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A Novel Framework to Evaluate Changes in Access to and Costs of Trade Finance

Abstract

In this paper we integrate the costs of trade finance in a computable general equilibrium (CGE) model to evaluate the trade and output effects of counterfactual policy experiments on costs of and access to trade finance. The costs of financing international trade consist of two components: the financial costs and the costs associated with the risk of goods not being delivered, considering risk aversion of traders. These costs are determined for four ways to finance international trade (cash-in-advance, trade loans, letters of credit, and exports financed with internal working capital). Trade finance costs are a weighted average of the costs under the four different ways of financing. The framework is applied to trade of four ECOWAS countries employing data collected on financial costs, costs of risk and trade finance instrument shares through a comprehensive bank survey in these countries complemented with data from the literature. Counterfactual experiments on increases in the availability of letters of credit and trade loans and the costs of these instruments show that raising the shares and costs to African averages would increase trade of the four ECOWAS countries by about 11%. The framework is generic and can be applied to other countries.

JEL-Codes: G580, F100, F140, F390, G210.

Keywords: trade credit, international trade, financial institutions, general equilibrium simulations.

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1 Introduction

International trade requires financing and risk mitigation. Exporters typically receive payment upon receipt by the buyer of the merchandise. Even if receiving an advance upon order, they would have to address working capital needs arising from the production and shipment of the goods, as well as managing the risk of non-payment. On the import side, international buyers must mitigate the risks of buying internationally while receiving proceeds of their own sales at a later stage, particularly if the import is an input or a finished good for local distribution. If left without any other alternative than paying cash-in-advance, the importer bears a risk of non-delivery, or of receiving a good whose quality would not have been asserted prior to the payment. Trade finance covers the spectrum of financial products and techniques mitigating risks involved in the lagged payment and deliveries of traded goods, at a certain cost.

While trade finance is generally regarded as having a favorable risk profile (International Chamber of Commerce 2019), and is perhaps more resilient than ordinary lending during crises (Prete and Federico 2014), its supply can be negatively affected by economic and financial shocks affecting financial institutions, the quality of financial institutions on which exporters rely, and other market factors (Amiti and Weinstein 2011; Chor and Manova 2012). After the global financial crisis, several international agencies alerted that firms in low-income countries faced structural difficulties in accessing trade finance, measured in terms of high levels of rejections of trade finance applications (African Development Bank Group 2022). When firms could access trade finance, they faced high interest rates and fees (African Development Bank Group 2020). Still, even in weak financial environments, access to trade finance is of considerable help to traders in mitigating delayed payment risks (Crozet, Demir, and Javorcik 2022, Auboin and Engemann 2013).

The literature has been making progress in measuring the impact of trade finance availability on trade flows, relying mainly on partial equilibrium, econometric analysis, using various metrics and methods. For example, Auboin and Engemann 2012 find that a 1% increase in insured trade credit granted to a country leads to a 0.3% increase in real imports of the country, using quarterly data of insured trade credit for 91 countries. Niepmann and Schmidt-Eisenlohr 2017b find that a one-standard-deviation negative shock to a country's letters of credit supply reduced exports of the United States of America (USA) to that country by 1.5% during the global financial crisis. Chor and Manova 2012 find a 0.2 elasticity between trade credit availability and imports, with a small but significant coefficient of the effect of firm's external financial dependence in the USA and imports. Paravisini et al. 2015 find an elasticity of 0.2% of exports with respect to credit, i.e. a broader category of finance than just trade finance, using firm-level bank credit data from Peru.

Since international trade transactions also involve risk, we also take the costs associated with risk into account. There is a small literature on the links between risk and patterns of trade. Novy and Taylor 2020 state that uncertainty shocks magnify the response of international trade, because of differential cost structure that would lead firms to cut orders on foreign inputs much more than for domestic inputs. Gervais 2018 predicts in an international trade model with risk that firms would prefer buying a larger share of their inputs from suppliers with low price variability to reduce the volatility in prices. He predicts that in markets with high price variability, the distribution of input demand would be more dispersed.

For trade finance, the risk factor plays a major role in periods of high uncertainty. Auboin and Engemann 2013 extensively review the use of trade finance policies in periods of crises. In particular, based on a large literature focusing on the 2008 financial crisis and the subsequent

great trade collapse, the authors suggest that a lack of trade finance was one of the reasons for the decline in trade. During a different crisis, namely the covid-19 pandemic, flows using bank-intermediated trade finance, such as letters of credit and other documentary collections, are found to have been much more resilient to the economic downturn (Demir and Javorcik 2020). In fact, a recent study by Crozet, Demir, and Javorcik 2022 shows that the use of letters of credit plays a major role in mitigating risk, and that exports of a product can be more resilient to crises if this product is traded intensively using letters of credit.

In this paper, we extend a computable general equilibrium (CGE) simulation model (Aguiar et al. 2019) with trade finance to quantify the impact of a change in both the availability and costs (interest rates and fees) of trade finance on trade flows (imports and exports) and output. The costs of financing international trade are modelled as part of import and export taxes since they reflect in part rents of the financial sector. The reason is that trade finance costs consist of payments of firms exporting/importing paying financing costs to the financial sector. Therefore, they are modelled as a tax instead of a resource wasting (iceberg) trade cost. A reduction in trade finance costs means that rents earned by the financial sector will fall, which can be captured by changes in import and export taxes in the model given that it features a consolidated household collecting both factor income and taxes.

The costs of financing international trade consist of two components: the financial costs and the costs associated with the risk of goods not being delivered, taking into account risk aversion of traders. These costs can be determined for four different ways to finance international trade, those described by Niepmann and Schmidt-Eisenlohr 2017a: cash-in-advance, trade loans, letters of credit, and exports financed with internal working capital. For these, we developed simple equations to define the financial costs and the costs associated with the risk of goods not being delivered. Total trade finance costs are written as a value share weighted average of the costs under the four different ways of financing.

The framework is applied to trade of four ECOWAS countries employing data collected on financial costs, costs of risk and shares of trade finance instruments employed through a comprehensive survey of banks in these countries on trade finance granted and refused by banks, at prevailing prices complemented with data from the literature on trade finance shares. We were able to collect country data on quantity and cost in the context of a joint study (International Finance Corporation and World Trade Organization 2022) by the International Finance Corporation (IFC) and the WTO on trade finance in the four largest Ecowas member-countries (Nigeria, Côte d'Ivoire, Ghana, Senegal).

Counterfactual experiments on increases in the availability of letters of credit and trade loans and the costs of these instruments in the four ECOWAS countries are conducted with the CGE model extended with trade finance, using the latest version of the GTAP Data Base (Version 11 for 2017), aggregated to 10 sectors and 20 regions. Access to trade finance or not will produce changes in the use of instruments (for example from cash-in-advance payments to letters of credit which might reduce the costs and risks of transacting), thereby modifying the financial cost of trade and thus overall trade costs.

The counterfactual experiments project the expected increase in trade generated by increases in trade finance availability and reduction of its cost relative to certain international benchmarks. Increasing the availability of trade finance towards African continental averages and lowering its costs towards benchmarks seen in more advanced emerging economies is projected to lift ECOWAS4 exports and imports of goods by around 11 percent, the equivalent of nearly $18 billion in annual merchandise trade. The elasticity of trade with respect to trade finance ranges correspondingly between 0.096 and 0.248 (trade-weighted average for the region at 0.123) reflecting the large variation in elasticities estimated in the literature. However, the elasticities

emerging from the model are in line with the elasticities estimated in the literature with elasticities varying from 0.3-0.4 in Auboin and Engemann 2012, 0.2 in Chor and Manova 2012 and about 0.04 in Niepmann and Schmidt-Eisenlohr 2017b.[1]

We perform robustness checks on assumptions on which data are difficult to obtain to show that they do not significantly affect the magnitude (and the direction) of the obtained trade effects. The simulations show that the projected increase in exports and imports is the largest for countries that have the worst initial trade finance market conditions. The simulated trade increase is driven by a decline in trade costs related to a shift, predicted by the model, from using no trade finance (paying cash-in-advance) to having access to it; and from using second- and third-best financing and payment solutions to using cheaper and less risky trade finance instruments. The experiments also show that intra-regional trade benefits the most from improved trade finance conditions. Furthermore, we find that the contribution of increased access to trade finance is much larger than the contribution of reduced fees on letters of credit (LC-fees) and reduced costs of trade loans.

The paper makes three contributions to the literature. First, this is to the best of the authors' knowledge, the first approach to integrate the costs of trade finance into a comprehensive general equilibrium quantitative framework enabling counterfactual policy experiments to evaluate the impact of variations in the availability and costs of trade finance on trade and welfare. Given the detailed general equilibrium nature of the model, the framework is particularly useful to analyze sectoral and geographical impacts on trade of changing trade finance conditions. Second, while applied to countries in West Africa, the analytical framework can be extended to any emerging and least developed economies for which similar data can be collected. Finally, the framework translates trade finance as a trade cost integrating trade finance and trade costs (present in the GTAP database) in one framework. The model relies on real-life instruments used in those countries. In this sense, the framework builds on the more detailed framework developed by Niepmann and Schmidt-Eisenlohr 2017a employing detailed country data from bank surveys.

The paper is organized as follows. Section 2 presents basic characteristics of trade finance, notably in the Ecowas region. Section 3 describes our methodology to incorporate the cost of finance for trade in a computable general equilibrium (CGE). Section 4 presents scenarios, results and robustness checks. Section 5 concludes the paper.

2 The Role of Trade Finance

In this section, we describe the role of trade finance instruments in facilitating international trade, first describing the different types of trade finance, their financial costs and the risks involved and then outlining the principal results of a recent study on trade finance in four ECOWAS countries, which serves as the main application of the trade finance framework developed in this paper.

2.1 Trade Payment and Finance Risks and Costs

The costs involved in carrying international trade are an important determinant of trade flows and comprise a range of transaction costs, including the cost of financing. Total prices and costs for settling and financing international trade transactions are determined by the instruments employed. We focus our analysis on four modes of payment or financing, each differing in

[1] Given that a one-standard deviation reduction corresponds with a 34% reduction, the implied elasticity in Niepmann and Schmidt-Eisenlohr 2017b is about 0.044.

cost and transactional risk: cash-in-advance payments of imports; exports financed by firm's own working capital; trade (pre-shipment export and import) loans; letters of credit. They fit the trade finance frameworks developed by Schmidt-Eisenlohr 2013, Niepmann and Schmidt-Eisenlohr 2017a, Auboin and Engemann 2012,Crozet, Demir, and Javorcik 2022, and Niepmann and Schmidt-Eisenlohr 2017b. These four instruments are the main source of international trade payments and financing used in the Ecowas-4 countries according to the survey conducted in these countries. The choice of a specific trade finance instrument matters because each instrument differs in the allocation of risk, financial cost and parts involved.

For example, in using cash-in-advance payments, the importer pays for goods upfront thus pre-financing the exporter's cash-flow, while incurring a (transactional) risk of not receiving delivery on time or at all, or receiving it in quantity and quality which could not have been verified prior to the payment. Therefore, the importer faces both the opportunity cost of using the firm's own cash flows and its capital, as well as a transactional risk that the capital engaged is lost if the other party to the transaction does not deliver, or if it delivers a deficient product.

Letters of credit are a payment guarantee in case of importer default. In fact, an issuing bank commits to pay for the transaction if the importer is unable to pay. A confirmation by the exporter's bank might be required for some transactions. In turn, the importer is charged a fee for the letter of credit issued by its bank, while the exporter would pay a confirming fee if the exporter's bank has to confirm the letter of credit.

If the importer has access to this instrument, most of the transactional risk is transferred to the bank(s) and no funds are engaged by the importer until it receives the merchandise. The transaction and payment risks are better spread across the different parties to the transaction.

The fee is smaller than an interest rate on a loan for several reasons. A letter of credit is a simple commitment to pay by the bank in the unlikely event that its client fails to do so. Not only does it carry, internationally, a very small default risk (a fraction of one percent), meaning that the likelihood of its falling into the balance sheet of the bank is small. Even if the bank had to pay, it would control the merchandise by the terms of the letter of credit, and could resell it covering part of its loss.

If exports are financed by a firm's own working capital, the exporter bears both transactional risks and financial costs. If not supported by a bank, the exporter may have to pre-finance the production and shipment of the exported goods until it is paid for, bear risks at each stage of the production process with the ultimate risk of non-payment by the buyer.

If a letter of credit is involved, the payment is guaranteed (provided the goods are delivered by the exporter). However, this does not solve the exporter's risks over the use of its own cash-flow for producing and shipping the goods. This risk depends on the length of the production and export cycle. In agriculture, risk may involve a full season, from the import of inputs (seeds, fertilizers) to cropping, transporting, storing, packaging and exporting, until payment is received.

Import and pre-export loans are funded trade finance instruments used to address the liquidity needs for both importers and exporters before receiving payment or getting paid. The financial cost of loans is the interest rate paid on the loans. Import and pre-export loans also help to mitigate the transactional risk of not receiving the immediate export receipt or proceeds expected from the purchased (imported) good (whether it is imported as an input or would be resold locally) .

Trade loans are generally highly collateralized. They are more expensive than letters of credit because letters of credit only provide a guarantee of payment at a later date and do not provide

working capital. Moreover, loans must be fully refinanced and capitalized. They bear higher default rates than letters of credit, thereby incurring higher capital and liquidity cost to the bank.

Summarizing, the financial costs incurred to face the risks involved in financing international trade transactions are threefold. First, the pure cost involved in bearing the transaction risk that the counterparty would not pay or not deliver the goods. Second, the financial costs associated with bridging the time between shipping out the goods and the time the importer receives the imported goods. Third, other financial costs associated with bridging the time between producing the goods and shipping them out (for the exporter), and the financial costs associated with bridging the time between obtaining the goods and selling them and recovering the money invested (for the importer). Trade finance aims at facilitating these transactions, by lowering the risks and therefore the costs by defining the way a transaction is organized.

