Urbanization and imports in Africa

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Abstract

The link between urbanization and African imports is a topical one, given the food vulnerability of african cities and the deficit structure of continental trade in the face of a strong proliferation of urban agglomerations. However, very little empirical work has been done on this relationship. This paper aims to analyze the impact of urbanization on imports in Africa. To this end, an augmented gravity model is estimated using Poisson pseudo maximum likelihood. The results show a positive effect of urbanization on total imports in Africa, especially in Sub-Saharan Africa, while the effect is reversed in North Africa. We also show that agricultural products are the most imported as a result of urbanization. In terms of specific products, urbanization leads to higher imports of rice, fish and oil, and lower imports of maize, palm oil and fertilizers.

Keywords: urbanization, imports, Africa, gravity models.

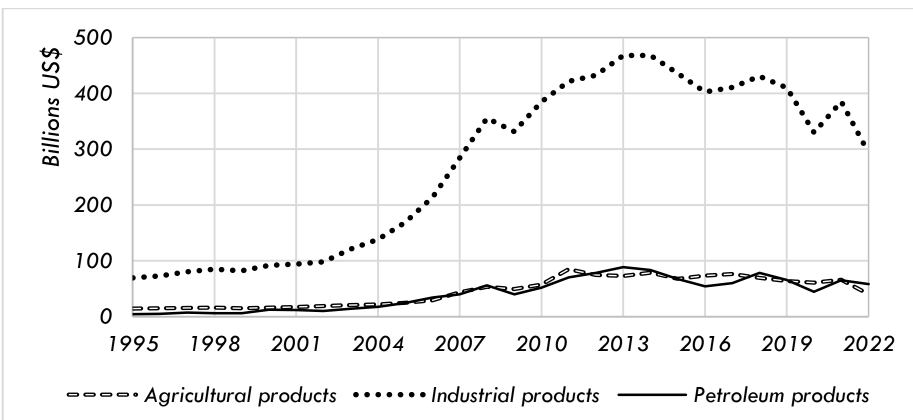
JEL classification : C20, F14, O18, O55.

1. Introduction

This paper aims to examine the effect of urbanization on imports both globally and by sector in Africa. The empirical strategy adopted is that of an augmented gravity model, in line with the theoretical foundations of such models introduced in the literature by Anderson and van Wincoop (2003) and recent advances on the topic (see Head and Mayer, 2014). The estimator used is the Poisson Pseudo Maximum Likelihood (PPML) according to Santos Silva and Tenreyro (2006, 2011). Following the prescriptions of Yotov et al. (2016), we use a five-year jump panel from 1995 to 2020 for 34 African importing countries with 119 partners.

In an increasingly globalized world, trade liberalization is seen as a guarantee for growth and development (World Trade Organisation, 2023). However, the structure of trade in African countries points to important trends that are likely to hinder their development goals. Since the early 2000s, the African continent has been running a trade deficit that is tending to become structural. An analysis of the import levels of African countries (*Figure 1*) shows a strong dominance of imports of industrial products. These account for more than half of the total value of Africa's imports.

Figure 1: Trends in African imports of agricultural, industrial and petroleum products



Source*: Authors based on United Nations data (2023).*

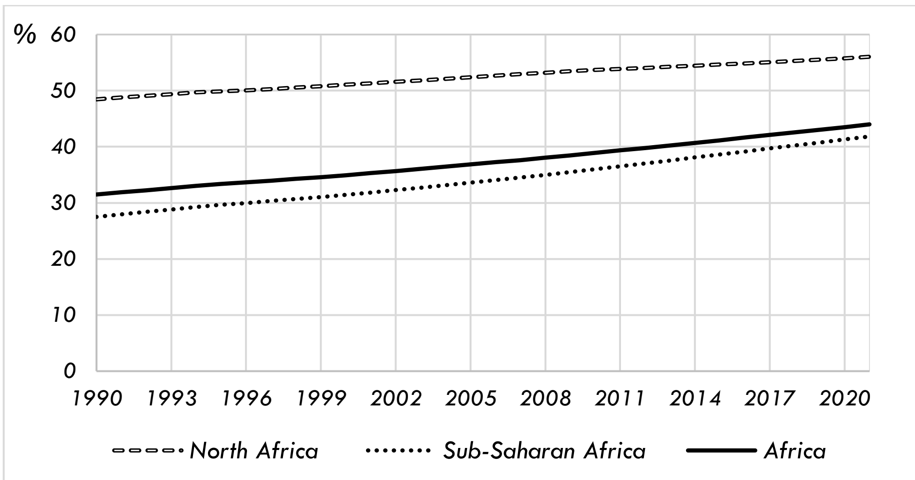
In addition, Africa is highly dependent on foreign agricultural products, with imports expected to reach $110 billion by 2025 according to the AfDB[2] (2022). To illustrate, in 2021, rice imports in SSA amounted to 4.45 billion US dollars (USD)[3], with Benin and Senegal being the main importers[4]. Most African economies are quite extroverted, consuming what they do not produce, and producing what they do not consume. In addition to this extraverted structure of the African economy, recent crises have had a negative impact on the daily lives of African populations that are heavily dependent on imports. Indeed, the Covid-19 pandemic and the Russian-Ukrainian conflict have severely disrupted the supply chains for consumer goods, leading to higher prices in

[2] AfDB: African Development Bank.
[3] SSA: Sub-Saharan Africa.
[4] United Nations Commodity Trade Statistics Database (UN Comtrade), 2023.

domestic markets. The weakness of African intra-regional trade, which will account for only 4.4% of continental trade[5] in 2019, the inadequacy of local production, and the growing demand for these products thus expose Africa to the dictates of international markets. These crises have definitively exposed the fragility of African economies, and call for the implementation of strong joint or idiosyncratic policies to improve their resilience.

At the same time, the rate of urbanization in Africa has accelerated. Large urban agglomerations are becoming increasingly dense, characterizing a continent in the throes of demographic change.

Figure 2: Evolution of the urbanization rate in Africa (1990-2021)



***Source**: Authors based on World Bank (2023)*

Since 1990, the number of cities in Africa has doubled from 3,300 to 7,600, while their combined population has increased by 500 million people[6] . With a particularly young population, Africa's cities are the fastest growing in the world (World Bank, 2023). The dynamics of urbanization in Africa, while growing, are heterogeneous from region to region (*Figure 2*). African cities will soon be home to the majority of the continent's population, with an estimated 950 million more inhabitants by 2050 (OECD/CSAO, 2020).

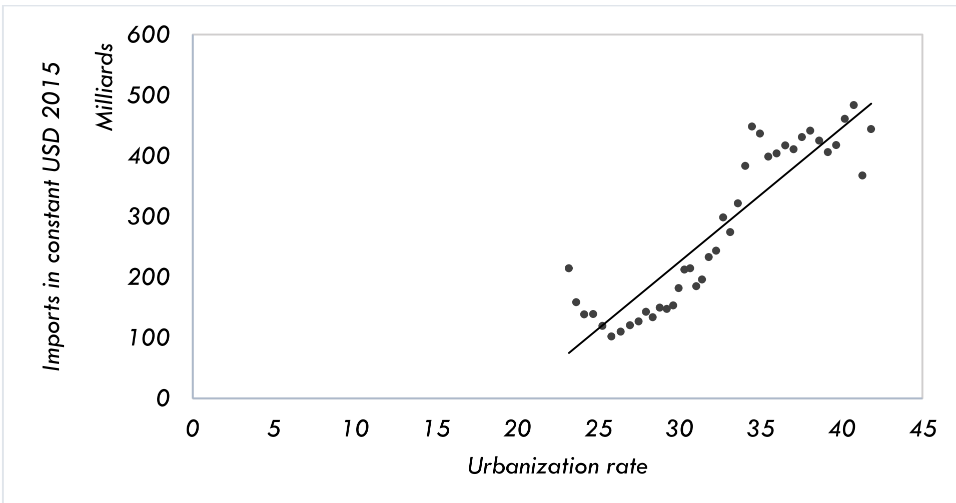
The role of urbanization in the development planning of African countries is not unanimously accepted. Indeed, while it is seen as an indispensable means to access the continent's structural transformation, some countries view it through a functional prism of environmental degradation and without productivity gains (UNECA[7], 2018). In Cameroon, for example, although the authorities see urbanization as an asset for economic development, they believe that urban growth is too rapid. Urbanization thus appears to be a challenge for which the DSCE[8] has set a target of a maximum urbanization rate of 57%. The SND30[9], for its part, denounces rapid and poorly controlled urban growth, and considers the implementation of an Urban Modernization Program.

