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Globalization and Burden of Non-communicable Diseases in Sub-Saharan African Countries

Abstract: Investigating the critical determinants of the burden of NCDs is one of the major concerns of countries around the world. This study uses data on 45 African countries from 2000 to 2019 to examine the effects of globalization and its dimensions on the burden of NCDs by disentangling between the de jure and de facto aspects. The second-generation panel data econometric tools with fixed-effects enabled to overcome the problem of cross-sectional dependence and endogeneity. With the robustness check, we find that overall globalization and its economic and social dimensions restrain the burden of NCDs in Africa while its political dimension expands it. The distinction between the de jure and de facto aspects of globalization demonstrates that, the de facto globalization decreases the burden of NCDs whereas de jure globalization does not affect it.

Keywords: De jure globalization, De facto globalization, Non-communicable Diseases, , Africa.

Mondialisation et fardeau des maladies non transmissibles dans les pays d'Afrique subsaharienne

Résumé *: L'étude des déterminants essentiels du fardeau des Maladies Non Transmissibles est l'une des principales préoccupations des pays du monde entier. Les données sur 45 pays africains de 2000 à 2019 sont utilisées pour examiner les effets de la mondialisation et de ses dimensions sur la charge des maladies non transmissibles en distinguant les aspects de jure et de facto. Les outils économétriques de données de panel de deuxième génération avec effets fixes ont permis de surmonter le problème de la dépendance transversale et de l'endogénéité. Grâce à la vérification de la robustesse, nous constatons que la mondialisation globale et ses dimensions économiques et sociales limitent le fardeau des maladies non transmissibles en Afrique, tandis que sa dimension politique l'accroît. La distinction entre les aspects de jure et de facto de la mondialisation démontre que la mondialisation de facto diminue le fardeau des MNT alors que la mondialisation de jure ne l'affecte pas.*

Mots clés *: Mondialisation de jure, Mondialisation de facto, Maladies non transmissibles, Afrique.*
JEL Codes: *F68 - I10 - O55.*

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1. Introduction

One of the major challenges facing global public health in recent decades is to fight the enormous deaths caused by non-communicable diseases (NCDs) (Li et al., 2022). NCDs refer to a group of diseases not caused by acute infection but have long-term health consequences and often create the need for long-term treatment and care. The NCDs mainly cover cancers, cardiovascular diseases, diabetes, chronic lung diseases and mental health problems (World Health Organization [WHO], 2022). NCDs pose an enormous burden to development in terms of loss of life and expense incurred in their treatment. According to WHO (2022), until 2019, 74% of global deaths are due to NCDs and 77% of these deaths occur in low- and middle-income countries. Given the burden of NCDs, the identification of internal and external risk factors to control the proliferation of these diseases is one of the current concerns of WHO and many governments of low and middle income countries. Indeed, globalization is mentioned in this context as a vector agent of NCD deaths among the external risks (Hanefeld, 2015; Silberschmidt, 2021). In addition, according to the WHO's 2022 report, the main cause of death in sub-Saharan Africa is non-communicable diseases such as cancer, cardiovascular disease and diabetes. These were responsible for 24% of deaths in 2000, rising to 37% in 2019 (WHO, 2022). Furthermore, the growing burden of NCDs is such that in the African region, the number of people living with diabetes is expected to reach 47 million by 2025, compared with 19 million in 2019 (WHO, 2022). This would represent an economic burden in terms of productivity and human capital that could be avoided if the determinants of this burden were known, which would help to slow the rising rate of these diseases and achieve the MDGs.

As the globalization is intensified in the recent decades, his repercussion on public health mainly on the NCDs dissemination, is one of the issues most discussed in the economic literature. Before the 1980s, the globalization is perceived focusing on its economic dimension. Economically, globalization refers to the national economies opening to international trade, foreign direct investment (FDI), portfolio investment and international capital flows (Dreher 2006; Goryakin et al., 2015). This means to dismantle the barriers and promote the information, which accompanies the above flows. From the 1990s, two main dimensions of globalization emerge, namely social and political globalizations. The social globalization pertaining to the international popularization of the cultures, values and customs of the national people through either physical contact (migration, tourism), or communication channels (telephones, Internet, medias and social networks). The political globalization however is understood as the dissemination of government policies with the countries involvement in various international treaties and the presence of theirs embassies in other countries or countries membership to some internationals organizations (Gygli et al., 2019; Lechner & Boli, 2020).

