Trade and Shocks Transmission in Africa: The role of AfCFTA

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Abstract- Using an instrumental variable (IV) strategy, we show that climate and political shocks in an origin country affect inflation in the destination country through trade in Africa. Specifically, a 1% decrease in imports resulting from such shocks leads to an increase in inflation in the destination country ranging from 0.05 to 0.06 percentage points. We then extend an international trade model based on Naito (2017) by incorporating money and productivity shocks to examine how the African Continental Free Trade Area (AfCFTA), adopted in 2021, could amplify the transmission of shocks across African countries. The model is estimated with Nigeria and South Africa, the two largest economies on the continent. Our findings indicate that the more African countries trade, the more they are exposed to shocks from their trading partners. For instance, if intra-African trade increases by 15% from its current level, the inflationary impact of a productivity shock in an origin country more than doubles in the destination country, rising from 0.3% to 0.68%. Moreover, the persistence of inflationary effects also becomes more important with deeper trade integration.

Keywords: Trade Economics, climate Shocks, RTA, AfCFTA

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1 Introduction

Despite an increasing number of Regional Trade Agreements (RTA), Africa's intra-regional trade was only 18% in 2020, compared to 68% in Europe and 58% in Asia (El-Shaa and DF António, 2022). To increase Regional trade, African countries adopted the African Continental Free Trade Area (AfCFTA) in 2021, the largest African RTA covering 54 out of 55 countries.[1] With the implementation of AfCFTA, intra-African trade is projected to increase significantly (Maliszewska et al., 2020; ElGanainy et al., 2023; World Trade Organization, 2023). Most studies project a 15% to 25% increase in trade over a decade following its full implementation (BAD, 2019; FMI, 2019; El-Shaa and DF António, 2022).[2] The recent trade war, which is disrupting traditional global supply chains and increasing protectionism in developed markets, presents a potential opportunity for African countries to strengthen intra-African trade and reposition themselves as alternative trade partners.

However, increasing intra-African trade may pose many challenges. Indeed, African countries have a higher vulnerability to a number of productivity shocks, including climate and socio-political shocks (Hassler and Krusell, 2012; IPCC, 2022, 2023). Therefore, increasing trade could increase the transmission of these shocks. Indeed, Schenker and Osberghaus (2025) show that weather shocks like extreme heat induce a decrease in exports, the impact increasing with high labor-intensity of exports. As one characteristic of African countries is that they are less industrialized and produce mainly raw materials (African Development Bank, 2017),[3] climate change could affect their exports and therefore prices with their African trading partners.

Given the anticipated surge in trade and the region's exposure to the shocks mentioned above, our research focuses on two main questions: to what extent do imports transmit shocks to inflation in the destination countries among African countries? And to what extent will AfCFTA amplify the transmission of shocks to inflation across countries?

To address these questions, we employ an instrumental variable (IV) strategy to show that trade transmits weather and political shocks from exporting countries to domestic prices within African countries. We rely on two primary data sources for this analysis. To capture weather shocks, we use the EM-DAT database, which records major disaster events globally (Delforge et al., 2025), focusing on natural disasters like droughts and floods in African countries. For socio-political shocks, we rely on the Armed Conflict Location & Event Data (ACLED) (Raleigh et al., 2023), and use the number of fatalities from protests, riots, strikes, political and military conflicts, and other social disturbances. Following the literature showing the impact of weather shocks and conflict on International trade (Jones and Olken, 2010; Abdel-Latif, 2024; Schenker and Osberghaus, 2025), we justify the exclusion restriction of these instruments by arguing that weather and socio-political shocks in the origin country does not directly affect inflation in the destination country, except in cases where the two countries are

[1] Only Eritrea has not signed the AfCFTA to date (ElGanainy et al., 2023).

[2] Maliszewska et al. (2020) states that trade could increase by 52% in 2035 and more than double after full implementation of AfCFTA.

[3] According to the African Development Bank, between 2011 and 2013, manufactured goods constituted only 18.5% of Africa's exports, while raw commodities dominated the export profile (African Development Bank, 2017).

close. However, we propose that trade acts as an indirect channel of transmission, which is the focal point of our analysis. Negative weather shocks like droughts, and socio-political shocks like violent conflicts may reduce exports, representing a negative productivity (or supply) shock likely to affect prices in the destination country. The validity of these instruments is discussed in Section 2.3.

We begin by assessing the relevance of our instruments, examining whether they induce variation in trade flows across African countries. We find a significant negative association between the number of natural disasters (droughts and floods) in the origin country and its export flows. We observe similar results for the number of deaths resulting from socio-political conflicts. We then investigate the inflationary effects of trade variations driven by these negative productivity shocks in the origin country on imports to the destination country. The results indicate that a 1% decrease in imports, caused by either weather shocks or violent socio-political conflicts in the main trading partners of a destination country, leads to a 0.05 to 0.06 percentage point increase in inflation in the destination country, depending on the specification and sample used. Given the average impact of weather and socio-political shocks on trade flows (a 4% drop) we estimate that on average these shocks add about 0.2 percentage points of inflation in destination countries in Africa.

To what extent will AfCFTA amplify the transmission of shocks to inflation across countries? To address this second question, we develop a dynamic stochastic model of international trade based on Naito (2017), incorporating Money-in-the-Utility (MIU) preferences and productivity shocks. This model is used to examine how the African Continental Free Trade Area (AfCFTA) might amplify the transmission of productivity shocks to inflation. We estimate the model using African economic data and simulate the potential impact of AfCFTA on the cross-country propagation of such shocks. Our analysis yields two key findings. First, increased intra-African trade intensifies the transmission of productivity shocks to inflation among trade partners. For instance, if intra-African trade rises by 15% due to AfCFTA, the inflationary impact of a productivity shock originating in one country increases in the destination country from 0.3% (its current effect) to 0.68%. Second, this amplification effect is nonlinear. When intra-African trade increases by around 25%, the inflation transmission effect rises only to 0.5%, which is lower than the 0.68% observed at a 15% increase. However, the persistence of the effect increases with greater trade integration.

Related Literature

This paper is related to two strands of literature. First, it is related to the literature on the transmission of shocks through trade across countries (Corsetti et al., 2008; di Giovanni and Levchenko, 2009; Enders and Müller, 2009; Caselli et al., 2020; Kejžar et al., 2022; Baqaee and Farhi, 2024; Benguria et al., 2024; Camara et al., 2024; Schenker and Osberghaus, 2025). Enders and Müller (2009) and Corsetti et al. (2008) provide empirical evidence on how international trade can act as a conduit for transmitting economic disturbances across borders. More recently, Baqaee and Farhi (2024), Benguria et al. (2024), and Camara et al. (2024) have explored the network effects and sectoral spillovers that amplify shock transmissions in global trade networks. Further, Kpodar and Imam (2016) investigates the effects of Regional Trade Agreements (RTAs) on growth volatility. Analyzing data from 172 countries over the period 1978-2012, they find that RTAs significantly reduce growth volatility. Their study suggests that countries are more likely to join RTAs when they are exposed to higher growth shocks and have potential partners with stable economic growth. We focus in this paper on prices stability.

Somanathan et al. (2021) and Burke et al. (2015) explore the impact of temperature variations on productivity and labor supply, demonstrating a non-linear relationship between temperatures and macroeconomic productivity. These studies suggest that climate shocks in one country can significantly affect its trade partners through changes in productivity and export capacities. We explore empirically that question among African countries. In addition to climate shocks, we study the effect of political shocks in an origin country on inflation in the destination country through trade. Despite this rich literature, studies on shock transmission through intra-trade in Africa are scarce, with some exceptions including Ncube et al. (2014), who focuses on output co-movement in Africa. This scarcity might be due to two reasons. First, the low level of intra-trade in Africa, around 18% in 2020, may have a negligible effect on shock transmission. However, with the recent African Continental Free Trade Area (AfCFTA), intra-trade in Africa is likely to increase, making the question of how trade transmits shocks in Africa a timely topic. Second, there is a lack of data to identify shocks that could be transmitted through trade. In this paper we use PRIO-GRID data on temperature and the Social Conflict Analysis Database (SCAD) from Idean et al. (2012) to provide evidence of shock transmission through trade among African countries.

The paper is also related to how RTAs transmit shocks across countries and their implications for monetary policy (Silveira, 2015; Corsetti et al., 2007, 2005). Eaton and Kortum (2012) discusses how the popular ricardian model can be used to address many economic issues, including the welfare effects of trade deficits, wage responses to decreases in trade barriers, and responses to technological changes. Eaton and Kortum (2002) develops a ricardian model that incorporates technology and geography in trade among countries. This model is used to quantify gains from trade and from tariff reductions. They find that all countries gain from free trade, with smaller countries gaining more than larger ones. They also calculate the role of trade in spreading technology across countries. Caliendo and Parro (2015) estimates the trade and welfare effects of NAFTA from tariff changes using a ricardian model similar to Eaton and Kortum (2002). Importantly, they study how gains from tariff reduction spread across sectors and find that tariff reduction leads to more specialization, especially for Mexico. They also find that, unlike Mexico and the US, Canada suffers a welfare loss. Shikher (2012) Build an Eaton and Kortum Model to study the effect of US-EU trade wars and the effect of trade barriers reduction between high-income and middle-income countries. Lind and Ramondo (2024) study how international trade can transmit ideas across countries and influence countries' growth. Our model is closer to Naito (2017), which combines an Eaton and Kortum (2002) model of trade with an Acemoglu and Ventura (2002) AK model to explain the implications of trade on economic growth. Since we are primarily interested in the effects of productivity shocks from an exporting partner on inflation in the destination country, we augment the model with a Central Bank.

The remainder of this paper is structured as follows. In Section 2, we provide empirical evidence of the transmission of climate and political shocks across African countries through trade. Section 3 presents the theoretical model. Section 4 discusses the results of the theoretical model. Finally, Section 5 concludes the paper.

2 Empirical investigation

This section aims to provide empirical evidence of shock transmission through trade. We begin by presenting the data and analyzing how climate and political shocks in an origin country affect inflation in its trading partner, the destination country.

2.1 Data presentation

The data we use for the analysis of shock transmission through trade come from two main sources. On the one hand, to capture weather shocks, we rely on the EM-DAT database developed by the Centre for Research on the Epidemiology of Disasters (CRED)[4] (Delforge et al., 2025). Since 1988, the EM-DAT database records major disasters globally by compiling and curating information from various sources. Disasters are defined by CRED as "situations or events which overwhelm local capacity, necessitating a request for external assistance at the national or international level". Moreover, EM-DAT on record "major" disasters, meaning those that induce at least either 10 fatalities, 100 affected people, a declaration of state emergency or call for international assistance. In this study, we measure weather shocks in a country by the number of natural disasters (droughts and floods) that occur in a given year. Hence, $NDisasters_{ot}$ will denote the number of natural disasters having occurred in country o in year t.

On the other hand, to capture socio-political shocks, we rely on the Armed Conflict Location & Event Data (ACLED)[5] (Raleigh et al., 2023). ACLED records 6 types of violent and non-violent politically-relevant events pertaining to political disturbance[6]. In this paper, we use the number of fatalities from those political disturbance to capture socio-political shocks. We aggregate this event-level information by computing the total number of fatalities at the country-year level. We then define $NFatalities - AboveQ3_{ot}$ as a dummy variable that is equal to 1 if the number of fatalities from socio-political conflicts in country o is above the 3rd quartile of the distribution in the entire sample.

As trade data, we use bilateral imports from the World Trade Organization *WTO Stats* database[7]. We construct our main aggregates of trade flows for this paper by using product-level trade flows classified at the two-digit level of the Harmonized System (HS) [8]. This allows for a granular examination of trade flows by broad product categories while maintaining consistency across countries and years. Our dataset spans the period from 2001 to 2019 and includes bilateral trade volumes for each product category among African countries.

Finally, we compute annual inflation for each country using the consumer price index (CPI) available in the World Development Indicators (WDI) database. To reduce the impact of outliers, we winsorize the inflation rate at the 5% level each period. [9]

[4]EM-DAT, CRED / UCLouvain, Brussels, Belgium – www.emdat.be

[5]ACLED, "Armed Conflict Location & Event Data (ACLED) Codebook," 17 January 2025. www.acleddata.com.