[5] Economic Development in Africa Report 2021, UNCTAD.
[6] « Dynamiques de l'urbanisation en Afrique 2022 », OECD/UN, 2022.
[7] UNECA: United Nations Economic Commission for Africa.
[8] DSCE: Growth and Employment Strategy Document (Cameroon).
[9] SND30: National Development Strategy 2020-2023 (Cameroon).

If not properly planned and managed, urban growth can exacerbate the continent's economic, social and environmental problems. However, some studies (OECD/United Nations, 2022; UNECA, 2018) agree on the urgency of integrating cities into planning due to the indispensability of urban productivity for economic growth and the complexity of large, multi-sectoral and long-term urban investments, which require effective coordination.

Increasingly massive imports of commodities into Africa could be the result of changing consumption patterns, which are likely to be influenced by urban growth. Indeed, statistical evidence suggests some positive correlation between the continent's total imports and the rate of urbanization (*Figure 3*).

Figure 3: Evolution of imports into Africa as a function of the rate of urbanization (1981-2021)



***Source**: Authors based on World Bank data (2023).*

The link between urbanization and food imports in Africa is not recent in the literature. The pioneering study by Sudrie (1986) concluded that urbanization was of limited relevance in explaining the evolution of food imports in Africa. However, subsequent studies have not reached a consensus (Courade, 1989; Tabi et al., 1990; Hugon, 1997). Recent theoretical studies show that households in urban areas tend to consume more processed and manufactured goods and spend more on housing than rural households (UNECA, 2018). Furthermore, urbanization pressures would negatively affect the production of staple crop due to reduced land availability, low yields, and the abandonment of certain crops (Abdulai, 2022), which would tend to reduce imports of agricultural inputs. The debate therefore remains topical, given the lack of attention paid to issue in the empirical literature and the methodologies used (descriptive statistics, simple linear regression model, Granger causality test). Furthermore, these empirical strategies are not the most appropriate to study the determinants of international trade. In addition, the effects of urbanization in most of these studies have been limited to agricultural or food imports, but changes in consumption patterns also affect manufacturing or industrial products (UNECA, 2018), as well as energy products (Fan et al., 2017). These impacts may therefore vary from one economic sector of activity to another, and from one specific product to another.

2. Literature review

The essence of the link between urbanization and imports comes from modern theories of international trade, which base their explanation of trade between countries on demand characteristics. Linder (1961) shows that a country may have built up a comparative advantage thanks to the existence of strong domestic demand. Thus, the close relationship between demand and income suggests that standardized demands is generally expressed in low-income countries. However, when cross-trade involves similar products, they are not strictly identical, but benefit from a "*quality of difference*" (Lassudrie-Duchêne, 1971). The differentiation of goods then makes it possible to satisfy a "difference" demand. Participation in international trade thus aims to improve consumer satisfaction, since the production apparatus must be able to market several varieties of goods adapted to the tastes of both domestic and foreign consumers.

Urbanization seems to be an important determinant of factors that can increase the demand for differentiated goods by encouraging the growth of imports. This was the subject of pioneering studies in Africa in the 1980s. Two theoretical justifications stand out in the literature. First, the movement of people from rural to urban areas tends to change the structure of national demand. This is mainly due in particular to changes in the consumption habits of the new urbanites and an increased diversification of the demand for consumer goods (Vennetier, 1988; Courade, 1989). This increased desire for diversity is generally satisfied only by differentiation of supply and, ultimately, by growth in imports of certain, mostly differentiated, goods when local production is insufficient to meet demand. This is generally the case in Africa, where there is little diversification of the productive base (Ben Hammouda et al., 2009).

Second, rural-urban migration can lead to a decline in the labor force on rural farms and industrial estates, resulting in a slowdown in rural production destined for increasingly important urban and export markets (Manitra et al., 2011). Indeed, Abdulai (2022) shows that the pressures of urbanization are reducing staple crop production through declining land availability, poor harvests and the abandonment of certain crops.

Urban growth is thus leading to a proliferation of urban food markets and a growing and diversified demand for sophisticated products, including processed and high-value products, increasing the complexity and extraversion of these markets (De Bruin et al., 2021). To compensate for the shortfall in rural agricultural production and to stabilize prices, governments tend to activate the import lever. However, the evolution of imports in Africa depends on several other factors, such as fluctuations in import prices and exchange rates (Genc and Artar, 2014). Increased demand for imported goods is also often linked to the fact that they can be purchased at relatively lower prices than local products. In the case of Cameroon, INS[10] (2023) confirms this fact, showing that the CPI[11] for local goods and services is significantly higher than for imported products. In addition, these relatively high prices for local products are mainly due to the weak structuring of value chains (Dabat and Fallot, 2010), problems of access to road infrastructure (Mpabe and Fondo, 2016), problems of access to energy, difficulties of access to finance, land tenure and agricultural inputs (Lerin et al., 2009), insufficient innovation and low mechanization (Aghion and Armendáriz de

[10] INS: Institut National de la Statistique (Cameroon).
[11] CPI: Consumer Price Index.

Aghion, 2004), and climate change[12] (Acacha and Vissin, 2015). However, the structure of demand for certain locally produced goods suggests that urbanization is likely to play a dominant role in their value. Indeed, it simultaneously leads to an increase in urban demand for goods produced in rural areas and a decrease in their supply due to a shrinking labor force.

Empirical evidence on the relationship between urbanization and imports in Africa is scarce in the literature. However, there is no consensus among the few studies that have been reviewed. Sudrie (1985) shows that while urbanization may be a factor influencing the level of agricultural imports into SSA in some cases[13], other variables, particularly national wealth, appear to be more important. This evidence is not shared by Tabi et al (1990), who show that urbanization leads to an increase in total current food imports in 13 of the 24 SSA countries in their sample, including Côte d'Ivoire and Nigeria. In 03 countries (Ethiopia, Sudan, Democratic Republic of Congo), the causality is reversed, while in the remaining 6 countries, including Cameroon, there is no causality. While these studies were limited to SSA, and thus did not pay particular attention to the countries of the North, the methodologies used by these authors (the simple regression model and the Granger causality test, respectively) and the modelling approaches do not seem robust to us. The models of Sudrie (1985) do not take into account the non-stationarity of the variables, which can lead to spurious regressions, while the causality tests carried out by Tabi et al. (1990) cannot truly reflect the effects of urbanization unless control variables and individual heterogeneities between countries are taken into account, in order to relativize the importance of urban growth in the evolution of imports. While these studies focus exclusively on food imports, CEA (2017) notes that changes in consumption habits also affect manufactured and industrial products. In addition, urbanization puts strong pressure on the demand for energy products (Fan et al., 2017).

A number of studies have highlighted the specificities of certain products. For example, an analysis of a survey conducted in West and Central Africa found that rice and wheat accounted for half of total consumption and two-thirds of starch products consumed in cities (Bricas et al., 2016). In rural areas, local production would be less marginalized for products such as maize, cassava, sorghum and to a lesser extent yam and plantain, which are much more widely consumed. Similarly, Traoré et al. (2020)[14] show that rice, wheat and wheat-derived products are the most imported cereals in West Africa. Imports of traditional cereals, especially maize, millet and sorghum, are relatively low. The authors explain the increase in regional demand for cereals by the population growth of the Sahel and West African countries, which tripled during the study period, but above all by the rapid urbanization, which favors the consumption of imported cereals with less complexity in use and relatively stable prices compared to local cereals with low processing rates. While many other exploratory studies have highlighted these specificities by product (Wade and Laçon, 2015; Vorley and Lançon, 2016; Zoma et al., 2022), it is clear that no empirical tests have been conducted to support these analyses.