In this paper we only consider the first two types of costs, since the choice of instrument to finance international trade transactions has only a marginal impact on these types of costs. Hence, for the counterfactual experiments it is not needed to take these costs into account.

2.2 Trade Finance in ECOWAS

As reported in the WTO-IFC report "Trade Finance in West Africa" (International Finance Corporation and World Trade Organization 2022), in 2021, trade finance flows provided by banks to importers and exporters in the Ecowas-4 were estimated to be $42 billion in 2021, supporting about 25 percent of these countries' merchandise trade. Non-bank formal financing alternatives (factoring, for example) are not used in these countries. Sub-optimal, informal modes of financing such as borrowing from families and friends exist, but are difficult to estimate without a demand-side survey. The share of trade supported in Ecowas-4 countries is smaller than the estimated average of the African continent, which includes countries with higher levels of financial sector development such as Northern Africa and South Africa (African Development Bank Group 2020). The rate of rejection of trade finance applications by firms is 25%, well above the continental average of 12% (African Development Bank Group 2020). Rejections disproportionately affect SMEs, in particular women-led SMEs. Trade finance availability is constrained by the limited access of local banks to correspondent banking relationships and high levels of risk associated with borrowers, which are well "justifiable" reasons for rejections.

However, a prime reason for rejection identified in the report is the systematic request to firms for additional collateral (cash or land, most often). In international trade, the merchandise itself is commonly used as collateral for trade finance - trade documents help in the process of the transaction transfer of ownership of that collateral. It can be resold to cover a bank's exposure and when transactions are covered by letters of credit, it can be seized ex officio in case of non-payment. However, banks in the survey said they often ask for further collateral on the basis that shortcomings in local legal enforcement mean they are not confident that they would be able to seize and resell merchandise. SMEs, with their smaller balance sheets, are more likely to face onerous collateral requirements and often lack the financial sophistication to negotiate effectively with their financiers.

The trade finance market is concentrated: the five largest banks in the region account for around 50 percent of trade finance supply, with scale effects leading the largest firms toward the largest banks which have more extensive networks of international correspondent bank relationships and can finance higher-value transactions. Self-exclusion following previous rejections of applications are prompting firms to simply refrain from applying to banks for financing to carry

out international trade. This, alongside limited supply, high prices, and frequent rejections make it unsurprising that the share of trade supported by trade finance in the ECOWAS4 is lower than elsewhere in Africa.

Traditional instruments, such as letters of credit, mainly for importers, and loans that largely comprise revolving, short-term capital and pre-shipment export facilities, are the main forms of trade finance used in the region. We have employed this information from the survey in the model as described in the next section.

3 Methodology

This section presents the framework leading to the integration of payment and finance related to trade into the model. We selected the four instruments relevant to the region: cash-in-advance, own fund/working capital used for the pre-financing of exports, letters of credit, and trade loans (import and pre-export). For each of these four instruments the financial costs and the costs associated with risk are described. The risk-associated costs take into account risk aversion. The framework can be extended to other regions in the world with similar market characteristics, notably where trade finance markets are weakly developed.

We first describe the employed trade model and the modelling of trade finance costs as part of trade costs. Then we turn to the modelling of the costs of the four instruments employed, starting with an exposition of how risk aversion is integrated in the model. Finally, we outline the data sources and calibration of trade finance costs in the baseline.

3.1 General Equilibrium Model

We use the WTO Global Trade Model - GTM - (Aguiar et al. 2019), a computable general equilibrium (CGE) model, to simulate the effects of changes in the price and availability of trade finance on trade flows. The WTO Global Trade Model is a recursive dynamic CGE model featuring intermediate linkages, multiple sectors, multiple factors of production and trade modelled according to an Armington structure. A detailed description of the model is in Aguiar et al. 2019.

The costs of financing international trade are included in the model as part of import and export taxes. The reason is that trade finance costs consist of payments to the financial sector to finance international trade of exporting and importing firms. Therefore, they are modelled as a tax instead of a resource wasting (iceberg) trade cost. A reduction in trade finance costs means that rents earned by the financial sector would fall. This can be captured by changes in import and export taxes in the model given that rents operate like a tax and that the model features a consolidated household collecting both factor income and taxes. Hence a change in the costs of trade finance works like a change in the tax rate on international transactions of goods.[2] In the literature NTMs with a rent-increasing character tend to be modelled as import and export taxes (See for example Fontagné, Gourdon, Jean, et al. 2013, Webb et al. 2020)

In the simulations the latest version of the GTAP Data Base, Version 11p3, for 2017 is aggregated (Aguiar et al. 2019) to 10 sectors and 20 regions. The data for 2017 are projected to 2022 imposing population, employment, and GDP growth rates and changes in the savings rate, based on data from the World Economic Outlook of the International Monetary Fund. The counterfactual experiments are conducted for the year 2022, imposing a fixed trade balance.

[2]To include trade finance costs as part of export and import taxes a pre-simulation is conducted modifying the base data, employing Altertax. This entails running the model with Cobb-Douglas preferences thus keeping spending shares constant.

3.2 Modelling of Trade Finance Costs as Trade Costs

In this part, we describe how the trade finance costs of the four instruments are modelled. For each instrument there are two types of costs, financial costs and costs associated with the risk of the transaction. The first cost is the financial cost of using the instrument, which is the fee paid for its use or the costs of financing the transaction. We also refer to this financial component as the "cost of funds", meaning the capital necessary to use the instrument. The costs associated with risk occur because goods might not arrive or importers might not pay for goods already sent by exporters. We take into account that traders (importers and exporters) are averse to risky outcomes with a chance of loss. Before describing the costs of each of the four instruments we first explain how the costs associated with risk are calculated for the four instruments. After describing the four instruments we discuss how the total trade costs of financing international trade transactions are calculated.

3.2.1 Integrating Risk Aversion in the Model

If traders are risk averse the costs associated with risks of the transaction tend to be larger than the share of goods not arriving in the destination. In this section we describe how the costs can be expressed as a function of the probability that goods do not arrive or importers do not pay for goods shipped. This probability can be measured for example by the share of nonperforming loans to total gross loans (NPLs) as further described below when discussing the specific instruments.

A transaction has a good outcome of 1 with probability $1-p$. The transaction has a bad outcome of 0 (meaning for an importer that the product is not received after paying for the goods, or the payment never occurs after an exporter shipped the goods) with a probability p. The costs associated with the risk is equal to the utility loss because of the risk. This loss is equal to the good outcome of 1 minus the certainty equivalent, which is defined as the certain value for which the agent is indifferent between engaging in the transaction or accepting this lower certain value.

To calculate the costs associated with risk we assume a constant relative risk aversion utility function:

$$U(x) = \frac{x^{1-\gamma}}{1-\gamma} \tag{1}$$

where γ is the CRRA parameter. We can calculate the certainty equivalent of the transaction, CE, as follows with p the probability of a bad outcome (goods not arriving):

$$\begin{gathered} u(CE) = E(u(x)) \\ u(CE) = p * u(0) + (1-p) * u(100) \\ \frac{CE^{1-\gamma}}{1-\gamma} = (1-p) * \frac{1^{1-\gamma}}{1-\gamma} \end{gathered}$$

Hence, the certainty equivalent is given by:

$$CE = (1-p)^{\frac{1}{1-\gamma}} \tag{2}$$

Having obtained the certainty equivalents (the certain value for which the agent is indifferent between engaging in the transaction or accepting this lower certain value), we can calculate the costs associated with risk as the good outcome, i.e. 1, minus the certainty equivalent:

$$TC\ of\ Risk = 1 - CE = 1 - (1-p)^{\frac{1}{1-\gamma}} \tag{3}$$

As shown in Conine, McDonald, and Tamarkin 2017, the formulation of risk aversion with a a constant relative risk aversion (CRRA) parameter has been largely used in the financial and macroeconomic literature, with a large interval of values. Studies focusing on risky assets markets have privileged estimates of the CRRA above 3. Azar 2006 finds calibrated CRRAs between 4.2 and 5.4 in a study mimicking the USA stock market. A large literature focusing on labor supply chose instead values of CRRA below one, such as Chetty 2006 choosing a coefficient of 0.7. As discussed in the annex, following this value employed for real economy applications instead of financial markets generates intuitive values for the costs associated with risk in our model.

As discussed in the next subsection on calibration the current framework implies that the costs of financing international trade are much lower under trade finance instruments such as letters of credit and trade loans than the other ways to finance international trade, since they help traders to cope with financial shocks (Auboin and Engemann 2013, Demir and Javorcik 2020, Crozet, Demir, and Javorcik 2022).

3.2.2 The Costs of the Different Trade Finance Instruments

Next, we describe the financial costs and the costs associated with risk of the four instruments considered relevant for the four ECOWAS countries, cash-in-advance (CIA), import and export loans (LOA), exports financed with internal working capital (INT_WC), and letters of credit and other documentary credit (LC).

Cash-in-Advance (CIA) As indicated earlier, the importer may be compelled to pay for the goods up-front, cash-in-advance, particularly in absence of trade finance available. The exporter would send the goods upon receipt of the payment or even later, but there are no firm guarantees other than the contract, once the payment is made. Under this payment option, the importer pre-finances the exporter's cash needs, while incurring the risk that goods would not be delivered, not fit the contract - this risk is unmitigated under cash-in-advance. Therefore, the importer bears both a high transactional risk and a financial cost linked to using own funds to make the payment (a combination of an opportunity and capital cost for the firm of using such cash without guarantees on the transaction). Under cash-in-advance, exporters do not incur financial costs or costs associated with risk since they would ship the goods only upon receipt of the payment. On the contrary, they receive early payment prior to shipping goods, hence maximizing their internal cash-flow. Cash-in-advance is the least attractive option for the buyer of all four payment/trade finance options the buyer (importer).

The total costs (TC) of using CIA in sector i from source (exporter) s to destination (importer) d can thus be expressed as follows:

$$CIA\_TC_{isd} = CIA\_RC_{isd}^{imp} + CIA\_CF_{isd}^{imp} \tag{4}$$

where $CIA\_RC_{isd}^{imp}$ is the risk cost (RC) or the transactional risk (for an importer to use CIA for transactions in sector i from exporter s to importer d). As explained in the previous subsection on risk aversion $CIA\_RC_{isd}^{imp}$ can be written as follows as a function of the probability that goods are not delivered, $CIA\_ND_{isd}^{imp}$:

$$CIA\_RC_{isd}^{imp} = 1 - \left(1 - CIA\_ND_{isd}^{imp}\right)^{\frac{1}{1-\gamma}} \tag{5}$$

$CIA\_CF_{isd}^{imp}$ is the costs of financing the transaction (CF) implied by the early payment by the importer under cash-in-advance (both the opportunity and firm's capital cost of using own cash), and CIA_TC_{isd} is the resulting total cost of using cash-in-advance.

Import and Export Loans (LOA) Import and export loans are trade finance instruments which can be used to address the liquidity needs for both importers and exporters until they have to pay or they get paid. The financial cost of loans are the interest rates on the loans. With a pre-export shipment loan, the exporter also incurs the risk of not being paid - this risk is not mitigated by the loan itself. The import loan does not mitigate or alleviate the risk of not receiving the merchandise (only a letter of credit would do that), so the importer similarly bears the risk of not receiving the goods. Therefore in both cases, the transactional risk remains relatively high, while the financial cost reflects levels of interest rates in the borrowing country (which, in turn are a function of the refinancing cost of these loans, i.e. policy interest rates, level of the financial sector's spreads above the policy rate and rents, and borrower's assumed creditworthiness). Equation 6 shows that the total costs of using import loans stems from the interest rate but also the risk of paying without receiving the goods (exporter's default). Symmetrically, for an export loan, Equation 7 contains the interest rate for this type of loan as well as the importer's default risk.

Import Loan The costs for an import loan are expressed as follows:

$$LOA\_TC_{isd}^{imp} = 1 - \left(1 - LOA\_ND_{isd}^{imp}\right)^{\frac{1}{1-\gamma}} + LOA\_CF_{isd}^{imp} \tag{6}$$

where $LOA\_ND_{isd}^{imp}$ is the probability that goods are paid for by the importer and not received, and $LOA\_CF_{isd}^{imp}$ is the interest rate on an import loan.

Export Loan For an export loan, the costs are expressed as follows:

$$LOA\_TC_{isd}^{exp} = 1 - (1 - LOA\_ND_{isd}^{exp})^{\frac{1}{1-\gamma}} + LOA\_CF_{isd}^{exp} \tag{7}$$

where $LOA\_ND_{isd}^{exp}$ is the probability that the exporter takes a loan and does not receive the importer's payment and $LOA\_CF_{isd}^{exp}$ is the interest rate on a pre-shipment loan.

Exports financed with internal working capital (INT_WC) In absence of availability of (or desire to contract) a pre-shipment export loan, an exporter can also decide (or be constrained) to finance the process of production for the purpose of exporting. Upon order, the exporter would typically receive a small advance from the buyer. In this case, the whole production and shipment cycle would have to be financed, including inputs purchase, salaries, machinery, packaging and shipping, before receiving its export receipt. By doing so, the exporter incurs the opportunity cost of using capital to produce the goods, and the transactional risk of sending the goods before the payment.[3] Both the costs of using own funds (like cash-in-advance, the opportunity and capital cost) and transaction risk are higher for the exporter when using own, internal working capital than by contracting pre-export shipment loans. The total costs for the firm of using own working capital/funds, $INT\_WC\_TC_{isd}^{exp}$, can be expressed as follows:

$$INT\_WC\_TC_{isd}^{exp} = 1 - (1 - INT\_WC\_ND_{isd}^{exp})^{\frac{1}{1-\gamma}} + int\_wc\_CF_{isd}^{exp} \tag{8}$$

where $INT\_WC\_ND_{isd}^{exp}$ is the probability that goods are sent and no payment is received, whereas $INT\_WC\_CF_{isd}^{exp}$ is the capital cost of using own funds to pre-finance the transaction, and $INT\_WC_{isd}^{exp}$ is the total resulting cost.