[6](i) armed battles, Explosions/Remote violence, violence against civilians, protests, riots and strategic developments. See at https://acleddata.com/faq/what-types-events-does-acled-code

[7]World Trade Organization (WTO)

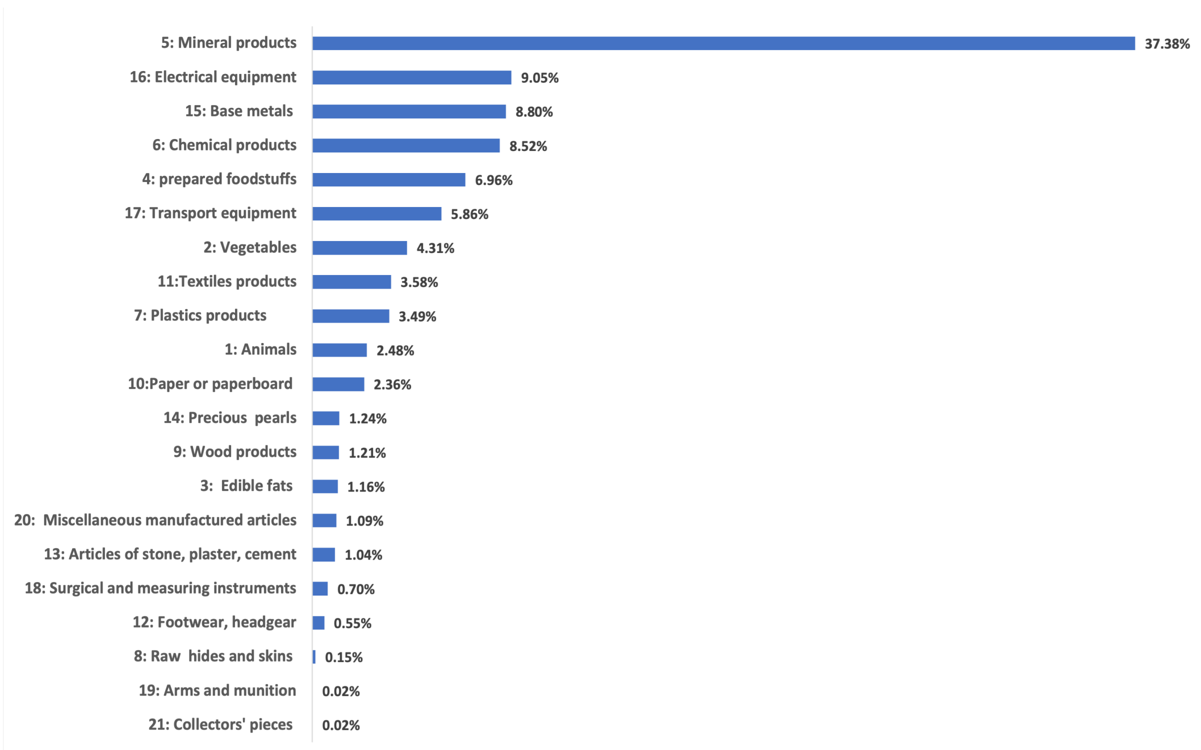
[8]The Harmonized System is provided by the World Customs Organization's website.

[9]The 99^{th} and 95^{th} percentile of inflation rate in the broad sample are respectively 198.5% and 29.8%.

2.2 Descriptive statistics

Figure 1 presents the average trade share of product categories among African countries between 1996 and 2016. We use a detailed product classification at the two-digit level from WTO. To compute the share, we aggregate the total trade volume for each year across all products and calculate the proportion of each product's trade volume to the total. Our findings show that *mineral products*, comprising oil, gas, cement, cobalt, aluminum, uranium, and other materials, were the most commonly exchanged products among African countries, followed by *electrical equipment, base metals, and chemical products*, each accounting for approximately 9% of total trade. In contrast, the least traded products were collector's pieces, arms and munitions, and raw hides and skins, which accounted for less than 0.5% of total trade.

Figure 1: Intra-African trade share by product category



Notes: Average trade among African countries by product over the period 1996-2016

In addition, there was a substantial variance in trade volume across different products. For example, animals had the least variation, with a standard deviation of 279,816, while the standard deviation of transport equipment was 554 times higher. [10] The most commonly traded products, *mineral products*, had a standard deviation that is approximately 94 times higher than animals. This variability in the data implies that some products are significantly more volatile in terms of trade volume than others. Moreover, this variability is still apparent at the country pairs level, as illustrated in Figure 4.

Table 7 in the Appendix presents descriptive statistics of the variables used in the

[10]For each product, we compute the standard deviation of trade values at the country-pair and year level

estimations. As the coverage of the trade data increases rapidly between 1996 and 2001, we only consider pairs of origin-destinations between 2001 and 2019. The sample considers all the pairs of origin-destinations for which some data on trade is available (1,712 pairs), The sample contains 53 origin countries and 38 destination countries. The complete list of countries is presented in Appendix 6.

The average number of natural disaster events (droughts and floods) over the sample, as measured by $NDisasters_{ot}$, is about 0.9 , while 18% of observations have experienced a severe political shock, as measured by $NFatalities-AboveQ3_{ot}$. The average inflation rate is about 5.7%.

2.3 Trade and shock transmission across African countries

2.3.1 Empirical specification

To what extent do imports transmit shocks to inflation in destination countries among African countries? To answer this question, we focus on weather and socio-political shocks in the origin country and ask whether inflation in the destination country is affected.

However, the relationship between inflation and imports is ambiguous, as both variables are determined simultaneously. A strong domestic demand could lead to inflationary pressures and simultaneously increase the level of imports. In this case, both variables will be positively correlated. In contrast, a negative foreign supply shock could reduce imports and create inflationary pressure in the domestic country if demand stays at its previous level. The latter channel is the one we are interested in estimating in this work.

Therefore, we rely on the local average treatment effect (LATE) interpretation of the instrumental variable estimand put forward in (Angrist and Imbens, 1994; Angrist et al., 1996). Indeed, for a given instrument Z, a treatment X, and an outcome variable Y, the IV-estimator identifies under suitable conditions the change in the outcome variable due to changes in the treatment X for those units who respond to the instrument Z. In our setup, a unit of observation is a pair of origin-destination countries (o, d), the instrument is a climatic or socio-political shock in the origin country (z_{ot}) and the treatment variable is the trade flow from country o to country d (x_{dot}). One of the conditions underlying the LATE interpretation in IV-regressions is that the instrument induces changes in the treatment variable. [11] Jones and Olken (2010) shows that higher temperatures in poor countries have a negative effect on the growth of their exports to the US and also to the world. Moreover, the decrease is experienced not only in agricultural goods but also in light manufacturing. For weather and political shocks to be valid instruments in our setup, they might first induce changes in trade flows across African countries. We show below, by estimating equation 1, that for a given pair of trading countries (o, d), a negative weather or political shock in the origin country o reduces trade flows from o to d.

$$x_{dot} = a_{do} + \gamma_t + \beta^W z_{ot}^{Weather} + \beta^P z_{ot}^{Political} + u_{dot} \tag{1}$$

[11] Also called endogenous variable

Where for each period t, x_{dot} denotes imports of country d from country o , $z_{ot}^{Weather}$ a negative weather shock in country o, $z_{ot}^{Political}$ a negative political shock in country o, a_{do} a destination $\times$ origin fixed effect, λ_t a time fixed effect, and u_{dot} an error term capturing other factors influencing international trade flows.

Now, one could think of multiple reasons for which a statistically significant drop in trade flows for the average country-pair might not lead to a significant negative supply shock in the destination country, and hence to inflation pressures. One such case is when countries tend to import mostly from a few other countries, so that the average flow would represent only a small portion of their import (Pareto distribution of trade flows). This channel is more pregnant in the case of Africa, as intra-continental trade is about 1/5th of total trade. Another case is when countries tend to have a well diversified set of trading country partners, so that they are able to compensate for the shortfall of a few of them. To address somewhat these two concerns, we use the following specification for our instrumental variable strategy, where we consider shocks in the main trading partners, on the one hand, and control for trade flows originating from outside Africa, on the other hand.

$$y_{dt}^{d} = B_d + \lambda_t + \alpha^{AFR} x_{dt}^{AFR} + \alpha^{nonAFR} x_{dt}^{nonAFR} + \varepsilon_{dt} \tag{2}$$

$$x_{dt}^{AFR} = A_d + \Gamma_t + \sum_{k=1}^{n} \beta^{W,k} z_{dt}^{Weather,k} + \sum_{k=1}^{n} \beta^{P,k} z_{dt}^{Political,k} + u_{dt} \tag{3}$$

Where for each period t, y_{dt}^{d} denotes inflation in the destination country d, x_{dt}^{AFR} imports of country d from all African countries o , x_{dt}^{nonAFR} imports of country d from all non-African countries o, a_{do} a pair destination $\times$ origin fixed effect, λ_t a time fixed effect, and ε_{dot} an error term capturing other factors influencing inflation aside from international trade. We assume that trade flows are potentially correlated with these latter factors: $cov(x_{dt}^{i}, \varepsilon_{dot}) \neq 0$, $i \in \{AFR, nonAFR\}$. For example, an increase in public spending in country d might simultaneously increase inflation and imports of machinery. To deal with this endogeneity issue, we use weather and socio-political shocks in countries that are the top-n main trading partners of country d (denoted by $z_{dt}^{Weather,k}$ and $z_{dt}^{Political,k}$ respectively, $k \in \{1, ..., n\}$) as an instrument to imports of d from within Africa. For a given year t and destination country d, origin countries are ranked according to their contribution to the total volume of imports country d in the preceding year $(t-1)$.

The second condition supporting the validity of IV-regressions states that the instrument should only influence the outcome variable through the treatment variable (exclusion restriction). Thus, in our case, a drought or armed conflict in the origin country should only affect inflation in the destination country through its effect on the supply of goods to the destination country. This would be violated, for example, if water distress increases systematically simultaneously in the origin and destination countries. In this case, both partners would experience a negative supply shock, and the estimated IV-effect would conflate inflationary pressures originating both inside and outside the destination country. We control for this possibility in an additional specification of equation 2, where we add two dummy variables indicating the occurrence of weather and socio-political shocks in the destination country.

We estimate the above regressions using the sample as described in table 7. We consider all the pairs of origin-destinations for which some data on trade is available between 2001 and 2019.

On the other hand to control for the heteroskedasticity of trade flows across different pairs of countries (see Figure 4), we estimate the regressions using both OLS and Feasible Generalized Least Squares as in Jones and Olken (2010).[12]
In a given year, for each pair, we use as a measure of weather shocks the number of natural disasters (droughts and floods) as reported in the EM-DAT database. Regarding socio-political shocks, we use a dummy variable equal to 1 if the number of fatalities during socio-political conflicts and political violence, as reported in the ACLED database, is in the last quartile of the sample.

2.3.2 Results

We begin by answering the question of whether the instrumental variables we consider do induce variations in trade flows across African countries. Results for the first-step regression are given in table 1.

Overall, we find a significant negative association of natural disasters (droughts and floods) and violent conflicts in the origin country with import flows to the destination country. Focusing on OLS regressions, one additional natural disaster increases in the origin country is associated with about 3.5% reduction of imports to destination countries. A correction for heteroskedasticity using FGLS brings the estimates at about 2.2%. These estimated effects are robust to the inclusion of the number of natural disasters in the destination country, supporting the fact that they are not driven by a spatial correlation in disasters occurrence. Regarding the effect of fatalities in socio-political conflicts in the origin country, results point to a negative association of imports with violent socio-political conflicts, with an estimated effect raging between an 11% to an 18% drop imports. At the bottom of Table 1, F-statistics across all regressions range from 6.3 to 11. This may suggest that our instruments are weakly correlated with trade flows, as they are not likely to be the main determinants of trade flow variations across African countries. Still, the application of Feasible Generalized Least Squares (FGLS) appears to enhance the strength of the instrumental variables by accounting for heteroskedasticity in the error structure. This improvement is reflected in the first-stage F-statistics, which rises when FGLS is employed. By producing more efficient and reliable first-stage estimates, FGLS contributes to stronger instrument relevance and helps mitigate concerns related to weak instruments.

We next turn to the analysis of the inflationary effects of trade variations due to negative supply shocks in origin countries. As described in the previous section, we focus on the shocks originating in the main trading partners for the previous year. Figure 5 plots point estimates from our IV-regressions as function of the number countries of top trading partners considered, and also depending the type of shocks (droughts, floods, and violent socio-political conflicts). Overall, results point a negative elasticity of inflation to imports, which is most significant when imports are instrumented by violent socio-political conflicts and droughts in the top-1 to top-3 major trading partners. Table 2 gives, alongside OLS estimates, the results for our most preferred specification, where

[12] Residuals from the OLS regressions are used to estimate pair-specific variances which are used as weights in a second OLS regression.

Table 1: First-step regression: shock-induced variations in trade flows

	$log(Import_{dot})$			
	OLS		FGLS	
	(1)	(2)	(3)	(4)
$NDisasters_{ot}$	-0.0354**	-0.0352**	-0.0217***	-0.0222***
	(0.0150)	(0.0150)	(0.00611)	(0.00619)
$NFatalities-AboveQ3_{ot}$	-0.181***	-0.182***	-0.114***	-0.115***
	(0.0660)	(0.0661)	(0.0340)	(0.0339)
$NDisasters_{dt}$		0.0144		-0.00369
		(0.0159)		(0.00695)
$NFatalities-AboveQ3_{dt}$		-0.0779		-0.0242
		(0.0580)		(0.0267)
Destination FE	F	F	F	F
Origin FE	F	F	F	F
Origin * destination FE	T	T	T	T
Year FE	T	T	T	T
R2	0.772	0.772	0.981	0.989
F-stat	6.307	3.581	11.00	5.722
Observations	20,162	20,162	20,162	20,162

Notes: Results based on data from 2001 to 2019. Bilateral import flows are obtained by aggregating 2-digit product-level bilateral imports from the WTO Stats database. Standards errors are clustered at the Origin * destination level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

For each year t, $NDisasters_{ot}$ is the number natural disaster events that occurred in country o. $NFatalities - AboveQ3_{ot}$ is a dummy variable equal to 1 if the number of fatalities from political and social conflicts in country o is above the 3rd quartile of the distribution of the entire sample, which here is 180.

we consider as instruments the number of droughts and the occurrence of violent socio-political conflicts in coutries being the top-3 trading partners of the destination country.

we can make two general technical observations: first, OLS and FGLS estimates (columns 1 and 4) are smaller in magnitude than IV estimates and statistically insignificant. This is consistent with the presence of endogeneity bias, for example arising from a positive domestic demand shock which will at the same time increase imports levels and inflation. Second, FGLS and IV-FGLS estimates tend to be more precise than plain OLS and IV estimates, which is consistent with the presence of heteroskedasticity. The presence of heteroskedasticity is formally tested using the Pagan and Hall (1983) test. As shown in the last row of Table 2, the test strongly rejects the null hypothesis of homoskedasticity, with p-values lower than 1%. We therefore prefer FGLS estimates in our analysis, as they account for heteroskedasticity in the error structure.