[12] However, the latter effect may not occur if resilience measures [adoption of short-cycle varieties, modification of sowing period, adoption of new crops, staggered sowing, agroforestry and animal cage construction (Arouna et al., 2013)] coupled with adequate industrial policies are put in place.
[13] Depending on whether we're talking about the real value of imports or the growth rate, the urban population by volume, the urbanization rate or the urban growth rate.
[14] Using Chow's structural analysis test on cereal imports in West Africa over the period from 1961 to 2017.

In the light of this review, urbanization seems to help explain imports to Africa, in this case of agricultural products. The proportions of this explanation remain unclear, as do the effects on total imports, other sectors (industrial and petroleum), and specific products.

3. Empirical strategy

3.1. Model specification

This paper uses a gravity model to estimate the relationship between urbanization and imports. Due to the large number of factors that can determine trade, this model has the advantage of incorporating a large number of variables and observations to further support possible correlations. In the international trade literature, it has become the most popular model for determining the influence of certain factors on trade flows (Boughanmi et al., 2021). The first empirical evidence for the gravity model dates back to the work of Tinbergen (1962), Pöyhonen (1963) and Linnemann (1966). Based solely on an economic implementation of Newton's law gravity, the model as estimated by these authors suffered from a lack of theoretical economic foundations. The work of Anderson and van Wincoop (2003) was an important step in this direction. These authors provided the first theoretical justification for the model, incorporating factors of multilateral resistance to trade. More recent studies have enriched the literature on possible specifications for these models (see Head and Mayer, 2014). The specification adopted in this study is as follows:

$$M_{ij} = GY_i^a Y_j^b \phi_{ij}^c R_{i(j)}, \quad (1)$$

where M_{ij} represents the volume of imports from country j to country i, Y_i and Y_j the respective GDPs of countries i and j, ϕ_{ij} characteristics common to countries i and j, $R_{i(j)}$ multilateral trade resistance factors, a, b and c parameters.

Several approaches have been taken in the literature to take account for multilateral resistance to trade. Helliwell (1998) suggests constructing proxies based on the distance between two countries as well as their GDPs. This approach has been adopted in several studies conducted in Africa (Avom and Mignamissi, 2017; Mignamissi, 2017). This article explores a very different approach. First, it introduces price levels captured by inflation (Anderson and van Wincoop, 2003) and second, it introduces importing and exporting country fixed effects and time fixed effects to capture cross-sectionally observable and unobservable multilateral resistance factors (Hummels, 2001; Feenstra, 2016). The gravity model estimated in this paper is an extended version of equation (1) taking into account the previous clarifications and is as follows:

$$\begin{aligned} \ln(M_{ijt}) = {} & \beta_0 + \beta_1 \ln(TauxUrba_{it}) + \beta_2 \ln(PIB_{it}) + \beta_3 \ln(PIB_{jt}) + \beta_4 \ln(pop_{it}) \\ & + \beta_5 \ln(pop_{jt}) + \beta_6 \ln(Dist_{ij}) + \beta_7 Infla_{it} + \beta_8 Infla_{jt} + \beta_9 \ln(DistIntra_i) \\ & + \beta_{10} \ln(DistIntra_j) + \beta_{11} \ln(GOV_{it}) + \beta_{12} FC_{ij} + \beta_{13} COL_{ij} + \beta_{14} CC_{ij} + \\ & + \beta_{15} LC_{ij} + \delta_i + \mu_j + \lambda_t + \varepsilon_{ijt}, \end{aligned} \quad (2)$$

where $TauxUrba_{it}$ represents the urbanization rate in country i in year t ; $PIB_{i(j)t}$ represents the nominal GDP of country $i(j)$ in year t ; $pop_{i(j)t}$ represents the population of country $i(j)$ in year t ; $Dist_{ij}$ represents the distance between country i and country j ; $Infla_{i(j)t}$ represents the inflation rate of country $i(j)$ in year t ; $DistIntra_{i(j)}$ is the intranational distance of country $i(j)$ calculated as the square root of the area of country $i(j)$ (Nitsch, 2000) ; GOV_{it} represents the business environment in country i in year t ; $FC_{ij}, COL_{ij}, CC_{ij}$ et LC_{ij} the socio-demographic variables take the value 1 respectively in the case of a common border, colonial dependence, common colonial past and common language; δ_i et μ_j cross-sectional fixed effects of countries i and j ; λ_t the temporal fixed effect ; and ε_{ijt} the term error.

Equation (2) represents the basic model for estimating the effect of urbanization on total imports. Several other models are estimated for sectoral imports (agriculture, industry and oil) and products (rice, corn, wheat, fish, palm oil, fertilizer, oil). In these models, the basic variables are not disaggregated, but other variables are introduced to capture the specific effects of each sector or product : (i) at the sectoral level, the share of each sector in the domestic economy of the country is introduced as a proxy for GDP, and (ii) at the level of specific products or goods, variables are constructed that make it possible to assess which countries i are the most competitive. $prod\_bien_{itk}$ to assess which countries i are "main producers" of each good k in year t :

$$prod\_bien_{itk} = \begin{cases} 1, & if\ \ PIB_{itk} > (PIB_{tk}^{Total})/100, \\ 0, & if\ else. \end{cases}$$

Where PIB_{itk} represents country i's production of product k in year t and PIB_{tk}^{Total} the continent's total production of product k in year t.

3.2. Choice of estimating technique

Log-linearization in gravity models is subject to the indeterminacy of trade nulls, which generally leads to biased results, but also to a resetting of the trade logarithm for low-trade economies. In particular, the omission of these nulls values can lead to selection bias and biased results when using truncation methods.

The ordinary least squares (OLS), which are traditionally used to estimate log-linearized equations generally face persistent heteroskedasticity (Head and Mayer, 2014; Yotov et al., 2016). Given these obstacles, Santos Silva and Tenreyro (2006) recommend the use of the Poisson estimator of the Pseudo-Maximum Likelihood (PPML). Despite reservations expressed by some authors (Martin and Pham, 2008; De Benedictis and Taglioni, 2011), a comparison of the PPML estimator with the gamma pseudo maximum likelihood (GPML) and a nonlinear least squares (NLS) estimator suggests that the PPML is the least affected by heteroscedasticity (Martinez-Zarzoso, 2013). Although the PPML is not always unanimously accepted in the literature, it is widely used. For this reason, we have chosen the PPML as our preferred estimation technique.

3.3. Data

The study sample is a five-year skip panel from 1995 to 2020 for 34 African importing countries with 119 partners (*Appendix Table 8*). Indeed, for gravity model estimation, Yotov et al. (2016) suggest using a skip year panel rather than a continuous year panel to ensure that bilateral trade flows adjust in response to changes in trade policies and others trade costs. In addition, Olivero and Yotov (2012) construct a dynamic gravity model and experiment with alternative interval specifications. Estimates of MGA[15] obtained with lags of 3, 4 and 5 years yield similar results with respect to estimates of standard gravity variables.

The different partners of the African countries were selected according to the structure of the CEPII database (Gravity Dataset), which includes these countries as trading partners, and the availability of data. To ensure data representativeness, complementarity of information and mitigation of biases that might be associated with a single source of information, data for the different variables are drawn from several sources (*Appendix Table 7*).

4. Results

4.1. Statistical results

Table 7 in the appendix presents the descriptive statistics for the variables included in the model. We can see that the average imports of the countries in the sample over the period studied amounted to US$91 billion. The figures for agricultural, oil and industrial imports are US$16 billion, US$33 billion and US$81 billion respectively. In addition, the average urbanization rate for these countries over the study period was 40.24%.