[3]Some of these transactions could happen in an Open Account (OA) setting. Since open account is not used in ECOWAS, it is not discussed in the analysis.

Letters of credit and other documentary credit (LC) Letters of credit are a payment guarantee in case of importer's default. An Issuing Bank (IB) commits to pay for the transaction if the importer is unable to pay. A confirming Bank (CB) in the exporter's region could also bear the final payment risk if the IB cannot pay neither. To open an LC, the importer incurs an opening fee to the IB and the exporter pays a confirmation fee to the CB. While being a guarantee of future payment after delivery, the letter of credit does not provide the exporter the required liquidity to produce and ship the goods - in other words it is not a substitute for a pre-shipment loan. The exporter would continue, under a letter of credit, to face an opportunity cost if using its own funds for this purpose[4]. However, as shown in Equation 9 and Equation 10, there is no cost associated with the transactional risk under an LC. Instead issuing and confirming fees are paid by respectively the importer and the exporter.

For an ECOWAS exporter, the trade finance costs under LC include the cost of financing the transaction. In regions that are considered riskier than ECOWAS, a CB would also be required - thus implying also LC confirmation fees. For an ECOWAS importer, LC costs include the LC opening fee, since the costs of financing the transaction are borne by the exporter.

The total costs for an importer and an exporter under LC can thus be written as follows:

$$LC\_TC_{isd}^{imp} = LC\_FEE_{isd}^{imp} \tag{9}$$

$$LC\_TC_{isd}^{exp} = \begin{cases} LC\_FEE_{isd}^{exp} + LC\_CF_{isd}^{exp} & \text{if importer's country is riskier than Ecowas} \\ LC\_CF_{isd}^{exp} & \text{otherwise} \end{cases} \tag{10}$$

where $LC\_FEE_{isd}^{imp}$ is the issuing fee paid to the IB, $LC\_FEE_{isd}^{exp}$ is the confirmation fee paid to the CB, $LC\_CF_{isd}^{exp}$ includes the capital costs for sending the goods beforehand, and $LC\_TC_{isd}^{imp}$ and $LC\_TC_{isd}^{exp}$ are the total resulting costs of using an LC for an importer and an exporter.

3.2.3 Total Costs of Trade Instruments

From equations (4), (6), (7), (8), (9) and (10), the total costs of trade instruments can be expressed as follows :

$$\begin{aligned} TC_{isd} =& sh_{isd}^{cia} * CIA\_TC_{isd} + sh_{isd}^{loa,imp} * LOA\_TC_{isd}^{imp} + sh_{isd}^{loa,exp} * LOA\_TC_{isd}^{exp} \\ &+ sh_{isd}^{int\_wc,exp} * INT\_WC_{isd}^{exp} + sh_{isd}^{lc} * [LC\_TC_{isd}^{exp} + LC\_TC_{isd}^{imp}] \end{aligned} \tag{11}$$

where sh_{isd}^{cia} is the share of trade covered by CIA, $sh_{isd}^{loa,imp}$ by import loans, $sh_{isd}^{loa,imp}$ by export loans, $sh_{isd}^{int\_wc,exp}$ by exports financed with internal WC, and sh_{isd}^{lc} by LCs.

The total costs of financing international trade are a weighted average of the costs of using each of the instruments with the weights determined by the relative importance in trade. The choice between the different instruments is not modelled as the result of optimizing decisions of traders in the framework. The shares are exogenously given, based on the data, and changes in these shares in the counterfactual experiments are also exogenously imposed. The shares reflect that different traders have a preference for different instruments to finance international trade transactions or alternatively are limited in their choice instrument because of institutional constraints such as a lack of collateral as described above.

[4]For an ECOWAS importer, LC costs include the LC opening fee. For an ECOWAS exporter, LC costs include the cost of funds. In regions that are considered riskier than ECOWAS, a CB would be required - thus implying also LC confirmation fees

3.3 Data Sources and Calibration

To calibrate baseline trade finance costs, information is needed on the share of trade covered by different instruments, the costs associated with risk and financial costs. These different components are discussed in turn, followed by a brief comparison of the total costs of the different instruments.

1. The share of trade covered by different instruments

- The shares of trade covered by import and export LC, sh^{lc}_{isd}, are obtained from Niepmann and Schmidt-Eisenlohr 2017a for a subset of countries. In this paper, we use the figures of the geographical distribution of SWIFT messages translating the use of letters of credit for each country with the United States. We assume that the use of letters of credit with the USA is on average representative of that for other partners. Using the value of exports (from GTAP data) with the USA, we translate the intensities in shares of trade covered by letters of credit and documentary trade finance. We then calculate trade-weighted regional averages using 20 GTAP regions. For the ECOWAS countries, they are obtained from a joint IFC-WTO survey as reported in Table 11. For the purpose of this paper only, outliers have been removed to calculate these shares, thus explaining the differences with the coverage reported in International Finance Corporation and World Trade Organization 2022.

- To derive the share of trade represented by funded trade finance, meaning import and export loans in our model, $sh^{loa,imp}_{isd}$ and $sh^{loa,exp}_{isd}$, we refer to African Development Bank Group 2020. This report indicates that on average, half of the banks' trade finance portfolios were associated with letters of credit or documentary trade finance, and the other half with funded instruments (import or export loans). Therefore, we use this 50% proportion to set $sh^{loa,imp}_{isd}$ and $sh^{loa,exp}_{isd}$ equal to the share of unfunded trade finance presented in the previous point.

- The shares of trade covered by cash-in-advance and exports financed with working capital, $sh^{cia,imp}_{isd}$ and $sh^{int\_wc,exp}_{isd}$ are assumed to cover each 50% of the non-trade finance transactions. Robustness checks are run on this assumption as presented below, showing that this assumption does not significantly modify simulation results. World Trade Organization 2016 suggests that globally, open account represents two times as many transactions as cash-in-advance. Since in ECOWAS open account is not used, similar importance is given to cash-in-advance and exports financed with working capital.

2. The costs associated with the transaction risk Trade finance instruments, i.e. trade loans and letters of credit, are less costly than the two other funding solutions, that is paying cash in advance and using own working capital/fund for producing for export or exporting directly. While letters of credit come with a fee, the costs associated with risk are transferred to the banks providing the letters of credit. The opportunity cost and risk of using own funding makes it more "costly" overall.

- The cost of transaction risk to use cash-in-advance (for an importer) and internal working capital for exports, $cia\_RC^{imp}_{isd}$ and $int\_WC\_RC^{exp}_{isd}$ are based on the share of bank non-performing loans to total gross loans (NPLs) provided by the African Development Bank

for ECOWAS countries (African Development Bank Group 2020) and by the International Monetary Fund through the World Bank website[5] for the rest of the world.

- the cost of transaction risk for import or export loans, $loa\_RC_{isd}^{exp}$ and $loa\_RC_{isd}^{imp}$ are based on ICC Obligor-weighted Export and Import loans default rates (International Chamber of Commerce 2019).

3. Financial costs Since the WTO Global Trade Model is a real model, the financial costs have to be expressed in real terms as well. Therefore, the expected rate of inflation is subtracted from the nominal financial costs, based on the expected inflation rate for 2022 from IMF projections[6].

- The LC issuing and confirmation fees, $lc\_fee_{isd}^{imp}$ and $lc\_fee_{isd}^{exp}$ are based on survey answers for ECOWAS countries. We use the average survey value obtained in ECOWAS to other developing economies. For developed economies, we use average OECD fees collected by the World Trade Organization and the African Development Bank.

- The cost of funds for cash-in-advance and exports with internal financing, $cia\_CF_{isd}^{imp}$ and $int\_WC\_CF_{isd}^{exp}$, are for the ECOWAS countries based on the cost of trade loans multiplied by a factor of two, which is motivated by the fact that survey answers for ECOWAS countries indicate that the interest rates for microfinance are twice as large as for trade loans. Robustness checks are run for this assumption using lower and higher multiplicative factors. The robustness results indicate that this assumption does not significantly affect the magnitude of the simulation results. For non-ECOWAS countries, lending rates provided by the International Monetary Fund through the World Bank website[7] for December 2021 are updated to June 30th, 2022 using the change in interbank rates for the same period.

- The cost of funds for using letters of credit for an exporter, $lc\_CF_{isd}^{exp}$, are calculated by multiplying the lending rates for each region by a ratio of the risk on export/import LCs - measured by the average default rate on export and import LCs (International Chamber of Commerce 2019) - and on cash-in-advance/working capital measured by the World Bank[8]. Therefore, the cost of funds for letters of credit is lower than for cash-in-advance and working capital, reflecting the fact that letters of credit are less risky.

- The interest rates on export and import loans, $loa\_CF_{isd}^{exp}$ and $loa\_CF_{isd}^{imp}$, are based on survey answers for ECOWAS countries. For non-ECOWAS countries, lending rates from the World Bank are scaled down by a factor of two reflecting that interest rates for microfinance are twice as large as for trade loans, reflecting the fact that a trade loan is cheaper than CIA or INT_WC. Robustness checks are run on this assumption as presented below. They indicate that this assumption does not significantly affect the magnitude of our results.

Two assumptions in the framework are not based on data: the shares of trade covered by cash-in-advance and exports financed with working capital, assumed to be both 50% of the share of trade not financed with trade finance; and the ratio of the costs of trade loans relative to the regular costs of funds, assumed to be 2. Robustness checks are conducted for both assumptions.

[5]International Monetary Fund, Financial Soundness Indicators. âBank nonperforming loans to total gross loansâ. 2022. Retrieved on September 19th, 2022 from https://data.worldbank.org/indicator/FB.AST.NPER.ZS

[6]World Economic Outlook, April 2022. International Monetary Fund. Retrieved on September 19th, 2022 from https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC/ADVEC/WEOWORLD/SDN

[7]International Monetary Fund, International Financial Statistics and data files. âLending Interest Rateâ. 2022. Retrieved on August 19th, 2022 from https://data.worldbank.org/indicator/FR.INR.LEND

[8]See [5]

Table 1: Changes in trade finance availability and costs in the counterfactual experiments

	Increase in Trade Finance Availability	Drop in LC Issuing Fees	Drop in LC LC Confirmation Fees	Drop in Trade Loan Costs
Côte d'Ivoire	21%	1.4%	2.1%	5.9%
Ghana	13%	0.4%	1.3%	7.1%
Nigeria	12%	0.4%	2.5%	8.3%
Senegal	24%	1.4%	2.0%	8.4%

4. Comparison of Trade Finance Costs Trade finance instruments, i.e. import and export loans and letters of credit, are less costly than the other two funding solutions, that is paying cash in advance and using own working capital/fund for producing for export or experting directly. While using trade finance bears an interest rate of a fee, the costs associated with risk are much smaller. The opportunity cost and risk of using own funding makes it more costly overall.

4 Scenarios and Results of Counterfactual Experiments

4.1 Scenarios

Four scenarios are constructed consisting of changes in the share of different trade finance instruments and the costs of trade finance in the ECOWAS countries. The changes are summarized in Table 1.

1. In the first scenario the share of trade supported by trade finance is increased to the African continental average of 40%. The resulting change is presented in Table 1 and the baseline shares are presented in Table 11.

2. In the second scenario, the cost of letters of credit is reduced to margins prevailing in the USA and Europe. The costs of unfunded trade finance (letters of credits and other documentary credit) are reduced, cutting both the LC issuing and confirmation fees, $lc\_fee_{isd}^{exp}$ and $lc\_fee_{isd}^{imp}$, for respectively the importer and the exporter. The projected change in the LC financial costs are calculated based on the results of the survey in the ECOWAS countries combined with the average letter of credit fees for the OECD.

3. In the third scenario, the price of import/export loans is also reduced to margins prevailing in the USA and Europe. The costs of trade loans decrease because through a reduction in the interest rates for import and export loans, respectively $loa\_CF_{isd}^{imp}$ and $loa\_CF_{isd}^{exp}$. The projected change in the costs of import and export loans is based on double differencing: the cost of funds are subtracted from the lending rates for both the ECOWAS countries and the OECD reference countries, comparing the difference in the gap in the two countries, projecting that the difference between the lending rates and the cost of funds will fall to the OECD level.

4. In the fourth scenario the three previous shocks are combined, implying that both the availability of trade finance increase and their costs fall.

4.2 Trade Cost Reductions

Under the combined shock, the ad valorem equivalent of trade costs decreases by up to 6% with greater effects on exports. Figure 1 displays the projected reductions in trade costs on both the

importer and exporter sides for the four economies under the different scenarios. We observe that the highest contribution comes from increased trade finance shares, whereas lowering letters of credit fees plays a smaller role. This is explained by the fact that the baseline share of trade financed with letters of credit is modest. As a result, the fees for this instrument are smaller than the costs of other types of trade finance facility - hence the impact of their reduction on trade costs is necessarily small too.

Figure 1 provides a breakdown by economy for the projected effect of raising the share of trade covered by trade finance. There, the largest cost reductions are for Senegal (6.20% on the export side) and the smallest for Nigeria (2.8%). Senegal has the lowest initial share of trade covered by trade finance. Therefore, increasing the coverage of trade finance to 40% of total trade leads to the largest trade cost reductions for Senegal.