The economic literature on the determinants of public health shows that globalization can affect NCDs deaths when taking into account the above dimensions. The economic literature predicts divergent effects of globalization on NCDs deaths according to the globalization dimensions. Accordingly, the economic globalization can be the source of the outbreak of NCDs which could certainly lead to huge deaths. Indeed, the

international trade liberalization favors the international movements of several varieties of products including poor quality products (drugs, alcohol, genetically modified organisms [GMOs]) whose consumption lead to overweight, obesity, raised blood pressure and cholesterol, and ultimately the NCDs and theirs deaths (Beaglehole & Yach, 2003; Huynen et al., 2005; García-Dorado et al., 2019). NCDs are also a concern in the context of environmental degradation through economic globalization. Indeed, to the extent that trade openness causes the environment pollution by the toxic gases emission, water pollution, it brings about the emergence of complex NCDs like chronic lung diseases, various forms of cancer and mental illness leading to huge deaths (Labonté, 2018). The international trade liberalization can limit the risks of contracting NCDs in some circumstances. In fact, when openness to trade is pursued by the higher technological and pharmaceutical products import that are useful to improve the health infrastructures and public health, this may lead to cushioning the burden of NCDs (Faunce et al., 2005; Barlow et al., 2017). Economic globalization affects the NCDs proliferation and theirs deaths through openness to foreign direct investment (FDI). With the softening of barriers that meet the multinational corporations, their importance to produce and distribute (cheaply) consumable goods become immeasurable. The multinational corporations have led to the proliferation of processed food products full of fat, sugar, alcohol and drugs whose consumption puts people to the risk of NCDs such as obesity, overweight and mental illness leading to NCDs and theirs deaths (Hawkes, 2006; Loewenson et al., 2010).

There are several channel through which the social globalization influences public health. The mingling of cultures, values and languages due to social globalization allows people to change their consumption tastes, especially in developing countries. The changes in consumption patterns can drive the unhealthy diet like the consumption of foods that could contain high sugar, fats, alcohols and drugs, responsible for NCD risks (obesity, overweight, mental problems) even NCDs and after huge deaths (Goryakin et al., 2015). Physical contact between people and access to information can cause mental stress for some people and generate the destabilization of their state of health (Cutler et al.; 2006; Labonté, 2018). The social globalization will be beneficial to curb the burden of NCDs in some circumstances. Indeed, the migration and tourism of health workers (doctors and nurses) allow the sharing of experiences on the medical treatment of some NCDs, so contributing to the reduction of the mortality rate due to NCDs. In addition, informations through all traditional and digital media can also inform people about a better diet (healthy and balanced diet) for good health, which can also reduce the risk of NCDs and the number of deaths due to NCDs in countries, particularly in developing countries (Huynen et al., 2005).

This study, which aims to examine the effects of globalization on NCDs burden, extend the previous empirical studies however with some contributions. Although there are studies that link various globalization indicators to the NCDs burden (numbers of deaths from NCDs) and risk factors in the framework of public health drivers' analysis, however, to the best of our knowledge, these studies do not take into account the recent updates that occurred in the context of globalization. The new updates of the KOF Globalization Index distinguish between the *de jure* and *de facto* globalization (Gygli et

al., 2019). While the *de jure* globalization encompasses policies or regulations (laws, decrees, rulings) that govern and orient the activities and practices of globalization, *de facto* globalization refers to movements and activities to the international scale. Until now, studies on globalization and NCDs burden or NCDs risk factors nexus do not include this categorization. We think that, this disentangling is important because it can lead to divergent outcomes using the both globalization indicators. Furthermore, making this distinction enable on the one hand to assess whether the regulations governing globalization take into account the NCDs issues and on the other hand, to link the globalization practices to its regulatory framework.

Another important contribution of this study is the effective treatment of spatial dependence. Indeed, a crucial issue discussed in the panel data literature in the recent decades is how the interdependence between the units studied (countries, individuals) work against the quality of the regressions outcomes. Indeed, the spillover effects, neighborhood and imitation activities may explain the mutual dependencies (cross-sectional dependence) between geographically localized units (Kelejian & Piras, 2017). The econometrics using the second-generation panel data regressions stem that the ignorance or use of unsuitable econometric tools to overcome this problem leads to biased and inconsistent estimation coefficients (Pesaran, 2020). To our knowledge, the previous studies on the effects of globalization on NCDs burden or their risks factors lacked to pay attention to this problem whose consequences involve the poor regression results. We first diagnose this problem using the second-generation panel regression tests and then use the estimation approach by Driscoll and Kraay (1998) to get the better estimation results.

The remainder of the article is structured as follows. Section 2 presents the methodology and estimation strategy, section 3 discusses the data, section 4 analyzes and discusses the estimation results and section 5 concludes.

2. Literature review

2.1. Theoretical literature

The theoretical literature identifies political globalization as a determinant of NCDs burden (NCDs deaths). Indeed, membership of international organizations, non-governmental organizations and the ratification of international treaties have repercussions on NCDs deaths. International public health governance organizations such as WHO and United Nations (UN), develop global policies (Political Declaration on Prevention and Control of NCDs, NCDs in the 2030 Agenda) to eradicate the NCDs and theirs associated risks such as obesity, overweight (Huynen et al., 2005). These international disease control policies, when adopted by countries, improve NCDs public health and significantly reduce the number of deaths. Some international organizations, although they do not have a vocation directly related to the burden of NCDs, derive policies, which affect the latter. These organizations include the World Trade Organization (WTO), World Bank (WB) and International Monetary Fund (IMF). The negotiations on trade liberalization, and dispute settlement on the implementation of sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT) within

the WTO can contribute either to protect people to NCDs risks or to disseminate these risks and even NCDs (Huynen et al., 2005; Labondé, 2019). To support countries through the structural adjustment programs, the World Bank and the IMF suggest policies including the improvement of social health infrastructure. These recommendations can, if suitably implemented, improve the NCDs healthcare and reduce the associated deaths (Skosireva & Holaday, 2010).