The correlation matrix (*Appendix Table 8*) suggests a positive and significant correlation between the urbanization rate and total imports. This correlation is confirmed by the upward trend in figure 5 in the appendix, which shows the mean scatterplot between the logarithm of the urbanization rate and that of total imports. In addition, the number of variables imposed by the model suggests a VIF (Variance Inflation Factor) test for multicollinearity (*Appendix Table 10*). This test confirms the absence of multiple collinearity (each variable has a variance inflation factor of less than 10).

4.2. Econometric results

Table 1 presents a series of models to assess the sensitivity and significance of the effect of the urbanization rate on total imports. First, we see that the standard gravity model variables, notably GDP, population, distance and socio-demographic variables, have the expected significance and signs. Strong economies tend to trade more (positive elasticities of GDP-related variables i and j, model 6), which supports Linder's theory (1961) : a large domestic population tends to increase total demand, supply and ultimately, imports to compensate the shortfall in local production. The effect is reversed for the population of the partner country. As expected, distance tends to reduce imports between African countries and their partners. Furthermore, the price level on foreign markets has a significant negative impact on African imports (-0.03%). This confirms the law of supply and demand, with African economic agents systematically reduce their demand for imports when prices rise. Finally, the socio-demographic dummy variables and the governance index act as catalysts for bilateral trade, helping to increase African imports.

Regarding the variable of interest, an increase in the urbanization rate has a positive and significant impact on imports. Thus, a 1% increase in the urbanization rate leads to a 4.2% increase in imports to Africa (*Model 6*). This shows that imports increase as urbanization accelerates. This result, although contrary to that of Sudrie (1985), confirms certain theoretical justifications (Vennetier,

[15] AGM: Augmented Gravity Model.

1988; Courade, 1989). Furthermore, when certain control variables are added or removed, the effect of the urbanization rate on total imports remains positive and significant.

Table 1 : Estimation results (total imports)

	Dependent variable: ln_Import					
VARIABLES	[1]	[2]	[3]	[4]	[5]	[6]
ln_TauxUrba$_i$	0.029***	0.032***	0.032***	0.030***	0.035***	0.042***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
ln_PIB$_i$	0.060***	0.060***	0.056***	0.060***	0.057***	0.049***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln_PIB$_j$	0.034***	0.035***	0.034***	0.034***	0.033***	0.033***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
ln_pop$_i$	0.020***	0.022***	0.023***	0.020***	0.023***	0.032***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
ln_pop$_j$	-0.054***	-0.050***	-0.049***	-0.054***	-0.048***	-0.037**
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
ln_dist$_{ij}$	-0.134***	-0.113***	-0.130***	-0.135***	-0.131***	-0.110***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Infla$_i$	0.000	0.000	-0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Infla$_j$	-0.0003***	-0.0003***	-0.0003***	-0.0003***	-0.0003***	-0.0003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln_DistIntra$_i$	-0.036***	-0.039***	-0.034***	-0.036***	-0.035***	-0.035***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ln_DistIntra$_j$	-0.034	-0.039	-0.039	-0.035	-0.038	-0.057
	(0.072)	(0.071)	(0.072)	(0.072)	(0.072)	(0.071)
FC$_{ij}$		0.134***				0.118***
		(0.010)				(0.010)
CC$_{ij}$			0.061***			0.041***
			(0.004)			(0.005)
COL$_{ij}$				0.107***		0.076***
				(0.008)		(0.009)
LC$_{ij}$					0.059***	0.032***
					(0.004)	(0.004)
ln_GOV$_i$						0.019***
						(0.004)
Constant	2.374***	2.164***	2.357***	2.389***	2.341***	2.196***
	(0.450)	(0.443)	(0.450)	(0.449)	(0.448)	(0.450)
Comments	15,340	15,340	15,340	15,340	15,340	14,570
Wald chi2	30201.77	30785.51	30587.62	30493.32	30533.87	30609.10
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.125	0.126	0.126	0.125	0.126	0.129

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

The results at the sectoral level (agriculture, industry and oil) show the same regularities in terms of signs and expected significance for the standard variables (*Table 2*). To assess the factor endowments of each country for the three sectors, the weight of each sector in the economy is introduced as a proxy for GDP. This shows that a high share of each branch in the GDP of the domestic country tends to reduce its intra-branch imports. This is consistent with the theory of absolute advantages, since countries tend to reduce their imports of goods for which they have high absolute endowments.

In contrast to total imports, where domestic inflation was insignificant, high prices in local markets help to reduce the import demand of each branch. Avom and Mignamissi (2013) argue that high inflation in country i increases domestic consumers' preference for foreign products. However, they point out that this evidence remains true until inflation is imported, and no longer driven by wage costs or currency. The reduction in intra-industry imports due to higher local inflation could therefore be due to higher prices of foreign products in the local market. This leads to a substitution effect between imported and domestic goods, and a reduction in import demand in each branch. On the other hand, the effect of international prices on agricultural imports remains negative and significant, unlike in the other sectors, where it becomes insignificant. Since most African countries lack the infrastructure to process much of their raw materials and natural resources locally, their bargaining power may be very weak. Imports in these sectors are therefore subject to price fluctuations in international markets.

Finally, these estimates show that the effect of urbanization remains positive and significant for imports of agricultural, industrial and petroleum products. The effect on agricultural products is in line with certain analytical and exploratory studies (Bricas et al., 2016; Traoré et al., 2020), which develop their analysis of the impact of urbanization around the gradual disruption of supply chain due to the abandonment of agricultural activities. Moreover, the effect is greater for agricultural products (+12.9%) than for industrial products (+9.8%) and petroleum products (+7%). This result is not insignificant. Indeed, the agricultural sector employs more than half of the total labor force in SSA (IMF, 2012) and provides a livelihood for a large number of small producers in rural areas. Small farms, which account for about 80% of all farms in SSA and who directly employ about 175 million people[16], are the ones that are most underserved as a result of rapid urbanization. The resulting decline in productivity has a disproportionate impact on agricultural imports.

Table 2: Estimation results (agricultural, industrial and oil imports)

	Agricultural		Industrial		Oil companies	
	PPML	ZINB	PPML	ZINB	PPML	ZINB
VARIABLES	[7]	[8]	[9]	[10]	[11]	[12]
$ln\_TauxUrba_i$	0.129***	0.129***	0.098***	0.097***	0.070***	0.085***
	(0.007)	(0.009)	(0.003)	(0.006)	(0.012)	(0.012)
$Agriculture(\%GDP)_i$	-0.001***	-0.001***				
	(0.000)	(0.000)				
$Industry(\%GDP)_i$			-0.001**	-0.001		
			(0.000)	(0.000)		
$OilsRents(\%GDP)_i$					-0.004***	-0.003***
					(0.001)	(0.001)
ln_PIB_j	0.021**	0.020	0.035***	0.035***	0.030***	0.025
	(0.009)	(0.013)	(0.006)	(0.010)	(0.004)	(0.021)
ln_pop_i	0.090***	0.090***	0.081***	0.081***	0.057***	0.069***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.006)	(0.005)
ln_pop_j	-0.084***	-0.082**	-0.025	-0.025	0.026***	-0.193***
	(0.027)	(0.035)	(0.016)	(0.024)	(0.006)	(0.056)

[16] Alliance for a Green Revolution in Africa, 2014.