As discussed, trade costs reductions are driven by two factors. First, increasing the availability of trade finance entails a shift from expensive instruments to cheaper trade finance instruments. This increase in the coverage of trade finance is particularly pronounced for intra-Ecowas trade. Since trade cost reductions occur both on the exporting and on the importing side, the reduction in trade costs is a factor five to ten times larger for intra-ECOWAS trade than for trade with non-ECOWAS countries.

Second, trade cost reductions come from decreases in fees and interest rates. When letters of credit or trade loans become more affordable, financing trade becomes cheaper. In the counterfactual experiment opening fees and confirmation fees become lower for ECOWAS countries. So only if these countries are importer (for opening fees) or exporter (for confirmation fees) trade cost reductions occur. The same holds for import and export loans. When the exporter (importer) is an ECOWAS country, export (import) loans become cheaper and as a result, trade costs fall.

Finally, a reduction in the price of letters of credit leads to a larger cost reduction on the import side than on the export side. This stems from the fact that the exporter's costs of using LCs are smaller in the baseline. In the simulations, it is assumed that ECOWAS countries only pay confirmation fees when trading with destinations that are riskier or as risky as ECOWAS. As a result, ECOWAS exports financed with LCs do not always involve a confirmation fee, whereas imports always involve an opening fee. Hence, if these fees are decreased in a counterfactual experiment, the observed cost reductions are necessarily larger on the import side.

4.3 Projected Trade Changes

Projected Changes in Total Trade The reductions in trade costs are projected to increase ECOWAS4 exports and imports by around 11%. Figure 2 displays the projected change in real exports and imports under the four scenarios: increases in the share of trade covered by trade finance, a reduction in letter-of-credit fees, a reduction in trade loan spreads, and the combination of all changes. The exports of ECOWAS4 countries are projected to increase by between 5.78% for Nigeria and 35.11% for Senegal, whereas the projected rise in imports is between 8.07% for Nigeria and 17.03% for Côte d'Ivoire. The large projected increase in exports from Senegal is driven by larger than average trade cost reductions relative to other regions, as well as the sectoral and geographical composition of the country's exports. A large share of this country's exports tends to occur in sectors with a large responsiveness to changes in trade costs, technically with a high trade elasticity. Therefore, the impact of trade cost reductions is larger. Detailed analysis for Senegal indicates that most of the increase in exports comes from more sales of chemicals to other African countries and to India, but also of minerals to the European Union (EU) and other developed countries (see Figure 8 in the annex).

On the other hand, the projected increase in trade is more moderate for Nigeria because

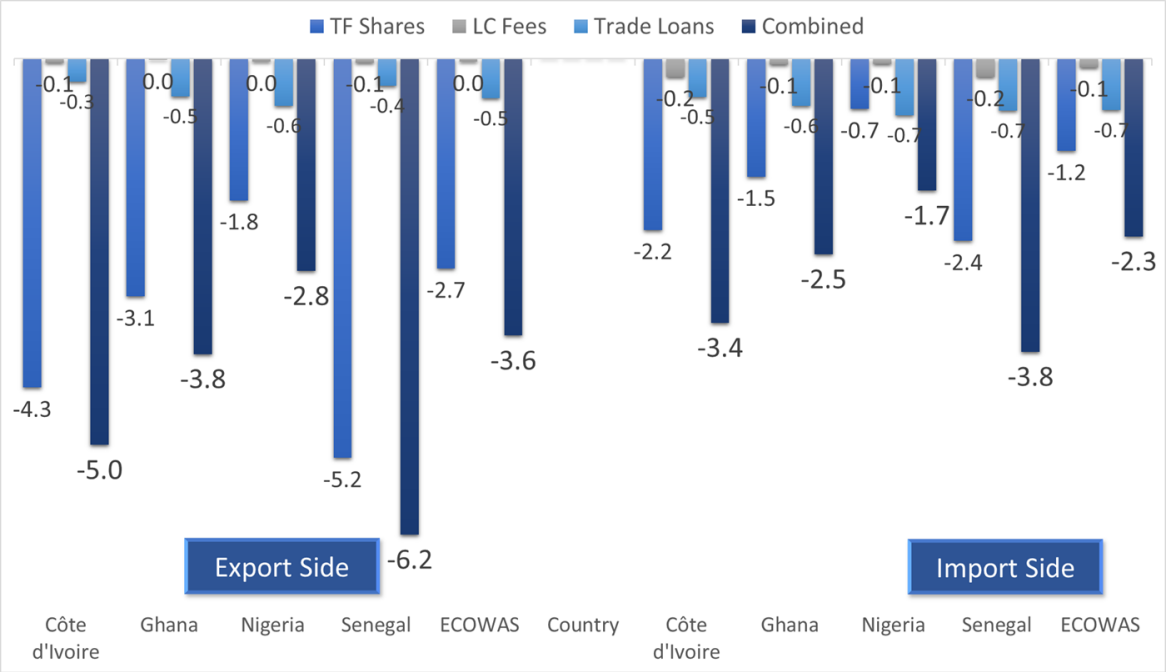

Figure 1: Projected ad valorem trade cost reduction (%) under four different scenarios

most of its exports consist of oil and minerals to developed countries (see Figure 9 in the annex), for which trade finance costs play a smaller role. Figure 2 also makes clear that the largest contribution to the projected increase in trade comes from an increase in the share of trade covered by trade finance. The reductions of LC fees and of the price of trade loans play a smaller role, because they contribute less to the reduction of trade costs as shown in Figure 1.

The projected increase in trade represents nearly $18 billion in foregone trade every year related to low availability and high costs of trade finance. The projected boost to trade for the combined shock - increasing the coverage of trade finance and decreasing the price of trade finance instruments - can also be interpreted as foregone trade for every year that trade finance availability is not improved, with numbers by country displayed in Table 2. For Nigeria, the largest foregone opportunity is for imports while for the rest of the ECOWAS4 countries it relates to exports.

Comparison with the literature The projected changes in trade can be compared with empirical estimates in the literature on the responsiveness of trade flows to trade finance supply. Chor and Manova 2012 find a 0.2 elasticity between trade credit availability and imports and a small but significant coefficient of the effect of firm's external financial dependence in the US and imports. Auboin and Engemann 2012 find that a 1% increase in insured trade credit granted to a country leads to a 0.3-0.4% increase in real imports of the country, using quarterly country-level data of export credit insurers for 91 countries. Niepmann and Schmidt-Eisenlohr 2017b find that a one-standard deviation negative shock to a country's LC supply reduces USA exports to that country by 1.5%. Given that a one-standard deviation reduction corresponds with a 34% reduction, the implied elasticity in Niepmann and Schmidt is about 0.044.

The projected changes in the simulations are in the same range of the estimates of these

papers. In our simulations, the increases in the trade finance share are respectively 109% (Côte d'Ivoire), 47% (Ghana), 40% (Nigeria) and 145% (Senegal). The projected trade increases (average of import and export changes) are 13.1% (Côte d'Ivoire), 11.75% (Ghana), 3.9% (Nigeria), and 16.6% (Senegal) implying elasticities of trade with respect to trade finance supply of 0.120 for Côte d'Ivoire, 0.248 for Ghana, 0.096 for Nigeria, and 0.114 for Senegal.[9] Thus, the trade-weighted average implied elasticity is of 0.123.

Hence, the elasticities vary widely reflecting the wide variation of the estimated elasticities in the literature. However, despite of the large differences in employed methodology,[10] the elasticities emerging from the model are in the same ballpark as the elasticities estimated in the literature.

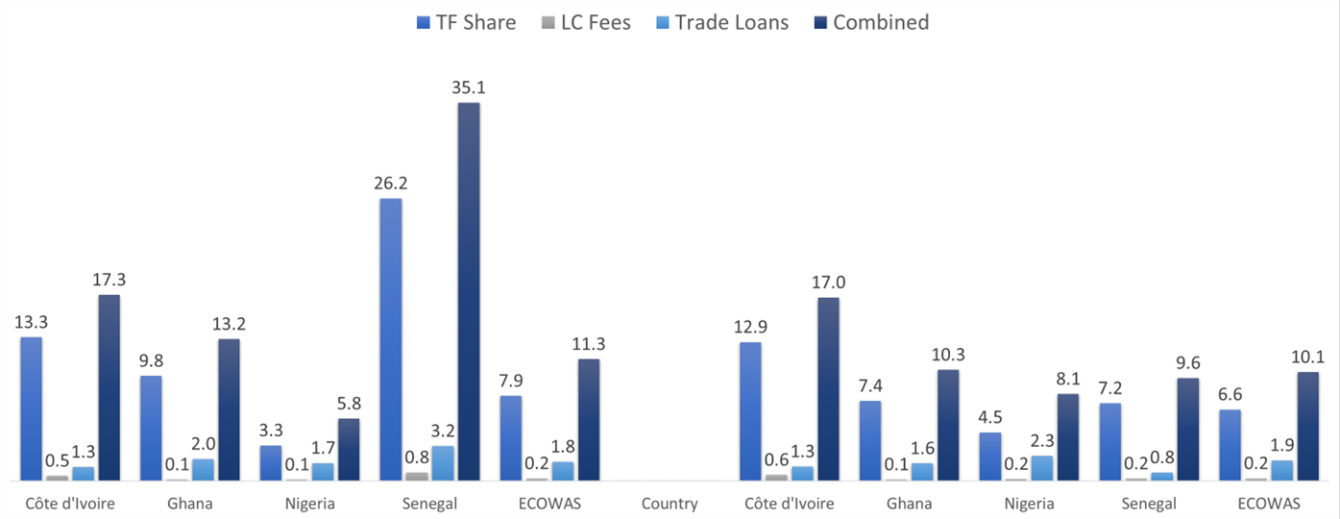

Figure 2: Projected change (%) in real exports and imports under four trade finance shocks

Projected Changes in Bilateral Trade Figure 3 displays the projected change in real exports and real imports for the four ECOWAS countries. The figure shows that the combined shock - both reducing trade finance fees and increasing the coverage of trade finance - generates the largest increase in real exports for intra-ECOWAS trade. The reason is that trade costs are projected to fall most for intra-ECOWAS trade in the counterfactual experiments, as they are projected to fall both on the importing and exporting side. Other regions with large projected increases of exports from the ECOWAS countries are Africa and India, since they have the largest initial trade finance costs and thus most scope for reductions in trade costs.

The largest projected increase of imports into ECOWAS countries is for intra-ECOWAS trade, for the same reasons presented earlier. Imports are also projected to significantly increase for trade with African and other developing countries. Since these countries have the highest baseline trade finance costs to export, an increase in the share of trade covered by trade finance in ECOWAS countries tends to reduce trade costs most for imports into ECOWAS from these regions (or exporting for African and other developing countries). On the other hand, projected

[9] the percentage changes are calculated as 20.9%/19.1%=109% for Côte d'Ivoire, 12.9%/27.1%=47% for Ghana, 11.5%/28.5%=40% for Nigeria and 23.7%/16.3%=145% for Senegal and the trade changes are simple averages of projected changes in imports and exports.

[10] it is important to observe that Auboin and Engemann 2012 estimate elasticities at the global level.

trade finance costs hardly fall for imports from the Middle East and the European Union, implying a smaller projected increase (or even a decrease for trade from Middle east to Côte d'Ivoire) in imports from these regions with imports shifting to other sources.

Table 2: Projected Increase in Trade under the Combined Shock

Projected Increase (mio $)	**Exports**	**Imports**	**Trade**
Côte d'Ivoire	2649.3	2385.5	**5034.8**
Ghana	2129.9	732.1	**2862.0**
Nigeria	2711.4	4187.0	**6898.4**
Senegal	1783.4	824.1	**2607.5**
ECOWAS	9434.8	8244.5	**17679.3**

4.4 Projected Changes in GDP

Table 3 presents the projected increase in GDP under the combined shock for the four countries studied. Increasing access to trade finance and lowering the costs of the instruments could boost the GDP of the region by more than $4 billion. This comes from the fact that increasing access to trade finance would boost trade by nearly $18 billion, generating an increase in GDP of the four countries. Effects range from $312 million for the smallest economy of the four, Senegal, to $1.7bn for Nigeria, the largest economy in the region.

The figures presented in Table 3 could be translated in percentages of GDP. For Côte d'Ivoire, the effect is largest and reaches nearly 2% of GDP (1.81$). Nigeria, which has the highest nominal value, would benefit from an increase equivalent to 0.45% of GDP. The figure ranges at 1.23% for Ghana and 1.48% for Senegal.

Therefore, increasing the availability and lowering the costs of trade finance could boost GDP growth as well. In other words, the current trade finance availability represents nearly 4$ dollars of foregone gross domestic product for the region.

Table 3: Projected changes in GDP under the combined shock

Projected GDP Increase (mio $)	
Côte d'Ivoire	1262.7
Ghana	725.6
Nigeria	1724.6
Senegal	312.0

4.5 Variants of The Model

Sectoral Variations

In the proposed framework, the use of letters of credit (LC) and trade loans is not changing sectorally. However, in reality, some sectors are more intensive in the use of letters of credit. Using the indicator of "LC-Intensity" calculated by Crozet, Demir, and Javorcik 2022, we can implement sectoral variations in this version of the framework.

The LC-Intensities provided in Crozet, Demir, and Javorcik 2022 are at the HS4 level. Using a concordance table, we map these figures to the sectors in our framework. Using GTAP trade

volumes, trade-weighted sectoral averages of LC Intensities are presented in Table 4. Only the oil sector has an intensity significantly higher than the median and the mean intensity.

In fact, the oil sector is above the 97th percentile of the distribution of LC-Intensities. According to the distribution provided in the paper, this would be translated in a share of trade covered by letters of credit of 40% (the 97th percentile is approximately 40%). Therefore, in this variant of the model, the coverage of trade by letters of credit in the oil sector is assumed to be 40%. To be consistent with the previous assumptions of our model, an identical share is assumed for trade loans. As a result, trade finance covers 80% of the transactions in the oil sector i the baseline.