2.2. Empirical literature

In the empirical side, the first strand of literature related to this study is those highlights that the globalization variables are associated either with the extent of some NCDs or theirs risks, and with changes in consumption habits. The study by García-Dorado et al. (2019) examines more than 20 empirical articles analyzing the effects of globalization variables on public health indicators including NCDs issues. They show that foreign direct investments (FDI) promote overeating and the prevalence of NCDs or theirs risks (obesity, overweight, diabetes). They also point out that the links between trade liberalization and the prevalence of NCDs are unclear, but there is evidence of a broad association with better food quality and reduced of NCDs. For social globalization, the authors conclude that it contributes to increasing overweight and obesity. Based on the compilation of 16 empirical studies, Barlow et al. (2017) summarize that the implementation of trade agreements (trade liberalization) leads to increased consumption of processed foods and sweet drinks which are potential risks for NCDs and associated deaths; and better access to pharmaceutical products contributing to the NCDs treatment and the associated deaths reduction. The authors also claim that this implementation causes a higher incidence of cardiovascular disease and risks of overweight and obesity. Using the aggregate index of globalization (KOF index of globalization), Goryakin et al. (2015) examine the effects of globalization on overweight and obesity for 56 countries over a period from 1991 to 2009. The authors indicate that globalization as a whole is noticeably and significantly associated with an increase in the individual propensity to be overweight among women but with the predominance of the influence of political and social globalizations. Based on trade openness and foreign direct investment as indicators of globalization, Miljkovic et al. (2015) show for 79 countries and the period from 1986 to 2008, that openness to trade increases obesity while FDI does not affect the latter. De Soysa and De Soysa (2018) also analyze the influence of globalization on overweight and obesity on a sample comprising children and young people for a period from 1990 to 2013. The authors demonstrate that globalization and some of their components such as trade openness, FDI reduce overweight and obesity among children and youth.

The second strand of literature related to this study, covers the studies which associate globalization to various mortality rates. Using the Maastricht globalization index, Martens et al. (2010) analyze the effects of globalization on various mortality rates. They show a negative association between globalization index and death rates. Tausch (2016) analyzes the correlation between globalization (measured by KOF index) and public health indicators (including mortality rate) in 99 countries and concludes that globalization improves health indicators (reducing the mortality rate) in 19 countries while in the other countries, globalization increases inequalities leading to the

deterioration of public health indicators. Using the KOF index, Jani et al. (2019) also show that economic and social globalization are very important in improving health indicators (reducing the mortality rate). Owen and Wu (2007), Mukherjee and Krieckhaus (2012) also find that globalization indicators are important for public health by reducing mortality rates.

3. Methodology and Estimation Strategy

3.1 Conceptual framework

Since the burden of NCDs (deaths due to NCDs) is a health status, the methodology of this study is built on the health production theoretical model by Grossman (1972). Indeed, the author considers a production function where an individual health depends on some characteristics (factors) related to the individual and his environment. The implicit function can formalize as follows:

$$H = F(Z) \tag{1}$$

In equation (1) *H* is the health variable (health status). *Z* is a vector, which encompasses the factors that can influence health. This vector includes economic, social and policy factors. We include our interest variable, that is globalization, in the model as the policy variable so that to analyze its effect on health. In accordance to the above theoretical formulation, the empirical specification is derived. We follow the specifications by Barenberg et al. (2017) and Ansari et al. (2003) in order to model the empirical link between the NCD burden and globalization.

3.2 Empirical framework

Thus, the following structural model is the baseline model, which will be subjected to several empirical tests.

$$h_{it} = \omega_{0i} + \omega_{1i} KOF_{it} + X_{it}\omega_2 + \vartheta_{it} \tag{2}$$

In model (2), h_{it} refers to the NCD burden variable for country *i* for year *t*, *KOF* is the interest variable, which is the globalization, *X* is the vector that encloses the control variables, which can be economic, social and policy variables. The ω are parameters to be estimated. ϑ_{it} is the composite error term comprising individual fixed effects (countries), time fixed effects and a set of factors that may explain the spatial dependence between countries.

In order to select an appropriate estimation technique, the model (2) will be subjected to several tests. The first test to be performed is the cross-sectional dependence test. This test is useful to choose between the first generation and second generation panel tests so that to test the unit root and cointegration. To diagnose the spatial dependence, the tests by Pesaran (2020). The test considers the cross-sectional dependence as a whole and do not impose restrictions on the individual and temporal dimensions of the panel. The test reject the null hypothesis of cross-sectional independence between units (countries) since the statistics associated with the tests are significant at 1% (table 1).