ln_dist_{ij}	-0.115***	-0.115***	-0.112***	-0.112***	-0.147***	-0.129***
	(0.004)	(0.006)	(0.003)	(0.005)	(0.007)	(0.010)
$Infla_i$	-0.002***	-0.002***	-0.001***	-0.001**	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$Infla_j$	-0.0004***	-0.0004*	-0.0001	-0.0001	0.0003	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
$ln\_DistIntra_i$	-0.063***	-0.063***	-0.033***	-0.033***	0.001	-0.009
	(0.004)	(0.005)	(0.003)	(0.004)	(0.009)	(0.008)
$ln\_DistIntra_j$	-0.182	-0.184	-0.055	-0.056	-0.038***	0.433
	(0.197)	(0.238)	(0.076)	(0.166)	(0.007)	(0.351)
FC_{ij}	0.131***	0.131***	0.128***	0.129***	-0.108***	0.017
	(0.013)	(0.017)	(0.011)	(0.015)	(0.024)	(0.026)
CC_{ij}	0.051***	0.051***	0.047***	0.047***	0.061***	0.054***
	(0.007)	(0.010)	(0.005)	(0.008)	(0.014)	(0.016)
COL_{ij}	0.104***	0.104***	0.080***	0.079***	0.183***	0.138***
	(0.013)	(0.024)	(0.009)	(0.023)	(0.020)	(0.029)
LC_{ij}	0.023***	0.022**	0.040***	0.040***	-0.036***	-0.018
	(0.007)	(0.009)	(0.005)	(0.008)	(0.013)	(0.014)
ln_Gov_i	0.026***	0.026***	0.072***	0.072***	0.013	0.028**
	(0.006)	(0.009)	(0.004)	(0.007)	(0.015)	(0.014)
Log(α)_cons		-45.613*		-16.753		-13.806
		(25.977)		(18.202)		(14.452)
Constant	3.957***	3.975***	2.305***	2.300**	2.164***	1.467
	(1.168)	(1.434)	(0.482)	(1.014)	(0.116)	(2.108)
Comments	10,488	10,488	13,769	13,769	4,501	4,501
LR chi2		6031.00		10156.06		2212.94
Wald chi2	12788.43		28449.69		913.56	
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.104		0.132		0.036	

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3 shows the estimation results for three agricultural products: wheat, rice and maize. Some elasticities show opposite signs for the control variables. For example, population growth in partner countries tends to reduce imports of wheat and maize, and increase imports of rice. This may be due to the fact that imported rice is relatively cheap and not much sought after by foreign populations. Contrary to their expected role as catalysts for trade, the common border, the common language and the common colonial past contribute to reducing wheat and corn imports, while distance favors rice imports. The reasons for these discrepancies are closely related to the structure of African trade. To illustrate, the main rice exporter to SSA is China (*Appendix Figure 4*), which is relatively distant from the continent and does not share a language. The same is true for wheat, whose main importer is India. The determinants of intra-product trade must therefore go beyond these socio-demographic variables, in order to capture other effects such as those of trade partnerships, regional agreements or even groups of major countries in international trade (BRICS[17], European Union, etc.).

The effect of urbanization on wheat imports is not significant. On the other hand, it is significant and negative for corn imports, and significant and positive for rice imports. In fact, a 1% increase in the urbanization rate tends to increase rice imports by 3.1% and decrease corn imports by 7.9%. Rice benefits from strong vertical differentiation (Petrov and Faure, 1996), which helps to satisfy

[17] BRICS: Brazil, Russia, India, China, South Africa.

urban consumers' taste for variety. As for maize, it is relatively less consumed in urban areas than in rural areas (Bricas et al., 2016), not least because it is rightly perceived as an inferior commodity.

Table 3: Estimation results for agricultural products: wheat, rice and corn

	Wheat		Corn		Rice	
	PPML	ZINB	PPML	ZINB	PPML	ZINB
VARIABLES	[13]	[14]	[15]	[16]	[17]	[18]
$ln\_TauxuUrba_i$	-0.028	-0.029	-0.079***	-0.069***	0.031*	0.030*
	(0.022)	(0.021)	(0.024)	(0.026)	(0.017)	(0.017)
ln_PIB_i	0.028***	0.030***	0.082***	0.081***	-0.007	-0.006
	(0.009)	(0.010)	(0.010)	(0.011)	(0.006)	(0.006)
ln_PIB_j	0.055***	0.057***	0.004	0.003	-0.053***	-0.053***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.006)
ln_pop_j	-0.126***	-0.130***	-0.041***	-0.043***	0.115***	0.113***
	(0.011)	(0.011)	(0.016)	(0.014)	(0.008)	(0.008)
ln_dist_{ij}	-0.092***	-0.092***	-0.108***	-0.107***	0.065***	0.064***
	(0.017)	(0.015)	(0.015)	(0.014)	(0.013)	(0.013)
$Infla_i$					-0.003***	-0.003***
					(0.001)	(0.001)
$Infla_j$					-0.004***	-0.004***
					(0.001)	(0.001)
$ln\_DistIntra_i$	0.041**	0.038**	-0.002	-0.005	0.044***	0.045***
	(0.016)	(0.015)	(0.015)	(0.016)	(0.009)	(0.010)
$ln\_DistIntra_j$	0.175***	0.176***	0.165***	0.166***	-0.023**	-0.021**
	(0.015)	(0.013)	(0.021)	(0.019)	(0.010)	(0.010)
FC_{ij}	-0.248***	-0.225***			0.211***	0.208***
	(0.059)	(0.052)			(0.037)	(0.039)
CC_{ij}	-0.061**	-0.062**	0.059**	0.055**	0.072***	0.072***
	(0.025)	(0.026)	(0.026)	(0.026)	(0.020)	(0.020)
COL_{ij}	0.080*	0.076*			0.070**	0.068*
	(0.046)	(0.039)			(0.032)	(0.037)
LC_{ij}	-0.070***	-0.070***	-0.068***	-0.058**	-0.089***	-0.090***
	(0.025)	(0.026)	(0.025)	(0.026)	(0.021)	(0.021)
$Prod\_blé_i$	0.027	0.030				
	(0.024)	(0.024)				
$Prod\_maïs_i$			-0.177***	-0.172***		
			(0.024)	(0.027)		
$Prod\_riz_i$					0.036**	0.032**
					(0.016)	(0.016)
Log(α)_cons		-4.187***		-3.271***		-3.447***
		(0.289)		(0.153)		(0.122)
Constant	1.345***	1.303***	1.124***	1.146***	1.976***	1.971***
	(0.251)	(0.239)	(0.191)	(0.203)	(0.175)	(0.180)
Comments	1,273	1,273	1,309	1,309	2,576	2,576
LR chi2		333.90		309.51		451.97
Wald chi2	379.05		379.68		608.85	
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.06		0.064		0.045	

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4 shows the results of the estimates for two industrial products (fertilizers and palm oil), fish and oil. The evidence observed for corn imports is maintained for fertilizer (-6.4%) and palm oil (-7.4%) imports. As a result of urbanization, the gradual abandonment of rural agricultural activities weakens the demand for the fertilizers needed to support crop growth. As peri-urban agricultural activities are generally not spread over large areas, they are less fertilizer intensive, and farmers often use traditional fertilizers (kitchen waste, animal excrement, etc.), which systematically reduces supply and ultimately fertilizer imports. As far as palm oil is concerned, unlike in rural areas where it is widely consumed, in urban areas it is very often substituted by refined oil for final consumption (Cheyns, 2001). As far as intermediate consumption is concerned, despite the strong industrial expansion that has taken place on the African continent (the area of origin of traditional oil palms) since the beginning of the 21st century[18], local palm oil production has been strongly criticized, mainly because of the environmental impact of industrial palm oil plantations (Corniaux et al., 2020). Reasons cited include deforestation, displacement of communities, monoculture, loss of biodiversity, deplorable working conditions, climate change, energy-intensive and polluting long-distance transportation.

On the other hand, fish and oil are increasingly imported as a result of growing urbanization (a 1% increase in the urbanization rate leads to a 10.1% and 18.3% increase in these imports, respectively). These strong effects are not insignificant. On the one hand, fish consumed in rural areas of Africa is generally locally caught and offers little variety, unlike fish consumed in urban or peri-urban areas. As a result, imports essentially meet the relatively diversified urban demand. On the other hand, the demand for oil and its derivatives generally comes from energy consumption for housing, automobiles and industry, which is mainly located in urban or peri-urban areas.