This implies that Counterfactual Experiment 1 is then slightly modified. More specifically, we apply the same shock applied in the previous section to all sectors except oil. In the oil sector the coverage of trade finance is extended from 80% to 90% in the counterfactual experiments.

Table 4: Sectoral Intensity in the use of Letters of Credit

Sector	**LC Intensity**
Crops	-0.134
Extractions	-0.047
Heavy Manufacturing	-0.130
Light Manufacturing	-0.103
Livestock	-0.109
Oil	0.679
Median	-0.112
Mean	-0.075

The results from Figure 4 show that the effect of the combined shock for Côte d'Ivoire (17% both on the export and import side) and Senegal (35% increase for real exports, 10% for real imports) is of similar magnitude than the one found in section 4.1. Ghana witnesses more significant jumps in trade under this sectoral approach, with effects increasing from 13.2% to 14.92% on the export side and from 10.3% to 11.2% on the import side.

However, for the ECOWAS region, the effects are much larger than those found in Ghana, Senegal, and Côte d'Ivoire. Overall, the trade-weighted boost observed in real export jumps from 11.3% to 12.75% on the export side, and from 10.1% to 12.01% on the import side. The figures for the largest economy considered, Nigeria, explain this. There, the increase in exports is two percentage points higher under this variant, and two and a half percentage points on the import side.

These larger increases in trade in trade under this variant with sectoral LC intensities are further reflected in the sectoral decomposition of Figure 5. Unsurprisingly, the figures for the oil sector are all higher than in the baseline scenario. For Nigeria, the boost to exports goes from 4.5% in the baseline scenario to 7.9% under this sectoral variant, and it doubles on the import side (from 5.8% to 11.5%). Since oil is the main trading sector of the country, the overall boost to trade reflects this trend.

For Ghana, Côte d'Ivoire, and Senegal, despite observing a similar pattern in the oil sector, this is only partly reflected in the country average due to the fact that oil is not as predominant in trade than it is in Nigeria. In these last three countries, oil represents a small fraction of overall trade such that the trade-weighted average is similar to the one found in the baseline scenario.

4.6 Robustness Checks

A range of robustness checks was conducted to confirm the validity of our analysis. The construction of baseline trade finance costs is based on a careful analysis of the available data, as presented in Annex 3 describing the conceptual framework for the counterfactual experiments. However, two assumptions had to be included with little guidance in the actual data. Therefore, robustness checks are included on these two assumptions.

First, the survey results (and insights from the literature for other regions) only provide information on the share of trade covered by trade finance instruments (letters of credit and trade loans). However, the distribution of the remaining share of trade between cash-in-advance (CIA) and exports financed with internal funds (INT_WC) for each of the 20 regions is unknown. In the baseline, the assumption is made that 50% of trade not covered by trade finance is covered by cash-in-advance, and 50% by exports financed with internal funds. A first set of robustness checks is conducted on this assumption. In Figure 6 the first robustness check called "30 CIA", the assumption is modified giving a 30% weight to cash-in-advance, and a 70% weight to exports financed with internal funds, meaning that 30% of the trade not covered by trade finance is covered by cash-in-advance, and 70% by exports financed with internal funds. In "70 CIA", the shares are inverted with a 70% weight for cash-in-advance, and 30% for exports financed with internal funds.

Second, for ECOWAS countries, data on the trade loan premiums charged by banks are based on a survey showing that the interest rates on other forms of financing (particularly micro-finance) are a factor two smaller than the interest rates on trade finance instruments. Combining this assumption with the survey results for the interest rates charged the trade finance instruments, the financing costs for cash-in-advance and exports financed with internal funds were calculated. For the other regions, the same assumption is made, i.e., that the interest rates on trade finance instruments are a factor two smaller than on other forms of financing. However, in those regions, data on lending rates for other forms of financing are available (through IMF data) and the costs of trade finance were thus calculated by dividing these lending rates by a factor 2. Two robustness checks are conducted on the factor 2 assumption. In the scenarios called "1.5 Premium" and "2.5 Premium", this premium was changed from 2 to 1.5 and 2.5 respectively. In other words, the cost of working capital with cash-in-advance or exports with internal funds are respectively 1.5 and 2.5 higher than the capital costs of trade loans.

Moreover, a last robustness check called "Comtrade" is presented. The counterfactual experiments are conducted on baseline trade data for 2022, projecting data from the GTAP Data Base for 2017. As an alternative, a pre-simulation was conducted for 2022 to bring the baseline trade data from this procedure in line with Comtrade (UN) trade data for the year 2020.

Table 5 and Table 6 show that the model is robust to the assumptions varied in this section. The projected change in exports varies between 10.45% and 12.06% with a projected change of 11.30% in the baseline specification, whereas the change in imports varies between 9.54% and 10.66% with a projected change of 10.11% in the baseline. Also in individual countries the variation is relatively modest with the largest variation projected for Senegal with the projected export changes varying between 32.26% and 38.02% with a baseline change of 35.11%.

Table 5: Robustness checks on the projected increase in trade under different assumptions

Exporter	Baseline	30 CIA	70 CIA	1.5 Premium	2.5 Premium	Comtrade
Côte d'Ivoire	17.28	18.20	15.72	16.23	18.32	17.25
Ghana	13.17	14.28	11.57	12.53	13.79	13.11
Nigeria	5.78	6.20	5.24	5.38	6.18	5.76
Senegal	35.11	34.33	34.81	32.26	38.02	34.67
ECOWAS	11.30	11.81	10.45	10.55	12.06	11.24

Importer	Baseline	30 CIA	70 CIA	1.5 Premium	2.5 Premium	Comtrade
Côte d'Ivoire	17.03	16.98	16.51	16.08	17.97	17.03
Ghana	10.32	10.63	9.68	9.86	10.77	10.32
Nigeria	8.07	8.09	7.90	7.60	8.54	8.05
Senegal	9.55	10.28	8.38	9.01	10.08	9.55
ECOWAS	10.11	10.21	9.72	9.54	10.66	10.09

Table 6: Robustness checks on the projected increase in trade for the risk aversion parameter

Country	Baseline (CRRA 0.7)	CRRA 0.9	CRRA 0.5
Côte d'Ivoire	17.28	28.97	13.49
Ghana	13.17	19.90	10.66
Nigeria	5.78	8.77	4.98
Senegal	35.11	65.53	26.91
ECOWAS	11.30	18.64	9.11

Country	Baseline (CRRA 0.7)	CRRA 0.9	CRRA 0.5
Côte d'Ivoire	17.03	28.31	13.36
Ghana	10.32	15.74	8.35
Nigeria	8.07	12.25	6.93
Senegal	9.55	15.27	7.59
ECOWAS	10.11	15.84	8.33

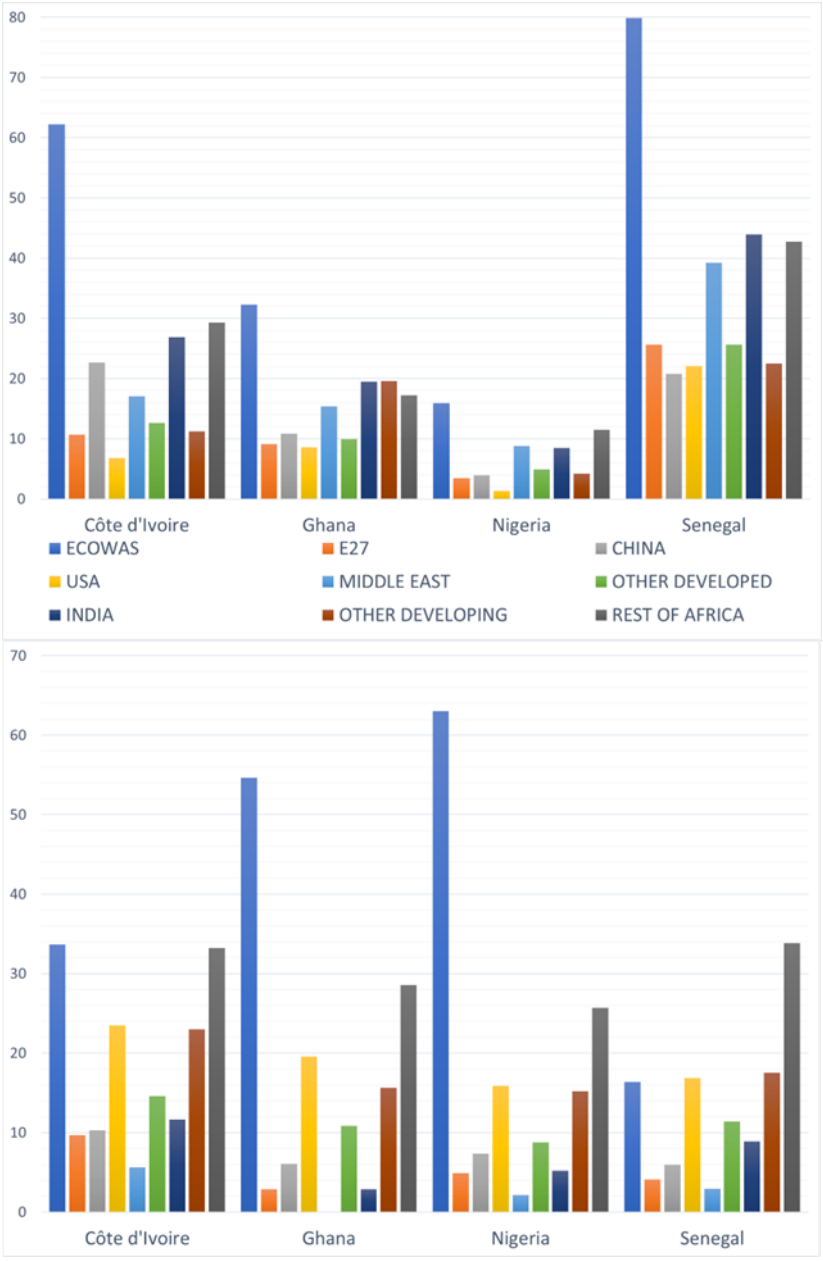

Figure 3: Projected change (%) in real exports and imports by partner under the combined shock

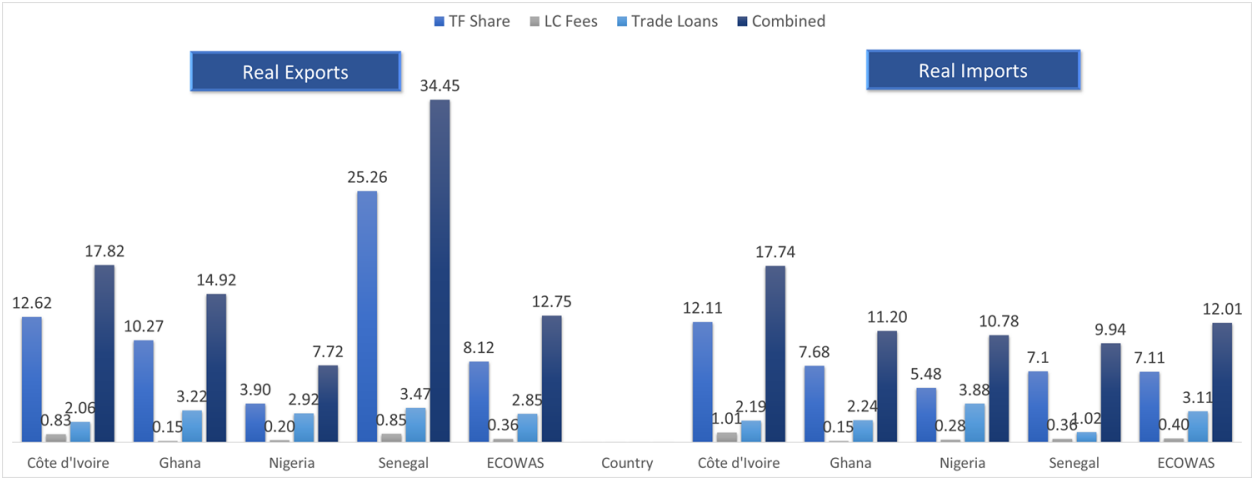

Figure 4: Projected change (%) in trade for the sectoral variant (combined shock)

