequality. Consequently, authorities prioritize food dependence over food self-sufficiency.

In the light of the above, this study seeks to analyze the effect of natural resources on food import dependence in sub-Saharan Africa with emphasis on democracy. The study has three main contributions. Firstly, it offers the first empirical evidence that supports the hypotheses mentioned above. It further expands on the empirical literature surrounding the factors driving food dependency, and highlights the importance of democracy in mitigating the impact of natural resources on food dependency. Secondly, this article provides the first empirical analysis of the impact of democracy in the relationship between natural resources and food dependence. Third, we investigate the extent to which democracy helps to moderate the nexus between natural resources and food dependence, using the five categories of democracy suggested by Varieties of Democracy (V-Dem). The use of V-Dem sheds light on which type of democracy moderates or exacerbates the effects of natural

resources on food dependence. The existing literature by Sen regarding the impact of democracy on mitigating food insecurity, as well as the substantial body of work on the resource curse by Venables (2016), Frankel (2012), and van der Ploeg (2011), have thus far not adequately highlighted this mechanism.

The positioning of the study departs from contemporary extant extractive industry studies which have largely focused on, *inter alia*: understanding new media trends in the global sustainability of electric vehicles minerals (Agusdinata and Liu, 2023); good governance and natural resources (Tatar et al., 2024); nexuses that drive strong sustainability (Nasrollahi et al., 2020); corporate, economic and social responsibility in extractive industry (Yousefian et al., 2023; Maybee et al., 2023; Neto and Mallett, 2023) and how shocks, uncertainty and climate change affect the underlying industry (Ezeaku et al., 2021; Li and Umair, 2023; Yuan et al., 2023; Schwab and Diaz, 2023).

The remainder of this article is structured as follows: Section 2 introduces the theoretical framework and empirical findings in the literature. Section 3 outlines the data and methodology employed. Section 4 summarizes and analyses the results obtained. Section 5 concludes the paper and puts forward policy recommendations.

2. Literature review

2.1. Direct link

Why many African countries choose food imports instead of food self-sufficiency as an approach to food security? An attempt of theoretical explanation.

The theory of comparative advantage states that countries have an advantage in specializing in products for which they have an absolute advantage (Smith, 1776) or relative advantage (Ricardo, 1817). African countries have an abundance of fertile land, large water reserves, a diverse climate, and an abundance of labour due to a remarkable positive demographic change. This abundance of labour not only represents a major market, but also offers opportunities for low wages, enabling them to specialize in labour-intensive food production such as cereals, particularly rice, oil and vegetables and sugar they used to import. The theory of comparative advantages is often used as a reference to show that trade liberalization reinforces food security (Lamy, 2012; World Bank, 2012; Zorya *et al*., 2015) though it may induce food dependence of countries without any comparative advantage in food production. In fact, efficiency gain that emanates from specialization according to comparative advantages coupled with freely traded food, should result in more availability and lower food prices in all countries, resulting in greater access to a more variety of food products and thus, improving food security (Clapp, 2015). This theory has been refined by Krugman (1986) who supports international trade but is opposed to the idea that international trade takes place strictly in a context of perfect markets. He points out that international specialization is also a function of comparative advantages linked to internal and external economies of scale and, above all, to the knowledge generated by R&D and investment in production infrastructures, which are known as constructed advantages.

Natural resources revenue abundance, particularly when it comes in the form of a windfall, can make it effortless for politicians and bureaucratic policymakers to squander it on uneconomic investments and conspicuous expenditures (Asanuma, 2008), such as subsidized food imports, which is detrimental to local food production. In the same vein, Oil-rich nations, especially those who reluctantly invest in agriculture are very willing to import expensive goods (Humbatova et al., 2022). According to Atkinson and Hamilton (2003), the utilization of rent to fund present public expenditures such as civil servants' salaries and subsidies for importing food is the primary reason for the resource curse. Such a decision can be theoretically explained borrowing the Keynesian theory, namely the marginal propensity to import. In fact, the economic growth led by natural resource exploitation can stimulate food dependence through the marginal propensity to import. Accordingly, any point increase of the GDP will, everything remaining equal, lead to a proportional increase of food imports.

However, these fine theoretical constructs do not provide sufficient justification for the choices made by many African developing countries in favor of food dependency as a food

security strategy, given their production potential. We can draw from many theories that analyze the indirect effect of natural resources on food imports.

2.2. Indirect link: transmission channels

The indirect effect of natural resources on food dependence can be analyzed through three channels, namely: first, the exchange rate channel also called the Dutch disease channel of Stevens (2003) that stipulates that, excessive dependence on natural resources can lead to an appreciation of the local currency, making local products less competitive on both international and local markets, exacerbating food dependence. Second, the channel of income inequality according to which the exploitation of natural resources breeds income inequality (Kim *et al*., 2020). In such circumstances, the healthy category of the population, typically urban dwellers, through snobbism and demonstration effect, tend to diversify their diets by placing more emphasis on imported foods. Third, the channel of democracy is also worth discussing because it substantiates the second hypothesis of the study.

Given the fact that this research puts much emphasis on institutions and more precisely on democracy, we insist much on it role in shaping the relationship between natural resource and food dependence. Based on the theoretical literature, we attempt to answer the following question: How can democracy constrain authorities to adopt efficient food policies in resource rich countries?

Public choices reinforced by the public choice theories of Buchanan and Tullock (1962) explain choice between food imports and food production. In fact, opportunistic behavioral models developed under these theories assume that politicians favour political benefits over social benefits. A government that functions well can implement policies that make local actors more flexible to gain rewards from the inflow of ideas, knowledge and products (Sterlacchini, 2008; Charron *et al*. 2014). The government's operations and choices depend on the institutional context, among other things. Institutions play a significant role in shaping economic performance (Rodrik *et al*., 2004). Political authorities contribute to the dynamism and growth of an economy by establishing clear guidelines, by preventing the exploitation of their positions, and by providing incentives to stimulate the activities of economic actors (Acemoglu and Robinson, 2012), including farmers**.** With clear and inclusive regulations, local actors are expected to demonstrate greater entrepreneurship, innovation and be in a better position to invest in new activities, such as food production. According to Robinson *et al*. (2006), the impact of rising commodity prices on the economy depends on the quality of institutions and the level of patronage in the public sector (defined as the use of public employment for personal gain and to maintain power). Sen (1990) emphasizes that preventing famines is straightforward when there is a democratic government subject to elections and critiques from opposition groups and independent media outlets. In his work on "Development as Freedom",

Sen suggests that the most robust early warning signs pertain to an active political opposition and a free press. Nevertheless, even in a democratic state, economic policies may still be inadequate, as substantiated by Ndi (2011).

In the absence of democracy, the exploitation of natural resources boost corruption and rent-seeking via exclusive licensing granted to the oligarch, political elites and their relatives (Van der Ploeg, 2011). Various studies suggest/argue that natural resources weaken democracy (Ross, 2001; Tsui, 2011; Cassidy, 2019). Also, Atangana (2019) contends that natural resource dependence in Africa causes institutional and political problems, including corruption, inefficient public administrations, lack of voice and accountability, weak rule of law and poor regulation quality. Also, Sen (1990, 2001, 2006) has consistently argued that access to food is determined by democratic institutions. These institutions hold leaders accountable and create incentives for them to provide public goods, such as infrastructure **(**Acemoglu and Robinson, 2006). Similarly, political leaders are constrained to provide affordable food to be reelected. In fact, the provisioning of public goods is a likely determinant of reelection success when the citizens undertake their civic duties during free and fair elections aimed among others at replacing incapable leaders (Ahlborg *et al*., 2015)**.** Similarly, since transparent and free elections enable citizens to replace leaders who are unable to meet their expectations and the provision of public goods is considered in the assessment of political leaders, the latter are constrained to provide affordable food in order to be re-elected (Ahlborg *et al*., 2015**).** In conclusion, natural resources, due to their negative impact on democracy, impede access to food on a feasible and efficient basis.