The presence of cross-sectional dependence in the structure of the panel data refers to the use of second-generation panel tests to analyze the variables unit root. We use the modified test by Im, Pesaran and Shin (IPS) (2003) that consider the cross-sectional dependence and suitable for unbalanced panel, that is the Cross-sectional Augmented Dickey Fuller (CADF) (Pesaran, 2007; Costantini & Lupi, 2013). The test assumes under the null hypothesis that the panel is homogeneous and not stationary against the alternative hypothesis of stationary heterogeneity panel in the presence of cross-sectional dependence (Burdisso & Sangiácomo, 2016). The statistic of the test, known as Cross-sectional Dependence ADF (CADF) follows, under the null hypothesis, the normal distribution with mean 0 and variance 1. The test rejects the null hypothesis of unit root (table 1). We turn now about the estimation technique that should be used in order to effectively handle the cross-sectional dependence.

Table 1: Cross-sectional and unit-root tests

Variables	Pesaran Cross-sectional dependence test			Pesaran CADF test		
	CD-statistics	p-value	Correla-tion	Z[t-bar]	P-value	Deci-sion
ncd_deaths (Log)	103.64	0.000	0.737	2.341	0.990	I(0)
Kofgi	120.08	0.000	0.853	-5.737	0.000	I(0)
Kofgidf	82.44	0.000	0.586	-5.856	0.000	I(0)
Kofgidj	122.74	0.000	0.872	-4.326	0.000	I(0)
Kofecgi	1.99	0.047	0.015	-4.088	0.000	I(0)
Kofecgidf	2.20	0.028	0.017	-4.472	0.000	I(0)
Kofecgidj	1.97	0.048	0.015	-0.975	0.165	I(0)
Kofsogi	124.44	0.000	0.948	-6.419	0.000	I(0)
Kofsogidf	117.44	0.000	0.895	-6.714	0.000	I(0)
Kofsogidj	118.50	0.000	0.903	-5.327	0.000	I(0)
Kofpogi	103.07	0.000	0.732	-6.482	0.000	I(0)
Kofpogidf	35.45	0.000	0.252	-3.116	0.001	I(0)
Kofpogidj	127.79	0.000	0.908	-7.200	0.000	I(0)
gdp_pc (Log)	119.99	0.000	0.863	-6.246	0.000	I(0)
gov_health_exp (Log)	.	.	.	-4.183	0.000	I(0)
health_exp (Log)	104.88	0.000	0.746	-5.275	0.000	I(0)
poplation_urban (Log)	135.25	0.000	0.974	1.359	0.913	I(0)
Education	112.30	0.000	0.815	5.331	1.000	I(0)
Sanitation	88.80	0.000	0.647	2.308	0.990	I(0)
Employment	12.38	0.000	0.089	3.359	1.000	I(0)

The commonly used estimation approaches to overcome the problem of cross-sectional dependence include the Feasible Generalized Least Squares approach by Parks (1967) and Kmenta (1986), the Panel-Corrected Standard Errors (PCSE) approach by Beck and Katz (1995) and the approach by Driscoll and Kraay (1998). Although these three approaches enable to overcome the cross-sectional dependence, each one owns the particularities that explain the reliability of its estimation results. Indeed, the Parks-Kmenta approach is preferred when the individual dimension *(N)* of the panel is less than

the time dimension *(T)*[1]. In the case where $T < N$, the approach by Beck and Katz (1995) gives the more suitable results. The approach by Driscoll and Kraay (1998) does not discriminate between the panel dimensions. We choose the latter estimation approach in this study. Indeed, the approach by Driscoll and Kraay (1998) is based on the non-parametric estimation technique, which is appropriated for more general forms of cross-sectional dependence (Hoechle, 2007). This approach also enables to take into account the individual heterogeneities while solving the heteroscedasticity and errors autocorrelation issues. Fixed effects are associated with this approach in order to consider endogeneity due to confounding factors and reverse causality. For the robustness check, the generalized method of moments (GMM) is used.

4. Variables and Data Description

4.1 Dependent Variable: Burden of NCDs

To analyze the effect of globalization on public health, we use the annual data on 45 African countries over the period from 2000 to 2019. The countries and period are selected according to the data availability especially on the dependent variable and the globalization variables. Depending on the availability of data, the objective of the study and as mentioned by some studies (Labonté, 2019; Mohindra, 2021), the burden of NCDs is measured by the total number of NCD deaths. Data on NCD deaths are taken from WHO.

4.2 Interest Explanatory Variables: KOF Globalization Index and its Dimensions

We measure globalization using KOF globalization index. The index acquired our attention for some motives. Firstly, this index includes the relevant dimensions of globalization, that is the economic, political and social dimensions. Moreover, the index encompasses a large panel data set comprising over 200 countries and along the period from 1970 to 2020. The data is easily accessible and are updated annually. Another important aspect of choosing the index is the distinction between the *de facto* and *de jure* globalization aspects introduced by the recent versions of the database[2].