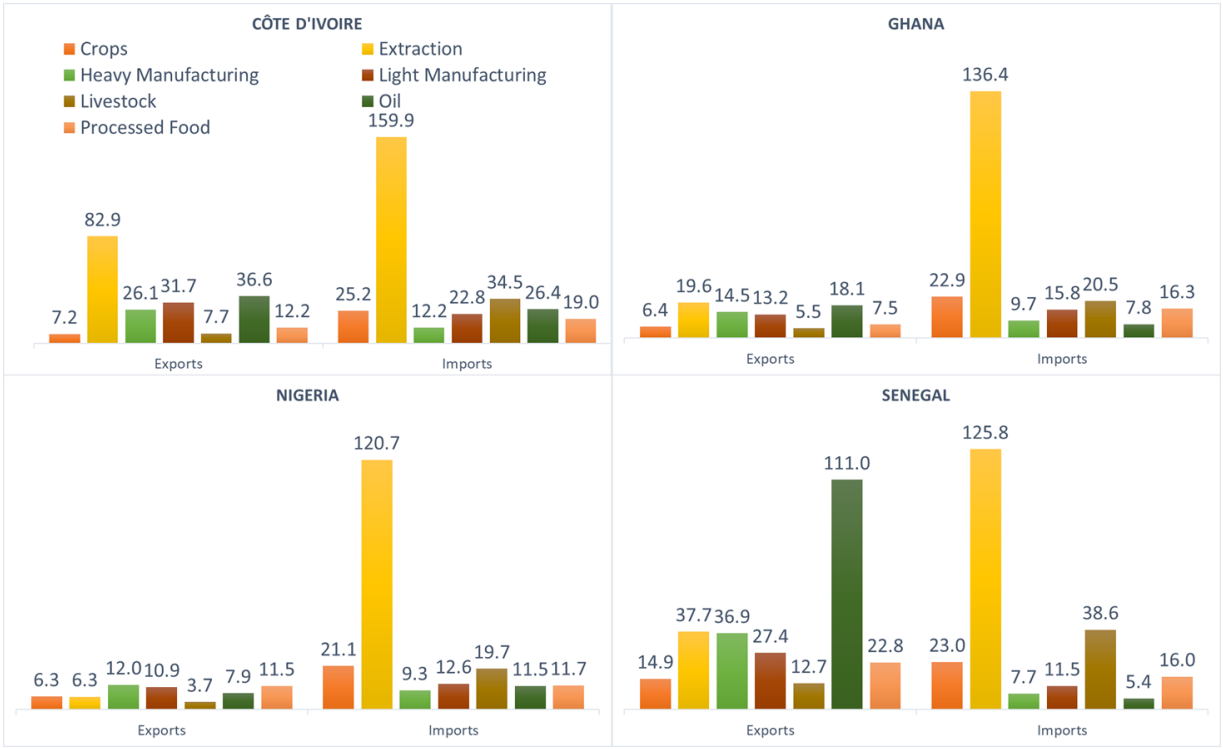

Figure 5: Projected change (%) by sector for the sectoral variant under the combined shock

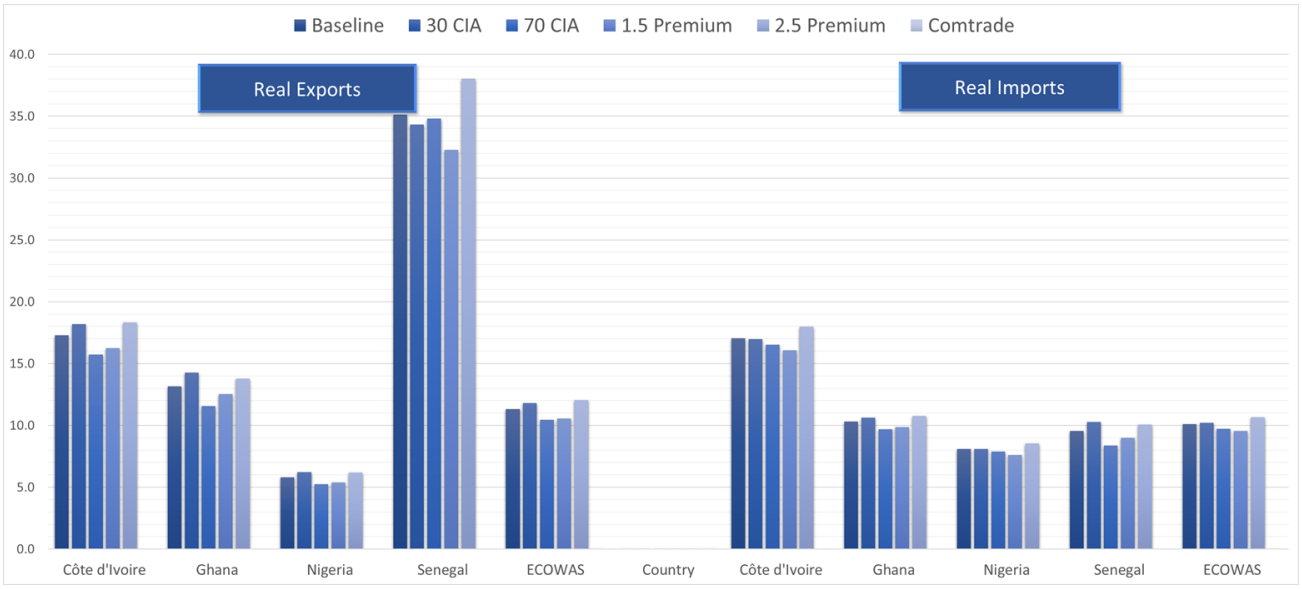

Figure 6: Robustness Checks for changes in the share of trade and in the costs

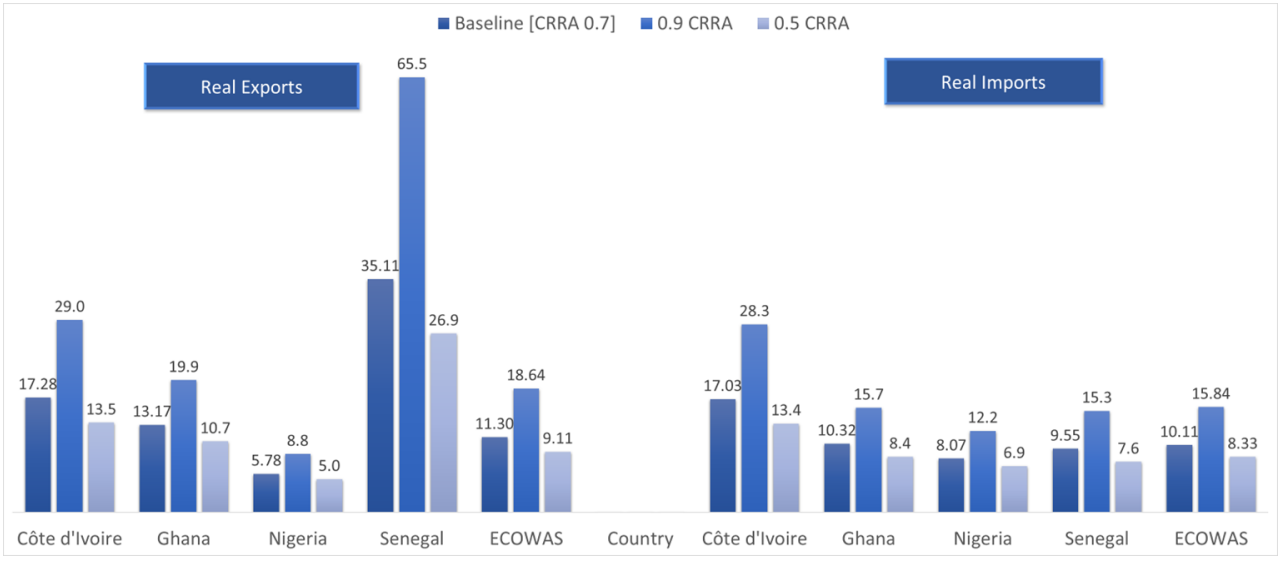

Figure 7: Robustness Checks for changes in the share of trade and in the costs

5 Conclusion

We present a novel framework to simulate the impact of changing trade finance conditions on trade. The analysis distinguishes between four modes of payment or financing, each differing in cost and transactional risk: cash-in-advance, export or import loans, exports financed with own working capital, and letters of credit. For example, under cash-in-advance the importer pays for goods upfront and in doing so, pre-finances the exporter's cash-flow thus incurring a transactional risk of not receiving a proper delivery, without the benefit of a collateral. Using this form of payment generates a maximal transactional risk and high financial costs relative to others financial instruments. Under letters of credit, most of this transactional risk is transferred to the bank(s) and no funds are engaged by the importer until receiving the merchandise. The exporter, however, has to pre-finance the production and shipment, even if the payment is guaranteed by a letter of credit, reason why pre-export credit plays an important role in trade finance.

In view of the high rejection rates for trade finance applications, high costs for facilities and low coverage revealed by the ECOWAS survey, four scenarios are simulated with the Global Trade Model, a computable general equilibrium model, modelling the costs of trade finance as trade taxes. In the first scenario, the share of trade supported by trade finance is increased in the four ECOWAS countries under review to the African continental average. In the second and third scenarios, the cost of trade finance instruments is reduced to lower margins prevailing in more advanced countries. The fourth scenario combines the reduction in costs and increased availability of trade finance.

The model generates trade cost reductions when the share of trade finance is increased and when interest rates and fees are reduced. An increase in the share of trade covered by letters of credit (through greater supply) reduces overall trade costs, reflecting the fact that trade finance is across the board (from an implied cost and risk perspective) a cheaper way to finance international trade than other payment options with larger risks which are prevailing when trade finance is not available or rejected by financial institutions.

Since trade finance costs are only a fraction of overall trade costs, which are very high in the four ECOWAS countries, even a substantial improvement in the availability of trade finance and a substantial reduction in the costs of trade finance may only generate a moderate reduction in overall trade costs. Still, the reductions the model generate is not disconnected from estimates of the literature, although in its lower bounds. A combination of an increase of the trade finance share of trade combined with the modelled reduction in trade finance interest rates and fees is projected to lead to an annual increase of trade flows of 11% on average for the four ECOWAS countries. The simulation results indicate that there is a sizeable payoff for policy makers and market participants to work on efficiency improvements in the operation of trade finance markets, although the low coverage and high fees of trade finance are not only driven by domestic factors.

Although the presented research is replicable for other countries similar to the ECOWAS countries with few available trade finance options, more work would be needed to expand such a framework to more advanced financial markets offering more sophisticated, mainstream forms of trade finance with supply chain finance arrangements (multiple factoring, payment chains insured by trade credit insurance, etc). However, the framework presented provides a good starting point.

The current work can be extended in at least three diferent directions. First, more data can be collected on features of the model for which currently assumptions are necessary. Second, more work can be done to include sectoral variation in both the share of different trade finance instruments and the interest rates and fees charged. In this paper, insights from the literature are employed to add sectoral variation although this has turned out to be complicated. Both these extensions are complicated by the fact that research on trade finance is typically limited by

the availability of data on trade payments and the supply and demand of trade finance. These data can only be obtained through extensive surveys in the absence of internationally reliable statistics on some of the trade finance instruments and their prices. Such surveys are necessary to collect data on the coverage of trade by each instrument (trade finance and non-trade finance). Data on the costs (interest rates and fees) can be difficult to obtain with the surveys as they are commercially sensitive and proprietary (opening and confirmation fees, trade loan interest rates, average default rates on trade finance instruments).

Third, the current framework with exogenous shares of the different ways to finance international trade can be extended to model the choice of instruments endogenously. This would imply that counterfactual policy experiments would be conducted on for example the degree of competition and the need for collateral to obtain trade finance.

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Annex

Data Collection

	sh_{isd}^{lc}	$sh_{isd}^{loa,exp}$ and $sh_{isd}^{loa,imp}$	$sh_{isd}^{cia,imp}$ and $sh_{isd}^{int\_wc,imp}$
ECOWAS	50% of the total coverage of Trade finance retrieved from IFC-WTO Survey	25% each of the total coverage of Trade finance retrieved from IFC-WTO Survey	50% each of the trade not covered by Trade Finance
Developed	Trade-weighted Regional Averages calculated using values from Niepmann and Schmidt-Eisenlohr 2017a	Each is half of the total of trade covered by LCs	50% each of the trade not covered by Trade Finance
Developing	Trade-weighted Regional Averages calculated using values from Niepmann and Schmidt-Eisenlohr 2017a	Each is half of the total of trade covered by LCs	50% each of the trade not covered by Trade Finance

Table 7: Assumptions on the Coverage of Trade by Each Instrument

[11] See footnote [5]
[12] See footnote [5]
[13] See footnote [5]
[14] See footnote [5].
[15] See footnote [7]
[16] See footnote[7] and African Development Bank Group 2020 for Côte d'Ivoire and Senegal.
[17] See footnote[7] and African Development Bank Group 2020 for Côte d'Ivoire and Senegal.
[18] See footnote[7] and African Development Bank Group 2020 for Côte d'Ivoire and Senegal.

	$loa\_RC_{isd}^{imp}$ and $loa\_RC_{isd}^{exp}$	$loa\_CF_{isd}^{imp}$ and $loa\_CF_{isd}^{exp}$
ECOWAS	ICC Obligor-weighted Import and Export Loans default rates from International Chamber of Commerce 2019	Retrieved from International Finance Corporation and World Trade Organization 2022
Developed	ICC Obligor-weighted Import and Export Loans default rates from International Chamber of Commerce 2019	We divide the regular lending rate by two (to be consistent with ECOWAS). By doing so, trade finance is two times cheaper than regular lending.
Developing	ICC Obligor-weighted Import and Export Loans default rates from International Chamber of Commerce 2019	We divide the regular lending rate by two (to be consistent with ECOWAS). By doing so, trade finance is two times cheaper than regular lending.

Table 8: Assumptions for import and export loans

	$cia\_RC_{isd}^{imp}$ and $int\_wc\_RC_{isd}^{exp}$	$cia\_CF_{isd}^{imp}$ and $int\_wc\_CF_{isd}^{exp}$
ECOWAS	For Ghana and Nigeria, Bank nonperforming loans to total gross loans retrieved from World Bank[11]. For Côte d'Ivoire and Senegal, West Africa average of the same figure retrieved from African Development Bank Group 2020.	We multiply the cost of trade loans by a factor of two. [TABLE NUMBER] justifies this choice. By doing so, trade finance is two times cheaper than regular lending.
Developed	Bank nonperforming loans to total gross loans retrieved from World Bank.[12]	Lending rates provided by the International Monetary Fund through the World Bank website[13] for December 2021 are updated to June 30th, 2022 using the change in interbank rates for the same period.
Developing	Bank nonperforming loans to total gross loans retrieved from World Bank.[14]	Lending rates provided by the International Monetary Fund through the World Bank website[15]. for December 2021 are updated to June 30th, 2022 using the change in interbank rates for the same period.