According to Auty (2001), the combination of abundant natural resources, ill-defined property rights, market imperfections and less restrictive institutions leads predatory states, rich in natural resources, to prioritize food imports through their political elites and oligarchs, in exchange for kickbacks. These choices are made to the detriment of productive activities such as R&D and investment in infrastructure that could make a significant contribution to local food production. The models developed by Lane and Tornell (1999) and Torvik (2001) support this idea. Indeed, in the choice between imports and food self-sufficiency, the presence of natural resources and/or an increase in their price tips the balance in favour of imports, notwithstanding the existence of comparative advantages linked to factor endowments or economies of scale. Resource abundance, therefore, generates contests and competition for the rents that can lead to the emergence of factional political and predatory states (James, 1999). To remain in power, the governments of resource-abundant countries need to find a way of redistributing rents to favoured groups (Auty and Gelb, 2001). Among the groups favoured are a small number of businessmen or food importers who have close connections with authorities and who benefit from the institutional monopoly in food imports. Authorities often prioritize the redistribution of rent over a cohesive food policy that bring more balance

between food imports and local food production. In this line, Arezki *et al*. (2021) proposed the concept of imperfect food import markets. They argue that, when distributing resources from rent, authorities may opt for a food import strategy that consist for instance of monopolizing food imports and the monopolization of food imports consists of granting exclusive import Licenses to the oligarchs, political elite and their relatives in exchange for rent-seeking activities. This is done at the expense of investments in basic infrastructures necessary to boost local food production by a large number of dispersed and unorganized farmers. The monopolization of imports results in sizeable margins obtained by dominant food importers, thereby raising public expenditure through subsidies and weakening food security. Tornell and Lane (1999) characterized this as the "voracity effect", in which the abundance of resources leads to the takeover of the state by influential groups. Such an effect results in a stagnation in food production growth, due to the misappropriation and maltreatment of public funds (Collier, 2007). Robinson *et al*. (2014) offer a comparable framework in which inducements for state capture rise due to natural resource exports. Rodriguez and Sachs (1999) suggest that natural resources give rise to an unwarranted sense of invincibility, leading countries to adopt a standard of living that surpasses their means.

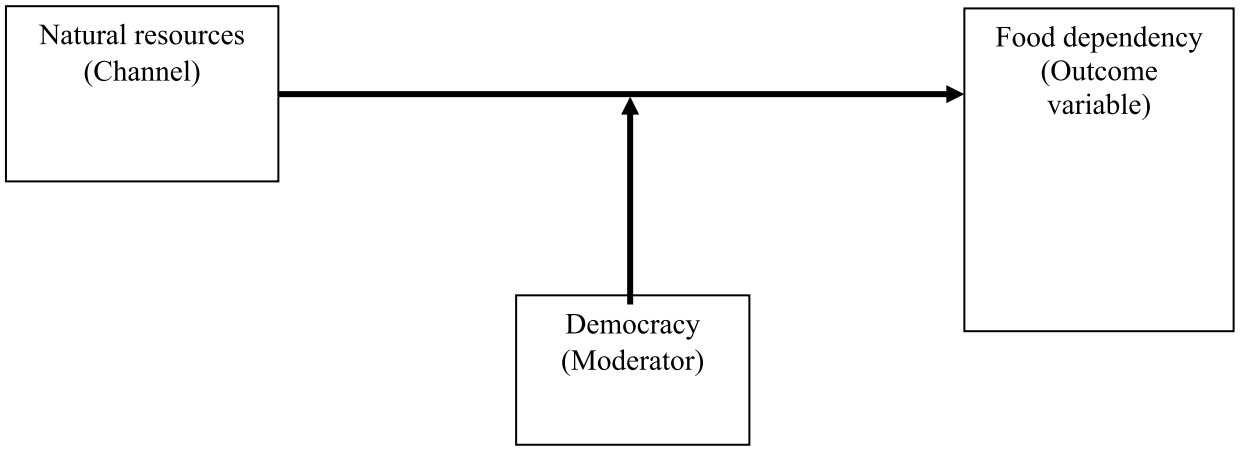
In the light of the above, it is assumed, in line with Sen's (1990) theory that, scenarios of famines are unlikely to occur in countries with democratic institutions and processes. Therefore, democratic institutions ensure a more effective and transparent administration of natural resource revenues to alleviate food dependency and hence food insecurity. We recognize with Sen (1981) that food crises are not solely a result of a mismatch between the amount of food and the size of the population, as food insecurity can arise despite an abundance of food. However, in the case of resource-rich African countries, revenues from natural resources are not invested in building the necessary infrastructure for increased food production, market access, storage, and transformation of food. Arezki (2021) attests that a handful of people operating businesses control food imports in these countries, shielding themselves from local competition through collusion or lobbying efforts that erect barriers to entry and increase their rents. These barriers undermine domestic food production, reduce government revenues, and have an impact on general welfare. While the state's contribution to their enrichment is not clear, the wealth of many of these affluent people operating businesses is linked to the importation of cigarettes, food, and alcohol, which compete with local food production. Proper management of natural resources may help to limit food dependency and reduce the threats to food security. The reasoning of this study is focused on the reduction of food dependence as a viable strategy to overcome food insecurity in Africa. The prevention of food insecurity is largely dependent on political mechanisms that determine the balance between self-sufficiency and food import. Based on these arguments, we formulate the following hypotheses:

H1: African countries' dependence on natural resources aggravates their food dependency.

H2. Democracy reduces the impact of natural resources on food dependency.

Following Akpa et al. (2024) on the moderating role of policy variables in interactive regressions, Figure 1 below shows the schematic framework underlying the problem statement considered in this study. As shown in the corresponding figure, natural resource has an impact on food dependency as apparent in Hypothesis 1 (i.e., H1) while democracy moderates the impact of natural resources on food dependency, as presented in Hypothesis 2 (i.e., H2).

Figure 1: Schematic framework



Very few empirical studies have attempted to analyze the impact of extractive natural resources on food dependency and their conclusions are conflicting. Arezki (2020) found that natural resources have a positive and significant effect on food dependency. Accordingly, the author found that natural resources have a negative effect on local agriculture, forcing countries to import more food. In the same vein, if oil prices increase, the importation of food follows positively and hence, weakening the local production of food (Ishmael, 2016). Besides, Humbatova et al. (2022) found a positive relationship between oil export and agricultural products and food that are imported in Azerbaijan.

3. Data and methodology

3.1 Data

The study utilizes secondary data from 38 African countries, covering the period between 2000 to 2020. The data are extracted from multiple sources, including the World Bank's WDI 2020 database, the V-Dem database, and the FAO's database. The availability of data determined the study period and the countries included in the analysis. Given the objective of linking food dependency and natural resources in Africa, it is advisable to clearly outline and describe the calculation method for the different economic metrics required in this modelling project.

Dependent variables

Food dependence is our explained variable. World development indicator database and FAO database provided the relevant information used to calculate food dependence indicators.

The first indicator is the food imports dependence provided by WDI, that is the share of food imports in US Dollar in the total merchandise imports in US dollar (Foodimp). We bring special emphasis on cereals because of their great proportion in food imports.

$$\text{Foodimp}_{it} = \frac{\text{Food imports}}{\text{Total merchandises imports}} \times 100 \qquad (1)$$

The second indicator of food dependence is the cereal dependence (Cerealdep). It represents the share of cereals imports in US Dollar in total cereals availability in US Dollar, calculated using the following FAO formulae:

$$\text{Cerealdep}_{it} = \frac{\text{Cereals imports}}{\text{Cereal production} + \text{cereals imports} - \text{cereals exports} \pm \text{stocks}} \times 100 \qquad (2)$$

In Equations (1) and (2), i represents countries and t, the time period.

Independent variables

They are of two categories: the variables of interest and control variables.

Variables of interest

The primary explanatory factor is the natural resource rent, which is measured in various ways in the literature. For this study, natural resource dependence is proxied by total natural resource rent expressed as a percentage of GDP (Rent), in accordance with extant literature on the consequences on natural resource rents (Nchofoung et al., 2021; Tadadjeu et al., 2023a). This metric is derived from the 2021 World Bank WDI and represents the revenues from the export of oil, natural gas, coal, mineral, and forest resources stated in US Dollar, expressed

in percentage of GDP. This indicator is frequently used in empirical analyses on resource curses (Tadadjeu et al., 2023b; Ngassam et al., 2024). We use the rent percentages of oil, gas, forest, and minerals, represented as a % of GDP, to evaluate the effect of each natural resource on food dependence.

Control variables

The control variables are obtained from the food dependence literature. Ikuemonisan *et al*. (2018) proved that an appreciation of the real effective exchange rate (Reer) causes an increase in food dependence. Similarly, Han and Li (2021) have shown that an increase in food production per capita in US Dollars (Foodpercap) can decrease food dependence, whereas an increase in population growth rate (Popgrowth) can increase food dependence (Dorninger *et al*., 2021; Qingjie, 2021). The impact of remittances (Remittance), the total amount of money sent by those who are working abroad to their family back home expressed in percentage of GDP, depends on how recipients use them, as they can both decrease or increase food dependence. According to Hugon *et al*. (1991), the urbanization rate (Urban), expressed as the percentage of the population living in urban areas, is positively correlated with food insecurity. The WDI database of the World Bank provides the relevant data for the control variables.