Due to the presence of heteroscedasticity, the Kleibergen-Paap (KP) test provides a

Table 2: Inflationary effect of shock-induced trade variations

	$Inflation_{dt}$					
	OLS	IV-OLS		FGLS	IV-FGLS	
	(1)	(2)	(3)	(4)	(5)	(6)
$log(import_{dt}^{AFR})$	-0.893	-8.167*	-6.496	-0.551	-5.845**	-5.172**
	(0.596)	(4.570)	(3.944)	(0.418)	(2.801)	(2.491)
$log(import_{dt}^{non-AFR})$	-0.104	2.216	1.820	-0.339	1.649	1.420
	(1.009)	(1.903)	(1.639)	(0.506)	(1.275)	(1.164)
$NDisasters_{dt}$			1.668**			0.691**
			(0.625)			(0.305)
$NFatalities - AboveQ3_{dt}$			0.948			0.578
			(0.875)			(0.414)
Destination FE	T	T	T	T	T	T
Year FE	T	T	T	T	T	T
Observations	540	540	540	540	540	540
CD Fstat		2.135	2.192		4.451	4.377
KP Fstat		9.999	10.03		12.15	12.02
KP pval		0.125	0.123		0.0588	0.0616
Pagan-Hall pval					0.0042	0.0012

Notes: Results based on data from 2001 to 2019. Inflation is annually winsorized at 5%. Bilateral import flows are obtained by aggregating 2-digit product-level bilateral imports from the WTO Stats database. In all IV estimations, we have 6 instruments capturing respectively the number of droughts and large casualties in socio-political conflicts in the top-3 main trading partners of destination countries: $NDisasters_{dt}^{k}$, $NFatalities - AboveQ3_{dt}^{k}$, $k \in \{1, ..., 3\}$
*Standards errors are clustered at the Origin * destination level.*
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

more robust measure of instrument strength than the Cragg-Donald (CD) test (Baum et al., 2007). Indeed, in settings with a single endogenous variable, as our case, the Kleibergen & Paap(2007) Wald statistic is equivalent to a *nonhomoskedasticity-robust F-statistic* (Andrews et al., 2019).

The p-values associated with the KP statistics (*see KP pval in the table*) indicate that the instruments are sufficiently strong to limit bias in the IV estimates to within a tolerable threshold of 10%, as suggested by Baum et al. (2007).[13]

Simple IV estimates (columns 2 and 3), using droughts and violent socio-political conflicts as instruments, yield negative coefficients that are not statistically significant, likely due to high standard errors. When correcting for heteroskedasticity using FGLS (columns 5 and 6), the coefficients remain similar in magnitude but become statistically significant at conventional levels (at least at 5%). This improvement in precision, alongside the stability in coefficient size, suggests that while heteroskedasticity affected inference, it may not have introduced large bias in the point estimates.

These latter results imply that a 1% decrease in imports due to increased number

[13] See also Stock and Yogo (2002) for a discussion on instrument strength under heteroscedasticity.

of droughts or the occurrence of violent socio-political conflicts in the origin country leads to an increase in inflation of 0.05 to 0.06 percentage points in the destination country, depending on the specification used. The results do not vary substantially when controlling for the number of natural disasters and the occurrence of violent socio-political conflicts in destination countries (see column 6), suggesting that the estimates are effectively capturing the impact of shocks originating in origin countries.

In this section we have shown that trade transmits political and climate shocks to inflation across African countries. The second question is: to what extent will AfCFTA amplify the transmission of shocks to inflation across countries?

While instrumental variable (IV) methods can identify a local average treatment effect (LATE) and are useful for estimating the causal impact of observable shocks, they are limited in their ability to study policy counterfactuals, such as the effects of the African Continental Free Trade Area (AfCFTA). In particular, trade liberalization under AfCFTA may modify firms' and consumers' behavior, rendering IV estimates based on pre-AfCFTA data unreliable. [14] Structural models, which embed economic behavior explicitly, are better suited to account for such changes. [15] Therefore to answer the above-mentioned question, we adopt a structural approach in the following section.

3 The Model

3.1 Model Environment

The model features a multi-country general equilibrium framework in which each country is populated by representative consumers, firms (both intermediate and final goods producers), and a central bank. Each country produces a non-tradable final good by aggregating a continuum of differentiated intermediate goods, which are tradable across countries subject to iceberg trade costs. Intermediate goods are produced by perfectly competitive firms, each of which produces a unique variety using capital as the sole input. The final good is produced under perfect competition using a Constant Elasticity of Substitution (CES) aggregator of intermediate goods. The final good is then used for both consumption and investment in capital.

The consumer's utility function includes real money balances, capturing Money-in-the-Utility (MIU) preferences, which generates a demand for money. The central bank in each country sets the nominal money supply according to an exogenous process. Each country experiences a country-specific productivity shock in the final goods sector, which affects the efficiency with which output is produced. This shock follows an autoregressive process of order one (AR(1)), capturing persistence over time.

Trade between countries is subject to bilateral iceberg costs, τ_{nj}, where shipping τ_{nj} units from country j delivers one unit to country n. These costs introduce home bias and allow the model to capture the frictions and asymmetries commonly observed in

[14] AfCFTA could alter trade and production incentives across all markets. It could also change countries' exposure to external shocks. A structural model endogenizes these amplification mechanisms, allowing us to examine how and why AfCFTA may amplify or dampen inflation spillovers.

[15] An insight aligned with the Lucas critique (Lucas, 1976).

trade data.

3.2 Households

We introduce money into the utility function (MIU) to generate a demand for money. Utility is derived from real money balances, represented as $m_{jt} = \frac{M_{jt}}{P^Y_{jt}}$, where M_{jt} denotes nominal money holdings and P^Y_{jt} is the price level in country j at time t. The household's optimization problem is defined as:

$$\max_{\{K_{jt+1}, m_{jt}, C_{jt}\}_t} \sum_{t=0}^{\infty} \beta^t U(C_{jt}, m_{jt})$$

$$\text{s.t: } C_{jt} + K_{jt+1} - (1-\delta_j)K_{jt} + \frac{M_{jt}}{P^Y_{jt}} = \frac{r_{jt}}{P^Y_{jt}} K_{jt} + \frac{M_{jt-1}}{P^Y_{jt}} \tag{4}$$

By substituting the real money balance expression, the budget constraint can be rewritten as:

$$C_{jt} + K_{jt+1} - (1-\delta_j)K_{jt} + m_{jt} = \frac{r_{jt}}{P^Y_{jt}} K_{jt} + m_{jt-1} \cdot \frac{1}{1+\pi_{jt}},$$

where π_{jt} is the inflation rate in country j at time t. The first-order condition with respect to real balances m_{jt} yields the demand for money. The supply of money is exogenously determined by the Central Bank.

3.3 Central Bank

The role of the Central Bank is only to supply money. [16] It follows this equation: $M_{jt} = (1+\mu_{jt})M_{jt-1}$. Expressed in terms of real balances (to be consistent with the consumer's formulation), it gives:

$$m_{jt} = (1+\mu_{jt}) \frac{m_{jt-1}}{(1+\pi_{jt})}. \tag{5}$$

where μ_{jt} is an exogenous (stochastic) growth rate of the nominal stock of money set by the Central Bank and π_{jt} is domestic inflation.

Denote $\bar{\mu}_j$ the average growth rate of the money supply. Define $u_t = \mu_{jt} - \bar{\mu}_j$ be the deviation in period t of the growth rate from its unconditional average value. Following Walsh (2003), this deviation is assumed to follow the stochastic process given by:

$$u_{jt} = \rho^u_j u_{jt-1} + \phi z_{jt-1} + \varphi_{jt} \tag{6}$$

with φ_{jt} is a white noise process and $|\rho^u_j| < 1$. One could note that the growth rate of the money stock displays persistence (if $\rho^u_j > 0$), responds to the real productivity

[16] While the model includes a monetary component, the analysis does not examine the conduct or implications of monetary policy.

shock z in the final good sector, and is subject to random disturbances through the realizations of φ_{jt}.

z_j is the productivity and follows:

$$log(z_{jt}) = \rho_j^z log(z_{jt-1}) + e_{jt} \tag{7}$$

e_{jt} is an iid process following a normal distribution according to: $e_{jt} \sim \mathcal{N}(0, \sigma_j^z)$.

3.4 Intermediate goods-producing firms

Each country j produces a variety $s_j \in S_j \subseteq [0,1]$. Firms produce under perfect competition. The profit maximization problem for an intermediate goods-producing firm is:

$$\max_{K^x(s_j)} \Pi^x(s_j) = p(s_j)x(s_j) - r_j K^x(s_j)$$

subject to:

$$s.t : x(s_j) = \frac{K^x(s_j)}{a_j(s_j)} \tag{8}$$

where $a_j(s_j)$ and $p(s_j)$ represent the unit capital requirements and the supply price, respectively. The zero-profit condition implies:

$$p(s_j) = a_j(s_j) r_j$$

Let A_j be an iid random variable for $a_j(s_j)$. As in Eaton and Kortum (2002), A_j^{-1} follows a Fréchet distribution:

$$F_j(h) = Pr(1/A_j \leq h) = \exp(-b_j h^{-\theta})$$

where $b_j > 0$ and $\theta > 1$.

We consider iceberg trade costs: shipping τ_{nj} units from country j delivers one unit to country n ($\tau_{nj} \geq 1$). Producing variety s_j in country j and delivering it to country n costs:

$$p_{nj}(s_j) = \tau_{nj} p(s_j) = \tau_{nj} a_j(s_j) r_j \tag{9}$$

The demand price of variety s in country n is:

$$P_n(s) = \min(\{p_{nj}(s)\}_{j=1}^N)$$

3.5 Final Goods-Producing Firms

Firms in the final good sector also operate under perfect competition. Shocks z_n in the final goods sector follow an AR(1) process as shown in equation 7. The profit maximization problem for final goods-producing firms is:

$$\max_{x_n(s)} \Pi_n^Y = P_n^Y Y_n - \int_0^1 P_n(s) x_n(s)\, ds \tag{10}$$

subject to:

$$Y_n = z_n \left(\int_0^1 x_n(s)^{\frac{\sigma_n - 1}{\sigma_n}} \, ds \right)^{\frac{\sigma_n}{\sigma_n - 1}}$$

where P_n^Y is the price of the final good in country n. As Lemma 1 in Naito (2017), we have:

$$P_n^Y(\{\tau_{nj} r_j\}_{j=1}^N) = c_n \left[\sum_{j=1}^N b_j (\tau_{nj} r_j)^{-\theta} \right]^{-1/\theta} \tag{11}$$

where $c_n = z_n^{-1} \Gamma \left(1 + \frac{1-\sigma_n}{\theta}\right)^{\frac{1}{1-\sigma_n}}$ and Γ is the gamma function.

As shown in Appendix C.1, the price of the final good is an index of intermediate goods prices denoted by Q_n. The probability that country n imports goods from country j is the share of imports from j in country n's total imports and is given by:

$$\Pi_{nj} = \int_{s_j \in S_{nj}} p_{nj}(s_j) x_n(s_j) \, ds_j / Q_n Y_n \tag{12}$$

3.6 Equilibrium

3.6.1 Definition of the Equilibrium

An equilibrium in a given country j is a set of quantities and prices such that:

- $C_{j,t}, K_{j,t+1}, m_{j,t}$ solve consumer's problem defined in (4) given prices $r_{j,t}, P_{j,t}^Y, \pi_{j,t}$
- $K^x(s_j)$ solve intermediate firms problem in (8) given $r_{j,t}, p(s_j)$
- The intermediate good $x_j(s)$ solve final good firm problem in (10) given $P_{jt}^Y, P_{j,t}(s)$
- Central Bank supplies the quantity of money following (5).
- Market clearing conditions:
  - Intermediate goods market: [17]

$$x(s_j) = \sum_{n=1}^N \tau_{nj} x_n(s_j), \;\; s_j \in S_j \tag{13}$$

  - Capital market (at any period t):

$$K_j = \int_{s_j \in S_j} K^x(s_j) \, ds_j \tag{14}$$

  - The final goods market clearing:

$$Y_{j,t} = C_{j,t} + K_{j,t+1} + (1 - \delta_j) K_{j,t} \tag{15}$$

  - Money market clears, supply by the Central Bank is equal to the demand by consumers.

[17] Since firms' problems are static, we omit time subscripts for simplicity. Otherwise, equations 13

3.6.2 Characterization of the equilibrium

The equilibrium is characterized by a system of equations that solve for the endogenous variables: $C_{j,t}, K_{j,t}, m_{j,t}, P^Y_{jt}, \pi_{jt}, r_{jt}$. For that, let us first derive the Euler equations, obtained by the first-order conditions.