Table 4: Estimation results for industrial products, fish and oil

	Fertilizers		Palm oil		Fish		Oil	
	PPML	ZINB	PPML	ZINB	PPML	ZINB	PPML	ZINB
VARIABLES	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]
$ln\_TauxUrba_i$	-0.064***	-0.040***	-0.074***	-0.076***	0.101***	0.100***	0.183***	0.175***
	(0.011)	(0.013)	(0.021)	(0.021)	(0.015)	(0.015)	(0.058)	(0.067)
ln_PIB_i	0.031***	0.005	0.007	0.007	0.072***	0.072***	0.097***	0.096***
	(0.004)	(0.005)	(0.009)	(0.009)	(0.005)	(0.005)	(0.025)	(0.026)
ln_PIB_j	0.011***	-0.002	-0.041***	-0.042***	0.005	0.006	-0.036*	-0.040*
	(0.004)	(0.004)	(0.009)	(0.008)	(0.004)	(0.004)	(0.021)	(0.020)
ln_pop_j	-0.017***	-0.004	0.080***	0.084***	-0.017***	-0.017***		
	(0.005)	(0.006)	(0.013)	(0.013)	(0.005)	(0.006)		
ln_dist_{ij}	-0.055***	-0.032***	0.006	0.009	-0.055***	-0.054***	-0.134***	-0.126***
	(0.007)	(0.009)	(0.013)	(0.012)	(0.006)	(0.007)	(0.037)	(0.041)
$Infla_i$	0.001***	0.001	-0.001	-0.001	0.002***	0.002***	-0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)
$Infla_j$	0.001***	0.001*	-0.006***	-0.005***	-0.001	-0.001*	0.001	0.002
	(0.000)	(0.000)	(0.002)	(0.002)	(0.001)	(0.000)	(0.001)	(0.002)
$ln\_DistIntra_i$	0.029***	0.044***	0.057***	0.059***	-0.052***	-0.051***	0.029	0.032
	(0.007)	(0.008)	(0.013)	(0.015)	(0.007)	(0.007)	(0.041)	(0.049)
$ln\_DistIntra_j$	0.038***	0.025***	-0.088***	-0.091***	0.049***	0.047***	0.071*	0.065*
	(0.007)	(0.008)	(0.013)	(0.014)	(0.007)	(0.007)	(0.038)	(0.035)
FC_{ij}	-0.055**	-0.047*					-0.288**	-0.239**

[18] FAO, 2016.

	(0.024)	(0.026)					(0.114)	(0.108)
CC_{ij}			0.132***	0.135***				
			(0.026)	(0.025)				
COL_{ij}	0.079***	0.078***			0.142***	0.140***	-0.194*	-0.147
	(0.020)	(0.026)			(0.023)	(0.026)	(0.108)	(0.094)
LC_{ij}	-0.025**	-0.026**	-0.187***	-0.184***	-0.028**	-0.027**	-0.161***	-0.163***
	(0.011)	(0.012)	(0.025)	(0.025)	(0.012)	(0.012)	(0.055)	(0.057)
$Fertilizer_i$	0.049***	0.070***						
	(0.011)	(0.012)						
$Prod\_hp_i$			-0.087***	-0.092***				
			(0.028)	(0.026)				
$Prod\_poisson_i$					-0.027**	-0.026*		
					(0.013)	(0.013)		
$Prod\_oil_i$							-0.530***	-0.460***
							(0.125)	(0.105)
Log(α)_cons		-19.239		-4.339***		-24.999		-2.067***
		(51.393)		(0.355)		(57.340)		(0.133)
Constant	1.865***	2.377***	3.040***	3.003***	0.844***	0.842***	1.163*	1.215*
	(0.116)	(0.134)	(0.217)	(0.206)	(0.119)	(0.124)	(0.615)	(0.634)
Comments	3,264	3,264	1,221	1,221	3,418	3,418	381	381
LR chi2		289.65		185.19		534.18		131.39
Wald chi2	438.81		221.64		603.82		258.80	
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.019		0.033		0,030		0.14	

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

4.3. Robustness tests

The validity of the estimation of gravity models by PPML is generally assessed by the robustness of these results with respect to competing estimators. Several estimators have been considered in the literature, each of which corrects a bias specific to PPML. In the context of our study, we have chosen (i) the ZINB (Zero Inflated Negative Binomial) estimator, which allows us to correct the bias *of overdispersion*, the inequality between the conditional variance of the dependent variable and its expectation, as well as the bias caused by inefficient management of the zero problem in the case of high proportions (De Benedictis and Taglioni, 2011), and (ii) the OLS estimator for quasi-similarity under first-order conditions with the PPML (Head and Mayer, 2014).

Table 5 shows the robustness of the results to the ZINB and OLS estimators. Both estimators confirm the positivity and significance of the elasticity between the log of the urbanization rate and that of total imports. The ZINB estimator shows a similar effect of the urbanization rate on total imports compared with the PPML (+4.1%). On the other hand, the OLS estimator overestimated the effect (+56.7%). For imports by branch and product, the robustness of the PPML estimates of the effect of urbanization is confirmed by the ZINB estimator (*Tables 2, 3 and 4*).

Table 5: Robustness of results to competing estimators (total imports)

Dependent var: ln_Import (total)	ZINB	OLS
VARIABLES	[27]	[28]
$ln\_TauxUrba_i$	0.041***	0.567***
	(0.007)	(0.057)
ln_PIB_i	0.049***	0.771***
	(0.004)	(0.031)
ln_PIB_j	0.033***	0.439***
	(0.010)	(0.076)
ln_pop_i	0.032***	0.404***
	(0.005)	(0.037)
ln_pop_j	-0.037	-0.659***
	(0.023)	(0.179)
ln_dist_{ij}	-0.109***	-1.682***
	(0.005)	(0.040)
$Infla_i$	-0.000	-0.000
	(0.000)	(0.002)
$Infla_j$	-0.000	-0.004***
	(0.000)	(0.002)
$ln\_DistIntra_i$	-0.034***	-0.499***
	(0.004)	(0.030)
$ln\_DistIntra_j$	-0.058	-0.646
	(0.164)	(1.332)
FC_{ij}	0.118***	1.588***
	(0.015)	(0.124)
CC_{ij}	0.041***	0.551***
	(0.008)	(0.060)
COL_{ij}	0.076***	1.400***
	(0.023)	(0.204)
LC_{ij}	0.032***	0.452***
	(0.007)	(0.059)
ln_GOV_i	0.019**	0.244***
	(0.007)	(0.057)
Constant	2.198**	9.002
	(0.998)	(8.073)
Comments	14,570	14,570
LR chi2	10419.79	
Prob > chi2	0.000	0.000
R-squared		0.701

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

4.4. Sensitivity tests

The sensitivity tests conducted here focus on specific regions or groups of importing countries (Sub-Saharan Africa, North Africa) and exporting countries (Africa, non-Africa). These regions are chosen because they have particular characteristics with respect to the variables of interest (urbanization rate and imports) identified in the stylized facts.

The results of these tests are presented in Table 6. We can see that the effect of urbanization on imports is mainly due to Sub-Saharan African countries, where the effect remains in the order of 4.5% for a 1% increase in the urbanization rate. On the other hand, the effect is negative for northern countries[19] , with a 9.3% reduction in total imports. However, this effect is not robust to the ZINB estimator. This divergence in results can be explained by the complexity of the sectors, the reversibility of the trends, the large socio-economic disparities and the differences in the urbanization process between sub-Saharan and northern African countries south of the Sahara and those to the north. As a result, the importance of external channels in the dynamics of urbanization is relativized (Hugon, 1997).

Furthermore, urbanization has a positive and significant effect on imports, whether the products come from inside or outside the continent (+4.5% for intra-African imports and +4.2% for imports from outside).