With regards to institutions, particularly democracy, previous studies have employed the Polity 2 index or Freedom House measures as democracy indicators (Bhattacharyya and Hodler, 2014; Omgba, 2015). Nevertheless, these indicators confine democracy to civil liberties and political rights (Oskarsson and Ottosen, 2010). We overcome this limitation by employing an alternative measure of democracy offered by the Varieties of Democracy (V-DEM) database, version V11.1, to investigate the direct and moderating impacts of different forms of democracy on the connection between natural resources and food dependence. Specifically, we utilize five democracy indicators that measure democracy in distinct ways (Coppedge *et al*., 2016). The electoral democracy (Electdem) evaluates how leaders respond to citizens and is demonstrated during the electoral process to gain the approval of the electorate. The indicator is based on free and fair elections, and the free functioning of political organizations. It is a measure of the capacity of people, specifically farmers, to vote out authorities who do not protect their interests and rights. The Liberal Democracy (Libode) evaluates to what extent the rights of individuals and minorities are preserved from the tyranny of the state and the majority. The deliberative democracy (Delibdem) principle focuses on the decision-making process within society. It can impact the decision to import food that may benefit only a select group of political clients over locally produced food, which supports income preservation and rural employment for farmers. The egalitarian democracy (Egaldem) values the assurance of individual rights and liberties for all, including farmers and city residents, fair distribution of resources such as land, water, and natural resource revenues, as well as even

distribution of power across different demographics and socioeconomic statuses, is also emphasized. Participatory democracy (Partdem) advocates for the involvement of all citizens in political processes, both electoral and non-electoral, as well as civil society participation and local and regional government power elections. We are inspired by a study from Nkoa *et al*. (2023) showcasing how it can decrease food dependence. These democratic indicators vary from 0 to 1, with higher values indicating a stronger democracy.

The appendix Table A1 provides the list of the panel countries. The Figure 1 illustrates the evolution of the three indicators of food dependence from 2000 to 2020, while descriptive statistics of variables used in the study, as well as correlation analyses, are presented in Tables 1 and Figure 2, respectively.

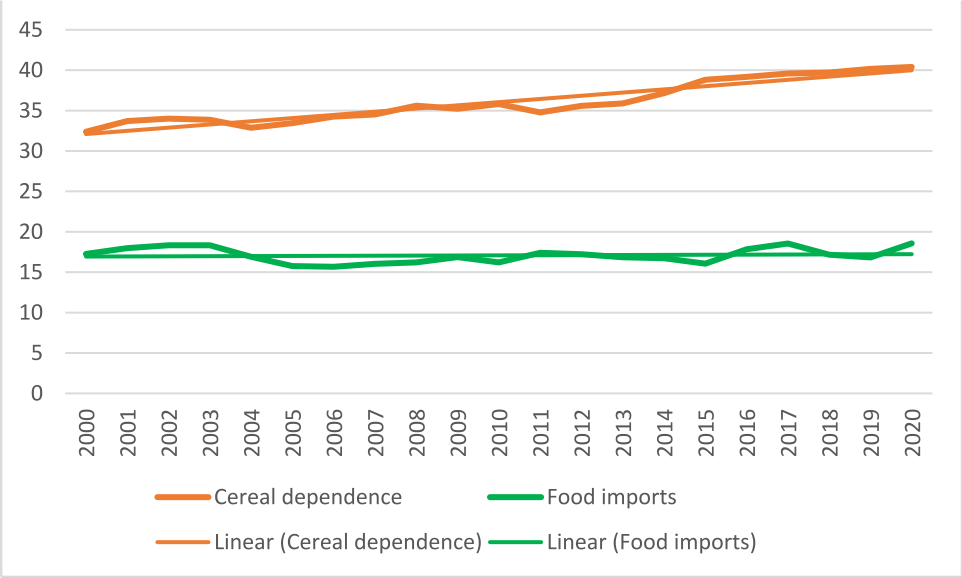


Figure 2: Evolution of the two indicators of food dependence from 2000 to 2020

Figure 2 shows that almost all food dependence indicators have increased during the time period of the study. Cereals record the highest dependence rate that rose from almost 30% in 2000 to 40% in 2020, representing an average annual growth rate of 3.33%. Food imports though relatively stable around the rate of 20% remains high. The food imports vary according to countries.

Coming to Table 1, the data show that, the average food import dependence is 17.277% with a minimum of 0.474% and a maximum of 52.311%. The standard deviation of 8.185% is high showing also the high variability between countries and time. The average cereal dependence is 36.90% with a minimum of -23.90% and a maximum of 100%. The standard deviation of 28.22% shows high variability between countries.

Tables 1: Descriptive statistics.

Variables	Mean	Std	Max	Min
Cereal dependence	36.905	28.228	100.000	-23.900
Deliberative democracy	0.348	0.189	0.733	0.039
Egalitarian democracy	0.302	0.155	0.654	0.044
Food imports	17.277	8.185	52.311	0.474
Remittances	6.932	35.146	343.209	0.000
Food production per capita	20.724	20.724	84.321	0.000
Forest rent	4.496	5.086	40.408	0.000
Gas rent	0.305	0.875	5.601	0.000
GDP per capita	1774.144	1926.598	11643.461	110.461
Liberal democracy	0.334	0.270	0.881	0.005
Mineral rent	1.303	2.822	24.834	0.000
Oil rent	3.889	10.104	58.138	0.000
Participatory democracy	0.266	0.126	0.533	0.061
Electoral democracy	0.448	0.188	0.792	0.116
Population growth	2.242	0.793	5.695	0.068
Reer	105.354	18.750	233.112	57.130
Total rent	10.383	9.750	58.688	0.001
Urban population	41.785	16.511	73.733	8.246

3.2. Empirical strategy

The aim of this study is to examine the impact of natural resources on food reliance. In the line with Arezki (2021) who examined the factors influencing food reliance in Africa, we define the following Equation (3):

$$Foodep_{it} = \alpha + \lambda Rent_{it} + \gamma X_{it} + \varepsilon_{it} \quad (3)$$

Where,

Foodep represents the country i's food dependence in year t

$Rent_{it}$ is the total natural resources,

X_{it} refers to the vector of control variables, comprising the GDP, the real effective exchange rate (Reer), the food production per capita (Foodpercap) in US Dollars, population growth rate (Popgrowth), the remittances (Remittance), the urbanization rate (Urban population) and i_t denotes the error term.

For the sake of a robustness of estimations, we use four estimation techniques: The ordinary least squares (OLS), the Lewbel two stage least square (2SLS), the Kiviet estimation approach and the system generalized method of moments (s-GMM) approach.

OLS estimates can suffer from bias of omitted variables and can be affected by serial correlations and heteroscedasticity. Moreover, Badeeb et al. (2017) call the necessity to deal with endogeneity issue when measuring the dependence on natural resources. Endogeneity may occur from various sources, including measurement errors, sample selection and

simultaneity biases. To circumvent these drawbacks of endogeneity we use the Lewbel 2SLS and a recent method proposed by Kiviet (2020).

Coming to Lewbel 2SLS, it brings solution to the problem of instrumental variable choice. In fact, instrumental variables can be used to adress both measurement errors and endogeneity issues. However it is difficult to find valid instruments that predict long run time series. When traditional instruments are difficult or cannot be found. We can resort to the approach proposed by Lewbel (2012) that makes use of heteroscedasticity in mismeasured or endogenous explanatory variable to build instrumental variables (Kiviet, 2023). Under the assumptions about covariance of certain variables with the error terms, the Lewbel 2SLS estimator replaces traditional exclusion restrictions. The overidentifying restrictions and first stage Fisher-statistics tests can be used to verify the covariance hypothesis.

Acording to Kiviet (2020), 2SLS has some limitations. Firstly, it is based on exclusion restrictions that are untenable. Secondly, estimators are built on preconditions that are statiscally unverifiable. Thirdly, the rule statistical inference on the actual value of these endogeneity corelations will be highly unreliable. Fourthly, on the basis of statistical evidence, the orthogonality of instruments and errors can only be partially vindicated.

Based on these drawbacks, and given the difficulty of finding an appropriate instrument for explanatory variables, we adopt an alternative estimation approach recently developed by Kiviet (2020). This method is diversely known as the method of internal instrumental variables, the noinstrument method and the Kinky least square method (KLS). The KLS method corrects the bias of OLS estimates for the postulated range of endogeneity (correlation between natural resources and error terms). Moreover in the presence of weak instruments, confidence intervals produced by KLS method are narrower compared to those of 2SLS (Kiviet, 2023).

Lewbel and 2SLS methods do not consider the dynamic nature of our basic model. This justifies why we resort to the system GMM method. Also system GMM approach has some advantages. In fact, beyond the fact that the s-GMM is more indicated with unbalanced panel data than the difference GMM which accentuates gaps (Roodman, 2009), the differences are not correlated, despite the fact that explanatory variables in levels are linked with country-specific effects. In spite of being more efficient from an asymptotic perspective, downward bias still characterizes standard errors associated with two-step GMM estimates. The corresponding shortcoming can be addressed by employing a finite sample correction to the two-step covariance matrix within the framework of Windmeijer (2005). The s-GMM approach reduces the impact of weak instrumentation and enhances the efficiency of the estimation. (Blundell and Bond, 1988). By treating the model as a system equation in first difference and in levels, it solves some of the endogeneity problems (Bond et al., 2001).