Euler Equation for Capital:

$$U_C(C_{jt}, m_{jt}) = \beta E_t \left[U_C(C_{j,t+1}, m_{j,t+1}) \left(\frac{r_{jt+1}}{P^Y_{jt+1}} + 1 - \delta_j \right) \right] \tag{16}$$

Euler Equation for Money:

$$U_m(C_{jt}, m_{jt}) = U_C(C_{jt}, m_{jt}) - \beta E_t \left[U_C(C_{j,t+1}, m_{j,t+1}) \left(\frac{1}{1+\pi_{jt+1}} \right) \right] \tag{17}$$

These Euler equations characterize the intertemporal optimization conditions for consumption and money holdings. [18] Combined with the budget constraint below, they describe citizens' optimization solutions.

$$C_{jt} + K_{jt+1} + m_{jt} = \left(\frac{r_{jt}}{P^Y_{jt}} + 1 - \delta_j \right) K_{jt} + \frac{m_{jt-1}}{1+\pi_{jt}} \tag{18}$$

The interpretation of these Euler equations follows standard intertemporal optimization logic.

Next, we derive the equation determining the nominal return on capital r_{jt}, which influences final good prices as shown in equation 11. The following lemma formalizes this relationship.

Lemma

The return on capital solves the following equation:

$$r_{jt}K_{jt} = \sum_{n=1}^{N} \Pi_{nj}(r_{nt}K_{nt} - M_{n,t-1}\mu_{nt}), j = 1, ..., N-1 \tag{19}$$

A detailed proof of this lemma can be seen in the appendix C.3. [19]

Interpretation: This equation can be broken down and interpreted as follows:

- Π_{nj}: represents the probability or fraction of the total value from country n that influences country j. It acts as a weighting factor that indicates the interaction between country n and country j.
- $(r_nK_n - M_{n,t-1}\mu_n)$: This term inside the summation can be broken down further:

and 14 would include time indices (e.g. $K_{j,t}$).

[18] Throughout the text, the terms 'money' and 'real balances' are used interchangeably to denote mj, t.

[19] Note that it's redundant to add the N-th equation, for more details see appendix C.4. In other words, this means that r_N can't be identified; we therefore normalized it to 1.

- r_nK_n: The total returns to capital in country n.
- $M_{n,t-1}\mu_n$: represents the additional money supply in country n at time t relative to time $t-1$. This term is subtracted from the total returns to capital, indicating the impact of money supply on the returns.

The equation states that the total returns to capital in country j (r_jK_j) are determined by summing up the weighted and adjusted returns to capital from all other countries. Each term in the summation adjusts the returns to capital from country n by subtracting the impact of the money supply. It illustrates the interdependencies and the role of trade in determining the distribution of capital returns among countries. Although we do not have a closed-form solution, we can describe the mechanism through which a productivity shock in one country affects inflation in its trading partners.

Mechanism (channel) of productivity shocks transmission to inflation. How does a productivity shock in a given country affect inflation in its trading partners? Consider a negative productivity shock in the final good sector of the origin country. This shock leads to a contraction in domestic output and a reduction in capital accumulation, since the final good is used for both consumption and investment in capital. The resulting decline in capital supply increases the marginal product of capital, thereby raising the domestic interest rate. Higher interest rates, in turn, elevate the production costs of intermediate goods, pushing up their prices. Because these intermediate goods are traded and used as essential inputs in final good production abroad, the price increase is transmitted across borders through trade linkages (see equation 9). In the destination country, higher imported input prices raise domestic production costs, ultimately leading to an increase in the final good's price level. This trade-based transmission mechanism, formally captured in equation 11, demonstrates how a domestic productivity shock can generate inflationary pressures in trading partner economies.

The next section estimates the model with African data to investigate the extent to which AfCFTA amplifies shock transmission across countries.

4 The effect of AfCFTA on shock transmission

To what extent will AfCFTA amplify the transmission of shocks to inflation across countries? In this part, we consider a three country version of the model. We chose Nigeria and South Africa to represents intra-African regional trade as they are the two largest economies in Africa. We also used China to represent the rest of the world. [20]. They are mainly used to estimate the productivity shocks persistence and their standard errors, as well as the trade cost.

4.1 Data for the estimation of parameters

It is well-documented that intra-African trade faces higher costs compared to other regions. Factors contributing to these elevated costs include infrastructural deficits, complex customs procedures, input delays, and regulatory barriers (Adom and Schott,

[20] Note that China has been Africa's largest trading partner during the last 15 years (The State Council) We alternatively used the US as the rest of the world, and the results were similar.

2024; Portugal-Perez and Wilson, 2008). As a measure of trade cost, we use the bilateral trade cost based on Novy (2013) from **ESCAP-WB** Trade Cost Database. It captures trade costs in its wider sense, including not only international transport costs and tariffs but also other trade cost components such as direct and indirect costs associated with differences in languages, and currencies, as well as cumbersome import or export procedures. The data is from 1995 to 2021 and covers over 180 countries. These trade cost data are generally higher than the value of the goods, making the ad-valorem trade cost higher than 1.

We used data on Total Factor Productivity (TFP) measures, which capture the efficiency with which inputs are transformed into outputs over time. [21] These measures are calculated using a Cobb-Douglas production function framework and adjusted for differences in capital and labor input quality. The current version (PWT 10.0) is described in detail by Feenstra et al. (2015).

4.2 Estimation of parameters and validation of the model

Table 3 displays the estimated trade cost between countries, the persistence of the productivity shocks, and their standard errors (std). [22] Table 8 contains the remaining parameters of the model, which are standard in the literature.

Table 3: Estimated Parameters and their Descriptions for the three countries.

Parameter	**Description**	**1.Nigeria**	**2.South Africa**	**3.China**
τ_{1j}	Trade cost to 1	1	2	1.6
τ_{2j}	Trade cost to 2	2	1	1.15
τ_{3j}	Trade cost to 3	1.15	1.6	1
ρ_j^z	Persistence of productivity shocks	0.946	0.968	0.887
σ_j^z	std of productivity shocks	0.043	0.036	0.062

Note: Trade cost refers to the average bilateral trade cost over the period 1995–2021. std denotes standard errors. The subscript j indicates country j. Trade cost values are expressed relative to domestic trade costs. For example, the trade cost between Nigeria and South Africa is twice as high as the internal trade cost within either country. Similarly, trade between Nigeria and China incurs a cost 1.6 times higher, while the cost between South Africa and China is 1.15 times higher.

To validate the model, we compare untargeted moments from the model to their counterparts in the data. Table 4 presents the results. First, we look at trade share, which is 18% in the data and 16.2% in the model. Second, since the focus is on inflation, we compare the standard errors of inflation in the destination country(represented by South Africa) to their model counterpart. These standard errors are obtained using the inflation generated in the destination country after a standard error productivity shock in the origin country (represented by Nigeria). Lastly, we look at the inflation correlation between the destination country and the origin country.

Overall, these three moments are close to each other when one compares the data

[21] TFP at constant national prices.

[22] It is worth noting that the trade cost estimates used in our analysis, taken from Novy (2013), are symmetric. We rely on these measures primarily due to the lack of more detailed data on intra-African trade costs. However, trade costs are not necessarily symmetric in reality; for instance, the cost of shipping goods from Nigeria to South Africa may differ from the cost of shipping in the reverse direction, as thoroughly documented in Brancaccio et al. (2020).

Table 4: Untargeted Moments

	Trade Share	Inflation Std	Inflation Correlation
Model	16.2%	3.98%	15.4%
Data	18%	4.39%	13.8%

Note: The table reports intra-African untargeted moments, calculated using data from 1975 to 2021. South Africa and Nigeria are used as representative countries for intra-African trade. The reported inflation correlation is measured between these two countries, using GDP deflator data from the World Development Indicators (retrieved on 25/04/2025). As a robustness check, we also used the consumer price index (CPI); the results were similar.

to their model-generated counterparts.

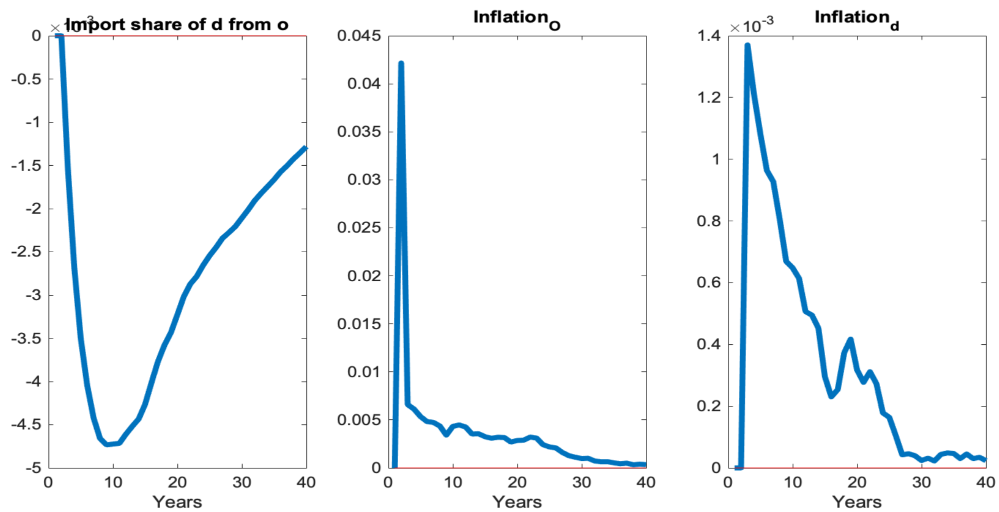
4.3 Results

Figure 2 illustrates the impact of a standard deviation negative productivity shock originating in the exporting (origin) country.[23] The first column displays the share of imports in the destination country sourced from the origin country; the second column shows inflation in the origin country; and the third depicts inflation in the destination country. The scenario corresponds to the Business As Usual (BAU) case, which uses parameters estimated from the previously described data. The results show that a negative standard deviation productivity shock reduces the import share from the origin country up to approximately 0.5%. [24] In the origin country, inflation rises significantly, reaching up to 4.2% after two years (captured by the variable $inflation_o$). In the destination country, inflation increases more moderately, peaking at 0.14% in the third year. Although the magnitude of the inflationary effect is smaller in the destination country, it dissipates more gradually and takes longer to return to its initial level compared to the origin country.

[23] As shown in Table 3, the standard deviation of productivity in the origin country, represented by Nigeria, is 4.3%. A negative one standard deviation productivity shock therefore, corresponds to a 4.3% decline in productivity.

[24] The Business As Usual (BAU) scenario is the model simulated using historically estimated parameters, before the implementation of AfCFTA. It reflects the status quo.

Figure 2: Supply Shocks in the origin country before AfCFTA



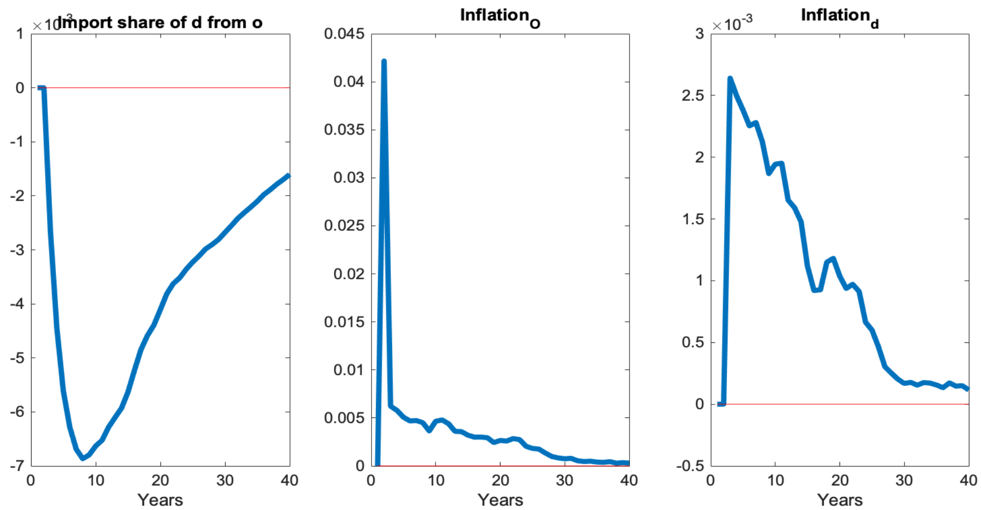
Notes: *This figure displays the impact of a Standard Deviation Productivity Shock in the Origin Country under the Business As Usual (BAU) Scenario. BAU is the model with parameters estimated with the data before AfCFTA (up to 20221). All the variables are expressed as a percentage deviation from the steady states.*

Channel of the Effect of a Productivity Shock: A negative productivity shock in any given country reduces both the country's output and its capital stock, as the final good is used for both consumption and investment in capital. This decline in capital supply leads to an increase in its price, reflected in a rise in the interest rate. Higher capital costs, in turn, raise the prices of both intermediate and final goods. Because intermediate goods are traded, these price increases are transmitted internationally, thereby raising prices in destination (importing) countries as well. Equation (11) formally captures the relationship between a country's price level and the interest rates of its trading partners. Additionally, Figure 6 in the Appendix illustrates the response of capital and interest rates to a productivity shock.

AfCFTA Scenario: Figure 3 presents the scenario under the African Continental Free Trade Area (AfCFTA). This scenario assumes an increase in intra-African trade from 16% to 30%, in line with most projections, which estimate trade growth between 15% and 25% following AfCFTA implementation. To simulate this, intra-African trade costs are reduced by 42.5%, from a value of 2 to 1.15.