Table 6: Sensitivity of results to importing and partner country region

	Importing country sensitivity				Sensitivity of the exporting country			
VARIABLES	Sub-Saharan Africa		North Africa		Africa		Outside Africa	
	PPML	ZINB	PPML	ZINB	PPML	ZINB	PPML	ZINB
$ln\_TauxUrba_i$	0.045***	0.044***	-0.093**	-0.093	0.045***	0.044***	0.042***	0.042***
	(0.004)	(0.008)	(0.037)	(0.086)	(0.011)	(0.014)	(0.004)	(0.009)
ln_PIB_i	0.055***	0.055***	0.030*	0.030	0.032***	0.033***	0.056***	0.056***
	(0.002)	(0.004)	(0.015)	(0.037)	(0.006)	(0.008)	(0.002)	(0.005)
ln_PIB_j	0.036***	0.036***	0.028***	0.028	0.110***	0.110***	0.035***	0.035***
	(0.006)	(0.011)	(0.010)	(0.023)	(0.003)	(0.004)	(0.006)	(0.012)
ln_pop_i	0.029***	0.029***			0.042***	0.042***	0.030***	0.030***
	(0.003)	(0.005)			(0.007)	(0.009)	(0.003)	(0.006)
ln_pop_j	-0.042**	-0.041	-0.009	-0.009	-0.019***	-0.019***	-0.006	-0.006
	(0.018)	(0.027)	(0.025)	(0.052)	(0.005)	(0.006)	(0.017)	(0.027)
ln_dist_{ij}	-0.140***	-0.139***	-0.047***	-0.047**	-0.135***	-0.135***	-0.071***	-0.071***
	(0.004)	(0.007)	(0.008)	(0.020)	(0.005)	(0.007)	(0.003)	(0.007)
$Infla_i$	-0.000	-0.000	-0.001**	-0.001	-0.001**	-0.001	-0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)	(0.000)	(0.000)
$Infla_j$	-0.001***	-0.001**	-0.001**	-0.000	0.000	0.000	-0.0003***	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
$ln\_DistIntra_i$	-0.034***	-0.034***	-0.007	-0.007	-0.039***	-0.039***	-0.036***	-0.036***
	(0.002)	(0.004)	(0.016)	(0.036)	(0.006)	(0.007)	(0.003)	(0.005)
$ln\_DistIntra_j$	-0.075	-0.076	-0.009	-0.009	-0.022***	-0.023***	-0.073	-0.073
	(0.080)	(0.179)	(0.092)	(0.420)	(0.006)	(0.007)	(0.070)	(0.166)
FC_{ij}	0.107***	0.107***	0.025	0.025	0.074***	0.074***	-0.111***	-0.111
	(0.010)	(0.017)	(0.026)	(0.049)	(0.012)	(0.017)	(0.025)	(0.068)
CC_{ij}	0.041***	0.041***	0.048***	0.048**	0.100***	0.100***	0.021***	0.021**
	(0.005)	(0.009)	(0.011)	(0.023)	(0.009)	(0.011)	(0.005)	(0.010)
COL_{ij}	0.070***	0.069***	0.015	0.015	0.190***	0.189**	0.084***	0.084***
	(0.009)	(0.024)	(0.013)	(0.092)	(0.022)	(0.080)	(0.009)	(0.024)
LC_{ij}	0.026***	0.026***	0.067***	0.067*	-0.010	-0.010	0.021***	0.022**
	(0.005)	(0.009)	(0.017)	(0.038)	(0.009)	(0.011)	(0.005)	(0.010)
ln_GOV_i	0.025***	0.025***	-0.026	-0.026	0.023**	0.022	0.020***	0.020**
	(0.004)	(0.008)	(0.018)	(0.044)	(0.011)	(0.014)	(0.004)	(0.009)
Log(α)_cons		-160.91***		-69.722		-50.436		-57.537**
		(22.680)		(54.585)		(42.149)		(24.596)
Constant	2.387***	2.387**	2.442***	2.442	0.291***	0.294**	1.467***	1.464
	(0.504)	(1.090)	(0.773)	(2.729)	(0.092)	(0.119)	(0.446)	(1.026)
Comments	12,362	12,362	2,208	2,208	4,369	4,369	10,201	10,201
LR chi2		8482.24		1782.05		2170.30		7133.05
Wald chi2	25691.84		44935.11		4949.38		22155.00	
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.125		0.144		0.09		0.127	

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, *p<10*

[19] Algeria, Tunisia, Morocco and Egypt (Libya is excluded from the sample due to data availability).

5. Conclusion

This paper aims to analyze the effect of urbanization on imports in Africa. To achieve this objective, an augmented gravity model was used, incorporating standard variables of this type of model, such as GDP, population and distance, as well as socio-demographic variables. The model was estimated using pseudo-Poisson maximum likelihood taking into account multilateral resistances captured by inflation and cross-sectional fixed effects (Hummels, 2001; Feenstra, 2016).

At the end of our estimations, we can draw three mains conclusions: i) urbanization tends to increase imports in Africa, especially in sub-Saharan Africa, with the opposite effect in North Africa ; ii) as a result of urbanization, agricultural imports grow disproportionately compared to industrial and oil imports; iii) urbanization has contrasting effects on imports of specific products: it contributes to increasing imports of rice, fish and oil, and to reducing imports of maize, palm oil and fertilizers.

The findings of this paper call on African countries, continental organizations and civil society to rethink the urbanization process so as not to undermine food security. This requires: (i) the effective establishment of production units in rural areas affected by the rural exodus; (ii) the promotion of large-scale production by rural farmers to enable better supply of cities.

6. APPENDIX

Figure 4 : Main exporters to SSA by product in 2022

Source: *Authors based on United Nations data (2023)*

Table 7: Descriptive statistics for variables and data sources

Variables	N	Mean	Mean (base)	Std. dev.	min	max	Sources
ln $Import_{ij}$ *(Total)*	16251	14.17	91765.3	3.772	0	23.493	UN[20] Comtrade database (2023)
ln $Import_{ij}$ *(Agricultural)*	11744	12.749	16049.3	3.655	0	21.487	UN Comtrade database (2023)
ln $Import_{ij}$ *(Industrial)*	15733	13.903	81011.6	3.816	0	23.46	UN Comtrade database (2023)
ln $Import_{ij}$ *(Oil companies)*	4901	12.177	33964.1	4.066	0	22.483	UN Comtrade database (2023)
ln $Import_{ij}$ *(rice)*	2807	10.328	4687.6	4.027	0	19.874	UN Comtrade database (2023)
ln $Import_{ij}$ *(corn)*	1366	10.136	6576.8	4.217	0	20.313	UN Comtrade database (2023)
ln $Import_{ij}$ *(wheat)*	1336	13.285	27146.4	4.520	0	21.21	UN Comtrade database (2023)
ln $Import_{ij}$ *(fish)*	3606	10.852	3008.4	3.503	0	19.397	UN Comtrade database (2023)
ln $Import_{ij}$ *(fertilizer)*	3457	12.013	3427.9	3.203	0	19.47	UN Comtrade database (2023)
ln $Import_{ij}$ *(palm oil)*	1395	11.103	7646.8	3.947	0	20.279	UN Comtrade database (2023)
ln $Import_{ij}$ *(oil)*	399	10.761	138190	5.987	0	21.865	UN Comtrade database (2023)
ln $TauxUrba_i$	16278	3.585	40.24	0.504	1.976	4.261	WDI[21] (2023)
ln GDP_j	15662	25.015	5.969e+08	2.257	18.77	30.67	CEPII[22] (2023)
ln GDP_i	15964	23.225	44845884	1.602	20.04	26.899	CEPII (2023)
ln pop_i	15964	9.33	24777.51	1.533	4.322	12.236	CEPII (2023)
ln pop_j	15710	9.496	62626.06	1.789	4.244	14.16	CEPII (2023)
ln $dist_{ij}$	15443	8.544	6219.51	0.706	2.079	9.882	CEPII (2023)
$Infla_i$	16278	6.778	6.778	8.525	-2.47	83.326	WDI (2023)
$Infla_j$	16278	6.212	6.212	16.522	-3.74	376.746	WDI (2023)
ln $DistIntra_i$	16278	6.159	650.732	1.004	3.066	7.342	WDI (2023)
ln $DistIntra_j$	16278	6.054	715.395	1.134	2.884	8.327	WDI (2023)
FC_{ij}	15443	/	/	/	/	/	CEPII (2023)
CC_{ij}	15443	/	/	/	/	/	CEPII (2023)
COL_{ij}	15443	/	/	/	/	/	CEPII (2023)
LC_{ij}	15443	/	/	/	/	/	CEPII (2023)
ln GOV_i	15474	3.422	32.89	0.397	2.303	4.159	Heritage foundation (2023)
$Agri(\%GDP)_i$	16053	19.085	19.085	11.552	1.828	51.925	WDI (2023)
$Industry(\%GDP)_i$	15813	24.313	24.313	8.811	9.286	66.179	WDI (2023)
$OilRents(\%GDP)_i$	16278	1.923	1.923	5.672	0	40.941	WDI (2023)
$prod\_riz_i$	16278	/	/	/	/	/	FAO[23] (2021)
$prod\_ble_i$	16278	/	/	/	/	/	FAO (2021)
$prod\_maïs_i$	16278	/	/	/	/	/	FAO (2021)
$prod\_poisson_i$	16278	/	/	/	/	/	ASM[24] (2020)
$prod\_HP_i$	16278	/	/	/	/	/	ITC[25] (2022)
$prod\_fertilizer_i$	16278	/	/	/	/	/	ITC (2022)
$prod\_petrole_i$	16278	/	/	/	/	/	SRWE[26] (2021)