In the literature, the GMM is frequently used to solve econometric problems such as endogeneity of certain variables and over identification. GMM provides efficient and convergent estimators in the presence of lagged variables (Blundell and Bond, 1998). Yet,

according to Blundell and Bond (1998), the s-GMM estimator treats the model as a system of equations in first difference and in levels to solve the endogeneity problem. Through s-GMM estimation process, the endogenous regressors in the level equation are instrumented using the lags of their first difference, whereas the endogenous estimators in the first difference equation are instrumented with lags at the level series (Bond *et al*., 2001).

In the System GMM, notwithstanding that the levels of the explanatory variables are linked with group fixed effects, the differences are not correlated. Another argument in favor of System GMM is that, unlike Difference GMM estimation, which has the drawback of emphasizing gaps, it performs better on unbalanced panel data (Roodman, 2009). System GMM resolves the aforementioned problems, but one lingers. Although asymptotically more efficient, the two-step GMM estimates substantially skew standard errors downwards. We are able to get around this problem, though, by using the finite-sample correction on the two-step covariance matrix that Windmeijer (2005) created.

The system GMM has a weakness in that it can generate too many instruments, which can lead to over-fitting of endogenous variables and weaken Hansen's test of joint validity of instruments. It can also produce biased estimates, even though it is robust in addressing the aforementioned endogeneity issues (Roodman, 2009). To mitigate this issue, we set a maximum for the amount of lags. As a result, we treat all explanatory variables as possibly endogenous and use lags ranging from t-1 to t-3 as the instruments for the regressions.

It is suggested by Arellano and Bond (1991) that the employment of first differences of the variables is used in order to purge the fixed effects. Therefore, the corresponding GMM model is specified by the following Equation (4):

$$Foodep_{it} = \alpha + \beta_0 Foodep_{it-1} + \lambda Rent_{it} + \gamma X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (4)$$

Where,

$Foodep_{it-1}$ is the lagged Food dependence

μ_i is an unobserved country-specific effect,

v_t is the time-specific effect. Several reasons motivated the choice of the GMM model.

Can democracy lift the resource curse?

According to Arezki (2021), natural resources increase state capture return, potentially engendering the choice of inefficient policies in the absence of strong political institutions. The role of political institutions is central in shaping the impact of natural resources through the definition, compliance and enforcement of rules and the redistribution of resource rents. Bhattacharrya and Hodler (2014) show that the quality of institutions, including democracy, can mitigate the negative impact of natural resources on various development outcomes. Institutions can play a key role because they define the level at which policy motivations are translated into policy outcomes (Robinson *et al*., 2006). However, a democratic context that generates political pressure may constrain policymakers to redistribute resources from rent in

the form of direct transfers or subsidies for investments in agricultural R&D, rural and agricultural infrastructure such as irrigation, mechanization, storage equipment, road infrastructure and human capital, which can improve competitiveness, boost local production and reduce food dependence. We contribute to this literature by examining the extent to which types of democracy mitigate the effect of natural resources on food dependence. We then estimate the following model in Equation (5):

$$Foodep_{it} = a + \beta_0 Food_{it-1} + \lambda Rent_{it} + \beta_2 Democracy_{kit} + \beta_3 (Rents \times Democracy)_{kit} + \gamma X_{it} + \mu_i + v_t + \varepsilon_{it} \quad (5)$$

$Democracy^k$ is the vector of democracy. K = (electoral, liberal, participatory, deliberative and egalitarian).

Figure 3A and 3B show the correlation between natural resource and various food dependence indicators.

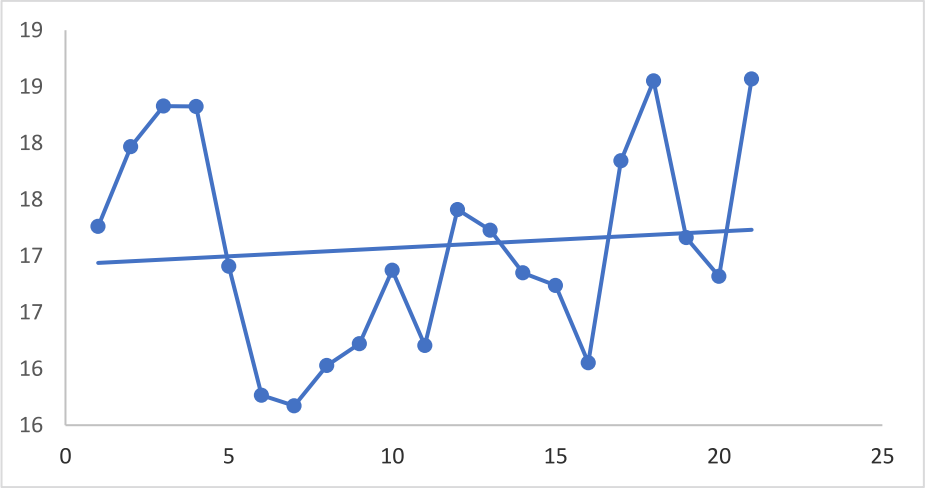


Figure 3-A : Natural resource and food imports

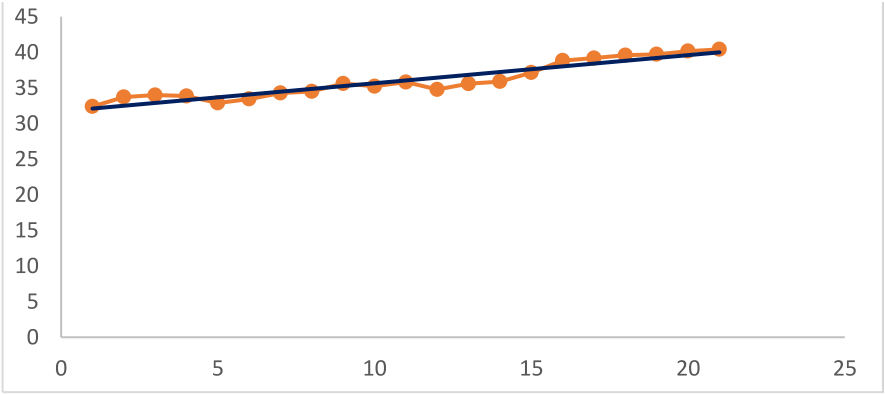


Figure 3-B: Natural resource and cereal dependence

Figure 3: Natural resource and food dependence

According to the figures, natural resources are positively correlated with food dependence. This corroborates the concept of the "paradox of plenty". However, the correlation does not men causation. It is necessary check the existence of robust evidence to support that natural resources exacerbates food dependence. This is done in the following Section 4.

4. Results and discussions

4.1 Baseline results

Table 2 presents different specifications for estimating the effect of natural resource on food dependance, as outlined in equation (4). Results in columns (1) and (4) which do not include control variables, show that 1-percentage-point increase in natural resources accentuate food dependence, specifically food imports and cereal dependence respectively by 0.0944 and 0.4264 percentage point. In column (2) and (5), we control for the urbanisation. The coefficients are still statistically significant with the expected sign. In addition to the control variables included in columns (2) and (5), we also control for remittances. Results still indicate that natural resources exacerbate food dependence in Africa.

These results confirm the curse of natural resources in terms of food dependence. These results are consistent with the findings of Arezki *et al*. (2021) and the voracity effect of Torner and Lane (1999). Therefore, our results show that the revenus from natural resource exploitation tend to be used less to produce food than investing in boosting food production.

Table 2: The effects of natural resource on food dependence (OLS estimates)

Variables	Foodimport			Cerealdep		
	(1)	(2)	(3)	(4)	(5)	(6)
Rent	0.0944***	0.0995***	0.0838***	0.4264***	0.1272	0.2333***
	(0.0302)	(0.0304)	(0.0305)	(0.1067)	(0.0906)	(0.0876)
Urban population		0.2626	0.3687**		9.7244***	10.3969***
		(0.1795)	(0.1807)		(0.5402)	(0.5226)
Remittance			-0.0302***			-0.1967***
			(0.0085)			(0.0234)
Constant	18.2577***	17.2127***	16.8197***	32.5981***	5.6942**	8.1996***
	(0.4303)	(0.8340)	(0.8349)	(1.4879)	(2.4629)	(2.3737)
Observations	764	764	764	743	743	743
R-squared	0.0127	0.0154	0.0316	0.0211	0.3192	0.3785
F	9.774***	5.964***	8.268***	15.960***	173.500***	150.000**

4.1.1 Sensitivity to additional control variables

First, we estimate coefficients of equation (4) by introduction four additional control variables, including real effective exchange rate, per capita GDP, population growth and food production. The results summarized in Table 3 show that natural resources keep a positive and statistically significant effect on food dependence. From column (1) to column (8), we notice that the effects of naturel resources remain positive.