The results exhibit a pattern similar to that observed in Figure 2. Notably, the inflation dynamics in the origin (exporting) country remain largely unchanged. However, the inflation response in the destination (importing) country becomes more pronounced compared to the Business As Usual (BAU) scenario. This heightened sensitivity is driven by greater transmission of price effects from the origin country. As goods become more expensive in the origin country following the productivity shock, and given the increased share of imports from that country under AfCFTA, the destination country experiences stronger inflationary pressure. Specifically, inflation in the destination country rises from 0.14% under the BAU scenario to 0.26% under AfCFTA.

Figure 3: Supply Shocks in the origin country after AfCFTA



Notes: *This figure illustrates the impact of a one standard deviation productivity shock in the origin country under an AfCFTA scenario (Scenario 2), which corresponds to an approximate 15% increase in intra-African trade. All variables are expressed as percentage deviations from their respective steady states.*

Simulated Scenarios. We simulate four scenarios. The *Business-as-Usual (BAU)* scenario uses parameters estimated from the data. Scenarios 1 to 3 correspond to *AfCFTA* (African Continental Free Trade Area) scenarios, incorporating reductions in trade costs intended to generate increases in intra-African trade between 15% and 25%, consistent with projections from studies such as Maliszewska et al. (2020), ElGanainy et al. (2023), and World Trade Organization (2023).

- **Scenario 1** reduces intra-regional trade costs from 2 to 1.5, increasing the trade share from the baseline of 16.2% to 22.6%.
- **Scenario 2** lowers trade costs further to 1.15, a 42.5% reduction, resulting in a 30.46% intra-regional trade share.
- **Scenario 3** applies an almost 50% reduction in trade costs, down to 1.001, leading to a 40% increase in intra-regional trade.

To ensure comparability with the instrumental variable (IV) estimates presented earlier, we scale the productivity shock to induce a 1% decline in imports. Specifically, we examine a negative productivity shock in the origin country that leads to a 1% reduction in imports in the destination country, and assess the resulting impact on inflation in the destination country.[25] Table 5 summarizes the results, reporting trade costs, the resulting trade shares, and the peak inflation observed in the destination country.

In the BAU scenario, a productivity shock in the origin country that leads to a 1% decline in imports results in a gradual rise in inflation, peaking at 0.3% after three

[25]Results for the same scenarios under a one standard deviation productivity shock are reported in Table 9 in the Appendix.

Table 5: Results of the simulation scenarios

Scenarios	Trade Cost	Trade Share	Inflation Peak
BAU	2	16.2%	0.3%
Scenario 1	1.5	22.6%	0.33%
Scenario 2	1.15	30.46%	0.68%
Scenario 3	1.001	40%	0.5%

Note: The table presents the simulated scenarios along with the corresponding results. The second column reports the intra-regional trade costs within Africa, while the third column shows the resulting trade share between African countries. The fourth column displays the peak inflation observed in the destination country following a productivity shock in the origin country. The dynamic pattern of the inflation response remains consistent with that shown in Figure 2; only the magnitude of the effect varies across scenarios.

years. This magnitude aligns with the range estimated in the previous IV analysis, which lies between 0.26% and 0.4%.

The remaining three scenarios correspond to the AfCFTA simulations discussed earlier. In Scenario 1, where intra-African trade increases to 22.6%, the same 1% reduction in imports leads to a slightly higher inflation peak of 0.33%. In Scenario 2, with intra-African trade rising to 30%, the inflationary effect intensifies, reaching a peak of 0.68%. Notably, inflation persistence is also stronger in this case: ten years after the shock, the inflation effect remains around 0.2% (see Figure 3), compared to just 0.05% in the BAU scenario with an intra-trade share of 16.2% (see Figure 2).

In Scenario 3, where intra-African trade reaches 40%, the inflation peak is slightly lower at 0.5%, but the persistence of the shock is even more pronounced. A decade after the shock, inflation remains elevated at approximately 0.3%, relative to 0.05% under the BAU scenario (see Figure 7 in Appendix).[26]

Interpreting the Magnitude of the Inflationary Effect. How important is an estimated inflationary impact of 0.68%? This figure corresponds to a moderate AfCFTA scenario, involving an intra-African trade increase of approximately 15%. While this figure may appear modest at first glance, its significance depends on the inflation-targeting regime of the country in question. For instance, in the West African Economic and Monetary Union (WAEMU), where the central bank targets inflation close to 2%, a 0.68% increase represents more than a third of the target, potentially complicating monetary policy implementation. [27]

Moreover, the persistence of the effect is particularly noteworthy. Our simulations show that in more integrated trade scenarios, the inflationary impact can last for a decade or more before dissipating. This long-lasting pressure could pose challenges for central banks attempting to maintain price stability, especially when managing simultaneous external shocks.

[26] The inflationary effect remains around 0.2% even after twenty years; see Figure 7 in the appendix.

[27] The West African Economic and Monetary Union (WAEMU) is a regional organization of eight West African countries that share a common currency (the CFA franc) and a central bank, the BCEAO (Central Bank of West African States). The union aims to promote economic integration and monetary stability among its member states.

5 Conclusion

In this paper, we document how climate and political shocks are transmitted through trade to inflation among African countries. Using an instrumental variable strategy, we show that a 1% decrease in imports due to such shocks increases inflation in the importing country by between 0.3% and 0.4%. To assess the potential impact of the African Continental Free Trade Area (AfCFTA), we extend a general equilibrium trade model that incorporates Money-in-the-Utility (MIU) preferences and productivity shocks. Estimating this model with African data, we find that if AfCFTA leads to a 15% increase in intra-African trade, the inflationary effect of a productivity shock on trading partners could more than double, reaching as much as 0.68%. We also find that while the magnitude of this transmission effect is nonlinear, its persistence increases with deeper trade integration.

Our findings underscore the complex role of regional trade agreements (RTAs) in promoting economic stability, particularly when trade partners are exposed to shocks. In the context of AfCFTA, each African country should seek to better understand the shock exposure of its key partners and diversify its trade relationships. This would enable countries to more effectively manage supply shocks by redirecting trade to less-affected partners within Africa when necessary.

This paper also raises important questions for future research: How will AfCFTA influence the transmission of shocks to economic growth? And how should central banks adjust their monetary policy frameworks to better manage inflation under deeper trade integration?

References

Abdel-Latif, H. (2024). Echoes across borders: Macroeconomic spillover effects of conflict in sub-saharan africa. *IMF Working Papers*, 2024:1.

Acemoglu, D. and Ventura, J. (2002). The world income distribution. *The Quarterly Journal of Economics*, 117(2):659–694.

Adom, I. M. and Schott, I. (2024). Input delays, firm dynamics, and misallocation in sub-saharan africa. *Review of Economic Dynamics*, 53:147–172.

African Development Bank (2017). Industrialize africa: Strategies, policies, institutions, and financing. Accessed May 2025.

Andrews, I., Stock, J. H., and Sun, L. (2019). Weak instruments in instrumental variables regression: Theory and practice. *Annual Review of Economics*, 11(1):727–753.

Angrist, J. and Imbens, G. (1994). Identification and estimation of local average treatment effects. 62:467–475.

Angrist, J., Imbens, G., and Rubin, D. (1996). Identification of causal effects using instrumental variables. *Source: Journal of the American Statistical Association*, 91:444–455.

BAD (2019). Intégrer l'afrique, connecter les personnes. *Revue annuelle du Groupe de la Banque africaine de développement sur l'efficacité du développement.*

Baqaee, D. R. and Farhi, E. (2024). Networks, barriers, and trade. *Econometrica*, 92(2):505–541.

Baum, C. F., Schaffer, M. E., and Stillman, S. (2007). Enhanced routines for instrumental variables/gmm estimation and testing. boston college economics. Technical report, Working Paper.

Benguria, F., Saffie, F., and Urzúa, S. (2024). The transmission of commodity price super-cycles. *Review of Economic Studies*, 91(4):1923–1955.

Brancaccio, G., Kalouptsidi, M., and Papageorgiou, T. (2020). Geography, transportation, and endogenous trade costs. *Econometrica*, 88(2):657–691.

Burke, M., Hsiang, S. M., and Miguel, E. (2015). Global non-linear effect of temperature on economic production. *Nature 2015 527:7577*, 527:235–239.

Caliendo, L. and Parro, F. (2015). Estimates of the trade and welfare effects of nafta. *The Review of Economic Studies*, 82(1):1–44.

Camara, S., Christiano, L., and Dalgic, H. (2024). The international monetary transmission mechanism. *NBER Macroeconomics Annual*, 39.

Caselli, F., Koren, M., Lisicky, M., and Tenreyro, S. (2020). Diversification through trade. *The Quarterly Journal of Economics*, 135(1):449–502.

Corsetti, G., Dedola, L., and Leduc, S. (2008). International risk sharing and the transmission of productivity shocks. *The Review of Economic Studies*, 75(2):443–473.

Corsetti, G., Martin, P., and Pesenti, P. (2007). Productivity, terms of trade and the 'home market effect'. *Journal of International economics*, 73(1):99–127.

Corsetti, G., Martin, P., and Pesenti, P. A. (2005). Productivity spillovers, terms of trade and the" home market effect".

Delforge, D., Wathelet, V., Below, R., Sofia, C. L., Tonnelier, M., van Loenhout, J. A., and Speybroeck, N. (2025). Em-dat: the emergency events database. *International Journal of Disaster Risk Reduction*, 124.

di Giovanni, J. and Levchenko, A. A. (2009). Trade openness and volatility. *The Review of Economics and Statistics*, 91:558–585.

Eaton, J. and Kortum, S. (2002). Technology, geography, and trade. *Econometrica*, 70(5):1741–1779.

Eaton, J. and Kortum, S. (2012). Putting ricardo to work. *Journal of Economic Perspectives*, 26(2):65–90.

El-Shaa, H. and DF António, G. (2022). Note d'orientation sur la zone de libre-échange continentale africaine (zlecaf) [l'afrique met en place la zlecaf : quiconque pense le contraire se trompe]. Note de sensibilisation, Nations Unies.

ElGanainy, A., Abbas, A., Allard, C., Balima, H., Hakobyan, S., Liu, F., and Weisfeld, H. (2023). *Trade integration in Africa: unleashing the continent's potential in a changing world*. International Monetary Fund.

Enders, Z. and Müller, G. J. (2009). On the international transmission of technology shocks. *Journal of International Economics*, 78(1):45–59.

Feenstra, R. C., Inklaar, R., and Timmer, M. P. (2015). The next generation of the penn world table. *American economic review*, 105(10):3150–3182.

FMI (2019). Perspectives économiques régionales pour l'afrique subsaharienne: Reprise dans un contexte de grande incertitude. Rapport, Fonds monétaire international.

Hassler, J. and Krusell, P. (2012). Economics and climate change: integrated assessment in a multi-region world. *Journal of the European Economic Association*, 10(5):974–1000.

Idean, S., Hendrix, C., Hamner, S. J., Case, C., Linebarger, C., Stull, E., and Williams, J. (2012). Social conflict in africa: A new database. *International Interactions*, pages 503–511.

IPCC, I. P. o. C. C. (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. IPCC.

IPCC, I. P. o. C. C. (2023). *Climate Change 2023: Synthesis Report*. IPCC.

Jones, B. F. and Olken, B. A. (2010). Climate shocks and exports. *American Economic Review*, 100(2):454–59.

Kejžar, K. Z., Velić, A., and Damijan, J. P. (2022). Covid-19, trade collapse and gvc linkages: European experience. *The World Economy*, 45(11):3475–3506.

Kpodar, K. and Imam, P. (2016). Does a regional trade agreement lessen or worsen growth volatility? an empirical investigation. *Review of International Economics*, 24:949–979.

Lind, N. and Ramondo, N. (2024). Global knowledge and trade flows: Theory and measurement. *Journal of International Economics*, page 103960.

Lucas, R. E. (1976). Econometric policy evaluation: A critique. *Carnegie-Rochester Conference Series on Public Policy*, 1:19–46.

Maliszewska, M., van der Mensbrugghe, D., Pereira, M. F. S., Osorio Rodarte, I., and Ruta, M. (2020). African continental free trade area: Economic and distributional effects.

Naito, T. (2017). An eaton–kortum model of trade and growth. *Canadian Journal of Economics/Revue canadienne d'économique*, 50(2):456–480.

Ncube, M., Brixiova, Z., and Meng, Q. (2014). Working paper 198 - can intra-regional trade act as a global shock absorber in africa?

Novy, D. (2013). Gravity redux: measuring international trade costs with panel data. *Economic inquiry*, 51(1):101–121.

Pagan, A. R. and Hall, A. D. (1983). Diagnostic tests as residual analysis. *Econometric Reviews*, 2(2):159–218.

Portugal-Perez, A. and Wilson, J. S. (2008). *Trade costs in Africa: barriers and opportunities for reform.* World Bank Washington, DC.

Raleigh, C., Kishi, R., and Linke, A. (2023). Political instability patterns are obscured by conflict dataset scope conditions, sources, and coding choices. *Humanities and Social Sciences Communications 2023 10:1*, 10:1–17.

Schenker, O. and Osberghaus, D. (2025). International trade and the transmission of temperature shocks. *Environmental and Resource Economics*, 88:965–1007.

Shikher, S. (2012). Putting industries into the eaton–kortum model. *The Journal of International Trade & Economic Development*, 21(6):807–837.

Silveira, M. A. C. d. (2015). Two-country new keynesian dsge model: A small open economy as a limit case.