***Note: The last seven (07) dummy variables have been constructed by the authors, in order to assess the effects of individual specificities in terms of production capacity on product imports. Major producing countries are those whose local production exceeds 1% of the continent's total production.

Source: *Authors.*

[20] UN : United Nations.
[21] WDI : World Development Indicators.
[22] CEPII : Centre d'Études Prospectives et d'Informations Internationales.
[23] FAO: Food and Agriculture Organization.
[24] WSA: World Sociological Atlas.
[25] ITC: International Trade Center.
[26] SRWE: Statistical Review of World Energy.

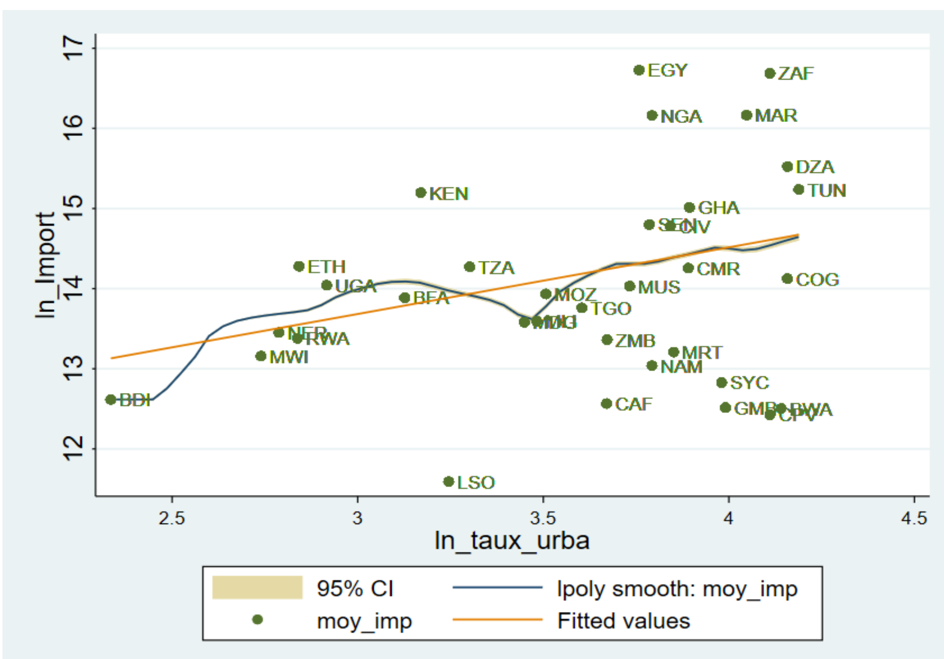
Table 8: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) ln_Import_{ij}	1.000															
(2) $ln\_TauxUrba_i$	0.128*	1.000														
(3) ln_GDP_j	0.599*	-0.001	1.000													
(4) ln_GDP_i	0.332*	0.335*	-0.053*	1.000												
(5) ln_pop_i	0.245*	-0.189*	-0.060*	0.743*	1.000											
(6) ln_pop_j	0.409*	-0.034*	0.691*	-0.078*	-0.047*	1.000										
(7) ln_dist_{ij}	-0.083*	0.003	0.332*	-0.052*	-0.090*	0.117*	1.000									
(8) $Infla_i$	-0.035*	-0.271*	-0.038*	-0.097*	0.151*	0.012	0.027*	1.000								
(9) $Infla_j$	-0.073*	-0.033*	-0.081*	-0.035*	-0.001	0.119*	-0.044*	0.120*	1.000							
(10) $ln\_DistIntra_i$	0.148*	-0.018*	-0.047*	0.568*	0.771*	-0.030*	-0.072*	0.116*	0.005	1.000						
(11) $ln\_DistIntra_j$	0.215*	-0.024*	0.441*	-0.055*	-0.029*	0.758*	0.040*	0.016*	0.130*	-0.019*	1.000					
(12) FC_{ij}	0.103*	-0.026*	-0.134*	0.006	0.038*	0.009	-0.467*	0.002	0.017*	0.063*	0.068*	1.000				
(13) CC_{ij}	0.014	0.049*	-0.212*	0.031*	-0.036*	-0.104*	-0.149*	0.042*	-0.028*	-0.064*	-0.078*	0.158*	1.000			
(14) COL_{ij}	0.141*	0.000	0.142*	-0.026*	-0.036*	0.075*	0.004	-0.004	-0.030*	-0.029*	0.025*	0.010	-0.062*	1.000		
(15) LC_{ij}	-0.013	-0.017*	-0.223*	-0.009	-0.046*	-0.130*	-0.199*	0.002	-0.041*	-0.069*	-0.101*	0.166*	0.592*	0.150*	1.000	
(16) ln_GOV_i	0.064*	0.394*	0.000	0.219*	-0.236*	-0.030*	0.063*	-0.081*	-0.001	-0.187*	-0.022*	-0.031*	0.055*	0.008	0.027*	1.000

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source : *Authors.*

Figure 5 : Average scatter plot between urbanization rate and total imports



Source: *Authors.*

Table 7 : VIF multicollinearity test

Variable	VIF	1/VIF
ln_pop_i	9.04	0.110623
ln_PIB_i	6.82	0.146731
ln_pop_j	3.96	0.252567
$ln\_DistIntra_i$	2.54	0.392949
ln_PIB_j	2.48	0.402921
$ln\_TauxUrba_i$	2.47	0.405011
$ln\_DistIntra_j$	2.45	0.407564
ln_GOV_i	1.71	0.584319
LC_{ij}	1.69	0.592695
CC_{ij}	1.62	0.616983
ln_dist_{ij}	1.48	0.675814
FC_{ij}	1.33	0.750447
$Infla_i$	1.20	0.836472
$Infla_j$	1.09	0.914035
COL_{ij}	1.09	0.918207
Mean VIF	2.73	

Source : *Authors.*

Table 8: List of importing and exporting countries

Importing countries	*Partner countries*
Algeria, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Rep, Congo Rep, Cote d'Ivoire, Egypt, Ethiopia, Gambia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Nigeria, Niger, Namibia, Rwanda, Senegal, Seychelles, South Africa, Tanzania, Togo, Tunisia, Uganda, Zambia.	Algeria, Antigua and Barbuda, Armenia, Australia, Austria, Bahrain, Bangladesh, Barbados, Belgium, Belize, Bhutan, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cameroon, Canada, Cape Verde, Central African Rep, China, Colombia, Congo Rep, Cote d'Ivoire, Cyprus, Czech Rep, Denmark, Djibouti, Dominica, Egypt, Equatorial Guinea, Estonia, Ethiopia, Finland, France, Gambia, Georgia, Germany, Ghana, Greece, Guyana, Hong Kong, China, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Latvia, Lebanon, Lesotho, Liberia, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Netherlands, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Saudi Arabia, Senegal, Seychelles, Singapore, Slovak Republic, Slovenia, South Africa, South Sudan, Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, Zambia.

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