In table 3 Columns (1) to (8), additionnai control variables are gradually introduced. Such introductions do not affect the signs of the coefficients of natural resources, although the slightly different magnitude of the coefficients is apparent. However, the results are consistent with those found in table 2 columns (1) to (3) that natural resources accentuate food dependence in Africa. The specifications in column (4) and (8) are our preferred specifications. In short, our preferred specifications in column (4) and (8) show that natural resource accentuates food dependance in natural resource exploiting countries by 0.1400 percent and 0.5764 percent.

Regarding the control variables, the results show that a 1-percentage point increase in urbanisation increases food import and cereal dependance respectively by 1.339 and 6.458 percentage-point.

The same percentage-point increase remittance instead reduce food import and cereal dependence respectively by 0.0435 and 0.1487 percentage point.

Also, per capita income growth reduces food imports while it accentuates cereal dependence. In fact 1-point increase in per capita GDP results in 0.0014-percentage point decrease in food imports and 0.0042 point increase in cereal dependance. This result may be explained by the fact that income increase may encourage households to change their consumption pattern by integrating in their diets, rice and wheat that are luxurus goods in Africa.

Table 3 : Effects of additional control variables

Variables	Foodimport				Cerealdep			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rent	0.0870***	0.1281***	0.1250***	0.1400***	0.2425***	0.4340***	0.5417***	0.5764***
	(0.0308)	(0.0305)	(0.0312)	(0.0344)	(0.0880)	(0.0838)	(0.0852)	(0.0921)
Urban population	0.3546*	1.2667***	1.3834***	1.3398***	10.5679***	6.6994***	6.2326***	6.4589***
	(0.1834)	(0.2218)	(0.2328)	(0.2537)	(0.5272)	(0.6107)	(0.6369)	(0.6840)
Remittance	-0.0301***	-0.0412***	-0.0425***	-0.0435***	-0.1996***	-0.1546***	-0.1448***	-0.1487***
	(0.0086)	(0.0085)	(0.0085)	(0.0103)	(0.0235)	(0.0223)	(0.0222)	(0.0264)
Reer	0.0027	0.0215	0.0217	0.0306*	0.0429	-0.0336	-0.0211	-0.0187
	(0.0160)	(0.0157)	(0.0157)	(0.0178)	(0.0450)	(0.0425)	(0.0421)	(0.0470)
GDPpercap		-0.0013***	-0.0015***	-0.0014***		0.0053***	0.0036***	0.0042***
		(0.0002)	(0.0002)	(0.0002)		(0.0005)	(0.0006)	(0.0006)
Population growth			-0.1821	-0.1379			-6.4684***	-6.6413***
			(0.5073)	(0.5319)			(1.3344)	(1.3727)
Food production percap				0.0007				-0.1642**
				(0.0250)				(0.0643)

Constant	16.6838***	13.7063***	13.9694***	13.0896***	13.8739**	1.2774	16.9733***	18.2880***
	(1.9362)	(1.9271)	(2.4418)	(2.6430)	(5.4635)	(5.2178)	(6.5295)	(6.9407)
Observations	743	743	735	647	722	722	714	626
R-squared	0.0324	0.0909	0.1021	0.0972	0.3892	0.4724	0.4825	0.5032
F	6.184	14.74	13.79	9.828	114.2	128.2	109.9	89.42

Population growth seems to reduce food dependence and this is explained by the fact that African agriculture remains more labour intensive. Part of additional population can serves as labour resource enabling to boost food production in Africa.

4.1.2 Robustness to alternative estimations techniques

As one can observ from previous estimations, in tables (2) and (3), the more we add control variables, the more the R^2 increases. The estimation including the variable of interest and all control variables is used to check the robustness of our analyses using alternative estimation techniques.

Despite the previous estimations obtained using the OLS estimators have revealed a robust and significant increasing effect of natural resources on food dependence in Africa, the possibilities of unobserved heterogeneity and reverse causality (which are some aspects of endogeneity) may bias the result and limit the relevance of our findings. Endogeneity is also related to omitted variables, error of measurement and mispecification. The Lewbel 2SLS (2012) model for the static model has been used in the literature to address these possible issues. Furthermore, this model resolves the instrumental variable selection issue that the instrumental variable approach and GMMs present. The results in Table 4 column (1) and (2) indicate that the sign of the parameters related to the natural resource indicator remains positive and significant. However, its impact is much greater than those presented in the previous tables.

Most often instrumental variable approach requires the choice of appropriate instrument, which is not an easy task. We employ an alternative estimating technique devised by Kiviet (2020) and build on recent work on the drivers of fuel poverty (Churchill and Smyth, 2022), acknowledging that the instrument used cannot be completely exogenous. The estimated results summarized in columns (3) and columns (4) of Table 4, support our previous findings that natural resources increase food dependence of African countries.

However, Lewbel and Kiviet methods do not allow us to test the dynamic character of our basic model. This is why we have resorte to the robustness of the system GMM method. We use the Equation (5) to estimate the s-GMM coefficients. We first check the validity of the s-GMM estimator before using the estimation results. The results of AR (1) and AR (2) in columns (5) and (6) of Table 4 respectively reject the null hypothesis of no first-order serial correlation in the residuals and validate the hypothesis of no second-order serial correlation.

Table 4 : Effects of natural resources on food dependence using alternative estimation techniques.

	Lewbel 2SLS		KIVIET		s-GMM	
Variables	Food import	Cereal dependence	Food import	Cereal dependence	Food import	Cereal dependence
	(1)	(2)	(3)	(4)	(5)	(6)
L.Foodimport					0.7182***	
					(0.0275)	
L.cerealdep						0.9547***
						(0.0090)
Total natural resource rent	0.5769***	1.2938***	0.1400***	0.5764***	0.0214*	0.0253***
	(0.0698)	(0.1594)	(0.0342)	(0.0915)	(0.0114)	(0.0067)
Urban population	1.8643***	5.2187***	1.3398***	6.4589***	0.5666***	0.3076**
	(0.2907)	(0.7454)	(0.2521)	(0.6796)	(0.1344)	(0.1215)
Remittance	-0.0365***	-0.1586***	-0.0435***	-0.1487***	-0.0145***	-0.0072***
	(0.0115)	(0.0276)	(0.0103)	(0.0263)	(0.0019)	(0.0019)
Reer	0.0377*	-0.0268	0.0306*	-0.0187	0.0175***	-0.0017
	(0.0198)	(0.0489)	(0.0177)	(0.0467)	(0.0054)	(0.0056)
GDPpercap	-0.0017***	0.0047***	-0.0014***	0.0042***	-0.0007***	0.0002
	(0.0003)	(0.0007)	(0.0002)	(0.0006)	(0.0002)	(0.0001)
Population growth	1.4417**	-9.1787***	-0.1379	-6.6413***	-0.0612	-0.2741*
	(0.6282)	(1.4986)	(0.5286)	(1.3639)	(0.3793)	(0.1479)
Food production percap	0.0855***	-0.2936***	0.0007	-0.1642**	-0.0030	-0.0022
	(0.0300)	(0.0708)	(0.0248)	(0.0639)	(0.0115)	(0.0057)
Constant	9.7315***	24.8061***	13.0896***	18.2880***	2.2554	0.8540
	(2.9739)	(7.3188)	(2.6266)	(6.8963)	(1.3669)	(0.7084)
Observations	647	626	647	626	608	588
R-squared	0.1310	0.4544				
widstat	38.81	49.59				
xkurtosis			65.18	63.02		
grid_min			-0.700	-0.700		

grid_max	0.700	0.700		
grid_step	0.0100	0.0100		
Number of countries			38	38
AR(1)			0.000487	0.0152
AR(2)			0.522	0.161
Instruments			23	23
Hansen			0.167	0.306

Notes: *. **. *** denote statistical significance at the 10%. 5% and 1% levels respectively

The Hansen statistical test for over-identification is insignificant, indicating that the instruments used satisfy the homogeneity restrictions. Finally, the number of countries is greater than the number of instruments in each specification. Based on these various statistical tests, the estimated s-GMM coefficients are adequately specified. The results in columns (5) and (6) still show that natural resources have a positive and significant impact on food dependency. A 1-percentage point increase in natural resources increases food imports and cereal dependence by 0.0214 and 0.0253 percentage point respectively.

4.2 Further analysis and robustness checks

Some scholars argue that the impact of natural resources on food dependence may be different depending on the type of resource. Isham *et al*. (2005) and Koa *et al*. (2023) found in their analyses that dependence on point resources, such as gas and oil, curses development outcomes more than dependence on diffuse resources (mostly forest and mineral resources). According to Bhattacharyya and Collier (2014), Yilanci *et al*. (2021) and Cockx and Francken (2016), the resource curse is unique to point resources. We then verify if the impacts of oil, gas, forest, and mineral resources on food dependence differ. The results presented in Tables 5 show that oil and gas resource exploitation have a positive and significant impact on food dependency while mineral resources negatively impact food dependence. Forest resource has not significant effect on food dependence. The effects of the natural resources on food dependency vary based on their point or diffuse character. The finding do not confirm the findings of Isham *et al*. (2005) and Nkoa *et al*. (2023) on the differentiated impact of natural resources on food dependency upon their diffuse and non-diffuse character.