Somanathan, E., Somanathan, R., Sudarshan, A., and Tewari, M. (2021). The impact of temperature on productivity and labor supply: Evidence from indian manufacturing. *Journal of Political Economy*, 129:1797–1827.

Stock, J. H. and Yogo, M. (2002). Testing for weak instruments in linear iv regression.

World Trade Organization (2023). World trade report 2023: Re-globalization for a secure, inclusive and sustainable future. Accessed: 2024-07-08.

Appendix

A Brief presentation of the AfCFTA

The African Continental Free Trade Area (AfCFTA)

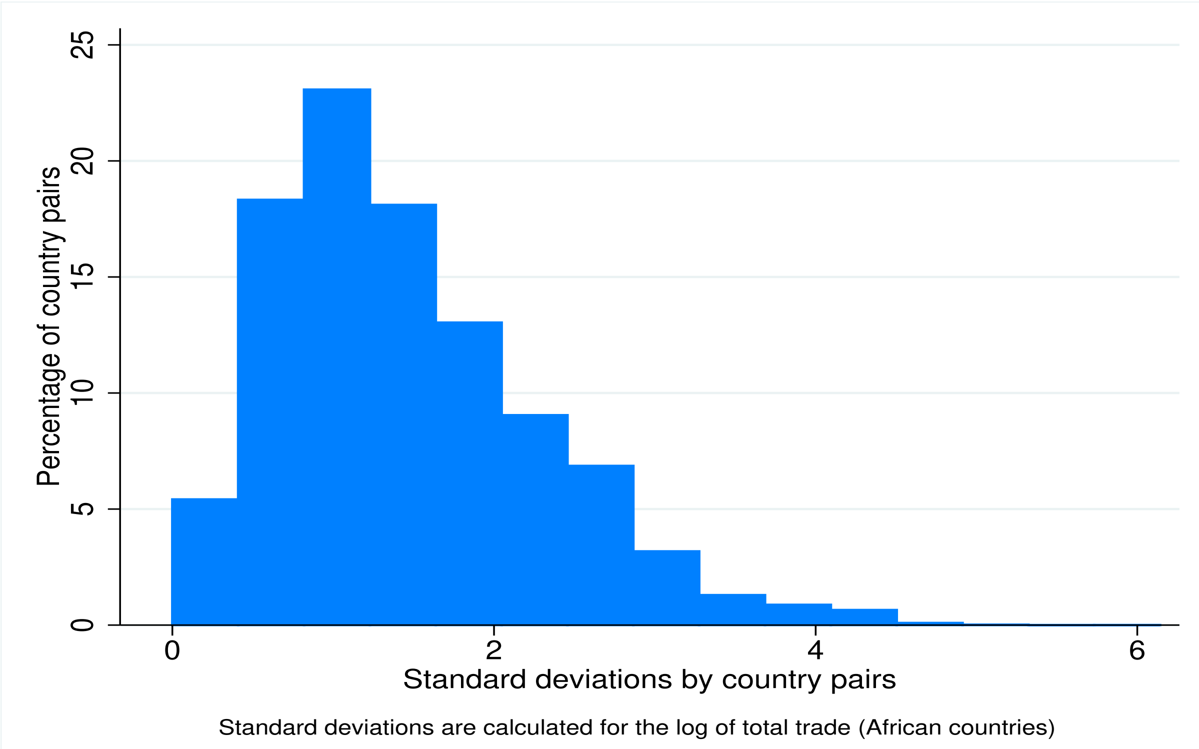
The African Continental Free Trade Area (AfCFTA), launched in 2021, is a transformative initiative to unify Africa into a single market for goods and services. As of early 2024, 54 out of 55 African Union member states had signed the agreement, and 47 had ratified it (Union, 2024). The AfCFTA aims to eliminate tariffs on 90% of goods and reduce non-tariff barriers, facilitating deeper continental trade integration. The World Bank projects that full implementation could increase Africa's income by approximately $450 billion by 2035 and lift 30 million people out of extreme poverty (World Bank, 2020). Despite this promise, intra-African trade remains limited—comprising only around 13% of the continent's total trade volume as of 2022 (Foundation ,2023), underscoring the need for improved infrastructure and regulatory alignment. For ongoing updates, consult the African Union portal at au.int.

B Trade and shock transmission

Table 6: List of African countries categorized as Origins and Destinations in the IV

Origins	**Destinations**
Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Republic of the Congo, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe	Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Egypt, Eswatini, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe

Figure 4: standard deviations of bilateral imports across pairs of countries



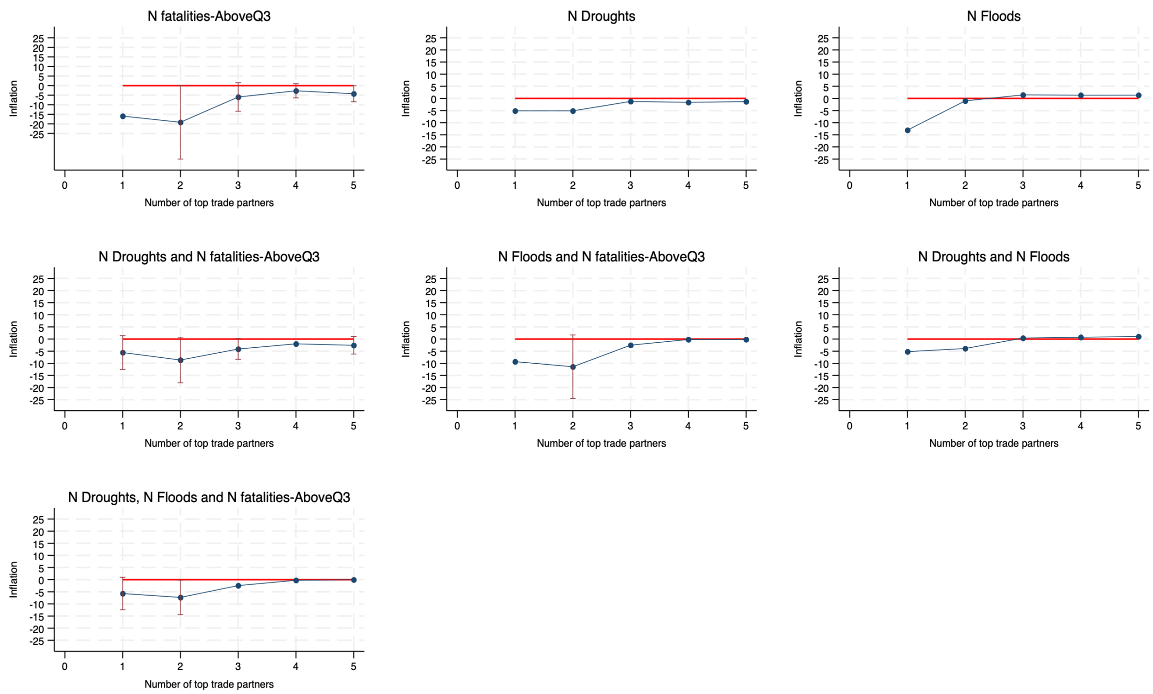
Notes: This graph presents standard deviations of bilateral imports by pairs of countries. When we also do the same exercise for the most exchanged products, "mineral products", we get similar results.

Table 7: Descriptive Statistics

	(1)						
	count	min	p25	p50	mean	p75	max
bilateral imports (million USD)	20,162	1.9e-09	0.024	0.33	35.9	5.22	5,132.5
imports from African countries (million USD)	20,162	10.3	369.2	841.6	1,433.8	1,740.5	12,956.5
imports from non African countries (million USD)	20,162	33.4	1,022.8	2,379.9	9,320.0	6,470.0	84,463.5
# fatalities in socio-political conflicts	20,162	0	1	14	396.3	158	11,451
# fatalities in socio-political conflicts if $\#fatalities > 0$	15,631	1	7	31	511.1	303	11,451
$NFatalities - AboveQ3_{dt}$	20,162	0	0	0	0.18	0	1
$NDisasters_{ot}$	20,162	0	0	1	0.89	1	7
$NDisasters_{ot}$ if $NDisasters_{ot} > 0$	10,925	1	1	1	1.65	2	7
pairwise SD of log(Imports)	20,162	0.0011	0.99	1.67	1.73	2.31	6.25
inflation in destination country	19849	-2.20	1.96	4.63	5.74	8.46	32.9
Observations	20,162						

Notes: This table presents some descriptive statistics of the variables used in the IV regression. Inflation in destination country is winsorized at 5% to reduce influence of extreme values.

Figure 5: IV-regressions for different combinations of instrument and top trading partners



Notes: To improve the readability of the graph, the confidence interval is not plotted when it is more than 3 times larger than the point estimate in absolute value. .

C Theorethical appendix

C.1 Index of intermediate goods prices

The price of the final good is an index of intermediate goods prices

Let us consider the minimisation problem:

$$\min_{\{x_n(i)\}} C_n = \int_0^1 P_n(i)x_n(i)\,di$$

Subject to:

$$Y_n = z_n(\int_0^1 x_n(i)^{\frac{\sigma_n-1}{\sigma_n}}\,di)^{\frac{\sigma_n}{\sigma_n-1}} \tag{20}$$

Where:

- $x_n(i)$ is the decision variable representing the quantity of the i-th input used (intermediate good).
- $P_n(i)$ is the price of the i-th input.
- Y_n is the output level that needs to be produced.

- z_n is a productivity parameter.
- σ_n is the elasticity of substitution between the inputs.

Lagrangian Function

To solve this optimization problem, we introduce a Lagrange multiplier λ for the constraint and set up the Lagrangian function $\mathcal{L}$:

$$\mathcal{L} = \int_0^1 P_n(i)x_n(i)\,di + \lambda \left[Y_n - z_n \left(\int_0^1 x_n(i)^{\frac{\sigma_n-1}{\sigma_n}}\,di \right)^{\frac{\sigma_n}{\sigma_n-1}} \right]$$

First-Order Conditions

To find the optimal $x_n(i)$, we take the derivative of $\mathcal{L}$ with respect to $x_n(i)$ and set it to zero:

$$\frac{\partial \mathcal{L}}{\partial x_n(i)} = P_n(i) - \lambda z_n \frac{\sigma_n}{\sigma_n - 1} \left(\int_0^1 x_n(j)^{\frac{\sigma_n-1}{\sigma_n}}\,dj \right)^{\frac{1}{\sigma_n-1}} x_n(i)^{-\frac{1}{\sigma_n}} = 0$$

Simplifying, we get:

$$P_n(i) = \lambda z_n \frac{\sigma_n}{\sigma_n - 1} \left(\int_0^1 x_n(j)^{\frac{\sigma_n-1}{\sigma_n}}\,dj \right)^{\frac{1}{\sigma_n-1}} x_n(i)^{-\frac{1}{\sigma_n}}$$

To find the relation between $x_n(i)$ and $x_n(i')$, we start from the first-order conditions derived:

$$P_n(i) = \lambda z_n \frac{\sigma_n}{\sigma_n - 1} \left(\int_0^1 x_n(j)^{\frac{\sigma_n-1}{\sigma_n}}\,dj \right)^{\frac{1}{\sigma_n-1}} x_n(i)^{-\frac{1}{\sigma_n}}$$

Similarly, for another input i':

$$P_n(i') = \lambda z_n \frac{\sigma_n}{\sigma_n - 1} \left(\int_0^1 x_n(j)^{\frac{\sigma_n-1}{\sigma_n}}\,dj \right)^{\frac{1}{\sigma_n-1}} x_n(i')^{-\frac{1}{\sigma_n}}$$

Now, we compute the ratio $\frac{P_n(i)}{P_n(i')}$:

$$\frac{P_n(i)}{P_n(i')} = \frac{\lambda z_n \frac{\sigma_n}{\sigma_n-1} \left(\int_0^1 x_n(j)^{\frac{\sigma_n-1}{\sigma_n}}\,dj \right)^{\frac{1}{\sigma_n-1}} x_n(i)^{-\frac{1}{\sigma_n}}}{\lambda z_n \frac{\sigma_n}{\sigma_n-1} \left(\int_0^1 x_n(j)^{\frac{\sigma_n-1}{\sigma_n}}\,dj \right)^{\frac{1}{\sigma_n-1}} x_n(i')^{-\frac{1}{\sigma_n}}}$$

Notice that many terms cancel out:

$$
\begin{aligned}
\frac{P_n(i)}{P_n(i')} =& \frac{x_n(i)^{-\frac{1}{\sigma_n}}}{x_n(i')^{-\frac{1}{\sigma_n}}} \\
\frac{P_n(i)}{P_n(i')} =& \left(\frac{x_n(i')}{x_n(i)}\right)^{\frac{1}{\sigma_n}} \\
\left(\frac{P_n(i)}{P_n(i')}\right)^{\sigma_n} =& \frac{x_n(i')}{x_n(i)} \\
\frac{x_n(i)}{x_n(i')} =& \left(\frac{P_n(i')}{P_n(i)}\right)^{\sigma_n}
\end{aligned}
$$