Table 9: Assumptions for cash-in-advance and internal financing (working capital) for exports

	$lc\_fee_{isd}^{imp}$	$lc\_fee_{isd}^{exp}$	$lc\_CF_{isd}^{exp}$
ECOWAS	Opening Fees from IFC-WTO survey	Confirmation Fees from IFC-WTO survey	We multiply lending rates by the ratio of the risk on LCs (average default Rate on export and import LCs, International Chamber of Commerce 2019), to the risk on regular lending[16].
Developed	Average OECD LC Opening Fees	Average OECD LC Confirmation Fees	We multiply lending rates by the ratio of the risk on LCs (average default Rate on export and import LCs, International Chamber of Commerce 2019), to the risk on regular lending[17].
Developing	Average LC Opening Fees from the IFC-WTO survey (for ECOWAS, applied to all developing regions).	Average LC Confirmation Fees from the IFC-WTO survey (for ECOWAS, applied to all developing regions).	We multiply lending rates by the ratio of the risk on LCs (average default Rate on export and import LCs, International Chamber of Commerce 2019), to the risk on regular lending[18].

Table 10: Assumptions on the Coverage of Trade by Each Instrument

The sources for the numbers in Table 11 are from a joint IFC-WTO survey for ECOWAS countries (International Finance Corporation and World Trade Organization 2022), where outliers have been removed for the purpose of this paper purely. For the other regions, we calculate trade-weighted regional averages using shares from Niepmann and Schmidt-Eisenlohr 2017a. Trade data come from the GTAP Data Base, Version 11. For some missing regions, we use the world average (13%) given in this same paper. Furthermore, African Development Bank Group 2020 indicates that on average, half of banks' trade finance portfolios are associated with unfunded trade finance, and half with funded instruments. Therefore, knowing the share of unfunded trade finance (letters of credit and other documentary credits, sh_{isd}^{lc} in our model), we derive the share of trade loans (funded trade finance, $sh_{isd}^{loa,exp}$ and $sh_{isd}^{loa,imp}$ in our model).

Table 11: Share of Trade Covered by Letters of Credit

REGION	**LC Share**
Côte d'Ivoire (Ecowas)	19.9 %
Ghana (Ecowas)	27.13 %
Nigeria (Ecowas)	28.47%
Senegal (Ecowas)	16.31%
Other Developed	19.8%
China	22.7%
East Asia	22.0%
South East Asia	23.4%
India	42.0%
South of Asia	13.0%
United States of America	8.8%
Latin America and Caribbean	7.9%
European Union (27)	22.6%
Middle East	26.7%
North Africa	13.0%
Rest of West Africa	13.0%
Central Africa	13.0%
East Africa	13.0%
South of Africa	13.0%
Rest of the World	13.0%

Figures in Table 12 are from the International Monetary Fund through the World Bank website[19] for all countries but Côte d'Ivoire and Senegal. For these two ECOWAS countries, since no data is provided by the IMF, we use the average for the region provided by African Development Bank Group 2020. We use these figures in our model for the cost of transaction risk to use cash-in-advance and working capital for exports (respectively $cia\_RC_{isd}^{imp}$ and $int\_wc\_RC_{isd}^{exp}$).

Table 12: Nonperforming loans to total gross loans (NPLs)

REGION	**NPLs to Total Gross Loans**
Côte d'Ivoire (Ecowas)	11.00%
Ghana (Ecowas)	15.10%
Nigeria (Ecowas)	6.00%
Senegal (Ecowas)	11.00%
Other Developed	0.89%
China	1.80%
East Asia	0.37%
South East Asia	2.21%
India	7.90%
South of Asia	7.08%
United States of America	1.10%
Latin America and Caribbean	2.54%
European Union (27)	2.62%
Middle East	5.36%
North Africa	12.70%
Rest of West Africa	11.43%
Central Africa	15.29%
East Africa	7.66%
South of Africa	5.27%
Rest of the World	10.18%

[19] See footnote [5]

Figures in Table 13 stem from International Chamber of Commerce 2019. They correspond to the obligor-weighted default rates for import/export loans by region, averaged over the years 2014 to 2018, then mapped to the regions of our model. In the model, these figures are integrated as the cost of transaction risk for import and export loans, respectively $loa\_RC_{isd}^{exp}$ and $loa\_RC_{isd}^{imp}$.

Table 13: Obligor-weighted Default Rates for Export and Import Loans

REGION	**Trade Loan Default Rate**
Côte d'Ivoire (Ecowas)	0.91%
Ghana (Ecowas)	0.91%
Nigeria (Ecowas)	0.91%
Senegal (Ecowas)	0.91%
Other Developed	0.74%
China	0.71%
East Asia	0.71%
South East Asia	0.71%
India	0.71%
South of Asia	0.71%
United States of America	1.18%
Latin America and Caribbean	1.56%
European Union (27)	0.74%
Middle East	1.14%
North Africa	0.91%
Rest of West Africa	0.91%
Central Africa	0.91%
East Africa	0.91%
South of Africa	0.91%
Rest of the World	0.23%

To obtain the opening and confirmation fees for letters of credit presented in Table 14, we use survey answers from International Finance Corporation and World Trade Organization 2022 for ECOWAS regions. For developed regions, we also use data from the same report, showing the average OECD fees for this instrument. For developing economies, we use the average fees obtained for the ECOWAS region in this same report. In the model, we write these parameters as $lc\_fee_{isd}^{imp}$ and $lc\_fee_{isd}^{exp}$.

Table 14: Opening and Confirmation Fees for Letters of Credit

REGION	**LC Opening Fee**	**LC Confirmation Fee**
Côte d'Ivoire (Ecowas)	1.50%	2.58%
Ghana (Ecowas)	0.50%	1.80%
Nigeria (Ecowas)	0.50%	3.00%
Senegal (Ecowas)	1.50%	2.51%
Other Developed	0.12%	0.50%
China	0.12%	0.50%
East Asia	0.12%	0.50%
South East Asia	1.00%	2.47%
India	1.00%	2.47%
South of Asia	1.00%	2.47%
United States of America	0.12%	0.50%
Latin America and Caribbean	0.12%	0.50%
European Union (27)	0.12%	0.50%
Middle East	0.12%	0.50%
North Africa	1.00%	2.47%
Rest of West Africa	1.00%	2.47%
Central Africa	1.00%	2.47%
East Africa	1.00%	2.47%
South of Africa	1.00%	2.47%
Rest of the World	1.00%	2.47%

To obtain real lending rates at June 30th, 2022 shown in Table 15, we initially retrieve nominal lending rates from the International Monetary fund through the World Bank website[20] that are for December 31st, 2021. Then, for each country in the sample, we retrieve directly from each Central Bank's website the change in interbank rates between December 31st, 2021 and June 30th, 2022. Using this change, we update the nominal interest rates to June 30th, 2022.

To obtain real interest rates (because the WTO Global Trade Model works in real terms), we correct these nominal interest rates for the expected inflatio n for the year 2022 according to the International Monetary Fund[21] In the model, this corresponds to the cost of funds to use cash-in-advance and working capital for exports, respectly noted as $cia\_CF_{isd}^{imp}$ and $int\_wc\_CF_{isd}^{exp}$.

For ECOWAS regions, nominal rates are not available on the International Monetary Fund data. Therefore, we use the trade loan interest rates obtained from International Finance Corporation and World Trade Organization 2022 that we multiplied by 2, as previously explained. The figures are shown in Table 16. This ensures that trade finance is two times cheaper than regular lending. Robustness checks are presented on this assumption.

Table 15: Nominal and Real Lending Rates at June 30th, 2022

REGION	***Nominal Rate***	***Expected Inflation 2022***	**Real Rate**
Other Developed	*4.13%*	*3.07%*	1.06%
China	*4.20%*	*2.10%*	2.10%
East Asia	*3.62%*	*3.57%*	0.05%
South East Asia	*5.49%*	*3.22%*	2.26%
India	*10.33%*	*6.10%*	4.23%
South of Asia	*7.08%*	*6.00%*	1.08%
United States of America	*5.00%*	*4.95%*	0.05%
Latin America and Caribbean	*16.01%*	*7.36%*	8.65%
European Union (27)	*2.34%*	*2.29%*	0.05%
Middle East	*3.78%*	*3.50%*	0.28%
North Africa	*9.10%*	*7.50%*	1.60%
Rest of West Africa	*6.30%*	*5.34%*	0.96%
Central Africa	*23.10%*	*6.40%*	16.70%
East Africa	*12.67%*	*7.20%*	5.47%
South of Africa	*8.16%*	*5.70%*	2.46%
Rest of the World	*7.70%*	*7.65%*	0.05%

[20] See footnote [7]

[21] International Monetary Fund, 2022. *World Economic Outlook 2022.* "Inflation rate, average consumer prices". Retrieved on September 21st from https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC/ADVEC/WEOWORLD/SDN.

In Table 16, we show the trade loan interest rates for the four ECOWAS countries presented in the report from International Finance Corporation and World Trade Organization 2022. In the model, this represents the parameters $loa\_CF_{isd}^{exp}$ and $loa\_CF_{isd}^{imp}$ for export and import loans respectively.

For the other regions, to the best of the authors' knowledge, no publicly available consistent data exists. Therefore, we use the real lending rates shown in Table 15 that we divide by 2, consistent with the approached used for ECOWAS regions. This ensures that trade finance is two times cheaper than regular lending. Robustness checks are presented for this assumption.

Table 16: Trade Loan Interest Rates from the IFC-WTO Survey

REGION	**Trade Loan Interest Rate**
Côte d'Ivoire	1.50%
Ghana	0.50%
Nigeria	0.50%
Senegal	1.50%

In Table 17, the column "LC Default Rate" shows the obligor-weighted default rate on Import LCs from International Chamber of Commerce 2019. The figure is the average by region over the period 2014-2018, that we eventually map to the regions of the model.

For non-ECOWAS regions, we use the bank nonperforming loans to total gross loans (shown in Table 12) from the International Monetary Fund[22], and we calculate a "ratio of risk". This ratio translates how less risky are letters of credit compared to regular loans. For one region, "Other Developed", this ratio is normalized to 1 because it is initially higher than one (intuitively, it does not make sense to have letters of credit being riskier than regular lending).

Since the cost of funds to use letters of credit represents the cost for an exporter to send goods before receiving any payment, it translates in fact the risk beared by the exporter to send goods beforehand, even though the final payment is granted by the letter of credit. To calculate this risk, we multiply the ratio of risk of the second column by the real lending rates (shown in Table 15) retrieved from the International Monetary Fund[23].

For Cote d'Ivoire and Senegal, the exact same approach is used, but as explained for Table 12, the figure used for NPLs is an average for the region.

Table 18 is directly taken from International Finance Corporation and World Trade Organization 2022. It displays the trade finance rates and micro-finance rates for Senegal and Côte d'Ivoire, two countries considered in the study. Using this data, we calculate an average rate of lending using pre-shipment finance at 11%. The rates applied for micro-finance lending being 21%, we find a ratio of 1.91 between trade finance and micro-finance, which is a second- or third-best solution in terms of financing. Therefore, this figure provides empirical support to our assumption of making trade finance two times cheaper than regular lending, which represents the least preferred financing solutions for our model.

[22] See Footnote [5]
[23] See footnote [7]

Table 17: Default rate and cost of funds for Letters of Credit

REGION	***LC Default Rate***	***Ratio of Risk*** *LC Default Rate / NPLs*	**LC Cost of Funds**
Côte d'Ivoire (Ecowas)	*0.30%*	*2.73%*	**0.41%**
Ghana (Ecowas)	*0.30%*	*1.84%*	**0.35%**
Nigeria (Ecowas)	*0.30%*	*6.63%*	**0.99%**
Senegal (Ecowas)	*0.30%*	*11.47%*	**0.55%**
Other Developed	*1.26%*	*100.00%*	**1.06%**
China	*0.28%*	*15.44%*	**0.32%**
East Asia	*0.28%*	*74.60%*	**0.04%**
South East Asia	*0.28%*	*12.56%*	**0.28%**
India	*0.28%*	*3.52%*	**0.15%**
South of Asia	*0.28%*	*3.93%*	**0.04%**
United States of America	*0.33%*	*30.18%*	**0.02%**
Latin America and Caribbean	*0.40%*	*15.70%*	**1.36%**
European Union (27)	*1.26%*	*48.23%*	**0.02%**
Middle East	*0.44%*	*8.25%*	**0.02%**
North Africa	*0.30%*	*2.36%*	**0.04%**
Rest of West Africa	*0.30%*	*2.62%*	**0.03%**
Central Africa	*0.30%*	*1.96%*	**0.33%**
East Africa	*0.30%*	*3.92%*	**0.21%**
South of Africa	*0.30%*	*5.69%*	**0.14%**
Rest of the World	*0.52%*	*5.15%*	**0.00%**

Table 18: Cost of Trade Finance compared to Regular Lending

	Senegal	Côte d'Ivoire
Pre-Shipment — Large Firm	*9%*	*9%*
Pre-Shipment — Small Firm	*13%*	*13%*
Average Pre-Shipment Rate	11%	11%
Micro-finance	21%	21%
Micro-finance to Trade Finance Rate	**1.91**	**1.91**

Risk Aversion

Instead of defining the costs associated with risk as the good outcome, i.e. 1, minus the certainty equivalent, i.e. the loss because of running risk, we can arrive at the same expression by defining the total costs of risk as the sum of the probability that goods get lost and the the costs of risk aversion with the costs of risk aversion defined as the difference between the expected value shipped when engaging in the transaction and the certainty equivalent:

$$Cost\ of\ risk\ aversion = (1 - p) - CE \tag{12}$$

The total cost of risk is then defined as the sum of the loss and the cost of risk aversion:

$$TC\ of\ Risk = Pure\ Risk\ +\ Cost\ of\ risk\ aversion$$
$$TC\ of\ Risk = p + [(1 - p) - CE]$$
$$TC\ of\ Risk = 1 - CE$$

As a result, the total cost of risk is simply 1 minus the certainty equivalent.