Looking at the effects of other control variables, we find that urbanization positively and significantly increases cereal and food imports, regardless of the estimator and the type of natural resource.

This effect can be explained by the fact that cereal production in Africa is highly labour intensive, given the low level of mechanization. The movement of people from rural to urban areas creates labour shortages, which can reduce production and stimulate imports. The movement of people from rural to urban areas also means that food supply decreases while food demand increases. The resulting growing gap is filled by subsidized food imports.

Population growth almost significantly reduces food dependence, but it significantly increases cereal dependence and food imports. These results seem to indicate that the additional population is still mostly employed in the agricultural sector and specifically in the production of other food crops such as banana, tubers, plantains, fruits and vegetables that are more profitable than cereals.

Table 5: The effects of various types of natural resources on food dependence

Variables	Oil		Gas		Mineral		Forest	
	Foodimport	cerealdep	Foodimport	cerealdep	Foodimport	cerealdep	Foodimport	cerealdep
	1	2	3	4	5	6	7	8
L.Foodimport	0.6957***		0.6875***		0.6907***		0.7034***	
	(0.0216)		(0.0040)		(0.0126)		(0.0091)	
L.cerealdep		0.9541***		0.9588***		0.9560***		0.9514***
		(0.0018)		(0.0053)		(0.0028)		(0.0055)
Oil rent	0.0267***	0.0106***						
	(0.0028)	(0.0012)						
Gas rent			0.1025***	0.0916**				
			(0.0303)	(0.0409)				
Mineral rent					-0.1647***	-0.0824***		
					(0.0146)	(0.0122)		
Forest rent							-0.0130	0.0118
							(0.0223)	(0.0151)
Urban population	0.4925***	0.3190***	0.5271***	0.3313***	0.2486	0.3585***	0.3854*	0.2617***
	(0.0442)	(0.0427)	(0.1208)	(0.0839)	(0.1590)	(0.0813)	(0.2166)	(0.0696)
Remittance	-0.0139***	-0.0061***	-0.0155***	-0.0062***	-0.0121***	-0.0087***	-0.0134***	-0.0065***
	(0.0007)	(0.0007)	(0.0018)	(0.0012)	(0.0027)	(0.0012)	(0.0027)	(0.0012)
Reer	0.0155***	0.0010	0.0165***	-0.0040***	0.0052	-0.0034	0.0138***	-0.0041
	(0.0022)	(0.0017)	(0.0027)	(0.0013)	(0.0055)	(0.0045)	(0.0035)	(0.0030)
GDPpercap	-0.004***	0.001**	-0.004***	0.001	-0.003***	0.002**	-0.004*	0.001
	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Population growth	0.0333	-0.4096**	0.0960	-0.4000**	0.0184	-0.0843	-0.0192	-0.4365***
	(0.0335)	(0.1988)	(0.1725)	(0.1781)	(0.2233)	(0.1648)	(0.2715)	(0.1063)
Food production percap	-0.0142*	0.0035	-0.0236***	0.0088	-0.0215*	0.0069	-0.0169	0.0156***
	(0.0077)	(0.0031)	(0.0058)	(0.0069)	(0.0124)	(0.0085)	(0.0122)	(0.0042)
Constant	2.6637***	1.1702*	2.5805**	1.3979*	4.9024***	0.7129	3.3546**	1.7585***
	(0.4311)	(0.6113)	(1.0945)	(0.8218)	(1.0983)	(0.8801)	(1.2584)	(0.6339)
Observations	608	588	604	584	608	588	608	588

Number of countries	38	38	38	38	38	38	38	38
AR(1)	0.000467	0.0153	0.000575	0.0183	0.000621	0.0153	0.000581	0.0149
AR(2)	0.548	0.154	0.555	0.133	0.517	0.152	0.540	0.157
Instruments	21	22	21	21	21	21	22	23
Hansen	0.589	0.539	0.940	0.878	0.167	0.585	0.188	0.998

Notes: *. **. *** denote statistical significance at the 10%. 5% and 1% levels respectively

Income earned from these most profitable activities is used to purchase imported goods such as cereals, whose prices are affordable, given the fact they are subsidized, oil, sugar, *inter alia*. This justifies why cereal dependency and food imports increase.

The inadequacy of local food production explains part of the food dependency mentioned by the AfDB (2020). In fact, the results indicate that food production has a negative and significant effect on global food dependence, but a positive effect on cereal dependence in oil, gas, mineral and forest resource exporting countries. These results can be explained by the fact that cereal yields in Africa are still low, while the preference for cereals to meet food needs is increasing. In addition, subsidies keep the price of imported wheat and rice lower than that of other locally produced foods.

Most farmers sell locally produced food to buy rice and wheat, which are more affordable. Another reason is anthropological and cultural. In fact, with time, the consumption patterns of most Africans especially those in urban areas became more extraverted. They tend to give more importance to these imported grains than to locally produced food. We remain inconclusive on the impact of food production on food imports, as the sign and significance of the coefficients vary depending on the estimator.

Remittance act as any windfall, such as the sudden increase in oil income resulting from the increase in oil prices, which often leads to the purchase of luxury imported goods (Megbowon1 and Sanusi, 2020). Remittances positively and significantly increase food dependency, regardless of the estimator and indicator used. These results corroborate the findings of Farzanegan and Hassan (2016) who supported that remittance inflows lead to trade deficit as recipients use them to purchase imported goods. However, the results contradict the findings of (Megbowon1 and Sanusi, 2020) who instead found a negative impact on food importation in Nigeria.

4.3 Does democracy lift or mitigate the curse?

The previous estimates are quite interesting as they provide useful information on how natural resource is affecting food dependence in Africa. However, the estimates do not

indicate the importance and significance of the channels from natural resource to food dependence.

The role of institutions, particularly democracy, is crucial in defining the relevance of natural resources. Institutions influence the nature of rules and their implementation. A strand of literature has shown that democracy can mitigate the natural resource curse in various development areas, particularly water and sanitation (Tadadjeu *et al*., 2020), export diversification (Djimeu, 2019) and access to energy (Nkoa *et al*., 2023). Democracy determines the extent to which political incentives and policymakers can choose between prioritizing food imports or food production. Natural resources are likely to have positive outcomes in countries with good institutions, including democracy, that promote accountability. Policy makers need to be accountable for their food policy orientations. Buchnan *et al*. (1962**),** Cabrales and Hauk (2011) posit that politicians are self-interested. Hence, they prefer to capture the rewards of resource wealth for themselves. In the case of food policy options, they have to choose between developing local production and/or importing food. However, political pressure from farmers whose interests are mostly or sometimes opposed to those of food importers, may influence their decisions in redistributing parts of the rent. In fact, institutional theories postulate that, political institutions create various incentives for autocratic and democratic leaders to provide public goods and services (Lake and Baum, 2001). Democratic institutions are said to affect food security (Sen, 1990). Indeed, the aforementioned author argues that food supply affects citizens' evaluations of political leaders in democracies. In democracies, the evaluation of political leaders influences their campaign strategies (Baskaran *et al*., 2015). We postulate that, democratic institutions through which a country's food policy makers are held accountable to various stakeholders, represent an incentive to provide the latter with public goods, such as infrastructure, that allow for increased local production and reduced food imports. In sum, each type of democracy is expected to mitigate the resource curse by boosting food production and reducing food dependency.

To test the channels highlighted in the literature, we use interaction analysis as presented in Equation (6). The effects of interaction between of natural resources and various dimensions of democracy on food dependance is presented in Tables 6. Table 6 shows the role of various dimensions of democracy in the relationship between natural resources and food dependence, while Figures 4 presents how the various dimensions of democracy influence the marginal effects of natural resources on food dependence captured by food imports and cereal dependence.

Looking at deliberative democracy, the coefficients of the interaction terms in columns (1) and (2) are negative (regardless of the food dependence indicator) and significant. Thus, deliberative democracy mitigates the effect of natural resources on food dependence. The deliberative principle of democracy states that the common good motivates political decisions, as opposed to emotional appeals, solidarity, parochial interests or coercion.

Accordingly, democracy goes beyond the aggregation of existing preferences and integrate dialogues at all levels, from the formation of preferences to the final decision among participants.