Thus, the optimal allocation of $x_n(i)$ in terms of $P_n(i)$ and $P_n(i')$ is:

$$
x_n(i) = x_n(i') \left(\frac{P_n(i')}{P_n(i)}\right)^{\sigma_n} \tag{21}
$$

Now integrate this expression in

$$
\begin{aligned}
Y_n =& z_n \left(\int_0^1 x_n(i)^{\frac{\sigma_n - 1}{\sigma_n}}\, di\right)^{\frac{\sigma_n}{\sigma_n - 1}} \\
=& z_n \left(\int_0^1 (x_n(i') \left(\frac{P_n(i')}{P_n(i)}\right)^{\sigma_n})^{\frac{\sigma_n - 1}{\sigma_n}}\, di\right)^{\frac{\sigma_n}{\sigma_n - 1}} \\
=& z_n P_n(i')^{\sigma_n} x_n(i') \left(\int_0^1 P_n(i)^{1-\sigma_n}\, di\right)^{\frac{\sigma_n}{\sigma_n - 1}}
\end{aligned}
$$

$$
\begin{aligned}
x_n(i') =& Y_n / (z_n P_n(i')^{\sigma_n} \left(\int_0^1 P_n(i)^{1-\sigma_n}\, di\right)^{\frac{\sigma_n}{\sigma_n - 1}}) \\
x_n(i') =& P_n(i')^{-\sigma_n} \left(\int_0^1 P_n(i)^{1-\sigma_n}\, di\right)^{\frac{\sigma_n}{1-\sigma_n}} Y_n / z_n \\
\int_0^1 P_n(i') x_n(i')\, di =& \int_0^1 P_n(i')^{1-\sigma_n}\, di \left(\int_0^1 P_n(i)^{1-\sigma_n}\, di\right)^{\frac{\sigma_n}{1-\sigma_n}} Y_n / z_n \\
=& z_n^{-1} \left(\int_0^1 P_n(i)^{1-\sigma_n}\, di\right)^{\frac{1}{1-\sigma_n}} Y_n \\
=& Q_n Y_n
\end{aligned}
$$

Q_n is a price index.
Coming back to the profit maximization problem:

$$
\begin{aligned}
\max_{x_n} \Pi_n^Y =& P_n^Y Y_n - \int_0^1 P_n(i) x_n(i)\, di \\
=& P_n^Y Y_n - Q_n Y_n
\end{aligned}
$$

subject to:

$$Y_n = z_n(\int_0^1 x_n(i)^{\frac{\sigma_n - 1}{\sigma_n}} di)^{\frac{\sigma_n}{\sigma_n - 1}}$$

Zero profit maximization yields

$$Q_n = P_n^Y \tag{22}$$

The probability that country n imports goods from country j is given by:

$$\Pi_{nj} = \int_{s_j \in S_{nj}} p_{nj}(s_j) x_n(s_j)\ ds_j / Q_n Y_n \tag{23}$$

C.2 Establishing: $Y_{jt}Q_{jt} = r_{jt}K_{jt} - M_{jt-1}\mu_{jt}$

Equating final goods market clearing to consumers' budget constraints, taking into account bonds market clearing gives:

$$\begin{aligned}
Y_{jt} &= C_{jt} + K_{jt+1} - (1-\delta)K_{jt} \text{ (Goods market clearing)} \\
&= \frac{r_{jt}}{P^Y_{jt}} K_{jt} + \frac{M_{jt-1} - M_{jt}}{P^Y_{jt}} \text{ (Consumer Budget constraint, with } D_{jt} = 0) \\
&= \frac{r_{jt}}{P^Y_{jt}} K_{jt} - \frac{M_{jt-1}\mu_{jt}}{P^Y_{jt}} \quad \text{(Using money supply in 5)} \\
Y_{jt}Q_{jt} &= r_{jt}K_{jt} - M_{jt-1}\mu_{jt} \quad \text{(Using 22)}
\end{aligned}$$

C.3 Proof of the lemma

Lemma: From Capital market clearing in (14), we have (abstracting time script):

$$\begin{aligned}
K_j &= \int_{s_j \in S_j} K^x(s_j)\ ds_j \\
&= \int_{s_j \in S_j} x(s_j) a_j(s_j)\ ds_j \text{ (By using intermediate production technology)} \\
&= \int_{s_j \in S_j} \sum_{n=1}^{N} \tau_{nj} x_n(s_j) a_j(s_j)\ ds_j \text{ (By using intermediate goods market clearing)} \\
&= \int_{s_j \in S_j} \sum_{n=1}^{N} \frac{p_{nj}(s_j)}{r_j} x_n(s_j)\ ds_j \text{ (By using (9))} \\
&= \sum_{n=1}^{N} (\int_{s_j \in S_j} p_{nj}(s_j) x_n(s_j)\ ds_j)/r_j \text{ (Interverting sum and integral)} \\
&= \sum_{n=1}^{N} \Pi_{nj} Q_n Y_n / r_j \text{ (Using (12))} \\
K_j &= \sum_{n=1}^{N} \Pi_{nj}(r_n K_n - M_{n,t-1}\mu_n)/r_j \text{ (using C.2)}
\end{aligned}$$

$$r_j K_j = \sum_{n=1}^{N} \Pi_{nj}(r_n K_n - M_{n,t-1}\mu_n), j = 1, ..., N-1 \tag{24}$$

$$\Pi_{nj}(\{\tau_{nk} r_k\}_{k=1}^{N}) = \frac{(b_j \tau_{nj} r_j)^{-\theta}}{\sum_{k=1}^{N} (b_k \tau_{nk} r_k)^{-\theta}}$$

C.4 Redundancy Explanation

Consider the system of equations for $j = 1, \ldots, N-1$:

$$r_j K_j = \sum_{n=1}^{N} \Pi_{nj}(r_n K_n - M_{n,t-1}\mu_n)$$

The equation states that the total returns to capital in country j, $r_j K_j$ are determined by summing up the weighted and adjusted returns to capital from all other countries. Each term in the summation adjusts the returns to capital from country n by subtracting the impact of the money supply.

Now, consider the system of N equations. If we know the equations for $N-1$ countries, the equation for the N-th country is automatically satisfied because the total system must balance.

1. **Equations for $j = 1$ to $j = N-1$**:

$$r_1 K_1 = \sum_{n=1}^{N} \Pi_{n1}(r_n K_n - M_{n,t-1}\mu_n)$$

$$r_2 K_2 = \sum_{n=1}^{N} \Pi_{n2}(r_n K_n - M_{n,t-1}\mu_n)$$

$$\vdots$$

$$r_{N-1} K_{N-1} = \sum_{n=1}^{N} \Pi_{n,N-1}(r_n K_n - M_{n,t-1}\mu_n)$$

2. **Summing these $N-1$ equations**:

$$\sum_{j=1}^{N-1} r_j K_j = \sum_{j=1}^{N-1} \sum_{n=1}^{N} \Pi_{nj}(r_n K_n - M_{n,t-1}\mu_n)$$

3. **Right-Hand Side Simplification**: Using $\sum_{j=1}^{N} \Pi_{nj} = 1$,

$$\begin{aligned}\sum_{j=1}^{N-1} \sum_{n=1}^{N} \Pi_{nj}(r_n K_n - M_{n,t-1}\mu_n) &= \sum_{n=1}^{N} (r_n K_n - M_{n,t-1}\mu_n) \sum_{j=1}^{N-1} \Pi_{nj} \\ &= \sum_{n=1}^{N} (r_n K_n - M_{n,t-1}\mu_n)(1 - \Pi_{nN})\end{aligned}$$

Therefore,

$$
\begin{aligned}
\sum_{j=1}^{N-1} r_j K_j &= \sum_{n=1}^{N} (r_n K_n - M_{n,t-1}\mu_n)(1-\Pi_{nN}) \\
&= \sum_{n=1}^{N} (r_n K_n - M_{n,t-1}\mu_n) - \sum_{n=1}^{N} (r_n K_n - M_{n,t-1}\mu_n)\Pi_{nN} \\
0 &= r_N K_N - \sum_{n=1}^{N} M_{n,t-1}\mu_n - \sum_{n=1}^{N} (r_n K_n - M_{n,t-1}\mu_n)\Pi_{nN} \\
r_N K_N &= \sum_{n=1}^{N} (r_n K_n - M_{n,t-1}\mu_n)\Pi_{nN} + \sum_{n=1}^{N} M_{n,t-1}\mu_n
\end{aligned}
$$

This latest equation clearly derives the expression for $r_N K_N$. One important feature of this equation is that its structure differs from the remaining $N-1$ equations. An additional term, $\sum_{n=1}^{N} M_{n,t-1}\mu_n$, is added to the sum. This term represents the total monetary adjustments across all countries. It accounts for the overall effect of the growth in the money supply from each country on the returns to capital in country N.

C.5 The stationary (scaled) model

The original model is not stationary because it exhibits growth. To make it stationary we scaled it by dividing by the capital of country N. The main change in consumers' problem will be in their Budget constraint, let's look at it in detail. We start with the initial Budget Constraint:

$$
\begin{aligned}
&C_{jt} + K_{jt+1} - (1-\delta_j)K_{jt} + \frac{M_t}{P_{jt}^Y} = \frac{r_{jt}}{P_{jt}^Y} K_{jt} + \frac{M_{t-1}}{P_{jt}^Y} \\
&C_{jt} + K_{jt+1} - (1-\delta_j)K_{jt} + m_{jt} = \frac{r_{jt}}{P_{jt}} K_{jt} + \frac{m_{jt-1}}{1+\pi_{jt}} \\
&\frac{C_{jt}}{K_{Nt}} + \frac{K_{jt+1}}{K_{Nt}} \cdot \frac{K_{Nt+1}}{K_{Nt+1}} + \frac{m_{jt}}{K_{Nt}} = (\frac{r_{jt}}{P_{jt}} + 1 - \delta_j)\frac{K_{jt}}{K_{Nt}} + \frac{m_{jt-1}}{K_{Nt-1}} \cdot \frac{K_{Nt-1}}{K_{Nt}} \\
&\tilde{c}_{jt} + (1+\gamma_{Nt+1})\tilde{k}_{jt+1} + \tilde{m}_{jt} = (\frac{r_{jt}}{P_{jt}} + 1 - \delta_j)\tilde{k}_{jt} + \frac{\tilde{m}_{jt-1}}{1+\gamma_{Nt}} \quad \text{(For stationarity)}
\end{aligned}
$$

The modified problem to solve is therefore:

$$
\begin{aligned}
&\max_{\{\tilde{c}_{jt}, \tilde{k}_{jt+1}, \tilde{m}_{jt}\}} E_0 \sum_{t=0}^{\infty} \beta_j^t u(\tilde{c}_{jt}, \tilde{m}_{jt}) \\
&\text{st:} \quad \tilde{c}_{jt} + (1+\gamma_{Nt+1})\tilde{k}_{jt+1} + \tilde{m}_{jt} = (\frac{r_{jt}}{P_{jt}} + 1 - \delta_j)\tilde{k}_{jt} + \frac{\tilde{m}_{jt-1}}{1+\gamma_{Nt}}
\end{aligned}
$$

Lagrangian and Euler Equations

To derive the Euler equations, let write the Lagrangian $\mathcal{L}$, where the Lagrange multiplier for the constraint is λ_t :

$$\mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta_j^t \Bigg\{ u(\tilde{c}_{jt}, \tilde{m}_{jt}) - \lambda_t \Big[\tilde{c}_{jt} + (1+\gamma_{Nt+1})\tilde{k}_{jt+1} + \tilde{m}_{jt} \\ - \left(\left(\frac{r_{jt}}{P_{jt}} + 1 - \delta_j \right) \tilde{k}_{jt} + \frac{\tilde{m}_{jt-1}}{1+\gamma_{Nt}} \right) \Big] \Bigg\}$$

First-Order Conditions

1. **With respect to $\tilde{c}_{jt}$:**

$$\frac{\partial \mathcal{L}}{\partial \tilde{c}_{jt}} = \beta_j^t \left(u_c(\tilde{c}_{jt}, \tilde{m}_{jt}) - \lambda_t \right) = 0 \quad \Rightarrow \quad \lambda_t = u_c(\tilde{c}_{jt}, \tilde{m}_{jt})$$

2. **With respect to $\tilde{k}_{jt+1}$:**

$$\frac{\partial \mathcal{L}}{\partial \tilde{k}_{jt+1}} = E_t \left(\beta_j^t \left(-\lambda_t (1+\gamma_{Nt+1}) \right) + \beta_j^{t+1} \lambda_{t+1} \left(\frac{r_{j,t+1}}{P_{j,t+1}} + 1 - \delta_j \right) \right) = 0$$

$$\Rightarrow u_c(\tilde{c}_{jt}, \tilde{m}_{jt})(1+\gamma_{Nt+1}) = E_t \left(\beta_j u_c(\tilde{c}_{j,t+1}, \tilde{m}_{j,t+1}) \left(\frac{r_{j,t+1}}{P_{j,t+1}} + 1 - \delta_j \right) \right)$$

3. **With respect to $\tilde{m}_{jt}$:**

$$\frac{\partial \mathcal{L}}{\partial \tilde{m}_{jt}} = \beta_j^t \left(u_m(\tilde{c}_{jt}, \tilde{m}_{jt}) - \lambda_t \right) + \beta_j^{t+1} E_t \left(\lambda_{t+1} \cdot \left(\frac{1}{1+\gamma_{N,t+1}} \right) \right) = 0$$

$$\Rightarrow u_m(\tilde{c}_{jt}, \tilde{m}_{jt}) = u_c(\tilde{c}_{jt}, \tilde{m}_{jt}) - \beta_j E_t \left(\frac{u_c(\tilde{c}_{j,t+1}, \tilde{m}_{j,t+1})}{1+\gamma_{N,t+1}} \right)$$

Combining these equations gives the Euler equation for the stationary model.