The KOF *de jure* and *de facto* globalization indices are obtained using the sub-indices of economic, political and social globalization dimensions. In the 2019 updated version, the sub-index of the *de facto* economic globalization stem from the commercial and financial indicators. The trade indicators relate to trade flows as a percentage of GDP. The financial indicators include the sum of stocks of assets and liabilities of foreign direct investment, portfolio investment (as a percentage of GDP) and the sum of primary and cross-border labor and capital incomes (percentage of GDP). The *de facto* social globalization sub-index considers some specific interpersonal, informational and cultural indicators. The interpersonal indicators include the international voice traffic, international financial transfers, international tourism and the share of people born

[1] Beck and Katz (1995) show that, when $T < N$, the variance-covariance matrix with the size NxN becomes singular and impossible to estimate in the presence of spatial dependence. See also Moundigbaye et al. (2018) and Reed and Ye (2011) for details on these approaches.

[2] See Gygli et al. (2019) for existing globalization indices and their drawbacks compared to the KOF index.

abroad. The informational indicators cover the stock of patent applications filed by non-residents, the sum of incoming and outgoing foreign students and the export of high-tech products. The cultural indicators are the number of McDonald's restaurants, number of IKEA stores and, trade in cultural goods; trade in personal, cultural and recreational services. The *de facto* political globalization sub-index incorporates the number of participations in United Nations peacekeeping missions, the number of embassies and NGOs in a country.

The sub-indices of the economic, political and social dimensions of *de jure* globalization also emanate from some particular indicators. The *de jure* economic globalization sub-index is based on the *de jure* trade and financial globalization indicators. The *de jure* trade globalization indicators focus on the average prevalence of non-tariff barriers and procedural costs based on the Doing Business report, trade taxes (as share of GDP). The *de jure* financial globalization indicators include the Chinn-Ito index from the IMF, Wang and Jahan index, and investment restrictions (prevalence of foreign ownership and regulation in relation to international capital flows)[3]. The *de jure* social globalization derive from the *de jure* interpersonal, informational and cultural globalization indicators. The *de jure* interpersonal indicators involve the number of landline and mobile phone users per 100 inhabitants, number of airports welcoming international flights and the freedom of foreigners to visit the country. The *de jure* informational globalization indicators encompass the number of televisions and Internet users per household, relevance of Internet use and freedom of the press. The *de jure* cultural globalization indicators incorporate the general government education expenditures as a percentage of GDP, gender parity index of primary school enrollment and civil liberty index. The *de jure* political globalization sub-index includes the number of multilateral treaties signed by the country since 1945 and the number of international organizations where the country is membership. The *de jure* and *de facto* globalization indices, and their sub-indices are the scales variables ranging from 1 to 100, where the value 1 denotes the minimum state of globalization and the value 100 the maximum state of globalization.

The negative and significant effects (negative coefficients) of globalization indices on NCD deaths means that globalization reduces the burden of NCDs. The correlation between the burden of NCDs and globalization indices are displayed in table 2.

4.3 Control Variables

The regressions additionally include some socioeconomic variables which are commonly used in the theoretical and empirical literature that deals with public health determinants analysis. Thus, the country's GDP per capita (as development level) is introduced as a control variable. When the country excels in GDP per capita, the latter can contribute to poverty reduction and consequently the improvement of public health (Huynen et al., 2005; Fayissa & Gutema, 2005; Labonté, 2018). The governments' health expenditures are also involved as the control variable. When governments invest in

[3]The Chinn-Ito index is an index measuring a country's degree of capital account openness (see Chinn & Ito, 2006). The Wang-Jahan capital account openness index is a de jure index that provides information on the state of openness of the capital account based on 12 types of asset categories (Jahan &Wang, 2017).

public health infrastructures, the public health can experience improvements through reduced mortality rates (Martens et al., 2010; De Soysa & De Soysa, 2018). The governments' health expenditures is evaluated as a percentage of GDP. Furthermore, the current health expenditures, population with access to basic health infrastructures, education level, employment rate and urban population are included in the regressions. These variables are identified in the literature as potentially affecting the public health including NCD deaths (Martens et al., 2010; Bergh & Nilsson, 2010). According to the literature, except the urban population, the other variables should decrease the death from NCDs. Table 3 provides the descriptive statistic, description and sources of the variables.

5. Results and Discussion

The results of this subsection are obtained using the Hoechle (2007) estimation technique with fixed effects in order to overcome the problem of endogeneity due to reverse causality or confounding factors. The estimation results in the three tables below are overall significant. Indeed, the Fisher statistics for the overall estimation significances are significant at 1%. Table 4 presents the effects of globalization and its dimensions on the burden of NCDs (deaths of NCDs) without distinction between the *de jure* and *de facto* aspects. Column (1) examines the effects of overall globalization while columns (2), (3) and (4) respectively show the effects of the economic, social and political dimensions of globalization. The coefficients associated with the globalization variables in columns (1), (2) and (3) are negative and significant at 1% or 5%, however the globalization coefficient in column (4) is positive and significant at 5%. These results mean that the globalization and its economic and social dimensions reduce the burden of NCDs (the NCD deaths) in Africa whereas the political globalization enhances the deaths from NCDs. For instance, increasing the overall KOF index of globalization by 10 units decrease the NCD deaths by about 0.033 unit. This same increase for the economic and social globalization indices lowers the NCD deaths by about 0.023 and 0.137 units respectively. With the political globalization which increases the death from NCDs, we observe that an increase of 10 units of the KOF political globalization index increases the NCD deaths by about 0.053 unit.