We present in Table 19 the results for several values of constant relative risk aversion (CRRA) based on the probability that goods get lost, based on the share of non-performing loans, NPLs[24]. We split the costs into the probability of loss, i.e. the share of non-performing loans NPL, and the additional costs because traders are risk averse.

With $CRRA = 0.5$, we see that a loan in a region with NPLs of 15%, i.e. a probability of 0.15 that loans are non-performing, would have a cost of 12.9%. This would imply that the higher the probability of loss, the lower the relative cost. With $CRRA = 0.9$ the costs would be rising exponentially, reaching up to 65% for the riskiest destinations with a loss probability of about 15%.

With an intermediate value of $CRRA = 0.7$, following the estimate by Chetty 2006, costs range from 0.9% for a loss probability of 0.37% to 27% for a loss probability of 15.29%. Under $CRRA = 0.7$, a region with an NPL of 15% is about two times as risky as a region with an NPL of 7.5%.

Using the same value of $CRRA = 0.7$, we present in Table 20 the costs associated with risk for trade loan default rates from International Chamber of Commerce 2019 splitting the costs into the probability of loss, i.e. the trade loan default rate, and the additional costs because traders are risk averse. Costs are ranging from 0.5% to 3.5%. Hence, for all regions (except the USA), the risk cost involved in the use of a trade loan is much lower than the risk cost for second-best solutions (cash-in-advance and working capital).

[24] See footnote [5]

Table 19: Risk Cost for Cash-in-Advance and exports financed with working capital

		Risk Aversion Cost			
REGION	NPLs	*CRRA = 0.5*	**CRRA = 0.7**	*CRRA = 0.9*	**Total Cost**
East Asia	0.37%	*0.4%*	**0.9%**	3.3%	**1.2%**
Other Developed	0.89%	*0.9%*	**2.0%**	7.6%	**2.9%**
United States of America	1.10%	*1.1%*	**2.5%**	9.4%	**3.6%**
China	1.80%	*1.8%*	**4.1%**	14.8%	**5.9%**
South East Asia	2.21%	*2.2%*	**5.0%**	17.8%	**7.2%**
Latin America and Caribbean	2.54%	*2.5%*	**5.7%**	20.1%	**8.2%**
European Union 27	2.62%	*2.5%*	**5.8%**	20.7%	**8.5%**
South of Africa	5.27%	*5.0%*	**11.2%**	36.5%	**16.5%**
Middle East	5.36%	*5.1%*	**11.4%**	37.0%	**16.8%**
Nigeria (Ecowas)	6.00%	*5.6%*	**12.6%**	40.1%	**18.6%**
South of Asia	7.08%	*6.6%*	**14.6%**	44.9%	**21.7%**
East Africa	7.66%	*7.1%*	**15.7%**	47.3%	**23.3%**
India	7.90%	*7.3%*	**16.1%**	48.2%	**24.0%**
Rest of the World	10.18%	*9.1%*	**19.9%**	55.6%	**30.1%**
Côte d'Ivoire (Ecowas)	11.00%	*9.8%*	**21.2%**	57.8%	**32.2%**
Senegal (Ecowas)	11.00%	*9.8%*	**21.2%**	57.8%	**32.2%**
Rest of West Africa	11.43%	*10.1%*	**21.9%**	58.9%	**33.3%**
North Africa	12.70%	*11.1%*	**23.7%**	61.6%	**36.4%**
Ghana (Ecowas)	15.10%	*12.8%*	**27.0%**	65.4%	**42.1%**
Central Africa	15.29%	*12.9%*	**27.2%**	65.7%	**42.5%**

Table 20: Risk Cost for Trade Loans

REGION	**Trade Loan Default Rates**	**Risk Aversion Cost**	**Total Cost**
Rest of the World	0.23%	0.75%	0.98%
China	0.71%	2.33%	3.04%
East Asia	0.71%	2.33%	3.04%
South East Asia	0.71%	2.33%	3.04%
India	0.71%	2.33%	3.04%
South of Asia	0.71%	2.33%	3.04%
Other Developed	0.74%	2.45%	3.19%
European Union (27)	0.74%	2.45%	3.19%
Côte d'Ivoire (Ecowas)	0.91%	3.00%	3.92%
Ghana (Ecowas)	0.91%	3.00%	3.92%
Nigeria (Ecowas)	0.91%	3.00%	3.92%
Senegal (Ecowas)	0.91%	3.00%	3.92%
North Africa	0.91%	3.00%	3.92%
Rest of West Africa	0.91%	3.00%	3.92%
Central Africa	0.91%	3.00%	3.92%
East Africa	0.91%	3.00%	3.92%
South of Africa	0.91%	3.00%	3.92%
Middle East	1.14%	3.74%	4.88%
United States of America	1.18%	3.89%	5.08%
Latin America and Caribbean	1.56%	5.09%	6.65%

Trade Cost Reductions

In Table 21, we show the obtained trade cost reductions by partner when running the counterfactual experiment under the combined scenario, Scenario 4, both on the import side and om the export side, for each of the four ECOWAS economies. As we see, the largest trade cost reductions occur for intra-ECOWAS trade. This follows from the fact that in ECOWAS, trade finance conditions would improve both for the importer and the exporter. Trade cost reductions are also substantial with partners having high initial trade costs, such as other African partners and India. Senegal, which has the worst initial trade finance conditions, sees trade costs reduced the most.

Table 21: Trade Cost Reductions by Trading Partner

Importer	ECOWAS	E27	CHINA	USA	MIDDLE EAST	OTHER DEVELOPED	INDIA	OTHER DEVELOPING	REST OF AFRICA
Exporter â†“									
Côte d'Ivoire	-10.9	-4.3	-4.3	-3.9	-5.0	-4.1	-5.8	-4.5	-6.4
Ghana	-7.9	-3.6	-3.5	-3.3	-4.0	-3.4	-4.5	-4.1	-4.8
Nigeria	-6.5	-2.4	-2.4	-2.2	-2.7	-2.4	-3.2	-2.5	-3.4
Senegal	-11.8	-5.1	-5.1	-4.7	-5.9	-4.9	-6.8	-5.5	-7.5

Exporter	ECOWAS	E27	CHINA	USA	MIDDLE EAST	OTHER DEVELOPED	INDIA	OTHER DEVELOPING	REST OF AFRICA
Importer â†“									
Côte d'Ivoire	-7.1	-2.3	-2.3	-4.3	-1.7	-3.4	-2.2	-3.3	-5.9
Ghana	-9.8	-1.7	-1.7	-4.4	-0.8	-2.8	-1.1	-2.9	-5.1
Nigeria	-8.6	-1.4	-1.4	-3.0	-0.8	-1.9	-1.2	-2.6	-4.0
Senegal	-7.5	-2.9	-2.9	-5.0	-2.3	-4.1	-2.8	-4.7	-6.7

Côte d'Ivoire								Ghana						
Region	Crops	Extraction	Heavy man	Light man	Livestock	Oil	Processed food	Crops	Extraction	Heavy man	Light man	Livestock	Oil	Processed food
Africa	0.13	0.02	1.87	0.32	0.00	1.35	0.52	0.02	0.01	0.67	0.08	0.00	0.11	0.08
China	0.01	0.14	0.05	0.01	0.00	0.14	0.01	0.02	0.28	0.01	0.02	0.00	1.94	0.01
Developed	0.16	0.03	0.71	0.03	0.00	0.33	0.23	0.24	0.01	1.32	0.02	0.00	0.11	0.06
Developing	0.76	0.00	0.59	0.01	0.00	0.00	0.15	0.26	0.19	0.03	0.02	0.00	0.00	0.06
ECOWAS	0.17	0.22	1.17	0.31	0.00	0.25	0.34	0.02	0.00	0.12	0.07	0.00	0.00	0.20
EU27	1.21	0.14	0.66	0.11	0.00	0.99	0.88	0.35	0.02	0.11	0.04	0.00	0.60	0.21
India	0.42	0.35	0.07	0.01	0.00	0.00	0.00	0.07	0.09	2.80	0.01	0.00	0.00	0.01
Middle East	0.16	0.11	0.04	0.02	0.00	0.01	0.07	0.05	0.00	1.35	0.06	0.00	0.02	0.03
USA	0.31	0.00	0.12	0.01	0.00	0.19	0.09	0.09	0.00	0.02	0.03	0.00	0.60	0.02

Nigeria								Senegal						
Region	Crops	Extraction	Heavy man	Light man	Livestock	Oil	Processed food	Crops	Extraction	Heavy man	Light man	Livestock	Oil	Processed food
Africa	0.00	0.12	0.07	0.01	0.00	0.30	0.02	0.06	0.53	6.25	0.40	0.01	1.92	2.14
China	0.00	0.03	0.01	0.01	0.00	0.02	0.00	0.52	0.30	0.03	0.03	0.00	0.00	0.05
Developed	0.01	0.12	0.07	0.01	0.00	0.17	0.00	0.19	0.79	2.76	0.09	0.01	0.00	0.31
Developing	0.04	0.03	0.01	0.00	0.00	0.13	0.00	0.10	0.02	0.06	0.02	0.00	0.00	0.10
ECOWAS	0.00	0.00	0.05	0.01	0.00	0.33	0.04	0.01	0.64	0.31	0.08	0.00	0.00	2.03
EU27	0.05	0.26	0.03	0.03	0.00	0.73	0.01	0.34	1.41	0.31	0.20	0.02	0.00	0.72
India	0.01	0.16	0.01	0.00	0.00	1.22	0.00	0.02	0.27	6.09	0.04	0.01	0.00	0.01
Middle East	0.02	0.50	0.10	0.01	0.00	0.12	0.00	0.01	0.47	2.83	0.02	0.00	0.00	0.02
USA	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.01	0.21	0.05	0.24	0.00	0.00	0.04

Figure 8: Contribution to the projected percentage change in real export for the four ECOWAS countries

Côte d'Ivoire								Ghana						
Region	Crops	Extraction	Heavy man	Light man	Livestock	Oil	Processed food	Crops	Extraction	Heavy man	Light man	Livestock	Oil	Processed food
Africa	0.8%	0.0%	6.7%	1.1%	0.0%	3.5%	3.1%	0.1%	0.0%	3.7%	0.4%	0.0%	0.8%	0.7%
China	0.1%	0.3%	0.3%	0.0%	0.0%	0.5%	0.1%	0.2%	2.1%	0.1%	0.2%	0.0%	18.3%	0.1%
Developed	2.8%	0.1%	4.8%	0.2%	0.0%	1.1%	2.7%	3.2%	0.1%	11.5%	0.3%	0.0%	1.4%	1.1%
Developing	10.6%	0.0%	3.5%	0.0%	0.0%	0.0%	1.0%	3.2%	0.7%	0.2%	0.2%	0.0%	0.0%	0.7%
ECOWAS	0.3%	0.1%	1.8%	0.5%	0.0%	0.4%	0.9%	0.1%	0.0%	0.3%	0.2%	0.0%	0.0%	0.8%
EU27	18.0%	0.3%	3.9%	0.7%	0.0%	3.4%	9.7%	4.5%	0.2%	0.9%	0.3%	0.0%	5.5%	3.5%
India	3.4%	0.4%	0.3%	0.1%	0.0%	0.0%	0.0%	0.6%	0.3%	14.6%	0.1%	0.0%	0.0%	0.1%
Middle East	1.5%	0.2%	0.2%	0.1%	0.0%	0.0%	0.6%	0.5%	0.0%	8.2%	0.5%	0.0%	0.1%	0.4%
USA	6.6%	0.0%	0.8%	0.1%	0.0%	0.9%	1.3%	1.3%	0.0%	0.2%	0.3%	0.0%	6.6%	0.3%

Nigeria								Senegal						
Region	Crops	Extraction	Heavy man	Light man	Livestock	Oil	Processed food	Crops	Extraction	Heavy man	Light man	Livestock	Oil	Processed food
Africa	0.0%	0.4%	0.3%	0.0%	0.0%	4.2%	0.1%	0.2%	0.7%	15.3%	1.1%	0.0%	2.1%	9.4%
China	0.0%	0.7%	0.1%	0.1%	0.0%	0.8%	0.0%	3.2%	0.9%	0.1%	0.1%	0.0%	0.0%	0.4%
Developed	0.2%	1.7%	0.7%	0.1%	0.0%	5.9%	0.0%	1.5%	2.6%	10.8%	0.4%	0.1%	0.0%	2.8%
Developing	0.6%	0.3%	0.1%	0.0%	0.0%	4.1%	0.0%	0.5%	0.1%	0.2%	0.1%	0.0%	0.0%	0.7%
ECOWAS	0.0%	0.0%	0.2%	0.0%	0.0%	2.4%	0.1%	0.0%	0.3%	0.4%	0.1%	0.0%	0.0%	4.4%
EU27	0.7%	6.6%	0.3%	0.3%	0.0%	26.8%	0.2%	2.2%	4.6%	1.1%	0.9%	0.1%	0.0%	5.3%
India	0.1%	0.9%	0.1%	0.0%	0.0%	15.2%	0.0%	0.1%	0.4%	14.6%	0.1%	0.0%	0.0%	0.0%
Middle East	0.2%	5.5%	0.7%	0.1%	0.0%	2.1%	0.0%	0.0%	1.1%	8.0%	0.1%	0.0%	0.0%	0.1%
USA	0.1%	0.1%	0.0%	0.0%	0.0%	16.6%	0.0%	0.1%	0.9%	0.2%	1.2%	0.0%	0.0%	0.3%

Figure 9: The share of exports of the four ECOWAS regions to different sectors and destinations