Capital Euler equation:

$$u_c(\tilde{c}_{jt}, \tilde{m}_{jt})(1+\gamma_{Nt+1}) = \beta_j E_t \left(u_c(\tilde{c}_{j,t+1}, \tilde{m}_{j,t+1}) \left(\frac{r_{j,t+1}}{P_{j,t+1}} + 1 - \delta_j \right) \right)$$

Money Euler equation:

$$u_m(\tilde{c}_{jt}, \tilde{m}_{jt}) = u_c(\tilde{c}_{jt}, \tilde{m}_{jt}) - \beta_j E_t \left(\frac{u_c(\tilde{c}_{j,t+1}, \tilde{m}_{j,t+1})}{1+\gamma_{N,t+1}} \right)$$

These Euler equations describe the intertemporal optimization conditions for consumption, capital, money, and debt. These equations, combined with the Budget Constraint below in equation 25, they describe citizens' optimization solutions.

$$\tilde{c}_{jt} + (1+\gamma_{Nt+1})\tilde{k}_{j_{t+1}} + \tilde{m}_{jt} = (\frac{r_{jt}}{P_{jt}} + 1 - \delta_j)\tilde{k}_{jt} + \frac{\tilde{m}_{jt-1}}{1+\gamma_{Nt}} \tag{25}$$

Summary of the equations characterizing the solution

The following system of equations summarizes the stationary solution to sole for: $\tilde{c}_{j,t}, \tilde{k}_{j,t}, \tilde{m}_{j,t}, , P^Y_{jt}, \pi_{jt}, r_{jt}, z_{jt}, u_{jt}, \gamma_{j,t}$:

$$
\begin{aligned}
u_c(\tilde{c}_{jt}, \tilde{m}_{jt})(1+\gamma_{Nt+1}) &= \beta_j E_t \left(u_c(\tilde{c}_{j,t+1}, \tilde{m}_{j,t+1}) \left(\frac{r_{j,t+1}}{P_{j,t+1}} + 1 - \delta_j \right) \right) \\
u_m(\tilde{c}_{jt}, \tilde{m}_{jt}) &= u_c(\tilde{c}_{jt}, \tilde{m}_{jt}) - \beta_j E_t \left(\frac{u_c(\tilde{c}_{j,t+1}, \tilde{m}_{j,t+1})}{1+\gamma_{N,t+1}} \right) \\
\tilde{c}_{jt} + (1+\gamma_{Nt+1})\tilde{k}_{j_{t+1}} + \tilde{m}_{jt} &= (\frac{r_{jt}}{P_{jt}} + 1 - \delta_j)\tilde{k}_{jt} + \frac{\tilde{m}_{jt-1}}{1+\gamma_{Nt}} \\
\tilde{k}_{jt} &= \sum_{n=1}^{N} \Pi_{nj}(\tilde{k}_{nt} r_n / r_j - P_{n,t-1} \frac{\tilde{m}_{n,t-1}}{1+\gamma_N} \mu_n / r_j) \\
P^Y_{jt}(\{\tau_{jn} r_{nt}\}_{n=1}^N) &= c_j [\sum_{n=1}^{N} b_n (\tau_{jn} r_{nt})^{-\theta}]^{-1/\theta} \\
log(z_{jt}) &= \rho^z_j log(z_{jt-1}) + e_{jt} \\
\mu_{jt} - \bar{\mu}_j = u_t &= \rho^u_j u_{jt-1} + \phi_j z_{jt-1} + \varphi_{jt} \\
\tilde{m}_{jt} &= (1+\mu_{jt}) * \frac{\tilde{m}_{jt-1}}{(1+\pi_{jt})(1+\gamma_{Nt})} \\
\gamma_{j,t} &= \frac{k_{jt}}{k_{jt-1}} - 1 = \frac{k_{Nt}\tilde{k}_{jt}}{k_{Nt-1}\tilde{k}_{jt-1}} - 1.
\end{aligned}
$$

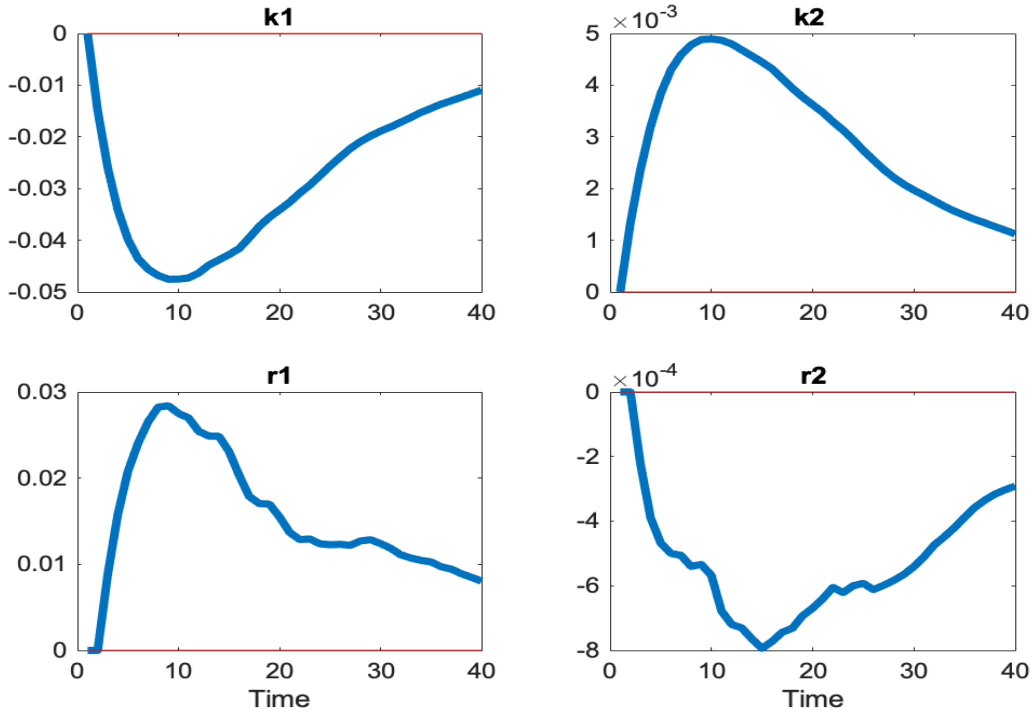
D Model's results appendix

Table 8: Model Parameters and Descriptions for the Three Countries.

Parameter	Description	1.Nigeria	2.South Africa	3.China
τ_{1j}	Trade cost to 1*	1	2	1.6
τ_{2j}	Trade cost to 2*	2	1	1.15
τ_{3j}	Trade cost to 3*	1.15	1.6	1
ρ_j^z	Persistence of productivity shocks*	0.946	0.968	0.887
σ_j^z	std of productivity shocks*	0.043	0.036	0.062
β_j	Discount factor	0.96	0.96	0.96
δ_j	Depreciation rate	0.05	0.05	0.05
ρ_j^u	Persistence of money supply shocks	0.5	0.5	0.5
σ_j^u	Volatility of money supply shocks	0.0045	0.0045	0.0045
ϕ_j	Persistence of productivity shocks on money supply shocks	0.5	0.5	0.5
σ_j	Elasticity of substitution between two varieties	1.15	1.15	1.15
$\bar{\mu}_j$	Long term money growth rate	0	0	0
b_j	country state of technology	0.5	0.5	0.5
θ	Inverse of the variability of productivity distribution in intermediate goods	1.2	1.2	1.2

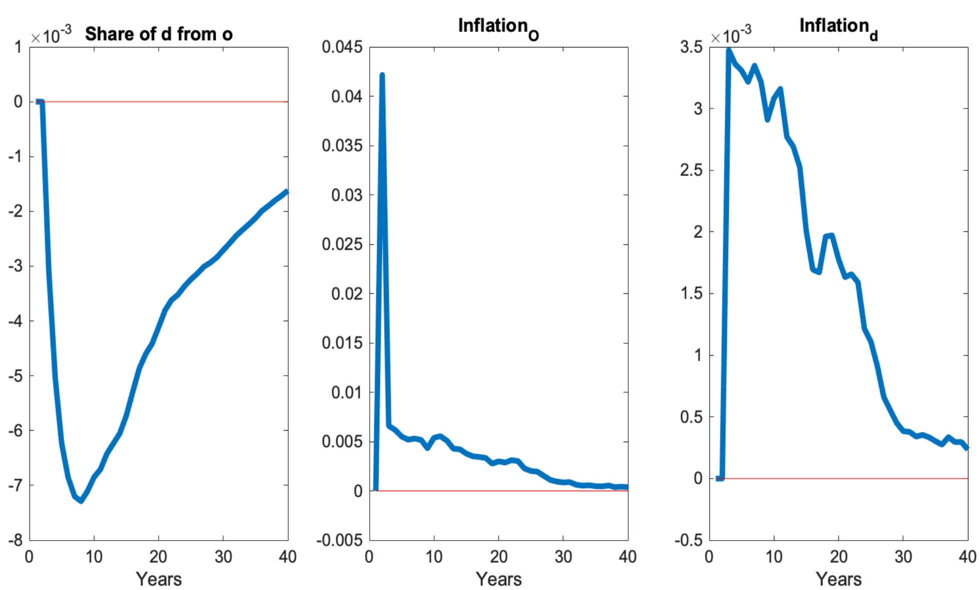
Note: The subscript j denotes country j. An asterisk (*) indicates a parameter estimated using data from the period prior to the implementation of AfCFTA. Trade costs are interpreted relative to domestic trade: for example, trade costs between Nigeria and South Africa are twice as high as within-country trade costs. Similarly, trade costs between Nigeria and China are 1.6 times higher, and between China and South Africa, 1.15 times higher.

Figure 6: Effect on Capital and interest rates



Notes: *Notes: This figure displays the impact of a Standard Deviation Productivity Shock in the Origin Country under the Business As Usual (BAU) Scenario. BAU is the model with parameters estimated with the data before AfCFTA (up to 20221). All the variables are expressed as a percentage deviation from the steady states.*

Figure 7: Effect of AfCFTA for an increase in intra-trade to 40%



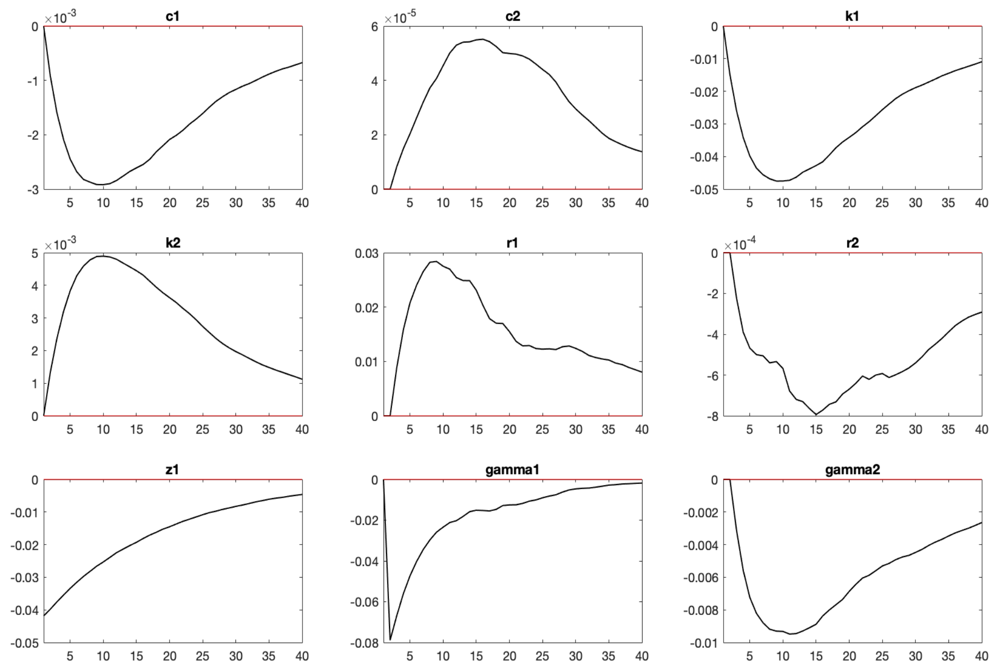
Notes: *This figure illustrates the impact of a standard deviation productivity shock in the origin country under an AfCFTA scenario (Scenario 3), which corresponds to an approximate 40% increase in intra-African trade. All variables are expressed as percentage deviations from their respective steady states.*

Table 9: Results of the simulation scenarios

Scenarios	Trade Cost	Trade Share	Inflation Peak	GDP Trough
BAU	2	16.2%	0.14%	-0.9%
Scenario 1	1.5	22.6%	0.2%	-1.2%
Scenario 2	1.15	30.46%	0.48%	-2.6%
Scenario 3	1.001	40%	0.35%	-2%

Note: The second column represents the intra-regional trade cost in Africa. The second column is the trade share between African countries, and the third column represents the peak in inflation in the destination country. The dynamic is the same as presented in Figure 2, only the magnitude changes. For scenario 3, in addition to lowering the trade cost to 1.001, we increase the relative trade cost between Africa and the rest of the world.

Figure 8: More complete dynamics including consumption and growth



Notes: *This figure displays the impact of a Standard Deviation Productivity Shock in the Origin Country under the Business As Usual (BAU) Scenario. BAU is the model with parameters estimated with the data before AfCFTA (up to 20221). All the variables are expressed as a percentage deviation from the steady states.*