Table 5 displays the effects of the overall *de jure* globalization and its dimensions on the burden of NCDs. The effects of the overall *de jure* globalization are presented in column (1) while the effects of the economic, social and political dimensions of *de jure* globalization are respectively analyzed in columns (2), (3) and (4). Columns (2) and (4) show that the coefficients of the *de jure* globalization are positive and significant at 1% or 5%. The coefficient in column (3) however is negative and significant at 1%. The coefficient of the overall *de jure* globalization in column (1) is insignificant. We demonstrate that the *de jure* globalization as a whole does not affect the NCD burden while its economic and political dimensions extend the NCD burden. The *de jure* social globalization, on the other hand, decreases the burden of NCDs. The regulation that governs globalization is not favorable as a whole to reduce the burden of NTMs even if *de jure* social globalization enable to limit the latter. Improving the *de jure* social globalization index by 1 point allows the NCD deaths to be reduced by about 0.012 point.

The effects of the *de facto* globalization and its dimensions on NCD deaths are examined in Table 5. Column (1) provides the effects of the overall *de facto* globalization while columns (2), (3) and (4) respectively show the effects of the economic, social and political dimensions of *de facto* globalization. The coefficients of the *de facto* globalization variables are negative and significant at 1% and 10% in columns (1), (2) and (3) while the coefficient in column (4) is positive and significant at 1%. These results convey the information that the *de facto* globalization and its economic and social dimensions restrain the NCD burden in Africa while its political dimension fosters the latter. The practices and activities of globalization as a whole lessen the NCD burden in Africa even though political globalization contributes to increase it. Increasing the overall *de facto* globalization index by 10 units decreases the death from NCDs by 0.034 unit. This same increase for the economic and social dimensions of the *de facto* globalization lowers respectively the NCD deaths by around 0.037 and 0.148 units.

We now examine the coherence between the regulations that govern globalization and the activities and practices of the latter. The motivation is to know whether the laws and decrees governing globalization are rigorously monitored in their implementation. If the implementation of these laws and decrees is effectively supported, there will be no difference between the effects of *de jure* globalization and those of *de facto* globalization. The task is carried out, by comparing the results from table (4) and those of table (5).

This comparison exhibits some discrepancies related to some coefficients' sign and significance. The coefficient of *de jure* globalization is insignificant while that of *de facto* globalization is significant. Moreover, the *de jure* economic globalization increases the burden of NCDs while the *de facto* economic globalization reduces it. This conflicting information shows some disconnect between the regulation that govern globalization and, activities and practices of globalization. This result raises the question not only about the elaboration but also the monitoring of the implementation of the regulations that govern globalization. The dissimilarities of the effects of the two aspects then show some shortcomings in the elaboration and monitoring of the implementation of laws and decrees that guide the activities and practices of globalization.

Our findings that globalization and some of its dimensions reduce the NCDs burden corroborate with some empirical studies that analyze the links between globalization and health outcomes and measure the latters' using different mortality indicators (Owen & Wu, 2007; Martens et al., 2010; Tausch, 2012; 2016; García-Dorado et al., 2019; Jani et al., 2019). Some studies that associate globalization to NCD risk factors such as obesity, overweight and blood pressure show that globalization increases the latters' through changes in consumption habits (consumption of alcoholic, fatty and very sweet products) which can lead to an increase in NCDs (Goryakin et al., 2015; Miljkovic et al., 2015; Schram et al., 2013; De Soysa & De Soysa, 2018). However, as mentioned above, globalization allows to acquire of new health technologies and pharmaceutical products allowing a better supervision and treatment of NCDs, which can then lead to a reduction in the burden of NCDs as the case in this study (Huynen et al., 2005; Labonté, 2019).

Table 6: Effects of *de facto* Globalization and its Dimensions on the Burden of NCDs