Table 6: the effects of deliberative and egalitarian democracy on food dependence

Variables	Delibarative		Egalitarian		Participative		Liberative		Electoral	
	Foodimport	Cerealdep	Foodimport	Cerealdep	Foodimport	Cerealdep	Foodimport	Cerealdep	Foodimport	Cerealdep
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
L.Foodimport	0.6996***		0.6806***		0.6981***		0.7080***		0.6987***	
	(0.0177)		(0.0180)		(0.0158)		(0.0186)		(0.0133)	
L.cerealdep		0.9396***		0.9355***		0.9346***		0.9540***		0.9284***
		(0.0076)		(0.0062)		(0.0091)		(0.0084)		(0.0093)
Type of democracy	0.5184	2.9036**	4.6564**	4.4746***	1.8580	5.3624***	5.2790***	1.3088**	1.3593	2.8945***
	(1.7275)	(1.2150)	(1.8631)	(0.8844)	(2.5160)	(1.8545)	(0.8856)	(0.5240)	(1.4551)	(0.9661)
Rent×Type of democracy	-0.1892***	-0.0836*	0.0595	-0.1857***	0.1904*	-0.1296	-0.2744***	-0.1039*	-0.1192*	-0.0918*
	(0.0688)	(0.0368)	(0.0634)	(0.0622)	(0.1026)	(0.0947)	(0.0486)	(0.0514)	(0.0621)	(0.0509)
Rent	0.0630**	0.0749***	-0.0155	0.0869***	-0.0490	0.0788**	0.0528***	0.0606***	0.0512*	0.0875***
	(0.0269)	(0.0240)	(0.0258)	(0.0164)	(0.0306)	(0.0295)	(0.0190)	(0.0128)	(0.0294)	(0.0296)
Urban population	0.5501***	0.3691***	0.6803***	0.4032***	0.6290***	0.5010***	0.0685	0.1049	0.5649***	0.4586***
	(0.1565)	(0.0765)	(0.1271)	(0.0737)	(0.1543)	(0.0967)	(0.2002)	(0.1077)	(0.1379)	(0.0840)
Remittance	-0.0132***	-0.0089***	-0.0156***	-0.0099***	-0.0148***	-0.0104***	-0.0070***	-0.0044**	-0.0142***	-0.0110***
	(0.0023)	(0.0014)	(0.0018)	(0.0013)	(0.0023)	(0.0017)	(0.0025)	(0.0017)	(0.0020)	(0.0016)
Reer	0.0219***	0.0001	0.0263***	0.0019	0.0226***	0.0000	0.0221***	-0.0040	0.0223***	-0.0013
	(0.0040)	(0.0035)	(0.0042)	(0.0029)	(0.0033)	(0.0034)	(0.0029)	(0.0037)	(0.0031)	(0.0033)
GDPpercap	-0.0006**	0.0001	-0.0008***	0.0001	-0.0006**	0.0001	-0.0002	0.0002	-0.0006***	0.0001*
	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0001)
Population growth	0.4011	-0.7469***	0.3258	-0.6414***	0.2858	-0.6978***	-0.1540	-0.6630***	0.2123	-0.7208***
	(0.2992)	(0.1709)	(0.2700)	(0.1463)	(0.2702)	(0.1782)	(0.1739)	(0.1759)	(0.2866)	(0.1545)
Food production percap	-0.0227**	0.0011	-0.0202*	0.0027	-0.0225**	-0.0027	-0.0172*	-0.0008	-0.0208*	-0.0012
	(0.0089)	(0.0071)	(0.0112)	(0.0077)	(0.0106)	(0.0053)	(0.0093)	(0.0059)	(0.0109)	(0.0049)
Constant	1.0005	1.0464	-0.3482	0.2944	0.7208	0.2933	2.0943**	2.3887***	0.9863	0.7765
	(1.1663)	(0.6865)	(1.0806)	(0.6825)	(1.2712)	(0.7979)	(0.8282)	(0.8240)	(1.1476)	(0.7021)

Observations	608	588	608	588	608	588	608	588	608	588
Number of countries	38	38	38	38	38	38	38	38	38	38
AR(1)	0.00055	0.0148	0.00054	0.0144	0.00052	0.0146	0.00047	0.0149	0.000549	0.0144
AR(2)	0.553	0.159	0.550	0.148	0.545	0.159	0.551	0.162	0.560	0.158
Instruments	21	21	21	21	21	21	21	21	21	21
Hansen	0.908	0.862	0.899	0.921	0.898	0.918	0.889	0.927	0.907	0.940
Thresholds values of democracy	0.3329	0.8959	No value	0.4464	No value	No value	0.1924	0.5832	0.4295	0.9539

Notes: *. **. *** denote statistical significance at the 10%. 5% and 1% levels respectively. Ne =

Applied to the food sector, this principle means that decisions leading to the choice of food policy options must be made on the basis of dialogue with different stakeholders, including representatives of farmers, food importers, input suppliers, consumers, state authorities, *inter alia*.

The results suggest that by distributing natural resource revenues according to these principles, the tropism towards food imports can be limited, thus slowing down food dependency. The threshold of deliberative democracy is 0.3329 (0.0630/0.1892) with food import and 0.8959 (0.0749/0.0836) with cereal dependence. These thresholds are the minimum levels of deliberative democracy required to limit food imports and cereal dependence.