Variables	(1)	(2)	(3)	(4)
kofgidf	-0.0034*			
	(0.002)			
kofecgidf		-0.0037***		
		(0.001)		
kofsogidf			-0.0148***	
			(0.002)	
kofpogidf				0.0040***
				(0.001)
gdp_pc (Log)	-0.3241***	-0.3065***	-0.2634***	-0.3127***
	(0.055)	(0.054)	(0.057)	(0.049)
gov_health_exp (Log)	0.2183***	0.2075***	0.1707***	0.1948***
	(0.016)	(0.015)	(0.015)	(0.021)
health_exp (Log)	0.1510	0.1375	0.2214**	0.1195
	(0.088)	(0.094)	(0.092)	(0.088)
poplation_urban (Log)	0.9223***	0.9012***	0.8818***	0.8587***
	(0.010)	(0.010)	(0.013)	(0.011)
education	-0.0297**	-0.0267**	-0.0246**	-0.0306***
	(0.011)	(0.012)	(0.010)	(0.011)
sanitation	0.0060***	0.0059***	0.0073***	0.0062***
	(0.001)	(0.001)	(0.001)	(0.001)
employment	0.0099***	0.0107***	0.0108***	0.0109***
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-2.8673***	-2.6307***	-2.6318***	-2.2412***
	(0.089)	(0.127)	(0.113)	(0.136)
Observations	867	867	849	867
F-Stat	66575	52308	67953	66751
F-Prob	0.000	0.000	0.000	0.000
Country-FE	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is. ***, **, and * denote significance at 1%, 5% and 10% respectively. Standard deviations in parentheses

Regarding the control variables, the latters' have in the most cases their expected effects. Indeed, GDP per capita, the government health spending, access to basic health infrastructures, employment and education reduce the NCD burden in most of our regressions. These variables respectively decrease the NCD deaths. In the cases where their coefficients have the opposite signs, those remain insignificant. The current health expenditure does not affect the NCD burden since its coefficients are insignificant for the most regressions. For the urban population, its increase would also lead to an increase in the burden of NCDs.

6. Conclusion

This study aims to examine the effects of globalization and its dimensions on the burden of NCDs in Africa for the period from 2000 to 2019. The globalization is measured by the KOF indices and the burden of NCDs is captured using the NCD deaths. The study disentangles the *de facto* globalization from the *de jure* one and uses the contemporary tools of panel data econometric analysis to overcome the problem of cross-sectional (spatial) dependence. Based on the robustness check, the findings highlight that globalization and its economic and social dimensions enable to control the burden of NCDs while political globalization extends deaths from NCDs. The disentanglement between the *de jure* and *de facto* aspects reveals that the *de facto* globalization is at the origin of the alleviation of the burden of NCDs by globalization.

According to the findings, we recommend the policymakers to strengthen the entrenchment of globalization by emphasizing on the social and economic dimensions. Doing so, they can support the use of New Information and Communication Technologies to share information to international scale. They must also promote the sharing of cultures, values and customs of the population through migration and tourism. The policymakers should exercise caution when encouraging their countries to join international and non-governmental organizations fighting various diseases, and when theirs countries strengthen the consular ties given that the political globalization increases the burden of NCDs. With regard to economic globalization, its regulatory framework must be deeply revised since the laws and decrees governing it are harmful for the burden of NCDs. The review of the regulatory framework would require the policymakers to address some requests such as: what products should be imported or exported, which corporation firms should be authorized in the country, so that the public health do not compromised. We should nevertheless point out that, taking into account these recommendations in the field of NCDs, must consider other areas.

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Table 2 : Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) ncd_deaths (Log)	1.000												
(2) kofgi	0.248	1.000											
	(0.000)												
(3) kofgidf	0.293	0.938	1.000										
	(0.000)	(0.000)											
(4) kofgidj	0.155	0.930	0.748	1.000									
	(0.000)	(0.000)	(0.000)										
(5) kofecgi	-0.203	0.635	0.603	0.580	1.000								
	(0.000)	(0.000)	(0.000)	(0.000)									
(6) kofecgidf	-0.307	0.425	0.519	0.267	0.868	1.000							
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)								
(7) kofecgidj	-0.002	0.681	0.488	0.786	0.773	0.353	1.000						
	(0.944)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)							
(8) kofsogi	-0.354	0.741	0.623	0.775	0.601	0.465	0.557	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
(9) kofsogidf	-0.386	0.672	0.610	0.659	0.590	0.515	0.464	0.960	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
(10) kofsogidj	-0.320	0.750	0.587	0.829	0.596	0.410	0.612	0.967	0.859	1.000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
(11) kofpogi	0.780	0.631	0.643	0.531	-0.069	-0.222	0.137	0.056	-0.010	0.099	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.039)	(0.000)	(0.000)	(0.095)	(0.775)	(0.003)			
(12) kofpogidf	0.783	0.574	0.623	0.443	-0.082	-0.242	0.133	-0.016	-0.078	0.031	0.975	1.000	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)	(0.000)	(0.000)	(0.636)	(0.021)	(0.355)	(0.000)		
(13) kofpogidj	0.676	0.655	0.600	0.621	-0.035	-0.156	0.125	0.178	0.116	0.210	0.919	0.808	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.299)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	
Mean VIF		**623.23**											

Table 3: Descriptive Statistic, Description and Sources of the Variables

Variables	Description	N	Mean	Min	Max	Sources
ncd_deaths (Log)	Total non-communicable disease deaths (Log)	900	10.08	5.950	13.01	WHO
ncd_deaths	Total non-communicable disease deaths	900	54,225	384	447,767	WHO
kofgi	Overall KOF globalization index	900	46.15	24	72	KSEI
kofgidf	De facto KOF globalization index	900	44.08	20	71	KSEI
kofgidj	De jure KOF globalization index	900	48.27	26	81	KSEI
kofecgi	KOF economic globalization index	900	43.27	21	85	KSEI
kofecgidf	De facto KOF economic globalization index	900	48.63	20	89	KSEI
kofecgidj	De jure KOF economic globalization index	860	37.91	17	81	KSEI
kofsogi	KOF social globalization index	900	38.86	12	78	KSEI
kofsogidf	De facto KOF social globalization index	880	33.94	8	72	KSEI
kofsogidj	De jure KOF social globalization index	900	43.68	13	85	KSEI
kofpogi	KOF political globalization index	900	56.20	20	89	KSEI
kofpogidf	De facto KOF political globalization index	900	49.09	7	92	KSEI
kofpogidj	De jure KOF political globalization index	900	63.34	28	90	KSEI
gdp_pc (Log)	GDP per capita	891	6.917	4.705	9.896	WDI
gov_health_exp (Log)	Government health expenditures	890	1.773	-0.457	3.463	WDI
health_exp (Log)	Current health expenditures	890	3.941	1.537	6.551	WDI
poplation_urban (Log)	Urban population	900	14.86	11.25	18.46	WDI
educationn	Education (Mean years schooling)	890	4.665	0.559	11.37	UNDP
sanitation	Access to basic sanitation	893	32.26	2.755	95.51	WDI
employment	Employment rate	900	60.33	30.79	85.87	WDI

Table 4: Effects of Globalization and its Dimensions on the Burden of NCDs

Variables	(1)	(2)	(3)	(4)
kofgi	-0.0033**			
	(0.001)			
kofecgi		-0.0023***		
		(0.000)		
kofsogi			-0.0137***	
			(0.002)	
kofpogi				0.0053**
				(0.002)
gdp_pc (Log)	-0.3252***	-0.3223***	-0.2991***	-0.3207***
	(0.055)	(0.055)	(0.055)	(0.051)
gov_health_exp (Log)	-0.2220***	-0.2153***	-0.2432***	-0.1938***
	(0.015)	(0.016)	(0.013)	(0.021)
health_exp (Log)	0.1481	0.1401	-0.2009**	0.1234
	(0.088)	(0.091)	(0.092)	(0.089)
poplation_urban (Log)	0.9200***	0.9079***	0.8921***	0.8575***
	(0.009)	(0.011)	(0.008)	(0.012)
education	-0.0292**	-0.0275**	-0.0140*	-0.0277**
	(0.011)	(0.011)	(0.007)	(0.010)
sanitation	-0.0062***	-0.0062***	-0.0066***	-0.0060***
	(0.001)	(0.001)	(0.001)	(0.001)
employment	-0.0099***	-0.0105***	-0.0093***	-0.0110***
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-2.8270***	-2.7169***	-2.5036***	-2.3002***
	(0.104)	(0.115)	(0.148)	(0.135)
Observations	867	867	867	867
F-Stat	77366	55422	133043	56342
F-Prob	0.000	0.000	0.000	0.000
Country-FE	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is. ***, **, and * denote significance at 1%, 5% and 10% respectively. Standard deviations in parentheses.

Table 5: Effects of *de jure* Globalization and its Dimensions on the Burden of NCDs

Variables	(1)	(2)	(3)	(4)
kofgidj	-0.0014			
	(0.002)			
kofecgidj		0.0047**		
		(0.002)		
kofsogidj			-0.0118***	
			(0.002)	
kofpogidj				0.0030**
				(0.002)
gdp_pc (Log)	-0.3277***	-0.3155***	-0.3042***	-0.3321***
	(0.054)	(0.054)	(0.054)	(0.056)
gov_health_exp (Log)	-0.2195***	0.2302***	-0.2572***	-0.2055***
	(0.014)	(0.013)	(0.013)	(0.019)
health_exp (Log)	0.1423	0.1330	-0.1809*	0.1368
	(0.089)	(0.096)	(0.089)	(0.091)
poplation_urban (Log)	0.9145***	0.9256***	0.8932***	0.8899***
	(0.010)	(0.012)	(0.008)	(0.010)
education	-0.0304***	-0.0477***	-0.0105	-0.0280***
	(0.010)	(0.013)	(0.006)	(0.009)
sanitation	-0.0061***	-0.0054***	-0.0065***	-0.0059***
	(0.001)	(0.001)	(0.001)	(0.001)
employment	-0.0100***	-0.0095***	-0.0096***	-0.0105***
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-2.7796***	-3.1380***	-2.4768***	-2.6379***
	(0.115)	(0.147)	(0.150)	(0.124)
Observations	867	837	867	867
F-Stat	74729	35362	101284	66947
F-Prob	0.000	0.000	0.000	0.000
Country-FE	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	Yes

Notes: The dependent variable is. ***, **, and * denote significance at 1%, 5% and 10% respectively. Standard deviations in parentheses.