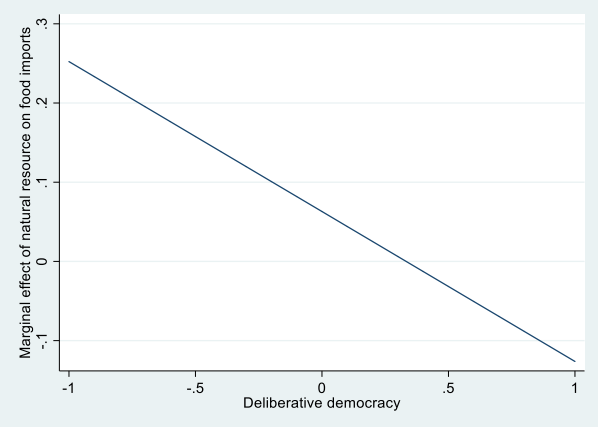


Fig. 4.1: The marginal effect of natural resources on food imports

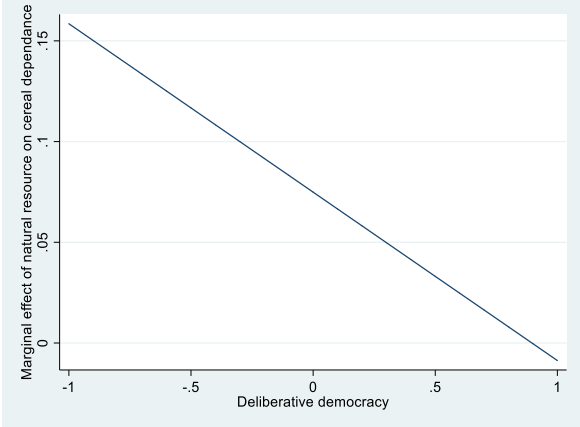


Fig. 4.2: The marginal effect of natural resources on cereal dependence

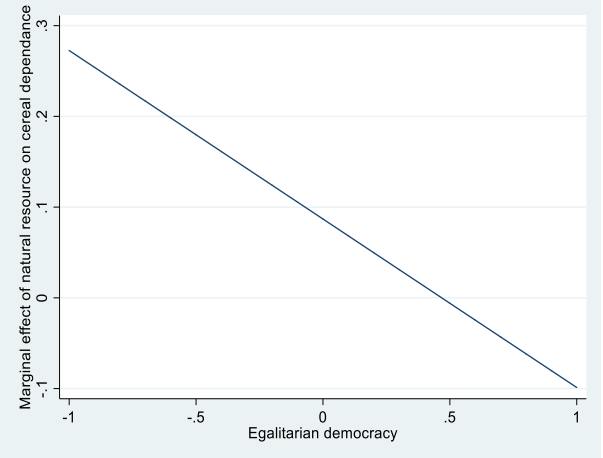


Fig. 4.3: The marginal effect of natural resources on cereal dependence

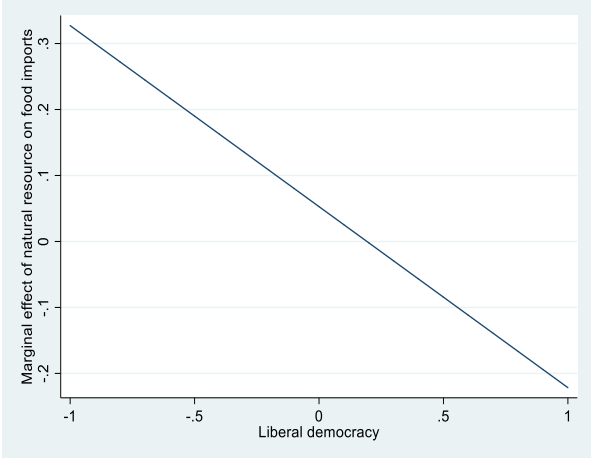


Fig. 4.4: The marginal effect of natural resources on food imports

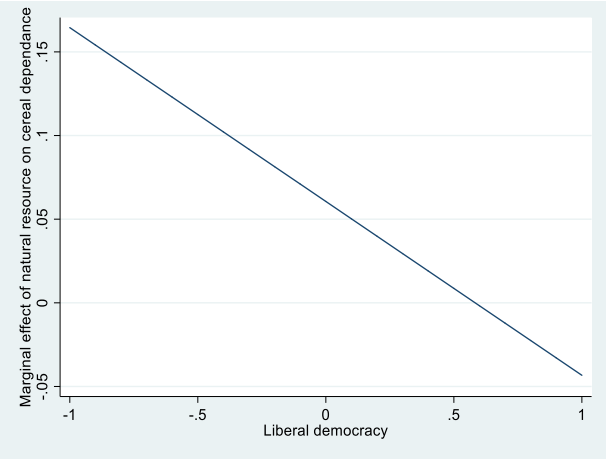


Fig. 4.5: The marginal effect of natural resources on cereal dependence

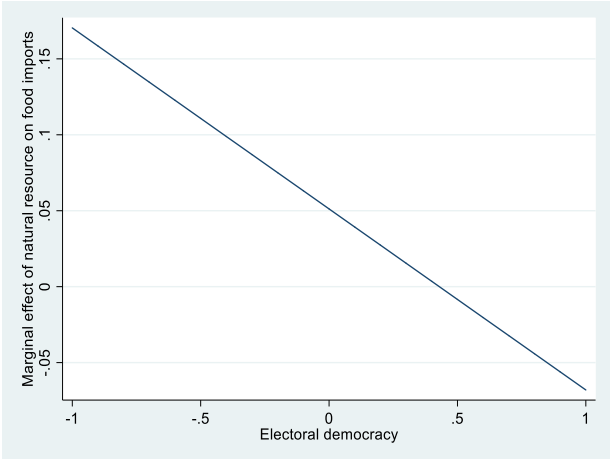


Fig. 4.6: The marginal effect of natural resources on food imports

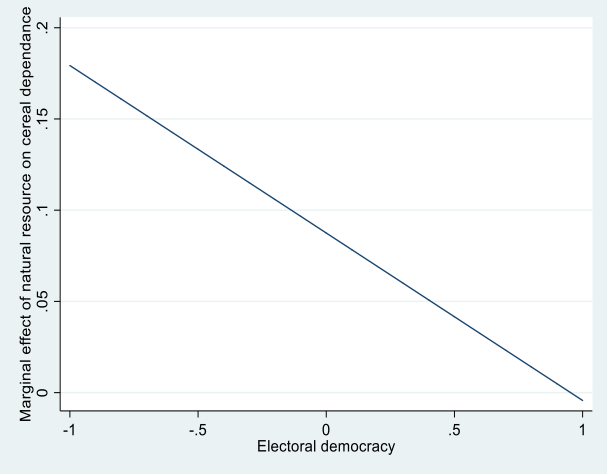


Fig. 4.7: The marginal effect of natural resources on cereal dependence

Figure 4: Marginal effects of natural resource on food dependence.

Similarly, the coefficient of the interaction terms between egalitarian democracy and natural resources in columns (3) to (4) is not significant for food import but negative with cereal dependence indicator. Egalitarian democracy moderates the effect of natural resources on cereal dependence. These results confirm the vision of Sen (1990), who defended the position that frequent elections and the various political freedoms that are available in democratic states, namely freedom of the media and freedom of expression, must be seen as a real force behind the elimination of food insecurity. In egalitarian democracy, the rights, and freedoms of individuals, namely farmers, agricultural input suppliers, food importers, are protected equally. Consequently, the distribution of rent among all stakeholders in such a context is more equitable. Rather than distributing rents only to a few groups, for instance food importers, the interests of different stakeholders including food producers should be considered. The political pressure from farmers whose interests are mostly or sometimes opposed to those of food importers, may influence their decisions in redistributing parts of the rents. This redistribution can

take the form of subsidies to farmers, investment in human capital, rural infrastructure, agricultural R&D, farmer education, with positive spill-over effects for the whole population. Redistribution can also take the form of subsidies to licensed food importers, which has a smaller spillover effect. This tends to limit the marginalization of food producers, resulting in low levels of production and hence food dependency. The threshold for egalitarian democracy is 0.4679 (0.0869/0.1857). The threshold corresponding to cereal dependence does not exist as the interaction coefficient is not significant. The egalitarian democracy threshold corresponding to food imports is 0.595.

Regarding participatory democracy, the results in columns (5) and (6) of table 6: the coefficient of interaction effects are not significant for food dependence but positive and significant for cereal dependence with cereal dependence (0.1904). Participatory democracy therefore lift the curse of natural resource as far as cereals are concerned. The coefficients associated to natural resources are not significant, meaning the nonexistence of thresholds.

With regard to liberal democracy, the coefficients of interaction effects of natural resource and liberal democracy are negative and significant with values of -0.2744 and -0.1039 respectively. The results confirm Sen's (2006) view that democracy acts as an early warning system and that a food crisis is prevented in a democratic context with respect for individual rights, a balance of powers, freedom of expression and information. However, this vision is not shared by Wall (2006), who rejects the idea that liberal democracy is an inoculation against famine, and an antidote to homelessness or widespread malnutrition, or the targeted killing of girl babies, as happened in India. In a liberal democracy, the rights of individual and minorities are protected against the tyranny of the State. There are constitutionally protected civil liberties, independent judiciary, strong rule of law and effective checks and balances that together limit the exercise of executive power. This feature does not seem appropriate to limit food dependence. The liberal democracy threshold corresponding to food imports and cereal dependence are respectively 0.1924 and 0.5832.

In Table 6, columns (9) and (10), the coefficients of the interaction of natural resources and electoral democracy on food imports (-0.1192) and on cereal dependence (-0.0918) are negative and significant. Electoral democracy moderates the effects of natural resource rent on food imports and cereal dependence. The thresholds are 0.4295 and 0.9531 respectively. This result supports the analysis of Sen (1990), who states that a government addresses the demands of citizens via the pressure exerted on the exercise of political rights by means of voting, protest and criticism, such that the opposition can make a substantial difference and significantly influence the government's performance. In the same vein as Waal (2006), in electoral democracy, different interest groups reward representatives, who protect them from hunger, through fair elections, but vote out those who have failed to do so. In fact, in electoral democracy, there is greater political competition; political and civil society organizations, including different food policy stakeholders, can operate freely; elections are clean, free, fair

and not influenced by systematic irregularities and fraud; elections influence the composition of the country's chief executive; there is freedom of expression and food policy stakeholders can present alternative views on food policy issues of political relevance through an independent media.

5. Conclusion and implications

There has been a debate about the way in which natural resources can promote the development of resource-rich countries. Some scholars have defended that natural resources can promote development depending on the institutional context. This paper extends the debate to food security by analyzing the impact of natural resources on food dependence for a panel of 38 African countries over time. Consistent with the natural resources curse hypothesis, we find robust evidence of the natural resource curse on food dependence as captured by food imports and cereal dependence. Thus, we confirm the first hypothesis that the natural resource curse accentuates Africa food dependence. Furthermore, our results show that this resource curse on food dependence varies according to the point or diffuse nature of the natural resource. However, the results also suggest that the unexpected impact of natural resources on food dependence is reversible. The curse can be can be transformed into a blessing if there is improvement of the democracy, namely the deliberative, egalitarian, liberal and electoral democracies.

The underlying findings call for a rethinking of food policies in Africa. To this end, we make the following proposals: First, we suggest that African governments implement an import substitution strategy by investing part of natural resource revenues in food production sector. The investments may be oriented towards public agricultural research, building roads, irrigation and storage infrastructure, electricity generation where possible and education. These investments have high capacity to boost and diversify local food production and limit the dependence on food imports which is showing its limits. Second, we suggest that African governments put more emphasis in building good institutions, especially democracy, which has proven to be a key variable in limiting food dependence. With a more deliberative, liberal, electoral and egalitarian democracy, political authorities in Africa resource-rich countries, will be more constrained to use rents to address basic constraints to local food production, rather than prioritizing food imports.

The findings of this study can be extended by engaging more countries in the sub-region as the relevant data become available. In this line of future research direction, updating the sample to more contemporary years is also worthwhile. It is also relevant to assess if the established findings in this study withstand empirical scrutiny in other developing regions such as in Latin Ameria and Asia. Furthermore, assessing other mechanisms by which food security can be promoted in the light of the Agenda 2063 of the African Union of making Africa less-reliant, is encouraging.

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Table A1. List of Panel Countries

Algeria	Central African Republic	Guinea	Morocco	South Africa
Angola	Chad	Guinea-Bissau	Mozambique	Togo
Benin	Congo	Kenya	Namibia	Tunisia
Botswana	Côte d'Ivoire	Madagascar	Niger	Zambia
Burkina Faso	Egypt	Malawi	Nigeria	Zimbabwe
Burundi	Ethiopia	Mali	Rwanda	Tanzania
Cabo Verde	Gambia	Mauritania	Senegal	
Cameroon	Ghana	Mauritius	Sierra Leone	